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Human Trafficking in the Emergency Department

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Human trafficking continues to persist, affecting up to 200 million people worldwide. As clinicians in emergency departments commonly encounter victims of intimate partner violence, some of these encounters will be with trafficking victims. These encounters provide a rare opportunity for healthcare providers to intervene and help. This case report of a human trafficking patient from a teaching hospital illustrates the complexity in identifying these victims. Clinicians can better identify potential trafficking cases by increasing their awareness of this phenomenon, using qualified interpreters, isolating potential victims by providing privacy and using simple clear reassuring statements ensuring security. A multidisciplinary approach can then be mobilized to help these patients. [West J Emerg Med. 2010;11(5); 402-404.]

INTRODUCTION

Human trafficking is usually discussed in the framework of human rights rather than health. However, engaging healthcare workers in preventing continued trafficking and caring for victims remains a challenge, despite the fact that these practitioners are in an ideal position to intervene. Healthcare providers, particularly emergency department (ED) personnel who often care for the disenfranchised are far more likely than the general population to interact with trafficking victims. Furthermore, these providers have a long history of identifying and assisting victims of intimate partner violence. Just as recognizing victims of intimate partner violence has become an integral part of every patient assessment in EDs, hospitals and physician's offices, healthcare providers should learn how to identify trafficking cases.

The United Nations currently defines trafficking as:

> *"The recruitment, transportation, transfer, harboring and receipt of persons, by means of threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or a position of vulnerability or of the giving or receiving of payment or benefits to achieve the consent o a person having control over another person, for the purpose of exploitation. Exploitation shall include, at minimum the exploitation of the prostitution of others or other forms of sexual exploitation, forced labor or services, slavery or practices similar to slavery, servitude or the removal of organs."* [1]

Trafficking of human beings is one of the most profitable businesses in the world today with annual revenues estimated at $9.5 billion.[2] At least 27 million and perhaps as many as 200 million people are estimated to be enslaved on our planet in 2008.[2] Slavery and trafficking has been documented in nearly every country, and current estimates place the number of persons annually trafficked across borders at 700,000 to 900,000 worldwide. The United States (U.S.) State Department asserts that at least 20,000 people are trafficked into the U.S. each year: 75% of the victims are in the commercial sex industry while 7% are in bonded labor. The remaining 18% of victims trafficked into the U.S. are forced into a variety of other forms of enslavement.[3]

Identifying trafficking victims is extraordinarily difficult. U.S. hospital EDs do not have databases of presenting complaints for this population. Victims of human trafficking have no "classic" presentation and often suffer from a variety of physical and mental health conditions.[4,5,6] In international trafficking cases, language barriers and victims' fear of authority (including healthcare workers) complicate an already

difficult task. Victims may be unfamiliar with Western or developed nations' healthcare systems.

Nonetheless, with appropriate training and awareness, healthcare providers can learn to identify and help trafficking victims. We present below a case example of a patient that presented to the Massachusetts General Hospital (MGH) ED, a facility affiliated with Harvard Medical School, with an annual volume of about ninety-thousand patients.

CASE REPORT

A 36-year-old Spanish-speaking female was transported by police to the MGH ED for "intimate partner violence." The initial history was vague on details: She reported that she had been living with her "boyfriend" for the previous two months, but in recent weeks was told she "constantly made mistakes" and was "punished for them" by the perpetrator. Her vital signs were normal. Examination revealed several ecchymoses in various stages of healing about her eyes and ears, her left shoulder, and her upper left thigh. There was no evidence of fractures.

Through a medical interpreter, a more detailed history revealed that her plight had been more complicated than was initially reported. Several months prior, she had been living in her home in Colombia, and was "befriended" by a woman who claimed that she was visiting the country temporarily. This new "friend" electronically introduced her to a man living in Massachusetts. After a brief period of email exchanges, our patient traveled to Massachusetts to meet her new online romance. She claimed to have been swept off her feet, and noted that "everything seemed perfect." However, within days, she found herself trapped and feeling helpless. He took away her passport and forbid her to leave his home. The romance was quickly replaced by endless work with physical and sexual abuse. After a few weeks, the woman that our patient had met in Colombia arrived at the home and took her place as the man's true spouse. On the day that our patient was transported to MGH, she had escaped the home and run to a neighbor for help.

DISCUSSION

This case provides several clues that this patient was a human trafficking victim . First of all, the patient did not initially reveal her true situation, revealing more details once a medical interpreter was employed. The reluctance of victims to disclose their true situations is well described in the literature.[7] There may be several reasons for patients' fears: (1) they view authority figures as being complicit in their victimization; (2) they are afraid that their abusers may find out about their revelations and punish them; and (3) they believe they will bring shame to their families or communities back home.[7]

Second, on initial examination, the patient noted "making mistakes" and "being punished" as a consequence. Many international trafficking victims may not speak English, and these subtleties in the history may only be picked up with the help of a qualified medical interpreter. Studies show that using a translator in clinical histories more often reveals important clinical information than histories taken in their absence.[7] Additionally, further studies report that patients who are not proficient in English leave health facilities with a greater understanding of the information imparted to them by providers as well as higher satisfaction when interpreters are used.[9]

Third, the victim came to the ED by herself. By coming alone, she had the opportunity to disclose to healthcare practitioners what was happening to her. In many cases of trafficking, the perpetrators will accompany victims to the health facility posing as a friend or family member. The trafficker may offer to translate for the victim, speak on behalf of the victim, and/or insist on remaining in the examination room. While the presence of a "friend" or "family member" may seem fortuitous to healthcare practitioners in a busy ED, given the delays in patient flow due to finding an interpreter, the results could be very harmful for the victim. The literature on intimate partner violence suggests that providing victims with privacy may lead to more complete disclosures than those taken with family or friends present.[10, 11]

As evidenced by this case report, the identification of trafficking victims is never easy, because victims may present with vague chief complaints or only psychiatric symptoms. However, the case report suggests that healthcare practitioners can increase their likelihood of identifying trafficking victims by: acknowledging victims' fears and providing a secure, non-judgmental environment in which to tell their stories; isolate suspected trafficking victims from anyone accompanying them to health facilities; and insist on using qualified interpreters when obtaining patient histories. Once a victim has been identified, healthcare practitioners should activate a multi-pronged, team response. Social workers and case managers should be engaged immediately to identify resources for victims (e.g., housing, food, medical care, legal services), and local law enforcement should be notified.[12]

SUMMARY

Human trafficking is flourishing in the world today and poses serious health risks for victims. Healthcare practitioners, particularly emergency physicians and other ED health workers, are well-positioned to identify and assist victims. However, as exemplified by our 36-year-old patient, practitioners must be sensitive to the widespread presence of trafficking and understand victims' vulnerabilities and critical needs. More resources should be devoted to training healthcare practitioners about this emerging issue and equipping healthcare systems to address the trafficking issue head-on.

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Miliary Tuberculosis Coinfection with Human Immunodeficiency Virus

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BACKGROUND

Tuberculosis was a major public health problem, given the estimated one billion people infected between 2000 and 2002.[1] A decrease in the incidence of tuberculosis was observed in the last decade, coinciding with improvements in social and healthcare conditions and availability of more effective antituberculous therapies. However, in the last two or three years, this decreasing trend has been interrupted by the presence of two emerging factors, the influx of immigrants and infection by the human immunodeficiency virus (HIV).[1] In the United States, this increase in the incidence of tuberculosis in recent years has been attributed, in part, to an increase in the diagnosis of this disease among immigrants from countries with a high prevalence of tuberculosis.[2] The case of an immigrant patient presenting with a septic respiratory clinical picture in which the final diagnosis was miliary tuberculosis and HIV coinfection is reported.

CASE REPORT

A 31-year-man from Guinea, who had moved to Barcelona three years before consultation, was admitted to the emergency department because of a wasting syndrome, characterized by asthenia, anorexia and weight loss. These symptoms had been insidiously developed over the past three months. The patient complained of cough, mucopurulent expectoration, nausea and vomiting and was unresponsive to antibiotic treatment during the last week. Family history and personal history were unrevealing. He was an active smoker. Physical examination showed fever (38ºC), a blood pressure of 75/35 mm Hg, a heart rate of 110 beats per minute and a respiratory rate of 32 breaths per minute with fatigue. Oxygen saturation breathing room air was 92%. Results of laboratory tests included serum creatinine level of 1.4 mg/dL, total bilirubin 2.1 mg/dL, aspartate aminotransferase 232 IU/L, C-reactive protein 20.8 mg/dL (normal range 0–0.8 mg/dL), white blood cell count 2060/μL (neutrophils 1860/μL, lymphocytes 160/μL), platelets 64000/μL and international normalized ratio 1.23. Baseline arterial blood gas analysis included PaO_2 61 mm Hg, $PaCO_2$ 26 mm Hg and pH 7.46. The chest radiograph revealed a micronodular interstitial pattern affecting both hemithoraces (Figure 1).

A tentative diagnosis of septic shock secondary to an infectious respiratory focus was established because of a lack of improvement after treatment with fluids. The patient received empirical antibiotic treatment with levofloxacin 500mg two times a day and trimethoprim sulfamethozaxole 160/800mg three times a day. A human immunodeficiency virus (HIV) test and Ziehl-Neelsen staining of the sputum smear were requested. The Ziehl-Neelsen test was positive

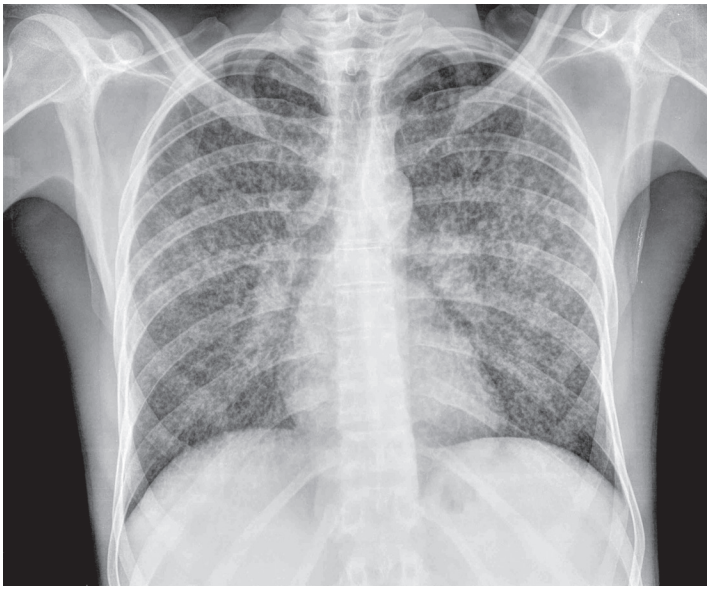

Figure 1. Bilateral micronodular interstitial pattern indicative of miliary tuberculosis.

(result was available at 12 hours of admission), and a diagnosis of miliary tuberculosis with pulmonary involvement was made. Quadruple antituberculous treatment (isoniazid, rifampin, pyrazinamide and ethambutol) was started. The clinical condition of the patient worsened, and he required admission to the intensive care unit (ICU). Continuous infusion of norepinephrine and invasive mechanical ventilation were required. One week after starting antituberculous treatment, the patient's clinical condition improved and he was discharged from the ICU.

HIV testing was positive (C3 category), the CD4 cell count was 44/mm^3 and the viral load 3,095,299 copies/mL. The sputum culture was positive for *Mycobacterium tuberculosis complex*, which was sensitive to all tuberculostatic agents. Treatment with antituberculous drugs was maintained, with good tolerance and favourable clinical course. Antiretroviral therapy was begun. The patient was discharged from the hospital 40 days after admission. The follow-up chest radiography obtained after one month of antituberculous therapy showed resolution of opacities (Figure 2).

DISCUSSION

Miliary tuberculosis is an extrapulmonary form of tuberculosis due to hematogenous dissemination of *Mycobacterium tuberculosis*, and occurs more frequently in infants, young children, elderly subjects and immunocompromised patients. Miliary shadowing was present in 29% of patients with disseminated tuberculosis.[3] Extrapulmonary tuberculosis has become more common since the advent of HIV infection. HIV is a recognised risk factor for extrapulmonary tuberculosis.[4] In adults, miliary tuberculosis may be secondary to a recent infection or due to reactivation of an old focus. Miliary dissemination occurs in 10% of HIV-infected patients and up to 38% in patients with HIV and extrapulmonary tuberculosis.[5] Clinical manifestations are non-specific and varied in relation to the predominant localization, including severe presenting forms with septic shock and respiratory insufficiency. Symptoms include fever, nocturnal sweating, anorexia and weight loss.[6] In patients with respiratory involvement, cough and other respiratory symptoms are present. In about 85% of patients, the chest radiograph shows a reticulonodular pattern with nodules of 2–3 mm in diameter.[5,6] The diagnosis may require sputum smear studies, fiberoptic bronchoscopy with bronchoalveolar lavage, blood cultures for *Mycobacterium spp.* or culture and histological detection of granulomas (caseous necrosis) in liver, lung or bone marrow biopsies.[5,6] Moreover, in case of HIV-infected patients with advanced immunosuppression, a differential diagnosis with other opportunistic infections, like *Pneumocystis jiroveci* pneumonia, should be established. In these patients, the diagnosis of miliary tuberculosis when the acid-fast stain is negative requires a high index of clinical suspicion.

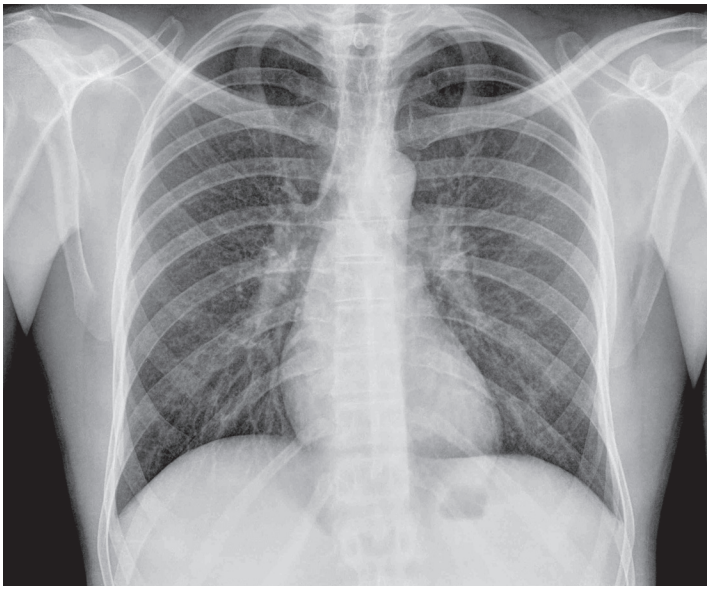

Figure 2. Resolution of bilateral micronodular interstitial pattern after one month of treatment..

In the case here reported, two aspects should be highlighted: firstly, the fact that positive bacilloscopy is exceptionally recorded in a patients with a miliary radiological pattern without pulmonary infiltrates, and secondly, the severity of the tuberculosis infectious process in a patient with HIV coinfection. Septic shock associated with miliary tuberculosis in HIV infection has a high mortality, but in this case, treatment was successful and allowed complete resolution of radiological findings.

In the last decades, a better clinical and immunological control of HIV-infected patients following the use of highly-active antiretroviral treatment has been associated with a decrease in the incidence of opportunistic infections, including infections caused by *Mycobacterium* spp.[7,8] However, in recent years, resurgence of these infections in the Western world (United States[9], United Kingdom, Sweden[10], Spain,[2,11]) have occurred probably in relation to the high immigration fluxes of people from countries with a high prevalence of tuberculosis. It is reported that many immigrants may be carriers of latent tuberculosis infection; a positive tuberculin test is found in 34.3–48.2% of the immigrant population, which is higher than rates found in the Spanish population.[12,13] In addition, the prevalence of latent tuberculosis in immigrants is related to the country of origin and its socioeconomic level, with higher rates among people from Asia, Central Africa, South Africa and Eastern Europe than in those from Latin America, North African countries and Commonwealth countries.[12] Extrapulmonary tuberculosis is more frequent in immigrant populations in some Western countries. Therefore, the relative increase in extrapulmonary forms of tuberculosis in these countries may be related to high rates of tuberculosis in immigrants.[12,13] Pleura and lymph nodes are the most frequent extrapulmonary sites in immunocompetent subjects, whereas miliary and lymph node involvement are most frequent in

immunocompromised patients.[15]

In summary, extrapulmonary and disseminated forms of tuberculosis infection may occur in our environment in relation to an increase in the immigrant population, occasionally associated with low socioeconomic status. These forms may have atypical presenting manifestations that together with cultural and idiomatic barriers may be difficult to diagnose and delay a correct diagnosis of tuberculosis.

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Chronic or Recurrent Pain in the Emergency Department: National Telephone Survey of Patient Experience

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Objective: Persons with chronic or recurrent pain frequently visit the emergency department (ED), yet little research examines this experience. We conducted this national survey to assess patients' ED experiences.

Methods: We developed and conducted a ten-minute telephone survey using random digit dial methodology. We included adults with chronic or recurrent pain reporting an ED visit within two years.

Results: We interviewed 500 adults. Sixty percent were female, their median age was 54, two-thirds were under a physician's care, and 14% were uninsured. They reported an average of 4.2 ED visits within the past two years. Almost one-half reported "complete" or "a great deal" of pain relief during the ED visit, while 78% endorsed as "somewhat or definitely true" that "the ED staff understood how to treat my pain." Although over three-fourths of patients felt that receiving additional information on pain management or referrals to specialists was "extremely" or "very" important, only one-half reported receiving such referrals or information. A significant minority (11%) reported that the "ED staff made me feel like I was just seeking drugs." The majority (76%) were "somewhat" to "completely satisfied" with their treatment while 24% were "neutral" to "completely dissatisfied". In multivariate models, age, recurrent pain, waiting time, imaging, receiving analgesics and pain relief predicted patient satisfaction.

Conclusion: Although those with chronic or recurrent pain report relatively high satisfaction with the ED, our findings suggests that specific areas, such as unmet needs for information and specialty referral, might be targeted to improve care. [West J Emerg Med. 2010; 11(5):408-415.]

INTRODUCTION

Chronic pain is common, with a prevalence of approximately 20% in the general population and is associated with frequent physician visits.[1-3] The reported prevalence of any pain among those visiting the emergency department (ED) is as high as 78%, and in a recent multicenter study, underlying chronic pain conditions were reported by 40% of all ED patients who presented with pain.[4-7] For one-half of these, an exacerbation of chronic pain was the proximal cause for the ED visit and those with chronic pain reported lower satisfaction with ED pain management than those presenting with acute pain.[7]

In 2006, to better understand the ED experiences of persons with chronic pain, the American Chronic Pain Association (ACPA) conducted a preliminary on-line survey among visitors to their website with chronic pain who had been treated in an ED within the past year. Of 250 respondents, 44% reported three or more ED visits within the past year, most commonly for pain that was out of control. Forty-four percent of respondents felt they were treated with dignity and respect by ED staff and only 22% were satisfied with their treatment. In terms of pain management, 47% rated their ED visit as "poor," "terrible," or "the worst experience of my life."[8] While this survey had a number of limitations and

did not attempt to recruit a representative sample of those with chronic pain, it suggested a mismatch between patient expectations and the ED treatment of chronic pain.

To more completely explore the problem of chronic pain and the ED, in March 2007 the ACPA employed Public Opinion Strategies, a national polling firm, to conduct a random digit dial telephone survey of Americans with chronic or recurrent pain treated in an ED within the past two years. The goal of this study was to characterize the ED experiences of a statistically valid, representative sample of the United States (U.S.) population suffering from chronic or recurrent pain.

METHODS

Survey Development

The survey instrument was developed with input from a panel of experts in pain medicine and emergency medicine, as well as representatives from chronic pain consumer groups. Survey items were adapted from the 2006 ACPA online survey, as well as previously conducted national pain surveys.[8-9] Items were chosen to assess features of the underlying pain condition, healthcare use, perceptions of the ED experience and respondent demographics. Panel members reviewed six successive revisions of the survey instrument, and after piloting in an initial thirty respondents, it was shortened to a length of ten minutes. Survey questions are shown in Figure 1.

Survey Methods and Sampling Design

We employed a national polling firm to conduct the survey using random digit dial methodology. In this process, a sample of telephone households in the continental U.S. is selected via random digit dialing (RDD) procedures, in which all telephone numbers, listed and unlisted, have an equal probability of selection. RDD samples are produced from a sampling frame that included all active telephone area codes and exchanges. Active blocks (contiguous groups of 100 phone numbers for which more than one residential number is listed) are added to the database, and listed business numbers are removed. The listed database is updated on a four- to six-week rolling basis, 25% of listings at a time, and the file of business numbers is updated quarterly.

Each telephone exchange is assigned to the county where it is most prevalent. In the first stage of selection, the database is sorted by state and county, and the number of telephone numbers to be sampled within each county is determined using systematic sampling procedures from a random start, such that each county is assigned a sample size proportional to its share of possible numbers. In the second stage of selection, telephone numbers are sorted within county by area code, exchange and active block, and using systematic sampling procedures from a random start, individual phone numbers within each county are selected. The sampled phone numbers are pre-dialed via a non-ringing auto-dialer to reduce dialing of non-working numbers.

Interviewers asked if the respondent was 18 years or older and if not then the respondent asked to speak to someone in the household 18 years or older. Respondents were then screened for type of pain (acute, recurrent or chronic) and their history of ED visits. Those with a history of chronic or recurrent pain who reported an ED visit within the past two years were included. All respondents were guaranteed anonymity. The survey was conducted over five days in March 2007.

Weighting

Final data were weighted using demographic information from the U.S. Census to adjust for sampling and non-sampling deviations from population values. Respondents were classified by age, race, sex and education. Weights were assigned to each combination of factors based on the corresponding population proportions according to the Census Bureau's most recent Current Population Survey.

Statistical Analysis

We carried out all analyses using the survey procedures in SAS 9.1 (SAS Institute, Cary, NC). These allow for appropriate weighting of responses obtained under complex survey designs. The survey has an overall margin of error of ± 4.38%. We analyzed descriptive data using PROC Surveyfreq and PROC Surveymeans. Frequencies and percentages are reported in terms of weighted results rounded off to the nearest integer. We performed between-group comparison of categorical outcomes (e.g., taking prescription opioids) using a weighted chi square statistic, while comparison of wait times in the ED was carried out using a weighted Mann-Whitney test. We used PROC Surveylogistic to calculate univariate odds ratios (OR) for predictors of satisfaction along with 95 % confidence limits (95 % CI) and significance levels. Satisfaction was defined as being "somewhat", "very", or "completely" satisfied with treatment received in ED. We created a multivariate logistic model with fixed entry of predictors to determine whether each factor remained significant after controlling for all other factors. A univariate p-value of 0.10 was necessary for inclusion in the multivariate model. We also included gender (female) and being white because they constituted potential confounding factors.

RESULTS

The telephone survey was conducted in on March 2007, and involved 148,451 attempted phone calls. Nearly one-third (31%) of the calls resulted in no answers and these numbers were redialed up to six times. In addition, another 31% of the calls were picked up by answering machines and these numbers were also dialed again up to six times. Ten percent of those reached by phone refused to participate in the survey.

1. There are three main classifications of pain. Chronic pain is ongoing and last three months or more. Recurrent pain comes and goes over time. And, acute pain is short term pain, usually from a specific injury. Would you define your usual experience with pain as chronic, that is long term, recurrent, that is off and on, or acute, that is short-term and usually injury related? (Only those with chronic or recurrent pain were asked to continue the interview.)

2. In the last two years, how many times, if any, have you been to a hospital emergency room because of your pain? (Only those reporting one or more visits were asked to complete the interview.)

3. At the time of your last emergency room visit, were you under the care of a doctor for management of your pain?

4. At the time of your last emergency room visit, where specifically in your body were you experiencing this pain we are discussing?

5. How would you rate your pain symptoms that caused you to go to the emergency room using a ten point scale, where one means that you feel that your pain was pretty much under control and ten means that you feel your symptoms were severe and not under control at all?

6. For how many years have you suffered from this pain?

7. What was the length of time in minutes you had to wait in the emergency room waiting area?

8. How satisfied were you with the medical treatment you received during your last visit to the emergency room.

9. What made your last visit to the emergency room a more satisfactory experience for you? What went well? What would you say did not go well?

10. What made your last visit to the emergency room a less satisfactory experience for you? What did not go well? Was there something with your last experience that you can say did go well?

11. How much pain relief did you receive as a result of visiting the emergency room?

12. Now I am going to read you a series of phrases. Please tell me how well each phrase describes the treatment you received during your last visit to the emergency room. Would you say the phrase is definitely true, somewhat true, somewhat untrue, or definitely untrue or do you not have a strong opinion one way or the other regarding the treatment you received during your last visit to the emergency room?

    A. I was treated with dignity and respect.

    B. The emergency room staff understood how to treat my pain.

    C. The emergency room staff made me feel like I was just seeking drugs.

    D. I felt like I was taken seriously.

13. Please tell me whether you received each of the following as part of your care during your last emergency room visit for your pain.

    A. Receive information about different treatment options.

    B. Receive a referral to a specialist or clinic that could better help you.

    C. Receive information on ways to better manage your pain.

    D. Receive hope and encouragement from the doctors or nurses on staff.

14. Please tell me how important each of the following is to you personally as part of your care in the emergency room. (extremely important, very important, somewhat important, not very important, or not at all important)

    A. Receive information about different treatment options.

    B. Receive a referral to a specialist or clinic that could better help you.

    C. Receive information on ways to better manage your pain.

    D. Receive hope and encouragement from the doctors or nurses on staff.

15. Did you receive the tests, such as x-rays or scans that you expected to receive in the emergency room during your last visit?

16. Did the staff provide an explanation as to why certain tests that you expected were not provided?

18. Did you receive the medications for your pain that you expected to receive in the emergency room?

19. Did the staff provide an explanation as to why certain medications that you expected were not provided?

20. At the time of your last emergency room visit, did your regular treatment for pain include prescription narcotic medication such as Vicodin, codeine, or Percocet?

21. Do you believe that you have ever become addicted to prescription narcotic medications?

22. Do you currently have health insurance benefits that help cover the costs of care for your pain?

Figure 1. Survey questions.

Table 1. Characteristics of respondents

Characteristics of Respondents		Frequency (percent), unless otherwise noted
Female gender		300 (60)
Mean age, median, (IQR)		54.1, 54 (43, 65)
Ethnicity	Non-Hispanic White	368 (74)
	African American	62 (12)
	Hispanic	26 (5)
	Native American	26 (5)
	Asian American	3 (0.6)
	Other	6 (1)
	Refused	9 (2)
Education	Some grade school	14 (3)
	Some high school	60 (12)
	High school graduate	202 (40)
	Technical/vocational school	9 (2)
	Some college	98 (20)
	College graduate	64 (13)
	Graduate/professional degree	49 (10)
	Refused	4 (1)
Household income	Under $20,000	135 (27)
	$20,000 - $40,000	121 (24)
	$40,000 - $60,000	59 (12)
	$60,000 - $80,000	51 (10)
	$80,000 - $100,000	42 (9)
	Over $100,000	47 (9)
	Refused	45 (9)
Insured		430 (86)
Pain classification	Chronic	284 (57)
	Recurrent	216 (43)
Mean ED visits in past 2 years (median, IQR)		4.2, 2 (1, 4)

IQR, interquartile range

The remaining respondents were asked to characterize their histories of pain as acute, recurrent or chronic and to report the number of ED visits they had made within the past two years. Those characterizing their pain as either chronic ("ongoing and lasting three months or more") or recurrent ("comes and goes over time"), who reported at least one ED visit within the past two years, were invited to complete the ten-minute survey.

The 500 respondents who met both pain and ED visit criteria constituted 15.34% of those who were reached by phone and agreed to the interview. Respondents' ages ranged from 19 to 95 years with mean and median ages of 54 years. Sixty percent were female, 74% were non-Hispanic whites, and 45% received education beyond the high school graduate level. Fourteen percent were uninsured, mirroring the rate for the underlying U.S. population. Chronic pain was reported by 284

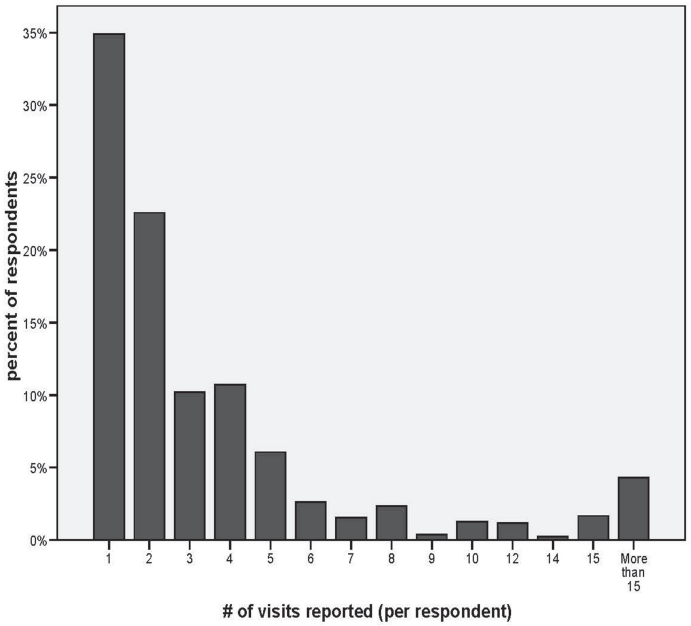

Figure 2. Number of emergency department visits reported over the past two years.

(57%) and recurrent pain by 216 (43%), with a median symptom duration of four years (mean 7.9 years, range 1-40 years). The group reported a median of two ED visits within the past two years (mean 4.2). [Table 1 and Figure 2]. Recurrent and chronic pain patients did not differ from each other significantly with regard to any background characteristic with the exception of number of ED visits with chronic patients reporting a mean, median (IQR [interquartile range]) of 5.3,2 (1, 5) visits compared to 2.6, 2 (1, 3) for recurrent pain patients ($p < 0.001$).

At the time of their most recent ED visit, 67% of respondents were under the care of a physician and 40% were regularly taking prescription opioids. Although the term "addiction" was not explicitly defined during the interview, 5% of respondents reported that they "believed that they had become addicted to prescription narcotic medications" at some time in the past. (Table 2)

Respondents reported high levels of pain intensity on arrival to the ED, with a median presenting pain score of 9 on an 11-point Numerical Rating Scale (NRS), with 77% reporting severe pain (NRS 8-10). In comparison to national data, their perceived waiting times were surprisingly short (41% < 30 minutes). Given the chronic nature of their pain syndromes, relatively large proportions of respondents reported pain relief during the ED visit, with 42% of respondents reporting either "complete" (18%) or "a great deal" (24%) of pain relief. Seventy-eight percent of respondents endorsed as "somewhat or definitely true" that "the ED staff understood how to treat my pain."

Although over three-fourths of patients felt receiving that additional information on pain management (83%) or referrals

Table 2. Characteristics of emergency department visit.

ED visit	Recurrent N (%)	Chronic N (%)	p-value
Under physician's care at time	121/216 (56)	215/284 (76)	<0.001
Presenting pain ≥ 8	150/212 (71)	229/281 (81)	0.005
Mean ED wait time in minutes (median, IQR)	75 (30; 10, 60)	85 (30; 10, 120)	0.50
Satisfied with ED care	179/215 (83)	202/284 (71)	.002
"Complete" or "A great deal" of pain relief	104/213 (49)	105/282 (37)	0.01
"Treated with dignity and respect"	199/214 (93)	245/283 (87)	0.03
"ED understood how to treat my pain"	177/211 (83)	212/280 (76)	0.04
"ED made me feel I was just seeking drugs"	16/212 (7)	37/280 (13)	0.04
"Felt I was taken seriously"	192/213 (90)	236/284 (83)	0.03
"Received information on treatment options"	57/109 (54)	73/134 (55)	0.91
"Received referral to specialists"	66/110 (60)	67/136 (49)	0.10
"Received information on pain management"	45/110 (41)	61/133 (46)	0.46
"Received hope and encouragement"	24/112 (22)	45 (134 (33)	0.04
"Received imaging studies I expected"	154/210 (73)	194/277 (70)	0.45
"Received medication I expected"	167/209 (80)	203/271 (75)	0.19
Taking prescription opioids	72/205 (35)	127/271 (47)	0.01
"Felt had addiction problem at some point"	5/201 (3)	17/265 (7)	0.05

to specialists (75%) was "extremely" or "very" important, only one-half reported receiving such referrals (44%) or information (54%). A minority of respondents (11%) reported that the "ED staff made me feel like I was just seeking drugs."

Respondents with chronic pain differed in many ways from those with recurrent pain. Respondents with chronic pain were more likely to be under a physician's care (76% versus 57%, $p < 0.001$), present with severe (NRS 8-10) pain (81% versus 71%, $p = 0.005$), take regular prescription opioids (47% versus 35%, $p = 0.01$), report feeling they had experienced an addiction problem at some point (7% versus 3%, $p = 0.05$), that the ED provided hope and encouragement (33% versus 22%, $p = 0.04$), and that the ED staff suspected they were drug seeking (13% versus 7%, $p = 0.04$). Those with chronic pain were less likely to report complete or a great deal of pain relief (37% versus 49%, $p = 0.01$), being treated with dignity and respect (87% versus 93%, $p = 0.03$), being taken seriously (83% versus 90%, $p = 0.03$), and feeling that the ED understood how to treat their pain (76% versus 83%, $p = 0.04$).

The majority of respondents (76%) was either "somewhat", "very" or "completely" satisfied with their medical treatment, while 24% were "neutral" to "completely" dissatisfied. In univariate analyses with satisfaction as the dichotomous outcome, the following factors were associated with satisfaction: older age (OR = 1.03, $p < 0.001$), higher education (OR = 1.13, $p = 0.10$), recurrent pain (OR = 2.00, $p = 0.002$), shorter waiting times (OR = 0.99, $p < 0.001$), increasing pain relief (OR = 5.15, $p < 0.001$), undergoing imaging tests (OR = 3.38, $p < 0.001$), receiving ED analgesics (OR = 3.44, $p < 0.001$), and having insurance (OR = 1.85, $p = 0.03$). Gender (female) and being white were not significantly associated with satisfaction based on univariate analyses: OR = 0.96, $p = 0.87$; OR = 1.13, $p = 0.61$, respectively.

Using fixed entry, we included all of the covariates listed above along with gender and being white, as covariates in a multivariate logistic regression model with satisfaction again as the dichotomous outcome variable. The following factors showed a statistically significant contribution to the model ($p \leq 0.10$): age (OR = 1.02, $p = 0.02$), recurrent pain (OR = 1.79, $p = 0.03$), waiting time in minutes (OR = 0.99, $p < 0.001$), undergoing imaging studies (OR = 1.91, $p = 0.02$), receiving analgesics (OR = 1.78, $p = 0.0503$), and pain relief (OR = 3.06, $p < 0.001$). The minimum p-value for all other predictors was 0.41.

DISCUSSION

Although most agree that ED use for those with chronic pain, like any chronic disease, is relatively high, this survey allows us to more precisely estimate the prevalence of ED use associated with chronic and recurrent pain. Given the U.S. adult population of approximately 225 million, our finding that 15% of those reached by phone met our inclusion criteria suggests that 34 million adults with chronic or recurrent pain make at least one visit to the ED every two years. Within this population, approximately 43%, or 15 million, experience recurrent pain, while 57%, or 19 million, have underlying chronic pain syndromes.

These estimates are roughly similar to calculations of ED use based on extrapolations from single site and multicenter

Table 3. Results of multiple logistic regression model predicting satisfaction.

Independent Variables	Univariate		Multivariate	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age	1.031 (1.020, 1.043)	<0.001	1.022 (1.005, 1.040)	0.01
Female	1.233 (0.855, 1.780)	0.26	1.126 (0.901, 1.292)	0.68
Education	1.140 (1.023, 1.269)	0.02	1.079 (0.901, 1.292)	0.41
Recurrent	2.000 (1.290, 3.113)	0.002	1.786 (1.053, 3.028)	0.03
Waiting Time (minutes)	0.993 (0.990, 0.995)	<0.001	0.995 (0.993, 0.997)	<0.001
Imaging	3.111 (2.046, 4.729)	< 0.001	1.907 (1.118, 3.251)	0.02
Analgesics	2.716 (1.739, 4.241)	< 0.001	1.777 (0.999, 3.161)	0.0503
Insured	1.582 (0.943, 2.654)	0.08	1.035 (0.522, 2.051)	0.92
Pain Relief	4.421 (2.973, 6.573)	<0.001	3.055 (1.636, 5.706)	<0.001
White	1.53 (1.019, 2.296)	0.04	0.803 (0.438, 1.473)	0.48

studies. In 2005, U.S. EDs received 115.3 million total visits annually, with approximately 86.5 million visits by adults.[12] From single site studies it is estimated that pain prompts approximately 70% of ED visits.[4-6] A recent multicenter study found that underlying chronic pain conditions existed in 40% of ED patients presenting with pain (or 28% of all ED patients) and for one-half of these (or 14% of all ED patients), the ED visit resulted from an exacerbation of this chronic pain condition.[7] These data suggest that 24 million ED visits occur annually among adults with chronic pain, while 12 million adult visits are due to exacerbations of chronic pain syndromes.

It is often suggested that ED use results from lack of insurance or poor access to primary care. In fact, most of our respondents had access to primary care, and the proportion of uninsured within our sample was similar to that of the general population. The age, gender and ethnicity distributions within our sample are also consistent with those of the chronic pain population. Our finding that more than three-quarters of respondents reported severe pain on presentation implies that ED visits are prompted by disease severity rather than other factors.

In contrast to the high levels of dissatisfaction found in our 2006 ACPA online survey, our respondents reported relatively high levels of satisfaction, associated with surprisingly high levels of reported pain relief, particularly when considering the chronic nature of our respondents' pain. [8] These findings highlight the recognized limitations of our previous on-line survey (i.e., only visitors to the ACPA website were invited to participate), and the importance of obtaining less biased sources of information when judging the quality of ED pain care.

Younger patients reported less satisfaction with ED pain care, and were more likely than older respondents to perceive that the ED staff considered them "drug seekers" while older patients were more likely to self-report fears of addiction. This may reflect both higher levels of social desirability bias in the responses of older patients, as well as a higher prevalence of aberrant drug-related behaviors among younger patients. Social desirability bias means that when patients know that they are being observed, they tend to respond in a way they believe is socially acceptable and desirable. In general we feel that this bias would foster responses that are more favorable toward ED providers, and we suspect it is more likely to be present among older respondents.

Our finding of relatively high satisfaction levels is consistent with several national surveys among those with chronic pain. In a 2003 random-digit-dial survey among 1,004 adults with chronic pain, 58% stated that they were "somewhat satisfied" or "very satisfied" with their pain treatment.[10] In a 2004 national telephone survey conducted by Roper Public Affairs and Media on behalf of the ACPA, 70% of adults experiencing chronic pain indicated that they were "satisfied" (43%) or "very satisfied" with their pain management.[11] Finally, in the 2005 ABC News/USA Today survey among 1,204 adults with chronic or recurrent pain, 59% indicated they received a "great deal" or "good amount" of pain relief as a result of seeing a physician.[9] It is difficult to make direct comparisons between the surveys cited above and our survey as they use different populations and samples; however, respondents tended to report relatively high levels of satisfaction with pain treatment.

The receipt of imaging studies was an independent predictor of satisfaction, although the contribution of such studies to patient well-being is likely to be small, particularly given the frequency of ED visits and the long duration of our respondents' pain syndromes. This suggests that both the ED staff and those with chronic pain may benefit from additional education efforts regarding the appropriate indications for imaging studies in the ED setting.

Although unrelated to satisfaction, over three-fourths of our respondents felt they needed additional information

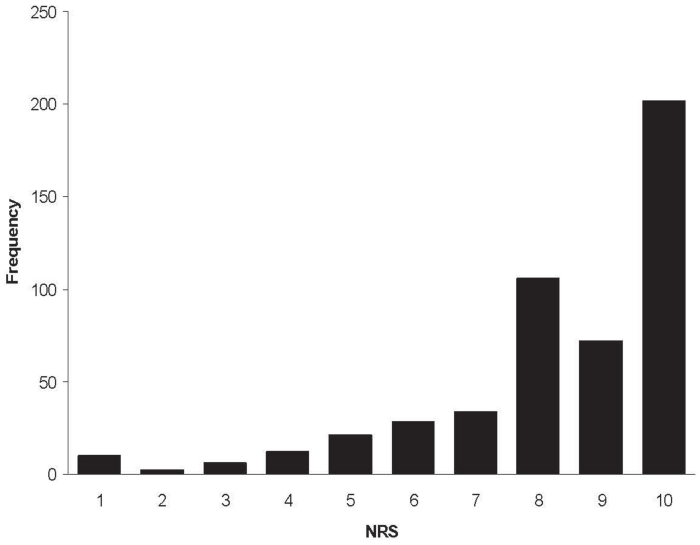

Figure 3. Arrival pain intensity at last emergency department visit based on a numerical rating scale (NRS)

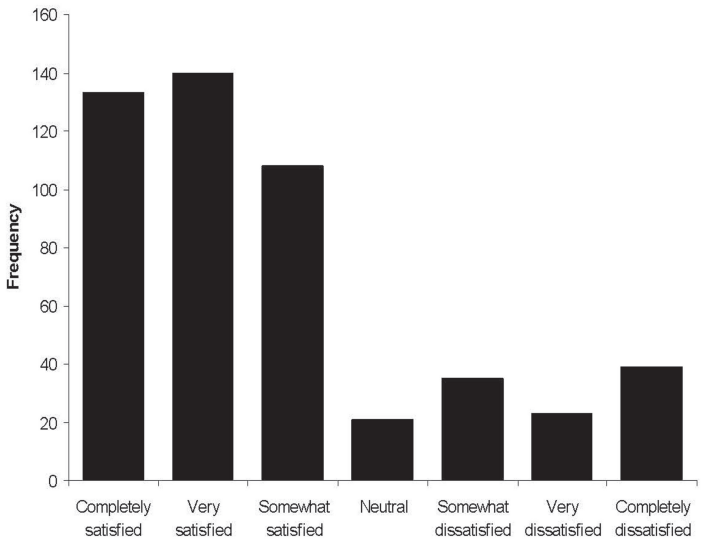

Figure 4. Patient satisfaction.

about their pain condition and considered referral to specialty-level pain care very important. Unfortunately, only one-half perceived that they had received sufficient information or referral, and this finding supports the need for increased education among ED staff and those with chronic pain, as well as improvements in access to pain medicine expertise.

LIMITATIONS

Limitations to our study should be mentioned. Retrospective judgments of pain intensity and waiting times are always difficult and our respondents' perceptions may be influenced by a number of factors, including overall satisfaction with care. Also, our survey shares the weaknesses of other telephone surveys, including an increasing level of difficulty in reaching potential respondents, in part due to the rise in use of answering machines and caller-identification information. These challenges are balanced by the cost-effectiveness and efficiencies of telephone surveys methods. In addition, our survey instrument, although modeled on prior surveys tools, has not been formally validated. It was developed by a panel of experts in pain medicine and emergency medicine, as well as representatives from chronic pain consumer groups, thus should have face validity. We have provided the survey questions themselves to allow others to judge their appropriateness.

CONCLUSION

The most positive news from this survey is that people with chronic pain who come to the ED seeking relief from severe pain generally receive rapid and effective care. The more negative findings indicate these patients appear to be frustrated by a lack of information about managing their pain, as well as a lack of access to specialty-level care. Although ED staffs are perceived to provide compassionate care to this rather large population, managing chronic or recurrent pain over a long period requires much more than an ED can offer. In the current healthcare environment EDs are under tremendous pressure to treat growing numbers of patients with fewer and fewer resources. Although the ED is to be commended for efforts to treat those in the midst of a pain crisis, persons with chronic pain need support beyond the hospital's walls.

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Evaluation of Emergency Medicine Community Educational Program

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Out-of-hospital emergencies occur frequently, and laypersons are often the first to respond to these events. As an outreach to our local communities, we developed "Basic Emergency Interventions Everyone Should Know," a three-hour program addressing cardiopulmonary resuscitation and automated external defibrillator use, heart attack and stroke recognition and intervention, choking and bleeding interventions and infant and child safety. Each session lasted 45 minutes and was facilitated by volunteers from the emergency department staff. A self-administered 13-item questionnaire was completed by each participant before and after the program. A total of 183 participants completed the training and questionnaires. Average score pre-training was nine while the average score post-training was 12 out of a possible 13 (P< .0001). At the conclusion of the program 97% of participants felt the training was very valuable and 100% would recommend the program to other members of their community. [West J Emerg Med. 2010;11(5):416-418.]

INTRODUCTION

Out-of-hospital emergencies occur frequently, and laypersons are often the first to respond to these events. High risk events include airway obstruction, cardiopulmonary arrest and cerebrovascular accidents. Community-based educational programs, including first aid and cardiopulmonary resuscitation (CPR) trainings, are available through organizations such as the American Heart Association/ American Stroke Association (AHA/ASA).[2] The American Academy of Pediatrics' Committee on School Health recommends basic and pediatric life support (BLS/PBLS) training for all high school students as part of their health education program.[1] Additionally, public education campaigns focusing on recognition of choking, stroke and heart attack have been developed to teach laypersons early recognition and basic interventions. Most recently the AHA developed an iPhone application to review first aid procedures and details on responding to first aid situations.[3]

School- and community-based training programs have been shown to successfully train participants in BLS and potentially impact care of their communities.[4-6] As an outreach to our local communities, we developed "Basic Emergency Interventions Everyone Should Know," a three-hour program addressing basic emergency skills.[7] The participants completed pre- and post-training questionnaires to assess the impact of the training program.

METHODS

This study was approved by our local institutional review committee. Informed consent was waived as participation was voluntary. We collected data from June 2007 to May 2008.

Training Scheme

"Basic Emergency Interventions Everyone Should Know" training consisted of a four-part facilitated program addressing CPR and automated external defibrillator (AED) use, heart

Table 1. Community Participants per Site (Brooklyn, NY)
N=183

	Male (n) %	Female (n) %	(n) %
School A	(35)19.1%	(11) 31.4%	(24) 68.6%
School B	(16) 8.7%	(6) 37.5%	(10) 62.5%
School C	(25) 13.7%	(7) 28.0%	(18) 72.0%
School D	(21) 11.5%	(1) 4.8%	(20) 95.2%
School E	(23) 12.6%	(6) 26.1%	(17) 73.9%
School F	(18) 9.8%	(5) 27.8%	(13) 72.2%
School G	(24) 13.1%	(13) 54.2%	(11) 45.8%
School H	(21) 11.5%	(3) 14.3%	(18) 85.7%

attack and stroke recognition and intervention, choking and bleeding interventions and infant and child safety. Our emergency department (ED) staff developed the curriculum based on an assessment of needs in our communities. The three-hour format was designed to allow the program to be taught in a single, early evening venue, allowing maximal participation of community members. The sessions were given concurrently, each lasting 45 minutes, and were facilitated by volunteers from the ED staff. Facilitators included emergency medicine and pediatric emergency medical faculty, emergency medicine residents and paramedics. The facilitators modeled skills being taught, and participants performed these skills during each session.

Our community outreach department arranged for the training to take place at eight community settings, including schools and churches. The participants were employees or invited community members from each site. No incentive or compensation was provided. Participants were representative of our local communities.

Each participant completed a self-administered 13-item questionnaire before and after the program. They also completed a pre-test and post-test questionnaire of the training program. The questions included the following topics: recognition and management of choking, understanding of basic CPR, early recognition of stroke and heart attack and AED use. Each correct answer received one point, for a total of 13 points.

Data were analyzed by SPSS version 15.[8] We used the Wilcoxon Signed Ranks Test to compare paired pre- and post-test results. Statistical significance was calculated at $P < .05$.

RESULTS

A total of 183 participants completed the training and questionnaires. The median age of the participants was 47 (14-85). The vast majority was female (72%). Number of participants per community site ranged from 16 to 35 (Table 1).

Average score pre-training was nine with average score post-training of 12 out of a possible 13. The difference between pre- and post-training was significant at $P < .0001$ (Figure 1). The two questions with the greatest increase in percent correct after training were question 7 (appropriate chest compressions/breath ratio) and question 13 (correct AED operation). For questions 7 and 13 scores increased by almost 90% and 50% respectively. Forty-seven percent of participants rated their level of knowledge and skills in basic emergency interventions as good to proficient prior to training. After training, 86% felt much more prepared or confident in their skills to save lives in an emergency situation ($P < .0001$). At the conclusion of the program 97% of participants felt the

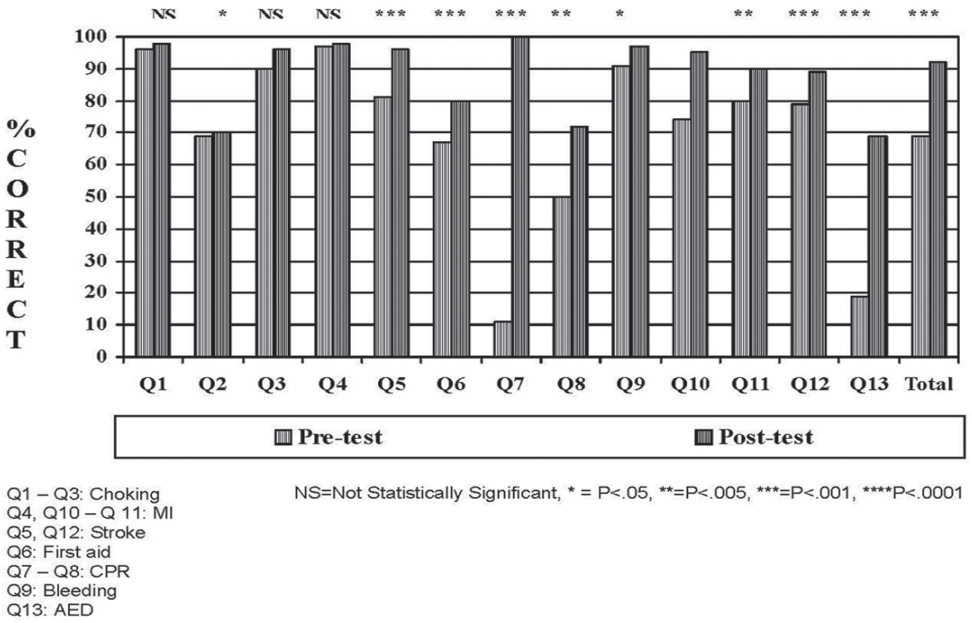

Figure 1. Percentage answers correct pre and post educational program.

training was very valuable, and 100% would recommend the program to other members of their community.

DISCUSSION

Education programs in basic emergency skills remain a viable option for improving a layperson's confidence and likelihood of intervening in a life-threatening situation. We found a significant increase in participants' self-assessment of basic emergency skills after a three-hour facilitated program. The program included a module on AED use, for which most participants had received no previous training. Broad availability of AEDs used by trained volunteers and laypersons has been shown to significantly improve long-term survival of out-of-hospital cardiac arrest victims.[9] AEDs are becoming increasingly available in our community settings, and laypersons should feel confident in using these devices when appropriate. "Basic Emergency Interventions Everyone Should Know" is one example of a community-based educational program designed to educate the lay public. This program is easily reproducible by ED staff and can be tailored to address the needs of the local community. Additionally, the modest time commitment allows for the program to be presented in a single session and is appropriate for many audiences.

LIMITATIONS

This program was developed to teach basic emergency skills to members of our community. Our pre- and post-questionnaires were intended to evaluate the effectiveness of our community outreach efforts. We chose to focus on immediate knowledge transfer to our participants. The results showed a significant improvement in scores and mastery of basic emergency skills, including AED operations. It is not known whether skills taught during our training sessions will be retrained, or if this knowledge will change health outcomes of our local communities. Of note, participants were given a copy of the training manual to use as a resource and copies were left within the training sites. Future studies are needed to evaluate long-term retention of basic emergency skills.

CONCLUSIONS

Our "Basic Emergency Interventions Everyone Should Know" program improved emergency medicine knowledge, skills and confidence of our community members thus increasing their likelihood to assist potential victims of out-of-hospital events. EDs have the opportunity to educate and improve the public's health and wellbeing through similar outreach programs.

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Prevalence, Health and Demographics of Emergency Department Patients with Diabetes

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Objective: To determine the prevalence of diabetes in Southern California emergency department (ED) patients and describe the self-reported general health, demographic and social characteristics of these patients with diabetes.

Methods: Between April 2008 and August 2008, non-critical patients at two Southern California EDs completed a 57-question survey about their chronic medical conditions, general health, social and demographic characteristics.

Results: 11.3% of the 1,303 patients surveyed had diabetes. Patients with diabetes were similar to ED patients without diabetes with respect to gender, ethnicity and race. However, patients with diabetes were older (51 vs. 41), less likely to have a high school education (64.0% vs. 84.7%), less likely to speak English (44.9% vs. 55.4%), and less likely to be uninsured (33.3% vs. 49.5%). Additionally, patients with diabetes had markedly lower self-reported physical health scores (37.1 vs. 45.8) and mental component score and mental health scores (42.0 vs. 47.4) compared with ED patients without diabetes.

Conclusion: In this study of two Southern California EDs, 11.3% of surveyed patients had diabetes. These patients were often poorly educated, possessed limited English language skills and poor physical health. ED personnel and diabetes educators should be mindful of these findings when designing interventions for ED patients with diabetes. [West J Emerg Med. 2010; 11(5):419-422.]

INTRODUCTION

Each year millions of patients receive health services in emergency departments (EDs), and, regrettably, for many of them, this may be their primary source of care.[1,2] A large portion of these ED patients have diabetes, and, alarmingly, previous research has demonstrated their mean HbA1c is over 9%.[3] Although numerous innovative programs have been created to help high-risk, disadvantaged patients achieve adequate glycemic control, none are based out of the ED.[4-7] To create such an ED-based program, we must first uncover some basic characteristics of ED patients with diabetes. As part of an ongoing needs assessment, we sought to determine the self-reported prevalence of diabetes in ED patients, their self-reported general health and associated demographic and social characteristics.

METHODS

We conducted an anonymous cross sectional survey of a convenience sample of patients presenting to the EDs at both the University of California, Irvine (UCI) and Los Angeles County Hospital at the University of Southern California (LAC+USC) from April -August 2008. The study sites were selected to evaluate a possible variance of diabetes prevalence across different types of Southern California EDs. UCI is a private academic hospital serving approximately 40,000 ED patients annually. LAC+USC is a county hospital in central Los Angeles and serves approximately 170,000 patients annually. Patients were eligible to complete the survey if they were 18 years or older, able to complete the survey in English or Spanish, and were not critically ill or injured. If necessary, the survey was read to the patient in their language

of choice, although generally the subjects completed a written survey. The protocol was reviewed and approved by the institutional review boards of the two institutions. Trained research assistants screened patients for eligibility in the adult waiting areas at each institution, obtained informed consent and administered the survey. The survey included 57 questions and took ten minutes to administer. Patients were queried regarding their demographic characteristics, ethnicity, chronic medical conditions, health insurance status and reasons for which they were presenting to the ED. Subjects then completed the Short Form Health Survey version 2 (SF-12). This is a validated tool that yields a mental component score (MCS) and physical component score (PCS) that can be compared across populations. The MCS and PCS for the general United States adult population are 50 with standard deviation of ten. We transcribed data from paper surveys into Microsoft Excel (Microsoft Corp, Richmond Wa.) and analyzed it using Stata 10.0 (Statacorp, College Station, Tx). Means and 95% confidence limits are reported. We performed tests of significance using the Fisher Exact test for categorical variables and Mann-Whitney U for continuous variables (as the data was non-normally distributed). Finally, we conducted a multivariate logistic regression to determine which variables were independently associated with a self-reported history of diabetes.

RESULTS

One thousand three-hundred three patients completed the survey, 802 at USC and 501 at UCI. Overall, 147 (11.3% 9.6-13.0%) reported a history of diabetes. Mean age of respondents was 42 years and 47% were male. The prevalence of disease did not vary significantly by site (11.6% at UCI vs. 11.1% at LAC+USC). Table 1 shows characteristics of patients with and without diabetes. ED patients with and without diabetes were similar in gender, ethnicity and race. However, ED patients with diabetes were older, less likely to have a high school education (64.0% vs. 84.7 %) or speak primarily English (44.9% vs. 55.4%) and more likely to be insured (49.5% vs. 33.3%) compared with ED patients without diabetes. Additionally, ED patients with diabetes had markedly lower self-reported PCS (37.1 [95% CI 35.7-40.3] vs. 45.8 [95% CI 44.0-46.5]) and MCS (42.0 [95% CI 39.4-43.6] vs. 47.4 [95% CI 46.8-48.0]) scores compared with ED patients without diabetes. On multivariate regression, older age and lack of a high school education continued to be independently associated with an increased odds of diabetes. (See Table 2 for results of the multivariate regression.)

DISCUSSION

This is the first study to document the prevalence of self-reported diabetes in ED patients. Two previous studies attempted to document the prevalence of undiagnosed diabetes in ED patients. Both, however, were undermined by poor follow up for confirmatory testing, leaving the results

Table 1. Characteristics of emergency department patients with and without diabetes.

	Patients without Diabetes	Patients with Diabetes	P value
Age (Median)	41	51	<0.001
Male	47.2%	46.1%	0.86
White	40.5%	35.1%	0.306
Black	8.3%	7.2%	0.855
Asian	9.3%	9.9%	0.863
Hispanic	59.8%	66.4%	0.142
High school education	84.7%	64.0%	<0.001
Uninsured	49.5%	33.3%	<0.001
Private insurance	21.5%	17.8%	0.372
MediCaid insurance	19.0%	20.7%	0.643
Medicare	7.0%	17.0%	<0.001
PCS	45.8	37.1	<0.001
MCS	47.4	42.0	<0.001
Born outside of United States	46.6%	58.0%	<0.001
Married	34.7%	44.9%	0.017
Children	63.6%	66.9%	0.459
Primarily English-speaking	55.4%	44.9%	0.018
Primarily Spanish-speaking	36.9%	47.6%	0.015

PCS, physical component score; *MCS*, mental component score

Table 2. Multivariate logistics regression.

	"Self-reported Diabetes"	
	Odds Ratio (95% CI)	p-value
Male	1.23 (0.78-1.95)	0.38
Hispanic	1.59 (0.87-2.92)	0.13
Married	0.95 (0.66-1.37)	0.78
Has children	0.95 (0.56-1.64)	0.88
Race		
White	Reference	
Black	1.13 (0.47-2.78)	0.78
Asian	0.90 (0.35-2.30)	0.82
Age		
18-30	Reference	
31-50	2.69 (1.30-5.57)	<0.01*
51-65	4.98 (2.27-10.90)	<0.01*
66-80	3.67 (1.26-10.70)	0.02*
>80	9.28 (2.97-28.99)	<0.01*
Expected source of payment		
Private insurance	Reference	
Medicare	2.03 (0.87-4.59)	0.09
Medicaid	0.77 (0.35-1.66)	0.50
Self pay	0.65 (0.33-1.27)	0.21

difficult to interpret. Our finding that one in nine sampled patients has diabetes and that their self-reported health is significantly lower than their ED counterparts without diabetes, coupled with prior research indicating ED patients with diabetes have HbA1c levels over 9%, suggest that the ED is an important area in which to plan and focus future interventions.[3]

Developing treatment interventions for ED populations with chronic diseases can be logistically difficult as these patients may lack the resources to optimize self-care. Our findings confirm some of these impressions. More than one-third of ED patients with diabetes had less than high school education, nearly half spoke primarily Spanish, and 33% were uninsured. In addition, their scores for physical and mental health were poor. Interventions aimed at helping this medically needed population must be mindful of these findings. Innovative strategies using nurse educators, case managers and community health workers have been successfully used in non-ED settings to help similarly disadvantaged people achieve improved glycemic control.[4-7,10] Unfortunately, to date, there have been no reported trials of ED-based programs to improve glycemic control or quality of life in patients with diabetes. Undoubtedly, the acute, symptom-driven and episodic care provided in the ED is not well suited for the management of chronic diseases such as diabetes. However, previous ED-based efforts for conditions such as smoking cessation, intimate partner violence, and alcohol aversion suggest that interventions for chronic conditions can be effective in the ED setting.[11-15] It follows that the ED visit may represent a unique teachable moment during which patients with diabetes can be offered resources to improve glycemic control and physical functioning. Moreover, for many patients with diabetes, the ED may be the primary potential entry point into the healthcare system.

LIMITATIONS

A limitation of our study is that we sampled only two academic Southern California EDs with largely Latino populations, thus limiting the generalizability of these findings. However, the EDs did vary in terms of size (170,000 vs. 40,000) and primary funding mechanism (county vs. private). A second limitation is that this study may underestimate the prevalence of diabetes in ED patients as some patients may have forgotten about this diagnosis while many others may yet be undiagnosed. Recent studies suggest the prevalence of undiagnosed diabetes in ED patients may be 3-7%, suggesting, if anything, a greater need for ED-based diabetes programs.[8,9] The use of a convenience sample may have introduced some selection bias although we cannot determine the direction this may have biased the result. In addition, we excluded patients who were critically ill or injured as we believed they would not be able to complete the survey. Thus, we do not know the prevalence of diabetes in this subset of patients. Finally, we did not test patients' glycosylated hemoglobin, and therefore cannot determine which variables are associated sub-optimal glycemic control.

CONCLUSION

In this study 11.3% of patients had a self-reported history of diabetes. These patients were older, less educated, had poorer physical and mental health and were less likely to speak English than their counterparts without diabetes. These findings should be considered when developing appropriate, effective and culturally sensitive ED-based mechanisms to help patients achieve glycemic control.

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Nonreciprocal and Reciprocal Dating Violence and Injury Occurrence Among Urban Youth

Swahn MH, Alemdar M, Whitaker DJ. Nonreciprocal and Reciprocal Dating Violence and Injury Occurrence Among Urban Youth. *WestJEM*. 2009; 11(3):264-268.

To the Editor:

Within public health research, "reciprocal" or "mutual" violence is defined as relationship violence perpetrated by both partners *in the same relationship*.[1-2] Michael Johnson[3] coined the phrase "common couple violence," which he defined as the perpetration of violence by both partners in a romantic relationship *during a specific interaction* (e.g., disagreement). The study of reciprocity, however, has not been without controversy. The terms "reciprocity," "mutual violence," and "sex symmetry" are used interchangeably in the literature to suggest that males and females are both violent in dating or intimate relationships. This has often been reduced to "women are just as violent as men," resulting in a very polarized field.[4-5]

The Youth Violence Survey: Linkages among Different Forms of Violence (Linkages), described by Swahn, Alemdar, and Whitaker,[6] asked participants who indicated they had been on a date in the last 12 months about their dating violence experiences, using ten behaviorally specific items assessing a large spectrum of increasingly violent behaviors (e.g. scratched, hit/slapped to punched or hit with something that could hurt to threatened with a weapon and hurt badly enough to need medical care). For victimization, the item was "*Thinking about the last 12 months, how often has someone you have been on a date with done the following things to you?*" For perpetration, it was "*Thinking about the last 12 months, how often have you done any of the following things to someone that you have been on a date with?"* These victimization and perpetration items, however, do **NOT** specify if the violence occurred in the same relationship. Given research indicating that one third of adolescent relationships last less than one month and another third last less than five months,[7] the reported violence likely did not occur within the same relationship and is likely not reciprocal. Although Swahn et al.[6] note this possibility in their limitations by saying "…findings may pertain across dating relationships and as well as to multiple partners" (sic)(p. 267), they fail to acknowledge that their data do not assess reciprocity.

The use of definitions consistent with the literature, particularly in the study of reciprocity, is critical to appropriately interpret and use research findings. Research in this area must strive to use valid methods of data collection (e.g., collecting victimization and perpetration data from one member of a relationship about the violence experiences of both members) in order to make any claims about reciprocity. Swahn et al.'s[6] paper measures the associations between physical dating victimization and perpetration, some of which *may* have been reciprocal, and demographic variables. However, the *meaningful* interpretation of sex differences in the experience of reciprocal physical dating violence, reported by Swahn et al.[6], is severely limited based on their analyses.

In sum, Swahn et al.[6] do not measure reciprocity as it has been defined in the literature on intimate partner and dating violence. A reader who is not intimately familiar with the Linkages data, however, may not understand this fact given the title of the paper and limited information presented. While they acknowledge that their findings may apply across dating relationships and to multiple partners, adequate information is not provided to allow readers to have a full understanding of how their operational definition of reciprocity affects their ability to measure this construct. We contend that the operational definition of dating violence reciprocity used by Swahn et al.[6] is fundamentally flawed and the paper cannot reach its intended goal "…to determine the scope and prevalence of dating violence reciprocity among teens…" (p. 265).

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The opinions and conclusions in this Letter to the Editor are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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In reply:

In response to our manuscript,[1] Basile[2] and Hamburger raise the importance of using clear definitions in dating violence research. We concur that the field is comprised of multiple definitions that are in need of more clarity and consistent use,[3-8] and we certainly could have been clearer in our language. However, we also find that there are emerging areas of research for which the best use of terms still have to be developed. Thus, whether or not "reciprocity" was the best term for the conceptual approach used for the analyses and findings presented in our manuscript[1] can be debated. Perhaps more significantly, the manuscript also raised other and equally important issues that we hope will help drive future research and guide violence prevention strategies, specifically for adolescents where most prevention efforts are targeted.[9]

The main objective of our brief research report[1] was to illustrate, primarily using descriptive and correlational statistics, that there was a significant association between victimization and perpetration of dating violence among adolescent boys and girls. This remains an understudied topic among adolescents, despite an emerging literature focused on adults that underscores that reciprocity is common and also more likely to lead to injuries, which has important implications for prevention.[6,8,10-14] Our findings, corroborated by earlier research of adults, show that adolescent boys and girls who report both victimization and perpetration are also more likely to experience injuries.[8,10]

We agree that ideally the findings we presented should pertain to specific relationships. However, given the scarcity of data available on this topic and the difficulty of studying adolescent relationships, as noted by Basile[2] and Hamburger, we thought it important to share these findings so that future dating violence research can be conducted with this important aspect in mind. Even though the adolescents included in our study may have responded across multiple partners and relationships, it is informative that the data we presented replicated findings from the adult literature, which used a more specific definition of reciprocity.[10] These findings raise important questions about reciprocity and the underlying processes by which reciprocity leads to greater injury, such as the escalation of violence among partners.[8,10,11] Similarly, the findings may also suggest that the propensity for an adolescent to be a victim and perpetrator of violence is stable across the brief and unstable relationships experienced in this developmental phase. With these questions in mind, we hope that the analyses we presented will be replicated in future studies that examine issues of reciprocity within and across relationships. However, these remain important and unaddressed questions for future research.

Finally, the most important issue going forward for the field of dating violence prevention research will be to conduct large, empirical studies of representative populations that apply a true public health approach to this important topic. Our efforts should focus on how to best serve boys and girls at risk for violence and to identify those relationship contexts and circumstances that increase risk for injury. Meanwhile, we welcome suggestions for new terminology and definitions that more accurately capture the range of dating violence victimizations and perpetration that may occur across relationships, specifically for adolescents.

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GlideScope Videolaryngoscopy in the Simulated Difficult Airway: Bougie vs Standard Stylet

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Objective: GlideScope® videolaryngoscopy (GVL) has been shown to improve visualization of the glottis compared to direct laryngoscopy (DL). However, due to the angle of approach to the glottis, intubation can still be challenging. We hypothesized that novice GVL users would be able to intubate faster and easier using an airway introducer (frequently known as a bougie) than with a standard intubating stylet.

Methods: Intubations were performed on a human airway simulator with settings for easy and difficult airways. Participants were emergency medicine (EM) residents or faculty (n=21) who were novice GVL users. Participants were intubated a total of eight times (four GVL, four DL) using either a bougie or an intubating stylet. We recorded time to intubate (TTI) and difficulty rating using a visual analog scale (VAS) and non-parametric statistical methods for analysis. We reported medians with interquartile range (IQR).

Results: The median TTI with difficult airway settings and the bougie-GVL was 76 seconds (IQR 50, 102) versus 64 seconds (IQR 50.5, 125), p=0.76 for the stylet-GVL combination. The median VAS difficulty score, on difficult airway settings, for the bougie-GVL was 5 cm (IQR 3.3, 8.0) versus 6.2 cm (IQR 5.0, 7.5) with the stylet-GVL, p=0.53.

Conclusion: Among novices using GVL for simulated difficult airway management, there was no benefit, in terms of speed or ease of intubation, by using the bougie over the standard stylet. [West J Emerg Med. 2010; 11(5):426-431.]

INTRODUCTION

The GlideScope® Ranger videolaryngoscope (GVL; Verathon Medical Inc., Bothell, WA) is a portable device that has a unique laryngoscope blade with a 60° distal anterior curvature.[1] The device has an anti-fog, high-resolution camera embedded in the blade which displays a real-time view of the patient's airway on a non-glare color monitor (Figure 1). This type of VL has been shown to improve the Cormack-Lehane laryngeal grade of view.[2-6] Additionally, studies have suggested that due to the shape of the GlideScope blade, less lifting force is needed with VL compared to direct laryngoscopy (DL).[6-8] Despite the ease of obtaining improved views, endotracheal tube (ETT) placement during VL can still be challenging because passage of the ETT through the glottis

Figure 1. The GlideScope Ranger®.

may require a considerable amount of manipulation.[2-4,6-7,9-15]

Several techniques have been studied to improve the ease of VL intubation such as modifying the angle of the ETT tip and changing the configuration of the overall ETT shape.[9-13] Additionally, several maneuvers have been described to improve alignment of camera and pharyngeal axes by optimizing the blade placement and amount of space necessary between the camera and glottis.[4,14-15] Furthermore, specially designed ETTs (e.g., GlideRite) and rigid stylet products (i.e., GlideScope Rigid Stylet) have been developed to address some of the recognized difficulties with ETT placement during GVL. However, a bougie may be a more commonly available and familiar airway adjunct. The bougie was developed for difficult airway management with DL. Several authors have suggested that the use of an introducer may help to overcome the recognized difficulties of manipulating the ETT through the glottis with VL.[16-18] However, we know of no studies that have directly addressed the use of the bougie in the context of videolaryngoscopy. We hypothesized that among novice users the more directable single-use introducer, bougie, would be faster and easier to use than the common, flexible intubating stylet.

METHODS

Study Design

This study was a prospective, randomized crossover trial.

Study Participants

We used a convenience sample of emergency medicine (EM) residents and faculty. Subjects were eligible if they had performed at least 20 intubations in the operating room and three standard intubations in the emergency department. We recruited novice GVL users to minimize the effect of experience as a confounder, and we excluded subjects who had performed more than five GVL intubations on human patients. Written informed consent was obtained from all participants and this study was approved by our local Institutional Review Board.

Study Protocol

The intubation trials consisted of eight intubations on a medium fidelity airway simulator, Laerdal AirMan (Laerdal Medical Corporation, NY) with rigid teeth inserts. After a brief, standardized orientation to the airway equipment, each operator was given ten minutes to practice using the equipment. Four intubations were performed with the standard airway setting and four intubations with the AirMan difficult airway setting (maximal cervical-spine stiffness and maximal mouth restriction: trismus). Participants performed the intubations using either a Macintosh DL or GVL with either standard stylet or bougie (Table 1).

Table 1. Trial summary.

INTUBATION TRIALS SUMMARY	
STANDARD AIRWAY	**DIFFICULT AIRWAY**
DL with Standard Stylet	DL with Standard Stylet
DL with Bougie	DL with Bougie
GVL with Standard Stylet	GVL with Standard Stylet
GVL with Bougie	GVL with Bougie

DL, direct laryngoscopy; *GVL,* GlideScope Video Laryngoscopy.

A standard 7.0, cuffed ETT (Mallinkrodt Inc., St Louis, MO) was used for all intubations. The standard stylet used in this study was the Satin-Slip Stylet (Mallinckrodt Inc., St Louis, MO). The bougie we selected for use in this trial was the 70 cm, 15 French, single-use introducer (SunMed Healthcare Com., FL) with coude tip.

When using the direct laryngoscope and standard-styletted ETT, we imposed an anterior tip curvature of approximately 45° with the bend just above the cuff. This created a "J-shaped" tip, as classically described for standard intubations.[19] For the GVL trials we shaped the ETT and bougie approximately 60° to conform to the curvature of the GVL blade, which is one of several commonly used angulations.[4] To maintain uniformity during the trials and between participants, the same investigator performed the following: manipulation of the malleable ETT stylet and bougie, maintenance of lubrication, equipment check prior to each trial, handoff of requested equipment, loading of ETT onto the bougie, inflation of the ETT balloon, connection of the ETT to the bag and orientation of the GVL screen. Operators were allowed to request external laryngeal manipulation or change the angulation of the ETT or bougie at their discretion. However, all participants were required to attempt intubation with the preset angles of the ETT and bougie prior to any manipulation.

We randomized the order of intubations by asking the subjects to line up uniform slips of paper, each of which identified a specific setting and equipment to be used on the back of the paper. Participants were informed immediately prior to intubation which equipment to use for that trial. The subjects were blinded to the difficulty settings imposed on the simulator.

Primary Outcomes

Time required to intubate

During each intubation trial, a single investigator recorded the time to intubate (TTI). TTI was recorded from when the blade passed the lips and ended with insufflation of air into the lungs as demonstrated by chest rise of the simulated patient.

Ease of intubation

After each intubation trial, the participants completed an intubation evaluation. The ease of intubation was measured using a 10 cm visual analog scale (VAS) with lowest score indicating least difficulty. We also tracked qualitative information in a comment section of the questionnaire.

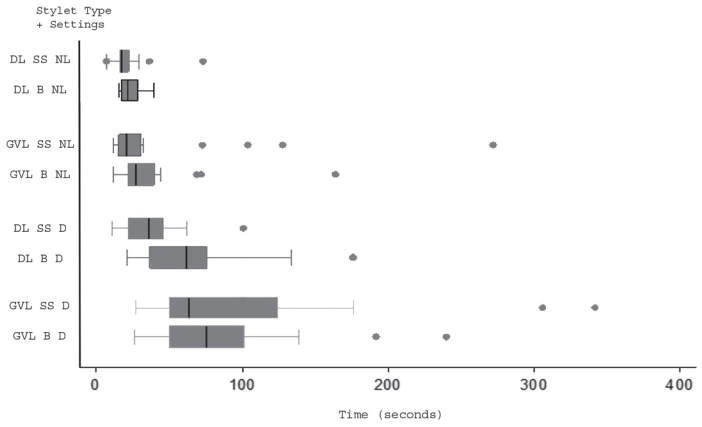

Figure 2. Time (seconds) to intubation using either the direct laryngoscope (bougie vs. stylet) and GlideScope (bougie vs. stylet) with normal or difficult airway settings. DL: direct laryngoscope, GVL: GlideScope Video Laryngoscope, SS: standard stylet, B: bougie, NL: normal airway settings, D: difficult airway settings.

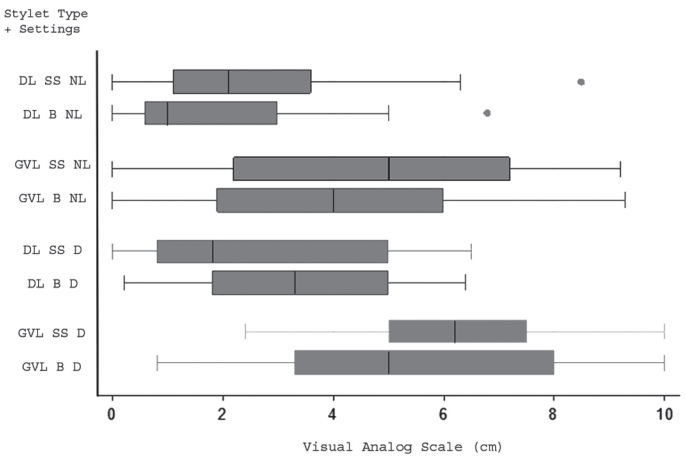

Figure 3. Difficulty of intubation among the various trials (10=most difficult). DL: direct laryngoscope, GVL: GlideScope Video Laryngoscope, SS: standard stylet, B: bougie, NL: normal airway settings, D: difficult airway settings.

This allowed free text commentary regarding manipulation techniques or other perceived difficulties with the intubation.

Data Analysis

For the sample size calculation, we considered detection of a 33% reduction in TTI using the bougie with the GVL clinically significant. Currently, as there is no agreement in the literature to clinically significant TTI differences, authors have selected variable cutoff points including five seconds[6], 10 seconds[9], 30 seconds[3]. The calculated sample size to power the study was 20 subjects. We set the standard deviation at 0.5 with standard type I and type II error rates ($\alpha = 0.05$, $\beta = 0.20$). For our primary outcomes we report medians with interquartile ranges (IQR). We performed nonparametric analysis using the Wilcoxon matched pairs signed rank test (StataCorp. 2003. Stata Statistical Software; Release 8. College Station, TX).

RESULTS

We recruited 22 EM participants. However, one was excluded from the study because he did not meet our definition of a novice user. The 21 participants included: 13 residents (62%) and eight faculty members (38%). Of the 21 participants, two (9%) had no training or experience with GVL, eight (38%) defined their prior experience as educational knowledge of GVL only, without any clinical experience, seven (33%) defined their prior experience with GVL on a simulated airway only, and four (19%) had some experience with GVL on human patients. The median number of prior DL intubations among the subjects was over 100 intubations, while the median number of prior bougie uses was five (range: 0-30) intubations.

We calculated TTI and VAS scores for all intubation trials. The median TTI with difficult airway settings using the bougie was 76 seconds (IQR 50, 102) while the standard stylet median TTI was 64 seconds (IQR 50.5, 125), P=0.76. The use of a bougie in this scenario did not significantly improve median TTI scores.

Figure 2 displays the results from the eight airway trials with respect to time. We ordered pairs by airway setting difficulty (normal or difficult), laryngoscope type (DL or GVL) and introducer type (bougie or stylet). GVL required more TTI (regardless of introducer) than the comparable trials using DL, in both the normal and difficult airway setting. For normal airway settings, the GVL required a median of 43.5 seconds (IQR 27, 62), versus 20 seconds (IQR 17, 25), P<0.01 for DL. For difficult airway settings, the GVL required a median of 68 seconds (IQR 50, 105), whereas DL required 24 seconds (IQR 18, 32), P< 0.01.

The median VAS score using the bougie-GVL with difficult airway settings was 5 cm (IQR 3.3, 8.0) while the standard stylet median VAS score was 6.2 cm (IQR 5.0, 7.5), P=0.53.

Figure 3 displays the eight airway trials with respect to ease of intubation as reported on the visual analog rating scale. We ordered pairs by airway setting difficulty (normal or difficult), laryngoscope type (DL or GVL) and introducer type (bougie or stylet). For normal airway settings, the median rating of GVL was 3.1 cm (IQR 1.5, 5) versus DL at 1.7 cm (IQR 0.8, 3.6), P=0.02. For difficult airway settings, the GVL rated a 5.85 cm (IQR 3.6, 8) whereas DL rated 4.7 cm (IQR 1.9, 6.1), P <0.01. The bougie did not significantly reduce VAS scores, and the GVL was associated with higher VAS scores compared to DL in both the normal and difficult airway setting.

Table 2 displays the qualitative intubation comments that were tracked and summarized into general categories. The main comments with GVL using the standard stylet were

Table 2. Qualitative commentary related to the intubation trials.

GVL with Standard ETT Stylet
Sharper curvature of the ETT tip was needed at the distal end (n=8)
Required partial removal of the stylet at the glottic opening (n=6)
Hard to pass the ETT through the glottis, required twisting of the ETT (n=4)
Required lifting of the epiglottis with the GlideScope blade (n=3)
GVL with Bougie
The ETT catches on the posterior arytenoids (n=9)
Required rotating or twisting of the ETT at the glottic opening (n=5)
Required changing the curvature of the bougie to enter glottis (n=5)
Required significant force to pass the ETT over the bougie at the glottis (n=5)

GVL, GlideScope Video Laryngoscopy; *ETT,* endotracheal tube

the need to make a sharper curvature of the ETT tip and the need to partially remove the stylet at the glottic opening to help advance the ETT into the glottis. The main comments with GVL using the bougie were that the ETT caught on the posterior arytenoids needs to be rotated or forced to enter the glottis, and the bougie curvature needed to be changed (comments did not include specific details on required changes for the bougie).

DISCUSSION

The bougie is a familiar and readily available difficult airway adjunct that we hypothesized would make VL-guided intubation easier and faster. Our assumption was that the adaptable shape, familiarity and directability of the bougie would be beneficial. However, we were unable to demonstrate an advantage over a standard stylet among novice GlideScope® users. We were surprised to find that the use of a bougie did not decrease the TTI or make intubation easier as measured by our rating scale.

Previous studies have shown that VL consistently improves the glottic view; however, negotiating placement of the ETT may still be a challenge.[2-6,9-15] This study highlights several potential intrinsic difficulties when combining the bougie with GVL. Providers reported that the ETT can "hang-up" on the posterior arytenoids when using the bougie as a guide and that the ETT required rotation or twisting and increased force to advance into the glottic opening. Ideally, the axis of the bougie should parallel the main tracheal axis. This may be easier to accomplish during DL because the operator aligns the oral and laryngeal axes to visualize the glottis. As a consequence, the angle of approach to the glottis is more direct. However, with VL the angle of approach often results in an oblique and anteriorly directed entry of the bougie tip

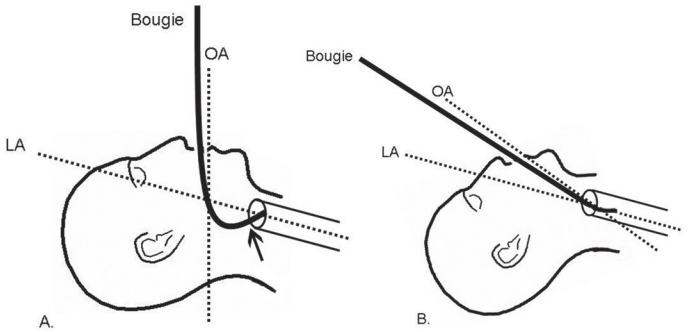

Figure 4. The arrow in diagram A demonstrates the location of potential resistance to glottic entry when using a bougie curved for GVL use.

into the glottis. Subsequent ETT placement may be difficult as the ETT tip encounters resistance at the level of the arytenoids (Figure 4). This may increase the amount of ETT "hang-up" at the glottic opening, creating a more difficult and time-consuming intubation. Given the qualitative data from the subjects, the bougie may have a steeper learning curve when used with the GVL compared to DL.

In practice, we found the classic Eschmann introducer (gum elastic bougie) to be too pliable to maintain a consistent 60-90° bend often necessary to enter the glottis when using the GVL.[16] The introducer we chose to use in this study was the 15 French single-use introducer (SunMed Healthcare) with coude tip with an imposed bend to match the shape of the GlideScope® blade. This particular product, made from low-density polyethylene, is stiffer and has more elastic memory than other introducers, making it potentially ideal for use with the GlideScope®

We had all operators start with the standard "J-shaped" tip when using the styletted-ETT for DL and a sharper curvature of approximately 60°, when using the bougie or ETT for GVL. The subjective comments from the participants suggest that slight changes in the ETT or bougie may increase the likelihood of success. When using the standard ETT malleable stylet for GVL, the most common comment was that the ETT tip needed a sharper degree of curvature to advance into the glottis. Various authors have recommended different ETT angles for use with the GVL between 60° and 90°.[4,9-13] Our findings support those studies that suggest that a 90° angle may be superior. Some participants noted the need to change the bougie curvature as well. However, the specific details of these changes were not recorded in the subjective comments. Further studies quantifying angulation changes to the bougie or evaluation of different devices (e.g. the GlideScope® specific rigid stylet) may be warranted for additional clinical relevancy.

Different techniques for providers to consider may include changing angulation of the bougie or ETT, reverse camber loading of the ETT, or different rotational techniques during advancement into the trachea. A recently developed

ETT, (GlideRite™, Parker Medical) was designed to avoid "hang-ups" on the laryngeal structures when using GVL. This tube has a flexible, curved, taper-centered tip compared to the chisel-shaped leading edge of a standard endotracheal tube. The development of this ETT suggests that "hang-up" is a recognized potential rate-limiting step during GVL. Further studies are required to determine if this new ETT or different insertion techniques will be helpful in conjunction with VL.

LIMITATIONS

Due to practical and ethical issues, we conducted our study using a simulated airway model (i.e., Laerdal AirMan). While this model gave us a consistent experimental platform, results from such a simulator may not necessarily translate identically to human subjects. This is particularly relevant to this study because stiffness and lubrication of tissues are important elements that may influence performance of the maneuvers we tested. We did attempt to compensate for this recognized issue by applying judicious amounts of lubrication in a consistent manner throughout the trial. This simulator platform has been used successfully in the past and is an accepted model for testing new airway devices.[5,6,15]

The operators were aware they were participating in a timed trial, which may have affected their clinical performance. However, any change in clinical performance would likely have been distributed equally across all of the trials, minimizing this effect. An additional possible confounder is operators' preexisting preferences regarding equipment or techniques, which may have influenced VAS score reporting. TTI is an objective variable while VAS is a subjective variable therefore the TTI and VAS may not always correlate.

We sought a comparatively inexperienced participant group to minimize confounding by technical expertise. We recruited both residents and faculty into the study, which may have some inherent bias in terms of experience, age or motor skills. Therefore, the findings of this study may not be generalizable to all GVL users. In particular, we noted longer TTI and increased difficulty associated with GVL use compared to DL. Advanced GVL users would likely have faster intubation times and lower difficulty scores compared to novice GVL users. Future studies would be needed to evaluate if the bougie would be helpful in advanced GVL users.

CONCLUSIONS

Among novice users of GlideScope® VL for simulated difficult airway management, no benefit was found using the bougie over the standard stylet. Difficulties may arise when using the bougie with GVL, including "hang-up" of the ETT on the posterior glottic structures. In such an event, ETT placement may require the use of increased force or use of various rotational movements of the ETT to achieve successful intubation.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

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Adherence to Dose of Succinylcholine and Etomidate in the Emergency Department

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INTRODUCTION

Many medications are administered according to the weight of the patient. Because it is often not available in the emergency department (ED), the patient's weight is therefore estimated. Several studies have shown that emergency physicians are inaccurate at estimating a patient's weight.[1-3] Medications to facilitate intubation, induction agents and paralytics are often weight-based.This study evaluated the accuracy of dosing succinylcholine, a paralytic and etomidate, an induction agent, in our ED.

METHODS

We conducted a retrospective chart review of all patients intubated in the ED between January 1, 2004 and December 31, 2004, at an urban Level I trauma center with approximately 50,000 ED visits annually. We identified all ED intubations by retrospectively reviewing the hospital financial databases for intubations of ED patients, and by patients who had critical care billing for an intubation procedure or for ventilator use in the ED. We also examined ED patient logs to identify all patients who were admitted to the intensive care unit (ICU), the operating rooms, or had expired. All intubations were tied to a unique visit. We reviewed the charts to determine if an intubation took place in the ED, and we recorded the dosages of all intubation medications used. We excluded from our cohort patients who were intubated prior to arrival in our ED either by another hospital or by pre-hospital personnel.

We measured the patient's actual weight using standard ICU bed scales on admission and then recorded it. The dosages of the intubation medications were calculated in mg/kg and compared to the standard dosages (etomidate 0.2-0.3mg/kg and succinylcholine 1-1.5mg/kg) to determine if they were accurate. We obtained the standard dose of succinylcholine from Micromedex Health Care Series Drugdex, which is the standard dosing in our ED. Etomidate dosing in our ED is 0.2-0.3mg/kg by our standard protocols. Succinylcholine and etomidate are the standard medications used for rapid sequence intubation (RSI) and were the medications used in all of the ED RSI we examined.

We entered de-identified data into a Microsoft Excel 2003 (Redmond, WA) database. Descriptive statistics, 95 % confidence intervals (CI) and standard deviations (SD) are reported when appropriate. We analyzed data using SPSS14 (Chicago Il.). The study was approved by the hospital institutional review board.

RESULTS

We identified 148 patients as being intubated in our ED during the one-year study period. This represents 2.7 intubations for every 1,000 patients seen. Of these, 129 were included in the analysis. Nineteen patients were excluded due to the absence of a recorded weight and/or medication dosage. Table 1 shows the data by gender. Sixty-one (47%) were female. The mean weight of patients was 82.9 kg (SD:17) for males and 68.7 kg (SD:17) for females. One hundred twenty-eight patients were intubated with succinylcholine. Seventy-seven patients (60% CI: 51-68) were given 120 mg of succinylcholine. Using a range of 1.0-1.5 mg per kg for succinylcholine, only 30% (CI: 22-38) of patients received a dose in the correct range. In the group of patients receiving succinylcholine, four (3%) were underdosed, and two (1.5%) were given less than 0.9mg/kg of succinylcholine. The mean weight of patients with an underdose was 111 kg (CI: 108-114). All of the patients given less than 0.9 mg/kg of succinylcholine were male. Sixty-six percent of patients received an excessive dose of succinylcholine (51% of men and 85% of women). Twenty-four (18%) received more than 2mg/kg of succinylcholine, including six female patients (5%) who received greater than 2.5mg/kg of succinylcholine. The mean weight for the group receiving an excessive dose of succinylcholine was 67 kg (CI: 64-70). Etomidate was given

Table 1. Weight-based medication administration.

Demographics	All		Male		Female	
Patients	129		68		61	
Mean age years (SD)	63.1	(20.4)	60	(21.6)	67.8	(18.1)
Mean weight in kilograms (SD)	76.1	(18.5)	82.9	(17.0)	68.7	(17.0)
Medications						
Succinylcholine	128		67		60	
% Correct 1-1.5mg/kg (CI)	30%	(22-38)	43%	(31-55)	15%	(6-24)
% Under 1 mg/kg (CI)	3%	(0-6)	6%	(0-12)	0%	*
% Over 1.5mg/kg (CI)	66%	(59-75)	51%	(39-63)	85%	(76-94)
Etomidate	126		66		60	
% Correct 0.2-0.3mg/kg (CI)	57%	(48-66)	65%	(31-55)	50%	(38-63)
% Under 0.2mg/kg (CI)	10%	(5-16)	16%	(0-12)	5%	(1-10)
% Over 0.3mg/kg (CI)	33%	(24-41)	19%	(39-63)	45%	(33-58)

SD, standard deviation; *CI,* confidence interval (95%)

in 126 of 129 intubations. Ninety-five percent of patients (CI: 91-99) were given 20 mg of etomidate. Fifty-seven percent (CI: 48-66) of patients were given a dose of etomidate within the correct range of 0.2-0.3mg per kg. Ten percent (CI: 5-15) were underdosed with etomidate. Three patients (2%) were given a dose of ≤0.15mg/kg of etomidate. The mean weight of a patient with an underdose of etomidate was 102 kg (CI: 98-106). Thirty-five patients (27%) were given an excessive dose of etomidate. The mean weight of those getting an excessive dose of etomidate is 57 kg (CI: 53-61). Seven patients (5%) were given a dose of 0.4mg/kg or higher of etomidate.

LIMITATIONS

As a single-center retrospective study we are limited in our ability to make general statements based on our study population. As we saw no pediatric patients, we cannot make any inferences about this population. Since there is no central way to identify patients intubated in our ED, we used multiple methods to identify cases; however, there is a chance we could have overlooked a particular group that could alter the outcome. Finally, we do not consider the clinical effects of the dosages administered; thus, a dose judged as inadequate may have been efficacious. Conversely, a dose judged as adequate could have been inadequate.

DISCUSSION

The process of RSI is common practice in emergency medicine. A key aspect to RSI is administering sedation and paralytic medications. Several studies have demonstrated that ED physicians have poor accuracy when estimating a patient's weight.[1-5] Furthermore, a study by Naguib et al.[6] has shown that underdosing succinylcholine can make adequate airway visualization and intubations more difficult. Our study set out to evaluate the accuracy of weight-based paralytic and induction agent dosing in ED patients. As an initial step, we chose to do a retrospective chart review of all ED intubations for a one-year period. Our intubation rate of 2.7 patients per 1,000 ED visits is very similar to prior work showing an ED intubation rate of 2.6 per 1,000 ED visits, which indicates our rate is similar to that of other urban EDs.[7] From our data there seems to be little variation in the amount of induction-agent dosing. There also appears to be greater variation in succinylcholine dosing, which may be due to weight estimation.

Although the study was not set up to answer why there was variation, it does describe the presence of that variation in the dosing of paralytics and induction agents. Our data shows that men are more often underdosed, and women are more likely to be overdosed with succinylcholine. Our data shows that succinylcholine was given in doses of 2.5 mg/kg or greater in six patients, all of whom were women. Furthermore, our data also shows that a small percentage of patients were given paralytic doses of less than 0.9 mg/kg. Several studies have shown that adequate to higher dosing of paralytics leads to more optimal intubating conditions.[8-10] Leemans et al. [10] have shown that higher doses of succinylcholine based on patient actual body weight, not lean body weight or ideal body weight, can lead to more successful intubation conditions. In a patient population with an increasing obesity prevalence, dosing medications on estimated actual body weight could potentially affect patient care and intubating conditions. Our study also provides information on the accuracy of estimated weight-based administration of succinylcholine and etomidate in ED patients. While we did not study the effects of overdosing the amount of succinylcholine, it does help to clarify administration of weight-based medications in the ED. Further studies are needed to evaluate the effect on intubating conditions in the ED when using estimated actual body

weights to determine the correct dosing of induction and paralytic medications for RSI.

Having shown the range of overdosing and underdosing of both paralytics and inducation agents in our ED, we believe that further studies should be done to detect difficulties during intubation that could result from this underdosing, including multiple intubation attempts, patient movement during intubation, and patients requiring redosing.

CONCLUSION

Physicians often give the same dose of RSI-induction medications regardless of a patient's weight. Men are more likely to be underdosed and women overdosed. There is little variation in the amount of induction agent used, and paralytic dosing has more variability. We believe that inadequate induction or paralysis may result from this under dosing; however, in this paper that potential outcome was not studied.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

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Randomized Controlled Trial of Prophylactic Antibiotics for Dog Bites with Refined Cost Model

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Objective: The aim of this study was to determine the rate of infection at which it is cost-effective to treat dog bite wounds with antibiotics.

Methods: Our study was composed of two parts. First we performed a randomized, double-blind controlled trial (RCT) to compare the infection rates of dog bite wounds in patients given amoxicillin-clavulanic acid versus placebo. Subjects were immunocompetent patients presenting to the emergency department (ED) with dog bite wounds less than 12 hours old without suspected neurovascular, tendon, joint or bone injury, and who had structured follow-up after two weeks. Second, we developed a cost model with sensitivity analysis to determine thresholds for treatment.

Results: In the RCT, primary outcomes were obtained in 94 patients with dog bites. The overall wound infection rate at two weeks was 2% [95% CI 0 to 7%]. Two of 46 patients (4%) receiving no antibiotics developed infections, while none of the 48 patients (0%) receiving prophylactic antibiotics developed an infection (absolute reduction 4% [95% CI -1.0 to 4.5%]). Using a sensitivity analysis across a rate of infections from 0-10%, our cost model determined that prophylactic antibiotics were cost effective if the risk of wound infection was greater than 5% and antibiotics could decrease that risk by greater than 3%.

Conclusion: Our wound infection rate was lower than older studies and more in line with current estimates. Assuming that prophylactic antibiotics could provide an absolute risk reduction (ARR) of 3%, it would not be cost effective to treat wounds with an infection rate of less than 3% and unlikely that the ARR would be achievable unless the baseline rate was greater than 5%, suggesting that only wounds with greater than 5% risk of infection should be treated. Future work should focus on identifying wounds at high-risk of infection that would benefit from antibiotic prophylaxis. [West J Emerg Med. 2010; 11(5):435-441.]

INTRODUCTION

Background

Dog bites are a common public health problem, and nearly five million people are bitten each year in the United States.[1] Although only one-fifth of bite victims seek medical care, these patients account for nearly one thousand daily emergency department (ED) visits in this country.[1,2]

The primary morbidity associated with dog bites is their infection rate, which is generally higher than normal wounds.[3-7] However, it is unclear whether bite wounds should be treated with prophylactic antibiotics. There are numerous contradictory studies regarding the exact incidence and true risk of infection. A meta-analysis of prior studies recommended the administration of prophylactic antibiotics, yet this study had several significant limitations.[5] For example, studies included in the meta-analysis had small sample sizes,

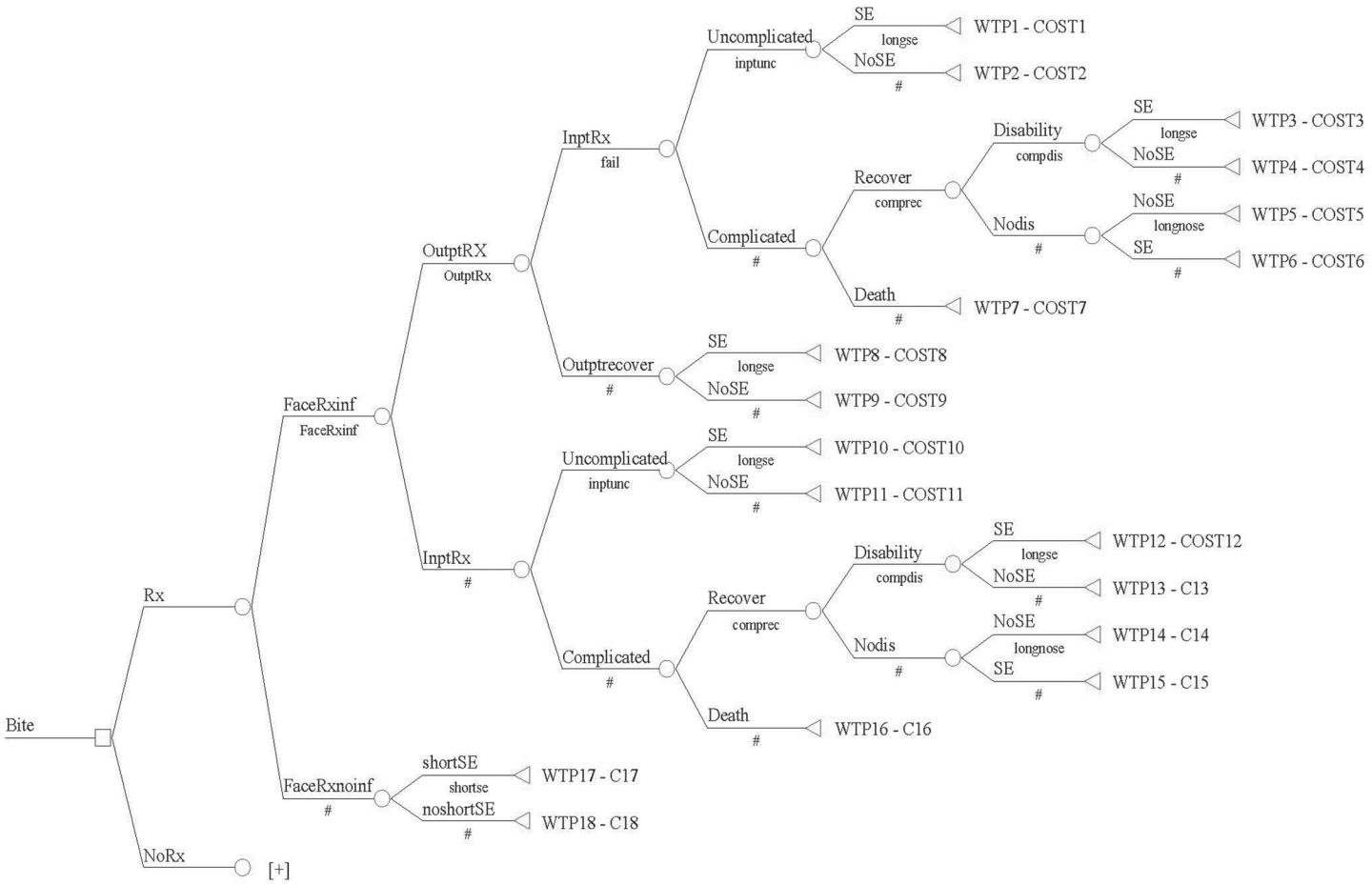

Figure 1. Cost model for the use of prophylactic antibiotics for dog bites
Inpt, Inpatient; *Inf,* infection; *Outpt,* Outpatient; *Rx,* perscription

different methodologies, lacked a standardized definition for wound infection, used a variety of antibiotics (often those to which the most common organisms from bites are not susceptible), and contained large range of infection rates in the control groups (from 3.2% to 45.8%).[3,5,8-9] Conversely, a more recent Cochrane review[9] of the same randomized controlled trials concluded there was no strong evidence for treating wounds with prophylactic antibiotics. The routine use of antimicrobials for such a common but controversial indication is concerning given the risks of medication side effects, increased resistance, and cost of approximately $30 million dollars per year.[10]

Goals of this investigation

The first objective was to determine the infection rate at which antibiotics are clinically warranted and cost-effective using a cost model and sensitivity analysis based on existing data from the literature and known costs associated with various treatments. The second objective was to estimate current rates of infection and verify previously published infection rates used in our model by conducting a randomized controlled trial of dog bite wounds treated with and without oral prophylactic antibiotics.

METHODS

Decision Tree Cost Model

A cost decision tree model based on all clinical outcomes and scenarios was developed using TreeAge Data 4.0 (Figure 1). This tree model mapped out all inpatient and outpatient treatment options, outcomes and side effects for patients sustaining dog bite wounds. The following pathways and assumptions were made: 1) patients would have the same chance of being treated as an outpatient or an inpatient once diagnosed with an infection regardless of whether they were on prophylactic antibiotics; 2) wound infections in patients on prophylactic antibiotics did not alter the chance of outpatient recovery, inpatient recovery, inpatient complication rates, chance of death, chance of disability or side effects; and 3) subsequent outpatient care and follow-up was included in the cost of inpatient care given the high cost of inpatient care and the low cost and variability of subsequent outpatient follow-up. Table 1 lists the estimates made regarding effectiveness and clinical outcomes in the cost model. It also outlines the source/reason for these estimates as well as the frequencies and ranges tested in the analysis. The legal costs resulting from liability of untreated wounds that become infected were omitted from this analysis since wound infection is an

Table 1. Estimates of antibiotic effectiveness and clinical outcomes in the cost model

Variable	Estimate	Evidence	Range Analyzed	Source
Baseline infection rate facial bites (FaceNoRxInf)	10%	Retrospective review	5% - 10%	[3] [6]
Infection Rate - prophylactic antibiotics – facial bites (FaceRxInf)	5.6% (95% CI 3.8 –8.2%)	Meta-analysis of RCT	3.2% - 10%	[5]
Baseline infection rate hand bites (HandNoRxInf)	36%	Retrospective Review	10% - 50%	[3] [6]
Infection rate - prophylactic antibiotics – hand bites (HandRxInf)	8.3% (95% CI 1.8 – 34.2%)	Meta-analysis of RCT	18% - 34.2%	[5]
Baseline infection rate other area (extremity and trunk) (OtherNoRxInf)	17%	Retrospective Review	10% - 30%	[3] [6]
Infection rate - prophylactic antibiotics – other areas	9.5% (95% CI 6.5% - 13.95)	Meta-analysis of RCT	6.5% - 14%	[5]
% Facial bites	50%	Survey estimates	N/A	[2]
% Hand bites	30%	Survey estimates	N/A	[2]
% Other	20%	Survey estimates	N/A	[2]
% of infected wounds considered for outpt Rx (OutPtRx)	90%	Physician Opinion	50% - 90%	
Failure rate of outpt antibiotics (Fail)	5 % - 15%	RCT for outpt treatment of cellulites	10% - 30%	[17], [18]
Risk of complicated inpt course (1-Inptunc)	1- 4%	Retrospective review	2% - 10%	[19]
Risk of disability after hand infection/surgery (CompDis)	5%	Retrospective review	1% - 10%	[20]
Risk of death w/ complicated infection (1-CompRec)	3%	Survey Estimate	2% - 3%	[2]
Antibiotic side effects (ShortSE; LongSE)	5% - 34%	RCT	5% - 34%	[17], [18]

Inpt, Inpatient; *Inf,* infection; *Outpt,* Outpatient; *RCT,* randomized, double-blinded control trial; *Rx,* perscription

expected complication and the treatment unproven. Of note, the highest liability from wound treatment is missed foreign body.[11]

The costs of cellulitis, septicemia, scar revision and incision and drainage of the skin were gathered from the Healthcare Costs and Utilization Project 2003 Nationwide Inpatient Sample and the costs of Outpatient Visit level 3 on the 2005 Medicare Fee Schedule.[12] These were then adjusted for inflation to 2006. The average price of amoxicillin-clavulanic acid is $5 a pill (range $2-7) .[13] The costs of these items are detailed in Table 2.

Sensitivity Analysis

The sensitivity analysis was performed using this decision tree. It calculated and compared the baseline treatment costs of all dog bite wound infections with the collective treatment costs of administering prophylactic antibiotics and treating the non-preventable infections. This calculation was run over varying baseline infection rates and percentage of wound complications prevented. Costs were based on the rate of each infection and the cost of each intervention needed to treat the infection. The analysis assumed that a broad-spectrum antibiotic such as amoxicillin-clavulanic acid would be used

Table 2. Cost data used in model

	HCUP Inpatient Charge	2003 Charge (Dollar)
	Diagnosis	
682.0	Cellulitis of face	10,644.00
682.4	Cellulitis of hand	12,252.00
682.9	Cellulitis, other	14,837.00
038.9	Septicemia	29,654.00
	Procedure	
86.04	Other Skin & Subq Incision and Drainage	16,648.00
86.89	Skin Repair & Plastic Reconstruction	25,868.00
	Medicare Charge	2005 Charge (Dollars)
	Outpatient Visit- Level 3	1,143.00

HCUP, Healthcare Costs and Utilization Project

for three days as the method of prophylactic treatment. All clinical outcomes were considered to their completion, and it was assumed that all costs and benefits occurred within one year of the bite and thus were not subject to discounting.

Randomized controlled study design

A randomized, double-blind controlled trial was conducted to compare the outcomes of dog bite wounds in patients given three days of prophylactic amoxicillin-clavulanic acid versus placebo. The study was approved by both the University of California San Francisco (UCSF) and Stanford University Institutional Review Boards.

Study Setting and Population

This study was conducted at the ED of the UCSF and Stanford University Medical Center (SUMC), with a combined annual census of 75, 000 visits per year. The study periods were from August 2003 – March 2006 (UCSF) and October 2004 – March 2006 (SUMC).

All dog bites, regardless of site were considered for enrollment. Patients were excluded if they met any of these criteria: 1) wounds over 12 hours old at presentation or already infected; 2) patients with immunosuppression; 3) patients with a penicillin allergy; and 4) wounds with suspected neurovascular, tendon, joint or bone injury.

Randomized controlled study protocol

In order to consider all eligible wounds and maximize patient recruitment, patients with dog bites were identified through a real time notification and tracking system of all ED patients, previously described.[14] The notification system screened all chief complaints on a tracking system 24/7, and the research coordinator was paged when a patient registered with "dog" or "bite" in the complaint. The coordinator then called to verify it was a dog bite and request patient enrollment. The emergency medicine physician obtained informed consent from the patient and enrolled the patient into a secure web-based system. The requested demographic, insurance, and visit data for this study was automatically sent to the research database and the appropriate fields populated. Once the consent was printed, signed and verified, the form randomized the patient to a treatment group based on patient weight via a computerized randomization code based in blocks of eight, and stratified according to weight to include children. Three-day courses of blinded medication was prepared by pharmacy and distributed to the patient in the ED with the first medication dose given in the ED. The physician completed the structured web-based data entry form. Printed standardized custom discharge sheets with instructions for taking medications, signs and symptoms of infection and when to follow-up were provided to every patient.

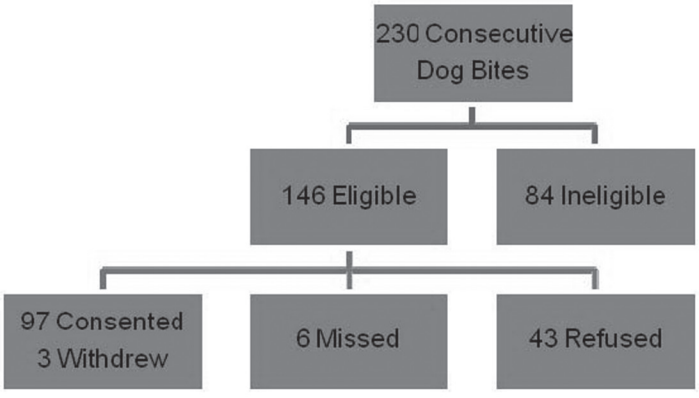

Figure 2. CONSORT diagram for the randomized control trial on the use of prophylactic antibiotics for dog bites

Outcome Measures

Patients were to call investigators or return to the ED if signs of infection developed. All patients underwent structured phone follow-up after 14 days during which they were queried as to: 1) if they had developed signs of infection (redness or discharge) and 2) whether any practitioner treated the wound with antibiotics for wound infection. This determination of infection and treatment was confirmed with the treating physician and was used as the primary outcome for the study for several reasons. The physicians making those determinations were blind to randomization and initial treatment, and in our cost model treatment decisions are what drive costs. Patient opinion as to whether they thought the wound was infected was not considered an outcome if it healed without any further treatment.

Data Analysis

Demographic and clinical characteristics in the randomized, double-blind controlled trial (RCT) were determined by t-tests, chi-square and Fisher's exact tests as appropriate. The RCT analyses were conducted using SPSS 11.0 (Chicago, Ill). The cost model and related sensitivity analysis was done in TreeAge Software 4.0 (Williamstown, Mass).

RESULTS

Study subjects

Figure 2 is a CONSORT diagram of patient enrollment. A total of 230 consecutive patients with dog bites presented during the study period. Of these, 84 patients (36.5%) were ineligible due to the exclusion criteria outlined above. Out of the remaining 146 (63.5%), six were missed and 43 refused enrollment. Ninety-seven patients (42% overall) were consented for the study and three subsequently withdrew or were not available for follow-up (Figure 2).

Results of Randomized Controlled Trial

Table 3 compares the patient demographic and wound characteristics of those that received prophylactic amoxicillin-clavulanic acid with those that received a placebo. The patients were of similar age and gender. The wounds of the

Table 3. Characteristics and outcomes of study patients in the randomized, double-blind controlled trial

	Antibiotics N=48	Placebo N=46	Difference (95% CI)
Age (years)	34	31	3 (-5 – 11)
% Male	56	61	5 (-2 – 2)
Length (centimeter)	2.1	1.6	0.5 (- 0.2-1.2)
Time from Injury (minutes)	176	188	12 (-109–84)
% Full thickness (through dermis)	56	66	10 (-3 – 10)
% Non-facial	81	64	17 (-0.6 – 33)
% Closed	17	32	15 (-2 – 30)
% Infected	0	4	4 (-1 – 4.5)

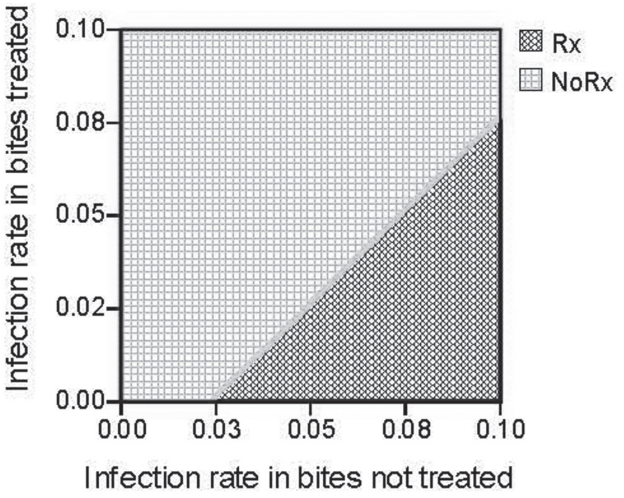

Figure 3. Sensitivity analysis of cost analysis comparing benefits of prophylactic antibiotics (Rx) at different infection rates

two groups were similar with regard to length and time from injury, though the placebo group tended to have a greater but non-significant proportion of full thickness, sutured and facial wounds (Table 3). None of the 48 wounds treated with antibiotics became infected, whereas two of the 46 wounds in the placebo group became infected for a difference of 4% (95% CI 4%-14%) between the two groups. The overall infection rate was 2% (95% CI 0-7%) and both infected wounds occurring in the placebo group were sutured, including one on the face and the other on the neck. Both were diagnosed two days after enrollment.

Results of the Sensitivity Analysis

Results of the sensitivity analysis are summarized in Figure 3. This graph shows the cost effectiveness of antibiotics at each baseline rate of infection from 0 to 10% given the corresponding rate of infection in the treated group. The diagonal line is the threshold for which it becomes beneficial to treat with prophylactic antibiotics. The cost model recommends treating wounds at greater than 5% risk of infection (even if they had only a small benefit of about 1-2%). It is likely not cost effective to treat wounds with less than 5% risk of infection and never at levels below 3%.

LIMITATIONS

The high number of eligible patients who refused to participate and the fact we excluded wounds with suspected tendon injuries or fractures could have affected the low number of infections we found in our study. However we did include certain high-risk wounds such as those that were punctures or on extremities.[4] There is also no clear validated outcome measure to determine traumatic wound infection. Failure to use a consistent validated outcome measure has limited previous studies and corresponding systematic reviews. The Centers for Disease Control (CDC) has a set of clinical and lab criteria to try to standardize the reporting of surgical site infections. This criterion includes the treating physician's assessment.[15] It was impractical for us to get all patients follow-up so that we could apply the objective CDC criterion, but for our study we did use the determination of the treating physician since it was a blinded assessment and also fit the outcome in our cost model.

Cost models are based on assumptions and tested across a range of sensitivity analysis as outlined in table 1. In the end, the assumptions need to make clinical sense and are estimated based on available data and tested in a sensitivity analysis (Figure 3). For example, we surmised that 90% of infections would initially get treated as outpatients after looking at published data and our institutional numbers.[10] It may be possible that more than 10% would get admitted for an infection, and if the number was higher the threshold to treat with prophylactic antibiotics would be higher (i.e., more money could be saved by preventing both infections and the increased costs of hospital admission).

Finally, while our clinical trial is small and not sufficiently powered by itself to find a difference, it will add to the existing literature to allow for more concordant and accurate systematic reviews and meta-analyses. The results are also useful to make treatment recommendations when they are applied through the cost model with sensitivity analysis (equivalent to 95% CI).

DISCUSSION

Our study showed that the current rate of infection from dog bite wounds is lower than reported in most prior studies, and our associated cost model showed that if the rate of

infection is less than 3-5% there is little value in the use of prophylactic antibiotics. This has led us to believe that we should focus on determining factors associated with high-risk wounds so that we can appropriately use prophylactic antibiotics.

From our analysis it is clear that the value of antibiotic use is related to the actual rate of infection and the drug's effect on preventing infections. For example, three days of amoxicillin-clavulanic acid costs about $30 (assuming $5 a pill), whereas the cost of developing an infection that requires a return visit to the ED, probable intravenous antibiotics and possible admission costs thousands of dollars. At the extremes, if 20% of patients develop infections and even 1% could be prevented with a short course of prophylactic antibiotics, the front-end cost of antibiotics in all cases is minimal compared to the large cost of treating infections that do occur. In that case only a small benefit (1%) would be needed to be cost effective. However, as the baseline rate of infection becomes lower in the population, it is harder to achieve a benefit with antibiotics. Figure 3 demonstrates that if the infection rate is 8%, there must to be a 3% decrease in the infection rate (to 5%) to be cost-effective to treat people with antibiotics. At a 5% baseline rate, there would need to be a 3% decrease to be cost-effective, which translates to an impractical 60% relative reduction in infections. At levels of infection less than 3% it is never cost effective to treat since the threshold line is already reached.

Our randomized controlled trial found that the overall infection rate of dog bite wounds was 2% (95% CI 0-7%) with a difference of 4% (95% CI -1-4.5%) between treatment and placebo groups. Based on the cost-model, it is not cost effective to give prophylactic antibiotics at 2%, though it may be justifiable at the upper end of the 95% CI of 7%. Our rate of 2% is lower than the most current reported infection rates of 5-10%[4] but similar to that found in other studies.[2,5] Several factors may account for this. We used a standardized definition of wound infection and a single agent known to be effective against the pathogens in dog bites. Previous studies used a variety of antibiotics (trimethoprim-sulfamethoxazole, cephalexin and erythromycin) with questionable efficacy against organisms such as *Pasteurella multocida*.[5,9] These studies also did not use a consistent method of determining outcomes. Furthermore, the studies included in a prior meta-analysis[5] and Cochrane review[9] were limited by design and lack of techniques related to improvement in wound cleansing that have occurred over the last 30 years, particularly irrigation. While the value, timing and route of antibiotic prophylaxis can be argued, the benefit of antibiotics is probably dwarfed by proper irrigation and its effect on wound colonization, which is the prime determinant of infection.[16] Since the publication of most of these studies there have been great improvements in wound irrigation and care.

A randomized controlled multi-center trial of sufficient power may address the issue of antibiotic effectiveness. If an absolute risk reduction of 3% can be shown, prophylactic antibiotic use would be cost-effective. However, given the low rate of wound infection, conducting a randomized controlled trial to determine if antibiotics could significantly decrease infection would require nearly 7,000 patients and a cost too great to warrant such a trial. It is also clear that different dog bite wounds have different risks, and assuming them to be of equal risk in treatment decisions makes little clinical sense.

We believe further research should focus on identifying factors associated with high-risk wounds. Our trial and previous literature suggest a small trend of benefit from antibiotic prophylaxis regardless of trial limitations. The results of this trial indicate that the baseline rate of wound infection is low, especially among low-risk wounds. Future studies should try to identify wounds that have a high risk of infection (above 3-5%) that would benefit from prophylactic antibiotics. For example, 13% of untreated sutured wounds got infected in this study suggesting they are at high-risk. There are currently no tools or decision guidelines to predict which bites are high-risk and likely to become infected. A set of clinical predictors to identify wounds at high risk of infection is needed and would be the next logical step to address the controversial issue of prophylactic antibiotics and guide physician management decisions.

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Conflicts of Interest: By the WestJEM article submission agreement, all authors are required to disclose all affiliations, funding sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

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Competitive Wrestling-related Injuries in School Aged Athletes in U.S. Emergency Departments

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Objective: To describe the characteristics of wrestling injuries occurring in male athletes aged 7-17 treated in United States (U.S.) emergency departments (ED) from 2000-2006, and to compare injury patterns between younger & older youth wrestlers.

Methods: A stratified probability sample of U.S. hospitals providing emergency services in the National Electronic Injury Surveillance System was used for 2000-2006. ED visits for injuries sustained in organized wrestling were analyzed for male patients ages 7-17 years old (subdivided into 7-11 years old [youth group] and 12-17 years old [scholastic group]).

Results: During the study period, there were an estimated 167,606 ED visits for wrestling injuries in 7-17 years old U.S. males, with 152,710 (91.1%) occurring in the older (12-17 years old) group. The annual injury incidence was 6.49 injuries/1,000 wrestlers in the youth group and 29.57 injuries/1,000 wrestlers in the scholastic group. The distribution of diagnoses was similar in both age groups, with sprain/strain as the most common diagnosis, followed by fracture and contusion/abrasion. Distributions of injury by location were significantly different between groups (p=0.02), although both groups exhibited approximately 75% of all injuries from the waist up. Overexertion and struck by/against were the most common precipitating and direct mechanisms in both groups, respectively. Over 97% of all injured wrestlers were treated and released.

Conclusion: The types of injury in youth (7-11 years old) wrestlers are similar to those of scholastic (12-17 years old) wrestlers, although the distribution of body parts injured differs between the age groups. The majority of injuries occurs above the waist and may be a target for prevention strategies. [West J Emerg Med. 2010; 11(5):442-449.]

INTRODUCTION

Background

The origins of wrestling can be traced back to the Sumerians as early as 5000 B.C., and records of ancient Olympic wrestling date back to the Greeks in 708 B.C.[1] Since those early days, wrestling has evolved into many different forms practiced all over the world with the major styles including freestyle, Greco-Roman and folkstyle. In the United States (U.S.), folkstyle is the style in which most athletes participate and involves younger athletes in youth programs as well as interscholastic wrestling teams at the middle school and high school levels. While overall participation has varied in recent years, U.S. wrestling participation has averaged 2.5 million participants per year over 2000-2006, with an average of 1.1 million participants wrestling greater than 50 days per year.[2] Despite having only the sixth highest average annual participation of boys in high school sports, wrestling is second only to tackle football for frequency of injury in high school athletes.[3-4]

The risk of serious injury is significant in young athletes and includes permanent debilitation from fracture, traumatic brain injury and rarely, death.[5-10] A number of these wrestling

injuries can be categorized as major or catastrophic ensuring that wrestlers will frequently require emergency treatment while some injuries will require inpatient care or even surgery depending upon the diagnosis.[5-6,9,11-13] Furthermore, the unique physical requirements and limb positions in wrestling also leads to rare but noteworthy injuries that have been reported in the medical literature.[14-20]

Because of its violent nature, wrestling has been a target of injury prevention efforts. These efforts have included regulations that cap excessive and rapid weight loss, mat and equipment engineering interventions, and revision of weight classes among others with effectiveness noted especially in the weight management interventions at the high school and collegiate levels.[7,8,21-25]

Importance

Our current knowledge of the distribution and nature of wrestling injuries is incomplete. While organizers, coaches and officials have made many efforts to ensure the safety of participants, injuries still occur, and the patterns of injury remain uncertain in the youngest athletes. Furthermore, the extent to which injuries at the youth level differ from those at the high school level is unknown. Overall, researchers have found that young athletes are more likely to suffer from physical injuries and avulsion fractures rather than ligament and tendon injuries like their older counterparts.[26] Additionally, the larger body surface area to mass ratio and developing motor skills of younger athletes have been shown to result in more serious injuries in some sports.[27]

Goals of this Investigation

Existing data reflect patterns of wrestling injuries only on a local or regional level. To our knowledge, a national assessment of youth wrestling injuries has not been undertaken. Given the lack of knowledge concerning wrestling injuries in school-aged athletes, we set out to 1) describe injuries in competitive wrestlers at the youth, and the middle school/high school levels from a national perspective and 2) compare the patterns of injury between these age groups.

METHODS

Study Design

This was a retrospective study using data from the National Electronic Injury Surveillance System (NEISS) for patients treated from January 1, 2000, through December 31, 2006. Our institution's Committee on the Protection of Human Subjects exempted the study protocol from institutional review board review.

Study Setting and Population

We obtained data from NEISS, which is a national probability sample of hospitals conducted by the U.S. Consumer Product Safety Commission. Data on injury-related visits are obtained from a national sample of 96 - 100 NEISS hospitals that was selected as a stratified probability sample of hospitals in the U.S. and its territories with a minimum of six beds and a 24-hour emergency department (ED). NEISS collects data on visits for consumer product-related injuries treated in U.S. EDs and provides data on approximately 350,000 injury-related ED visits annually. It is intended to provide national incidence estimates of consumer-product related nonfatal injuries and poisonings treated in U.S. hospital EDs. For purposes of the present study, all ED visits resulting from wrestling-associated injury were included. NEISS codes wrestling injuries as those resulting from wrestling activities, apparel or equipment. We reviewed the narrative portion of each record and included in our analysis only those ED visits for injuries resulting from organized wrestling activities. In addition, visits derived from wrestling activities other than Folkstyle/Scholastic, Freestyle or Greco-Roman wrestling were excluded (e.g., sumo wrestling, mud wrestling, etc.). Finally, because the injury numbers in female participants were very low and the NEISS estimates were therefore unstable, we restricted our analysis to male participants only.

Measurements

NEISS collects information on the date of treatment, patient age, diagnosis, body part injured, patient disposition, locale in which the injury occurred, the type of product associated with the injury and a brief narrative describing the circumstances of the injury event. Incident locale is coded by NEISS as: home, farm/ranch, street or highway, other public property (includes store, office building, restaurant, church, hotel, motel, hospital or other medical facility, nightclub, theater or other public property), mobile home, industrial place, school, place of recreation or sports, or not recorded. For the present study, only injuries that occurred at school or at a place of recreation or sports were included. Since deaths are not fully captured by NEISS, patients who were dead on arrival or died in the ED are excluded. Similarly, patient outcome subsequent to leaving the ED is not included in the NEISS data. Two age groupings were used for analysis: 7-11 years and 12-17 years. These were intended to approximate elementary school age and middle/high-school age. NEISS diagnosis was recoded as: contusion/abrasion, strain/sprain, fracture, dislocation, laceration, traumatic brain injury (TBI), and other. The diagnosis category TBI included NEISS diagnosis codes for concussion, for internal injury in which "head" was the body part affected, as well as NEISS diagnosis code for fracture in which "head" was the body part affected.[28] NEISS body part categories were recoded in combination as: wrist/hand/finger, head/neck, shoulder, ankle/foot/toe, trunk/pubic region, arm (upper or lower), elbow, knee, and leg (upper or lower). Information in the narrative was used to code precipitating and direct mechanisms of injury as: fall/takedown, struck by/against, overexertion, other, or unknown/unspecified. Two researchers coded these variables

independently, based upon the standard guidelines of the NEISS All Injury Program, defining the precipitating mechanism as the initiating mechanism that started the chain of events leading to the injury, and the direct mechanism as the most immediate mechanism that caused the actual injury.[29] In accord with that program, overexertion was defined as "overexertion of one's body or a body part, causing damage to muscle, tendon, ligament, cartilage, joint, or peripheral nerve (e.g., common cause of strains, sprains, and twisted ankles); overexertion from lifting, pushing, or pulling; damage to body parts of a person caused by exertion from excessive force such as pulling of a person's arm, leg, or other body part by another person or an inanimate object, equipment or structure." Differences in coding were initially resolved through discussion between the two reviewers. When differences could not be resolved in that manner, a third independent researcher helped to resolve the discrepancy.

Participation data were available through the Sports Business Research Network[2] and are derived from annual reports provided by the National Sporting Goods Association (NSGA). The NSGA conducts annual mail based surveys of 30,000 pre-selected U.S. households, collecting self-reported sports participation data for U.S. residents. Eligible participants include household members ≥ 7 years of age who report participation in wrestling at least once during the 12-month period. Information collected includes age, sports participated in, and number of days participated during the previous twelve months. Participation numbers are grouped into age ranges and include the same age groups: 7-11 and 12-17 years. These data were available for the years 2001, 2003, 2004, and 2006.

Data Analysis

ED visits resulting from injuries involving organized wrestling were analyzed for patients 7 through 17 years of age. Data were analyzed with SAS (version 9.1.3; SAS Institute, Inc, Cary, NC) using the Survey Procedures (PROC SURVEYFREQ) to account for the complex sampling design and the weighting structure utilized by NEISS. Each case was assigned a sample weight by NEISS based on the inverse probability of selection. These weights were used to calculate national estimates of nonfatal injuries. Confidence intervals and coefficients of variation were calculated by using a direct variance estimation procedure that accounted for the sample weights. Consistent with the NEISS recommendations, we designated estimates as unstable when: computations were based on fewer than 20 NEISS cases (based on unweighted data), individual national estimates were less than 1,200 (based on weighted data), or the coefficient of variation (CV) of the estimate was greater than 30%. Univariate differences between the two age groups were examined using weighted chi-square testing for categorical variables. Annual injury incidence was calculated per 1,000 wrestlers based on NEISS estimates and average annual participation numbers for the

Table 1. Wrestling-related injuries in athletes presenting to emergency departments by age, United States, 2000-2006

Characteristic	National Estimate*	%
Total	173,604	---
Male	167,606	96.5%
Female	5,998	3.5%
7-11 years		
Male	14,896	91.4%
Female	1,409	8.6%
Total 7-11	16,305	100.00%
12-17 years		
Male	152,710	97.1%
Female	4,589	2.9%
Total 12-17	157,289	100.00%

* Based on NEISS-AIP weights

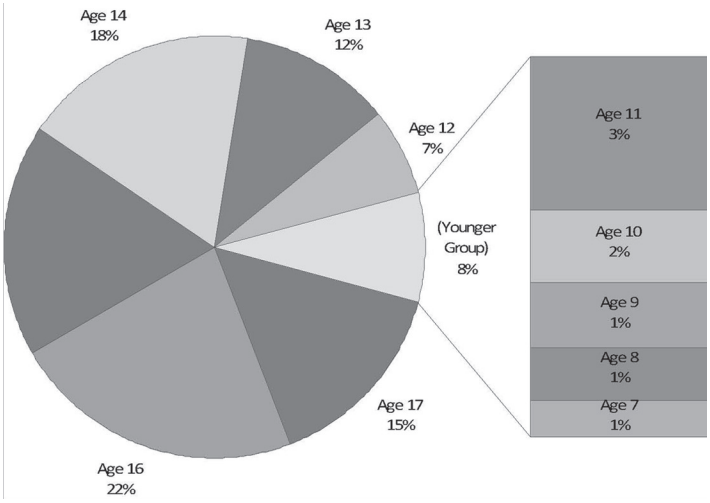

Figure 1. Age distribution of male emergency department visits for wrestling-related injuries, 2000-2006 (n=167,606).

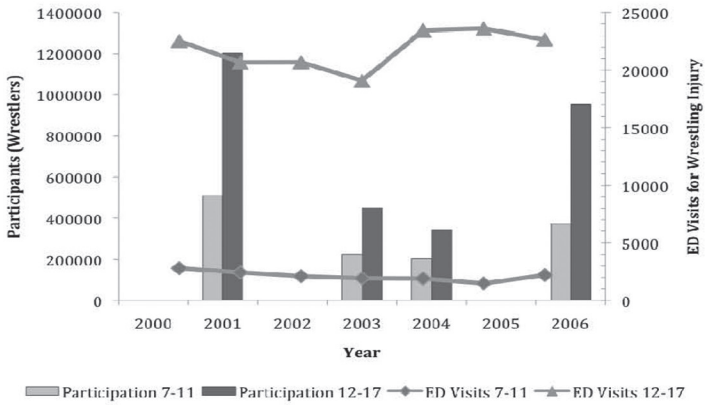

Figure 2. Wrestling participation and United States emergency department visits for wrestling injuries, by age group, 2000-2006.

Table 2. Wrestling-related injury characteristics of male athletes presenting to emergency departments by age group, United States, 2000-2006

	Males				
	Age 7-11		Age 12-17		
Characteristic	n*	% (95% CL)	n*	% (95% CL)	p
Total Injuries	14896	--	152710	--	--
Injuries by Diagnosis					0.28
Sprain/Strain	5757	38.7 (32.4-44.9)	55910	36.6 (34.7-38.5)	
Fracture	3858	25.9 (20.3-31.5)	33764	22.1 (20.5-23.7)	
Contusion/Abrasion	2422	16.3 (11.5-21.1)	22843	15.0 (13.6-16.4)	
Other/Not Stated	1088†	7.3 (4.1-10.5)	13103	8.6 (7.5-9.7)	
Traumatic Brain Injury	676†	4.5 (1.9-7.2)	9437	6.2 (5.3-7.1)	
Laceration	424†	2.9 (0.8-4.9)	9063	5.9 (5.0-6.9)	
Dislocation	671†	4.5 (1.8-7.2)	8590	5.6 (4.7-6.5)	
Injuries by Location§					0.02
Wrist/Hand/Finger	2772	18.6 (13.6-23.6)	28193	18.5 (16.9-20.0)	
Head/Neck	2352	15.8 (11.2-20.4)	22169	14.5 (13.2-15.9)	
Shoulder	1776	11.9 (7.7-16.1)	22839	15.0 (13.6-16.4)	
Ankle/Foot/Toe	1661	11.2 (7.1-15.3)	14350	9.4 (8.3-10.5)	
Trunk/Pubic Region	1625	10.9 (6.9-14.9)	15480	10.1 (9.0-11.3)	
Arm, Upper or Lower	1581	10.6 (6.6-14.7)	8087	5.3 (4.4-6.2)	
Elbow	1148†	7.7 (4.5-10.9)	9476	6.2 (5.3-7.2)	
Knee	994†	6.7 (3.5-9.9)	12876	8.4 (7.4-9.5)	
Face/Ear/Eye/Mouth	669†	4.5 (1.9-7.1)	15073	9.9 (8.7-11.1)	
Leg, Upper or Lower	257†	1.7 (0.0-3.5)	3481	2.3 (1.7-2.8)	
Injuries by Precipitating Mechanism					0.29
Overexertion	4900	32.9 (26.9-38.9)	53519	35.0 (33.2-36.9)	
Struck By/Against	4686	31.5 (25.5-37.5)	51903	34.0 (32.1-35.8)	
Fall/Takedown	3387	22.7 (17.4-28.1)	26134	17.1 (15.7-18.6)	
Unknown	1764	11.8 (7.8-15.9)	19061	12.5 (11.2-13.8)	
Other	159†	1.1 (0.0-2.3)	2093	1.4 (0.9-1.8)	
Injuries by Direct Mechanism					0.92
Struck By/Against	6924	46.5 (40.1-52.9)	67886	44.5 (42.5-46.4)	
Overexertion	4918	33.0 (27.0-39.0)	54283	35.5 (33.7-37.4)	
Unknown	1758	11.8 (7.7-15.9)	18783	12.3 (11.0-13.6)	
Fall/Takedown	1062†	7.1 (3.9-10.4)	9622	6.3 (5.4-7.2)	
Other	235†	1.6 (0.0-3.2)	2135	1.4 (1.0-1.9)	
Disposition					0.28
Admit/Transfer/Observation	436†	2.9 (0.8-5.1)	2883	1.9 (1.4-2.4)	
Treated and Released	14460	97.1 (94.9-99.3)	149421	98.1 (97.6-98.6)	

* Based on National Electronic Injury Surveillance System - AIP weights
§ Known body parts analyzed only
† National estimates less than 1,200 cases are considered unstable by National Electronic Injury Surveillance System

study years using 2001, 2003, 2004, and 2006 participation data from the Sports Business Research Network.

RESULTS

Characteristics of Study Subjects

There were an estimated 173,604 ED visits for wrestling-related injuries in 7-17 year olds from 2000 through 2006. Of these 96.6% of the visits were by male patients, comprising an estimated 167,606 visits. Among male participants, 91.1% of all visits occurred in the 12-17 year age group. The gender and age distributions of these visits are depicted in Table 1 and Figure 1. Participation statistics were available for years 2001, 2003, 2004, and 2006 and are compared to annual ED visits for wrestling injuries in Figure 2.

Main Results

The characteristics of U.S. ED visits for wrestling-related injuries are illustrated in Table 2. There were approximately 10 times more injuries in the scholastic (12-17 years) age group than in the youth (7-11 years) group over the seven-year study period. In contrast, the number of wrestling participants over the study period for the scholastic group was only slightly more than twice that of the youth group, with an average of approximately 330,000 participants/year in the youth group and 740,000 participants/year in the scholastic group. The annual injury incidence for our study period was nearly 5 times higher in the scholastic group, equaling 29.57 injuries/1,000 wrestlers/year (95% CI 26.74-32.40) versus 6.49 injuries/1,000 wrestlers/year in the youth group (95% CI 4.97-8.03).

The distribution of diagnoses was similar in both age groups, with sprain/strain as the most common diagnosis, followed by fracture and contusion/abrasion. There was no significant difference between the two age groups. Greater than 97% of all injuries were treated in the ED and released.

The distribution of body parts injured was significantly different between the youth and scholastic groups (p=0.02). In the youth group, wrist/hand/finger injuries were most common (18.6%, 95% CL 13.6-23.6%), followed by head/neck injuries (15.8%, 11.2-20.4%) and shoulder injuries (11.9%, 7.7-16.1%). In the scholastic group, wrist/hand/finger injuries were also most common (18.5%, 16.9-20.0%), followed closely by shoulder injuries (15.0%, 13.6-16.4%) and head/neck injuries (14.5%, 13.2-15.9%). In both groups, approximately 75% of all injuries occurred above the waist.

Overexertion and struck by/against were the top two precipitating mechanisms for both age groups and the distribution of mechanism for both age groups was statistically similar. For direct mechanism, both groups again had the same ranking of categories, although struck by/against supplanted overexertion as the most common mechanism in both groups. Nearly 80% of all injuries directly occurred via struck by/against and overexertion in both groups.

DISCUSSION

Our investigation is the first to compare ED treated wrestling injuries of youth participants with those of middle and high school wrestlers on a national level. We found that the overall patterns of injury were similar between both groups. This could be due to comparable rules, competition structure, and practice regimens at both levels. However, our findings are especially interesting given the overall differences in injury patterns that Yard et al.[30] described when they compared high school wrestlers with their collegiate counterparts. This disparity might be explained by the fact that the rules and level of competition are more comparable for youth wrestlers and middle/high-school wrestlers than for the high school and collegiate levels.

In general, we found that the frequency of injury in scholastic (12-17 years) wrestlers was approximately ten times greater than that of youth (7-11 years) wrestlers across most categories. This is particularly noteworthy given that participation rates in the older group were only about two times higher over the entire study period suggesting that there may be differences in the rate of injury between the age groups. Strauss and Lanesse[31] examined wrestling injuries in several tournaments and found that the youngest wrestlers (8-14 year olds) were injured at a rate of 3.78/100 tournament participants, whereas the high school wrestlers' rate was 11.15/100 tournament participants. Although many studies have attempted to quantify these injury rates in various wrestling settings (multiple seasons, individual tournaments, high school and collegiate)[12,30-35] and have tried to characterize the rates in different manners (player-matches, player-seasons),[12,30,31,33] there is still considerable variability in the reported data, making comparison difficult. It is likely that the older wrestlers in our study faced a much greater time of wrestling exposure, participating in daily practices and more matches, whereas youth wrestlers often practice once or twice weekly with matches only on the weekend. This might explain the difference in injury rates. It is also possible that older wrestlers are stronger, more violent, or less flexible than the younger wrestlers, accounting for the difference in injury incidence. Additional evaluation of the level of injury exposure in the younger wrestlers may be warranted.

In our study, we found the annual cumulative injury incidence to be 6.49 injuries/1,000 wrestlers/year for the youth group and 29.57 injuries/1,000 wrestlers/year in the scholastic group. While significantly lower than that reported by Lanesse et al., this likely reflects the level of injury that presents to the ED. However, finding that almost 3% of the older wrestlers will require ED evaluation annually suggests that wrestling continues to have a very high rate of injury. When compared to our previously published results on football injury[36], the younger athletes' injury rates in the two sports are nearly identical (6.49/1,000 for wrestling vs. 6.1/1,000 for football), while the older wrestlers rates are

almost 3 times those of football players (29.57/1,000 for wrestling vs. 11.0/1,000 for football). Future investigation is necessary to determine why the scholastic wrestlers are experiencing a higher rate of injury requiring ED evaluation.

The distribution of diagnoses in our two groups was similar, supporting what has previously been reported in the wrestling literature regarding individual tournaments, single seasons and collegiate wrestling.[12,30,33,35] The distribution of diagnoses in our study was also similar to that reported for other high school sports such as football, basketball, and baseball.[11 37,38] However, when compared to results from these and other sports, it is apparent that our results contain a higher representation of more severe injuries, especially fractures. This is likely due to the fact that our data include only injuries presenting to EDs and represents a higher level of medical acuity than reported in many other studies of practice or competition.

Our youth and scholastic groups were significantly different when comparing body parts injured. Youth wrestlers experienced a greater proportion of finger/wrist/hand injuries and head/neck injuries. In contrast, scholastic wrestlers injured large joints, such as the shoulder, proportionally more than the younger wrestlers. Although differences in body part groupings make it somewhat difficult to directly compare our findings with those reported by others, the high proportion of upper extremity injuries and head/neck injuries that we report is consistent with previous studies.[8,12,30-33,35] Notably, this pattern of higher rates of head/neck and upper extremity injuries is more similar to sports like baseball or softball, and distinct from those of sports such as basketball or soccer, where lower extremity injuries predominate. [11,38-40] This is probably due to the unique athletic movements required in each of these individual sports. It is interesting to note that in our investigation, approximately 75% of all injuries occurred above the waist. This suggests possible preventative interventions such as equipment or rule changes as the target of further investigation.

The injury mechanisms in our study were also similar between the younger and the scholastic-aged groups. Again, the overall preponderance of contact injuries (our struck by/against category) is consistent with existing literature.[12,30,33,35,41] Where our study differs is through re-coding the dataset to involve both a precipitating and a direct mechanism. By doing this, we attempted to describe more accurately the complex interaction between the athlete and his or her competitive environment, an approach that has not been undertaken in previous wrestling research. Whereas most wrestling injuries involve direct contact with the opponent and the mat, many injury processes originate with overexertion (as defined by NEISS-AIP) in both age groups. This might suggest the need for new or different methods of training, stretching and/or conditioning.

Finally, although our findings over-represent serious injuries by looking specifically at ED data, wrestlers, coaches, parents and fans can be reassured by our finding that 97% injuries were treated and released from the ED did not require inpatient treatment. However, it must be noted that our data do not fully characterize the time loss and rehabilitation costs of the wrestling injuries seen in the ED, a major consequence of any athletic injury.

Further analysis of wrestling injuries could be improved with better information on the duration of athlete exposure, especially in the youth wrestlers and would enable quantification of risk facing these athletes. The ED is certainly a good location to capture injury data on a national basis, but future research on national wrestling injuries might explore a point of surveillance closer to the athletic competition. Additional studies might benefit from more complete or universal classifications for injury mechanisms or body parts involved, enabling better comparison and reproducibility in the literature.

In summary, our national study of wrestling injuries in young and scholastic-aged athletes disclosed many similarities between both the diagnoses and mechanisms involved. We did, however, find significant differences between groups when examining the part of the body involved in injury. While further study of this relationship is necessary, we suggest that patterns of wrestling injury in younger athletes are likely different than those of their older counterparts, and may benefit from targeted prevention efforts. Furthermore, the finding that 75% of injuries occur above the waist may signal the need for youth and high school wrestling governing bodies to consider prevention strategies including re-examination of the rules of competition for opportunities to reduce head and neck, trunk and upper extremity injuries.

LIMITATIONS

There are several limitations to our study. While the NEISS captures injuries presenting to U.S. EDs, it does not address minor wrestling injuries that are seen in a non-acute care setting or managed by coaches or trainers. These minor injuries likely make up the majority of wrestling injury encounters, making our description a significant underestimate of overall injury incidence. These minor injuries are frequently an important cause of loss of participation, as well as pain and suffering. As such, our analysis likely overemphasizes the most severe injuries seen in wrestling participation and may not be directly comparable to individual teams' experiences.

An additional limitation of using NEISS is that it codes for only the most severe injury in the case of a multiply injured patient, thereby possibly excluding minor injuries. As mentioned earlier, catastrophic injuries involving death are excluded from NEISS and would be missed in our analysis. While death is a rare occurrence in competitive wrestling, we are unable to discuss that outcome in our study.[5]

Our age grouping approximated a youth wrestling (amateur club) population and compared it to an interscholastic wrestling (middle and high-school) population.

Additionally, these groupings are consistent with existing participation data. However, it is possible that these age groupings overlap somewhat and may confound our data.

We attempted to restrict our analysis to only competitive wrestling (practice and competition) through two methods. First, by restricting location codes to school and place of recreation or sport, we attempted to minimize non-organized wrestling settings. Second, by review of the NEISS narrative descriptions, we were able to exclude additional records that did not involve athletic competition or training. Despite these two facets to our methodology, a few cases may have been erroneously omitted or included.

Our analysis was limited to descriptive data only. Accurate exposure (gym classes, practices and matches) data are difficult to obtain for these participants, especially at the youth wrestling level. While the National Federation of High School Sports maintains detailed annual participation data, the organizational structure at the middle school and youth levels makes it difficult to obtain similar data. However, generalized participation numbers were available for several years of our study and provided an overall comparison.

The annual injury incidence enables comparison of our results to reported injury rates in other wrestling studies and data from additional sports. Because participation statistics were not available for all study years, an average yearly participation was calculated using the four years of data out of the seven study years. With significant participation variability over the study period, the injury incidence may not accurately reflect the true exposure of athletes to wrestling injury. However, because the NSGA defines a participant as one who has participated in wrestling "at least once in the last 12 months," the number of participants is likely an overestimate of competition level wrestlers. This would cause our calculation to be a significant underestimate of the true injury incidence.

Finally, because females make up such a small portion of the population in question, approximately 7% of all participants in our study period, we eliminated females from our analysis and our conclusions are limited to male athletes only.[2]

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Leukocytosis as Prognostic Indicator of Major Injury

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Objective: To test the diagnostic use of the triage white blood cell (WBC) count in differentiating major from minor injuries.

Methods: We conducted a retrospective study of a prospectively collected database of trauma patients 13 years of age or older at a Level I trauma center from January 2005 through December 2008. We excluded all patients with obvious life-threatening injuries requiring immediate surgery, isolated head trauma, transferred from another institution or dead on arrival. We recorded age, sex, injury mechanism, vital signs, WBC, base deficit (BD), lactate (LAC) and calculated injury severity scores (ISS). Major injury was defined as either a change in hematocrit >10 points or blood transfused within 24 hours, or ISS >15.

Results: 805 patients were included in the study with an average age of 38.6 years (Range 13-95 yrs) years. 75.3% of patients were male, 45.6% had blunt and 34.4% had penetrating trauma. For vital signs, blood pressure was not significantly different between major and minor injury patients. Major compared to minor injury patients had a statistically but not clinically significant higher heart rate. Major injury patients had significantly ($p < 0.0001$) higher WBC count (10.53 K/µl, 95% CI: 9.7-11.3) compared to patients with minor injuries (8.92 K/µl, 95% CI: 8.7-9.2), but both were in the normal range. Patients with major compared to minor injury had significantly ($p < 0.0001$) higher BD (-3.1 versus -0.027 mmol/L) and higher LAC (3.9 versus 2.48 mmol/L). Areas under the curve for WBC count (0.60, 95% CI: 0.54-0.66) are similar to BD (0.69, 95% CI: 0.63-0.74) and LAC (0.66, 95% CI: 0.60-0.71).

Conclusion: WBC count is not a useful addition as a diagnostic indicator of major trauma in our study population**.** [West J Emerg Med. 2010; 11(5):450-455.]

INTRODUCTION

Emergency physicians are continually searching for early markers that efficiently differentiate trauma patients with major versus minor injury. Historically Advanced Trauma Life Support taught us the value of injury mechanism, physical exam and vital signs in identifying trauma patients who require emergent workups for suspected life-threatening injuries.[1] While hypotension and tachycardia are specific for major injuries, normal vital signs are not sufficiently sensitive to reliably exclude bowel, vascular or solid organ injuries.[2-4] Lipsky[5] showed that a significant proportion of trauma patients who eventually die had normal vital signs in the emergency department (ED). This has led investigators to manipulate heart rate and blood pressure creating the Shock Index, which has shown only limited success over traditional vital signs in rapidly ruling out significant injuries.[6-8]

Lactate (LAC) and Base Deficit (BD) both measure the gap between oxygen demand and delivery and are successful markers in hypovolemic shock for predicting trauma mortality and transfusion requirements.[9-12] While the addition of BD and LAC measurements in trauma patients with normal vital signs improves the detection of major injury, many patients could still be missed.[13]

Major injury is associated with a stress-induced neuro-

humoral response stimulating the secretion of epinephrine and cortisol.[14-15] This release of stress hormones after trauma is evidenced by hyperglycemia, which showed a comparable performance to BD and LAC in predicting mortality.[16-19]

In normal healthy subjects these same stress-induced hormones, epinephrine and cortisol, produce leukocytosis from both bone marrow and splenic sources.[20,21,22] It has been hypothesized that elevation of a trauma patient's white blood cell (WBC) count may be a surrogate marker of neuro-humoral activation and be valuable in identifying patients with major injuries. Studies in blunt trauma patients have shown higher WBC counts in their more severely injured patients.[23-26]

Rovlias et al[27] in their study of head trauma patients in the neurosurgical intensive care unit (ICU) showed WBC count was significantly higher in patients with severe head injury compared to those with minor or moderate injury. We hypothesized that the WBC count would be successful in differentiating major from minor injuries in a heterogeneous cohort of blunt and penetrating trauma patients. We tested the diagnostic performance of the initial WBC count in differentiating major from minor injury in trauma patients, specifically excluding those with isolated head trauma.

METHODS

Study Design

This was a retrospective study of a prospectively collected database of trauma patients used to evaluate the utility of initial WBC count, BD and LAC to detect major injury. The local institutional review board (IRB) of State University of New York Downstate Medical Center and Kings County Hospital approved this study. Requirement for informed consent was waived by the IRB.

Study Setting & Population

This study was conducted at Kings County Hospital, a Level 1 trauma center in Brooklyn, New York, which receives 135,000 annual ED visits and has approximately 1,000 major trauma resuscitations a year. Trauma patients 13 years of age or older with significant mechanisms defined by our trauma team activation protocol of blunt or penetrating trauma had blood tests performed as part of their diagnostic evaluation. These trauma patients were enrolled from January 2005 to December 2008. Thirteen years old is the cut-off age for adult trauma patients in our institution. Patients excluded from our study were those with obvious injuries requiring immediate surgery, patients transferred from other institutions or those dead on arrival. We excluded these patients because an initial triage screening test is neither needed nor helpful to determine the course of action. The diagnosis and disposition of these patients are either already determined, as in the case of transfers, or obvious for patients in need of emergent surgery or dead on arrival. Patients who went immediately to the operating room included trans-abdominal gunshot wounds or blunt or penetrating torso injuries that were hemodynamically unstable. The decision was made to go for emergent surgery by the operating surgeon in conjunction with the ED attending. Biomarkers are obviated in these patients who need definitive surgical treatment by mechanism and clinical grounds alone.

Finally, we excluded all patients with a history of isolated head trauma as this injury pattern has already been shown to increase WBC count.[27]

Study Protocol

The decision to begin a trauma workup in the ED and thus make a patient eligible for this study was based on the trauma team activation protocol. The criteria for trauma team activation defined by our institution are as follows: all penetrating injuries of the trunk including groin, buttocks and neck; all penetrating injuries of the extremities in proximity to major vessels; all blunt trauma with accompanying hypotension; all patients with multiple trauma resulting in pelvic fractures or two or more long bone fractures; all patients with at least one long bone or pelvic fracture associated with a thoracic or head injury; all patients who have fallen two or more stories; all pedestrians who have sustained significant injuries as a result of being struck by a moving vehicle; all patients with central nervous system injury with a history of one of the following: loss of consciousness, posturing, lateralizing signs, open cranial injury, or paralysis; all head injury patients with significant symptoms such as: severe headache, nausea and vomiting, dizziness, or amnesia; and all patients with a trauma score of 13 or less. Patients were enrolled by convenience sampling, and treating physicians were not blinded to vital signs or results of WBC, BD, and LAC testing. Patient workup and treatment were not specified in this study protocol.

Measurements

Academic associates only collected data from patients identified by the trauma team activation protocol. Academic associates are medical or undergraduate students who are trained data abstractors. They are certified to assist our department in data collection during their research elective, only after passing the "Protection of Human Subjects" course offered by the IRB. Data collectors were not involved in patient care.

Demographic data, vital signs, including systolic blood pressure (ED-SBP), diastolic blood pressure (ED-DBP) and heart rate (ED-HR), as well as mechanism of injury and physical findings were recorded for all patients. Following resuscitation and trauma workup, all information regarding the recorded injuries was collected, including the results of imaging studies, invasive procedures (diagnostic peritoneal lavage, angiography, chest tube insertion, *etc.*) and findings of operative diagnostic or therapeutic procedures. Serial hematocrit and the number of units of blood transfused in the patients' first 24 hours of hospitalization were also recorded.

We calculated injury severity scores (ISS) for all patients according to the 1990 revision of the Abbreviated Injury Scale.

As part of our routine trauma evaluation, arterial blood gases (Radiometer ABL 725, Copenhagen, Denmark) were drawn concurrently with the recording of triage vital signs during the initial assessment. Blood testing for all trauma patients included an initial complete blood count, arterial BD, and LAC levels.

Data Analysis

Predictor variables were WBC count and metabolic parameters (BD and LAC). Normal levels of BD were defined as greater than -2.0 mMol/L, and normal LAC were defined as less than 2.2 mMol/L, both based on our hospital's normal values. By definition, these levels of BD and LAC are outside the 95% confidence interval for their normal values in our population. We chose these values to maximize the sensitivity of these metabolic parameters.

Outcome variables included minor or major injury. Patients with major injury were defined as those with any of the following: patients receiving a blood transfusion within the first 24 hours, having a decrease in hematocrit of greater than ten percentage points in the first 24 hours, or any trauma patient with an ISS > 15. An ISS ≤ 15 has previously been used in the literature to define minor injury.[23] Blood transfusion requirement and decrease in hematocrit have been shown to be accurate indicators of major injury in previous studies. In earlier studies done at our center, trauma patients without these criteria (minor injury) had a mortality rate of less than 1%.[29-31]

Data were reported as means ± standard deviations, or cell counts and percentages with 95% confidence intervals. Group comparisons were analyzed by student's t-tests or chi-square; where appropriate, all tests were two tailed (SPSS version 15.0, Chicago, Illinois). The alpha value was set at 0.05. Difference between proportions with 95% confidence intervals was determined by using the methods of Newcombe.[32] Receiver operator characteristic (ROC) curves were generated for initial WBC count, BD, LAC and vital signs (ED-SBP, ED-DBP, ED-HR) discriminating major from minor injuries in trauma patients, using Analyze-It version 1.73, Analyze-It Software Ltd. United Kingdom.

RESULTS

Between January 2005 to December 2008, we studied 805 trauma patients with a mean age of 38.6 years (Range 13-95 yrs.). 75.3% (n = 606) of patients were male. Mechanisms of injury were blunt, penetrating, falls and other (Table 1).

We subdivided study patients into the main outcome variables, minor versus major injury. One hundred thirty-four (16.6 %) patients met criteria for major injury, and 671 (83.4 %) were classified as minor injury.

Table 2 compares the demographics, mechanisms of injury, vital signs and metabolic parameters between minor and major injury patients. There were no differences in age between the major and minor injury groups;75.4% (n = 505) of patients with major injury and 75.3 % (n = 101) of patients with minor injury were males. There was no difference in ED-SBP and ED-DBP between the major and minor injury groups. Only ED-HR had a statistical ($p<0.0001$) but not a clinical difference between the two groups (mean difference of 8.36 mmHg, 95 % CI: 4.8-11.9). BD was significantly ($p<0.0001$) larger (mean difference of 3.06 mmol/L, 95% CI, 2.31 to 3.82 mmol/L) in the major compared to minor injury patients. Major injury patients also had a significantly ($p<0.0001$) higher LAC by a mean difference of 1.39 mmol/L (95% CI, 0.85 mmol/L to 1.94 mmol/L) compared to the minor injury group.

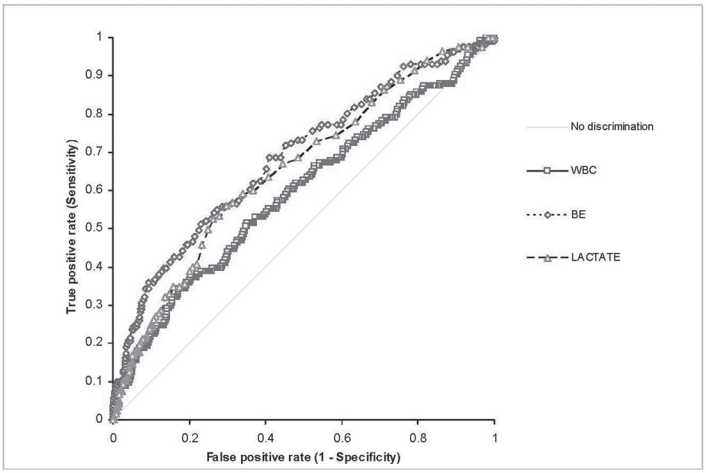
Table 1. Overall trauma data

N=805		
Age	Mean=38.6 years Median=35; range=13–95	
Sex	75.3% Male	
Trauma	Blunt	45.6% (n=367)
	Penetrating	34.4% (n=277)
	Fall	17.3% (n= 139)
	Other	2.7% (n=22)
Injury Severity	16.6 % Major Injury	

Table 2. Comparison of minor versus major injury

N = 805	Minor injury (N=671)	Major injury (N=134)	p-value
Blunt	45.8% (307)	44.8% (60)	0.85
Penetrating	34.3% (228)	36.6% (49)	0.62
Fall	17.3% (116)	17.2% (23)	1.0
Other	3.0% (20)	1.5% (2)	0.56
Age	38.3 (± 17.9)	40.5 (± 18.1)	0.2
Gender (male)	75.3%	75.4%	1.0
ED-SBP	137.9 (± 21.8)	137.3 (±23.8)	0.78
ED-DBP	77.3 (±16.4)	76.4 (±18.9)	0.60
ED-HR	87.5 (±17.9)	95.8 (±22.1)	<0.0001
Base deficit	-0.027 (± 3.5)	-3.1 (± 5.6)	<0.0001
Lactate	2.48 (±2.49)	3.9 (± 3.65)	<0.0001

ED-SBP, emergency department systolic blood pressure; *ED-DBP,* emergency department diastolic blood pressure; *ED-HR,* emergency department heart rate



Test	Area	95% CI	SE
WBC	0.60	0.54-0.66	0.031
Lactate	0.66	0.60-0.71	0.028
BD	0.69	0.63-0.74	0.028

Figure 1. Comparison of receiver operating characteristic (ROC) curves for base deficit (BD), lactate and white blood cells (WBC) by injury number.

Patients with a major injury (10.53 K/µl, 95% CI: 9.7 to 11.3) had a significantly ($p<0.0001$) higher WBC count compared to those with minor injury (8.92 K/µl, 95% CI: 8.7 to 9.2). However, the average WBC count in both major and minor injuries was within normal range (4.5 to 10.9 K/µl). The areas under the curve for ED-SBP, ED-DBP and ED-HR were 0.51, 0.49, and 0.61 respectively (ROC curves not shown). Figure 1 compares the ROC curves for WBC counts, BD and LAC in differentiating major from minor injury in trauma patients. The area under the curve for WBC counts (0.60, 95% CI: 0.54 to 0.66) is not significantly different than LAC (0.66, 95% CI: 0.60 to 0.71) or BD (0.69, 95% CI: 0.63 to 0.74). The area under the curve for WBC in only patients with normal vital signs was 0.55 (95 % CI: 0.46-0.64).

DISCUSSION

We studied the use of the WBC count as an initial triage screening test in the ED to distinguish trauma patients with major versus minor injury. We found that even though the WBC count in patients with major (10.53 K/µl) compared to minor (8.92 K/µl) injury was significantly higher, the average WBC counts in both cases were in the normal range. The area under the ROC curve for WBC counts in all patients (0.60) and those with only normal vital signs (0.55) was a poor discriminator of major versus minor injuries.

The literature has shown variable conclusions about the use of the WBC count for screening trauma patients. Several studies have described a significantly higher WBC counts in their most severely injured trauma patients. Morell et al.[23] in their study of 156 blunt trauma patients found a statistically significant elevation in WBC counts in patients with an elevated ISS ($p<0.002$) and longer ICU stays ($p<0.006$), but failed to demonstrate a linear relationship between WBC counts and these outcome variables. Santucci and colleagues[24] retrospectively studied 279 blunt trauma patients and found a statistically higher ($p<0.001$) mean WBC count in patients with a significant injury compared to those without, but also found a poor correlation ($r = 0.369$) with ISS. Holmes et al.[25] performed a retrospective study of 1040 children under 15 years of age with blunt trauma admitted to their Level 1 trauma center. They concluded that moderate risk patients with intra-abdominal injuries (IAI) ($n = 22$) had higher mean WBC counts compared to those without IAI. However, none of these three research groups were able to identify any clinically useful WBC cutoffs to reliably exclude major injury.

Chang and colleagues[26] prospectively studied 882 blunt and penetrating trauma patients to determine the association of WBC count with demographics, mechanism and severity of injury, outcomes, and the need for therapeutic interventions. They found that variations in WBC count were associated with race and injury severity, but they were not useful in predicting the need for volume resuscitation, transfusion or surgery. However, in patients with a Glasgow Coma Scale ≤ 8, the mean WBC count was more than the upper limit of normal (12,000) suggesting that head injury maybe a confounding variable that leads to an elevation in WBC count. Because of head injury being a possible confounder in the above poly-trauma studies we specifically excluded isolated head trauma patients. The correlation between head trauma severity and elevations in WBC counts is also clearly demonstrated in the study by Rovlias and Kotsou[27]. In their prospective study of 624 patients with isolated head injury, WBC counts were not only higher in more severe head injuries but also correlated with degree of severity and neurologic outcomes.

LIMITATIONS

Our study population excludes patients who were unstable and/or who met criteria for rapid surgical exploration (*e.g.,* gunshot to abdomen) because arterial blood gas measurements were not taken before their operating room transfer. Patients were enrolled by convenience sample because data abstractors were not present 24 hours a day. Because of this time limit, a significant percentage of trauma patients may have been missed. The above conditions restricted the number of eligible study patients and may explain why only 805 trauma patients were enrolled over the study period in a large Level 1 trauma center. Excluding patients who rapidly went to surgery may have falsely depressed the evidence of stress leukocytosis in our trauma subjects. These limitations may affect the applicability of our results regarding patients who are unstable and in need of emergent surgery, but provide valuable data for patients with occult injuries. We used ROC curve analysis and not a multivariate technique to look for a clinically significant cutoff for WBC.

CONCLUSION

Our findings in a heterogeneous blunt and penetrating trauma cohort (excluding isolated head injury) support the findings of previous studies of blunt cohorts: although there is a statistically significant higher WBC count in patients with major injuries, no clinical cutoffs or use are identified. WBC count was not a useful addition as a diagnostic indicator of major trauma in our study population**.**

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Improving Diagnostic Accuracy of Anaphylaxis in the Acute Care Setting

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The identification and appropriate management of those at highest risk for life-threatening anaphylaxis remains a clinical enigma. The most widely used criteria for such patients were developed in a symposium convened by National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network. In this paper we review the current literature on the diagnosis of acute allergic reactions as well as atypical presentations that clinicians should recognize. Review of case series reveals significant variability in definition and approach to this common and potentially life-threatening condition. Series on fatal cases of anaphylaxis indicate that mucocutaneous signs and symptoms occur less frequently than in milder cases. Of biomarkers studied to aid in the work-up of possible anaphylaxis, drawing blood during the initial six hours of an acute reaction for analysis of serum tryptase has been recommended in atypical cases. This can provide valuable information when a definitive diagnosis cannot be made by history and physical exam. [West J Emerg Med. 2010; 11(5); 456-461.]

INTRODUCTION

Identifying "a textbook case" of anaphylaxis is something that most practicing emergency physicians are comfortable doing. When asked, treating physicians are likely to describe patients who presented with evidence of circulatory instability or collapse, mucosal edema and, in some cases, mechanical obstruction of the airway generally in the context of various initial cutaneous manifestations such as urticaria, angioedema, flushing or pruritus. In this paper, we will review a growing body of data indicating that there is more to making this diagnosis than generally is appreciated, and how diagnostic accuracy can be improved.

THE DIAGNOSIS OF ACUTE ALLERGIC REACTIONS

Currently, there is no universally accepted clinical definition of anaphylaxis. The diagnosis may be challenging as there is a large variability in presenting clinical signs and symptoms. In recognition of this, the National Institute of Allergy and Infectious Disease (NIAID) and the Food Allergy and Anaphylaxis Network (FAAN) convened a consensus meeting in July 2005 on anaphylaxis, which included representatives from 16 different organizations from North America, Europe, and Australia, to develop a clinically useful and universally accepted definition of anaphylaxis and provide guidance on the most appropriate management of anaphylaxis. These guidelines were published in 2006 and are currently widely accepted (Table 1). Despite a wide array of symptoms included in the clinical criteria, the consensus panel concluded that one in twenty patients is likely to be misdiagnosed. Clinicians are left with a considerable number of cases where there may be some doubt concerning the diagnosis.[1]

Studies on anaphylaxis report a range in incidence from 3.2 to 58.9/100,000 cases annually.[2-5] This wide range is likely a reflection of the variation in diagnostic criteria used and the paucity of a "gold standard". Published studies reflect this variation with some strictly narrowing inclusion criteria to subjects with hemodynamic instability or mucocutaneous involvement while others use broader definitions making interpretation difficult.[3,5-7]

The difficulties in standardization of research on anaphylaxis appears to also translate into clinical practice. A survey of 11 emergency medical systems (EMS) revealed a highly variable incidence of anaphylaxis ranging from 0.04% to 3.4% of all ambulance runs with the majority of systems reporting less than 1%. Among those EMS agencies reporting on the use of epinephrine autoinjectors, such injectors had been used in 0.16 to 31.1% of the cases.[8] A study comparing 21 North American emergency departments (ED) noted that

Table 1. Clinical criteria for diagnosing anaphylaxis

Anaphylaxis is highly likely when any one of the following three criteria are fulfilled:
1. Acute onset of an illness (minutes to several hours) with involvement of the skin, mucosal tissue, or both (e.g. generalized hives, pruritus or flushing, swollen lips-tongue-uvula)
AND AT LEAST ONE OF THE FOLLOWING
a. Respiratory compromise (e.g. dyspnea, wheeze-bronchospasm, stridor, reduced PEF, hypoxemia)
b. Reduced BP or associated symptoms of end-organ dysfunction (e.g. hypotonia [collapse], syncope, incontinence)
2. Two or more of the following that occur rapidly after exposure *to a likely allergen for that patient* (minutes to several hours):
a. Involvement of the skin-mucosal tissue (e.g. generalized hives, itch-flush, swollen lips-tongue-uvula)
b. Respiratory compromise (e.g. dyspnea, wheeze-bronchospasm, stridor, reduced PEF, hypoxemia)
c. Reduced BP or associated symptoms (e.g. hypotonia [collapse], syncope, incontinence)
d. Persistent gastrointestinal symptoms (e.g. crampy abdominal pain, vomiting)
3. Reduced BP after exposure to *known allergen for that patient* (minutes to several hours):
a. Infants and children: low systolic BP (age specific) or greater than 30% decrease in systolic BP*
b. Adults: systolic BP of less than 90 mm Hg or greater than 30% decrease from that person's baseline

PEF, Peak expiratory flow; *BP*, blood pressure.

*Low systolic blood pressure for children is defined as less than 70 mm Hg from one month to one year, less than (70 mm Hg + [2 times age]) from one to ten years, and less than 90 mm Hg from 11 to 17 years.[1]

the recognition of acute allergic reactions caused by food exposures was highly variable. It was also notable that the proportion of patients referred to an allergist or provided with a prescription for self-injectable epinephrine on discharge from the ED was 12 % but highly variable[9] (Figure 1).

In one retrospective study reviewing all ED records for a period of four months only one in every four patients who met criteria for anaphylaxis had been correctly diagnosed during their ED visit.[6] The majority were diagnosed as having an acute allergic reaction. Based on the studies discussed above, there appears to be significant evidence of a need to standardize how anaphylaxis is diagnosed in the ED setting.

Beyond the complexities of identifying anaphylaxis, there are numerous reports of atypical presentations of acute allergic reactions that make this clinical diagnosis very challenging. This is evident in asthma, which is a disease related to anaphylaxis. In a study that reviewed the death records of individuals considered to have had an apparent fatal asthma attack, autopsy findings revealed that several of these patients

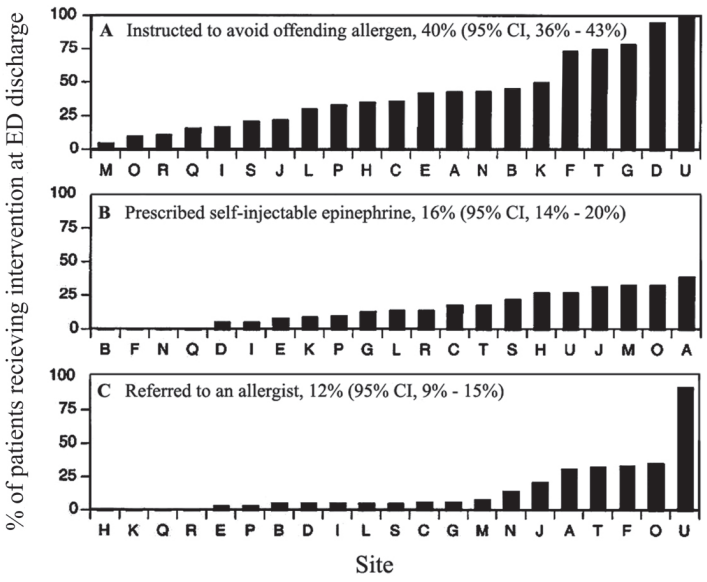

Figure 1. Percentage of patients discharged from the emergency department with documentation of instructions to avoid the offending allergen (A), prescription for self-injectable epinephrine (B), and referral to an allergist (C).

had actually died from anaphylaxis.[10] Acute symptoms of airway obstruction during an anaphylactic event have been misdiagnosed as being caused by a foreign body in the airway.[11]

Cardiac manifestations of anaphylaxis may mimic an acute coronary syndrome and acute anaphylaxis has been described to present with arrhythmias.[12] This may be due to the physiologic stress of anaphylaxis in patients with pre-existing coronary disease, but histamine has also been shown to directly induce coronary vasospasm in individuals with normal coronary arteries.[13,14] This may occur as a part of the Tako-Tsubo or "broken heart" syndrome which is often attributed to abrupt physiologic stress.[15,16] Exercise induced anaphylaxis may present as a syncopal event and should be considered in the differential diagnosis under appropriate circumstances.[17]

Vocal chord dysfunction is another cause of acute stridor presenting with a sensation of throat swelling. This condition can be challenging to differentiate clinically from anaphylaxis. When available, fiberoptic laryngoscopy during the attack will reveal no swelling but the characteristic intermittent adduction of the anterior vocal chords during inspiration.[18-20] Other anxiety states such as panic attacks, globus hystericus and Munchausen stridor can also cause similar symptoms.

The symptoms of acute attacks of hereditary angioedema can be identical to acute allergic reactions but usually do not respond to medications used to treat anaphylaxis. Other conditions known to cause anaphylaxis-like symptoms are flush syndromes such as carcinoid or disulfiram reactions, restaurant syndromes such as reactions to monosodium glutamate, sulfites or scombroid, autonomic epilepsy and vasomotor rhinitis.

Considering all the above reported atypical presentations of anaphylaxis, it may be challenging in a significant number of cases to determine with any certainty the cause of a patient's acute symptoms based on history and physical exam alone. This may be complicated even further if a detailed history is unobtainable or if a patient is not seen until after the acute symptoms have subsided.

LESSONS FROM SEVERE AND FATAL ANAPHYLAXIS

Fortunately, the majority of acute allergic reactions are mild and self-limited. Overall, mortality from anaphylaxis appears to be relatively rare, on the order of less than 1% of all cases.[2-5,7] The highest published mortality rates are in the pre-hospital setting with a Norwegian study reporting a mortality rate of 7%.[21] However, several of the large anaphylaxis case series do not report a single case fatality.[2,4-5,7,9] This may be due to selection bias since many of the fatalities occur in the pre-hospital setting. Published case series of anaphylaxis fatalities suggest an incidence ranging from 0.3 to 0.8 per 1,000,000 with an increase in fatality rates among the elderly presumably due to comorbid conditions and iatrogenic drug exposures.[22-24] When acute anaphylaxis results in death, the most common mechanism is circulatory collapse in cases of venom injections or iatrogenic reactions and respiratory failure in cases of food allergy.[22,24]

Interestingly, the presence of cutaneous signs appears to be inveresly proportional to the severity of the anaphylactic event.[24] In two studies of fatal anaphylaxis it was noted that less than 20% of the subjects had cutaneous findings.[24,26] This stands in contrast to anaphylaxis studied in the office setting where the majority of patients had cutaneous signs.[2,3,7,27] This may indicate that mucocutaneous signs take longer to develop than shock and respiratory distress and patients who live long enough to develop such signs are more likely to survive. Data from the pediatric population suggests that cutaneous signs also appear less frequently children than in adults, with about one in every five reported patients not having cutaneous findings.[5] This paucity of cutaneous findings in the most severely affected is likely to contribute to misdiagnosis.

A prior history of asthma appears to be associated with poor outcomes. Almost all reported cases of fatal food related anaphylaxis occurred in individuals with a known history of asthma.[16,23,28,29] That stated, the severity of previous attacks appears to be an unreliable prognostic tool as the majority of reported case fatalities have a history of only mild allergic reactions.[16,23]

In a review of 164 cases of all-cause fatal anaphylaxis in Great Britain, about half were noted to be iatrogenic.[30] The most common iatrogenic causes reported were anesthetics and antibiotics, and fatal cases had a median time to cardiac arrest of only five minutes. Fatal venom injections had a median time to death of 15 minutes, ranging from 4-120 minutes, but fatal food allergy occurred slower with a median time to death of 30 minutes, ranging from six minutes to six hours. Also of note was that fatal food allergies occurred most commonly in children and younger individuals, whereas fatal iatrogenic anaphylaxis were seen more frequently among older individuals, likely due to higher exposure rates. In cases where death occurred several hours after the onset of symptoms, subjects commonly presented with mild symptoms, which then rapidly progressed during their period of observation. One case series noted that four patients had developed fatal circulatory collapse within minutes of being placed in an upright position and recommended keeping these patients laying flat.[31]

It is recommended that all individuals who have suffered an acute allergic reaction from exposures that might be encountered in nonmedical settings should receive instructions on how to avoid the precipitating allergen if it is known. Before discharge from the ED, patients should also be given a prescription for self-injectable epinephrine for use if anaphylaxis develops. Patients are also recommended to follow up with an allergist and should be given information on how to learn more about allergy from websites such as www.foodallergy.org.

Despite the widespread use of self-injectable epinephrine, it must be stressed to patients that they must still avoid the offending allergen and that the epinephrine can not be relied on as a rescue medication. Auto-injectors have been associated with failures due to technical issues such as incorrect technique of administration or failure of the correctly administered dose to prevent fatality.[16,30,32] Similiarly, when epinephrine has been given by health care providers, errors regarding appropriate dosaging and concentration of epinephrine used have been associated with poor patient outcomes. The use of pre-filled injectors by health care providers may avoid such errors.[31,33]

MARKERS OF ANAPHYLAXIS - TRYPTASE

A detailed clinical history and physical exam may not correctly identify all cases of anaphylaxis. Using laboratory markers as diagnostic adjuncts has been proposed and markers such as prostaglandin D_2, carpoxypeptidase, CD63, interleukin 4 and 6, CRP and tryptase have been evaluated for this purpose.[34-36] Histamine released by degranulation of mast cells can be measured within five to ten minutes but only remains elevated for 30-60 min and therefore has a very limited value. To date, the marker most widely recommended is serum tryptase.

Tryptase is a neutral protease present in the secretory granules of all mast cells and to a lesser extent in basophiles.[37] It is found in two isomers: α-tryptase, which is primarily elevated in those with mastocytosis; and β-tryptase, which is more commonly elevated in anaphylaxis.[38] The most widely available assay measures total serum tryptase. One milliliter of serum is required for the assay and must be processed within three days if refrigerated.[39] The peak level of serum tryptase in anaphylaxis

is one to two hours after the precipitating event and the serum half-life is approximately two hours.[40] The ideal time to measure serum tryptase is considered within three hours but significant elevations can be found up to six hours or longer.[41-43]

In a study on anaphylaxis in children during a food challenge, an elevated tryptase had a sensitivity of 89% and specificity of 88%.[44] In a review of 18 patients with confirmed anesthesia anaphylaxis, 12 had elevated serum tryptase levels.[42] In the context of an acute event, an elevated tryptase level supports the diagnosis of anaphylaxis. Greater diagnostic accuracy however, appears to be associated with changes from a baseline level. In cases of experimental anaphylaxis in an antivenom trial a single serum tryptase value had a sensitivity of 36% and specificity of 93%, whereas a difference from baseline or delta tryptase level of 2.0 mcg/L had a sensitivity of 73% and specificity of 98%.[45] This suggests that it may be useful to obtain a baseline tryptase value during a follow-up visit with the allergist.

USE OF TRYPTASE IN THE EMERGENCY DEPARTMENT

As discussed above, making the correct diagnosis in atypical cases can be challenging for the ED physician and using serum tryptase as a diagnostic adjunct should be considered. Current practice guidelines from the American Academy of Allergy, Asthma and Immunology and the American College of Allergy, Asthma and Immunology recommend that measuring serum tryptase may be helpful to confirm a diagnosis of anaphylaxis or rule out other causes. The guidelines note that proper timing when obtaining blood for tryptase measurement is essential and should be performed within six hours.[46] The United Kingdom Resuscitation Council guidelines on anaphylaxis also recommend using serum tryptase during the acute attack to confirm the diagnosis [47]

Only two studies have been identified where tryptase was measured specifically in ED patients with acute reactions. A study of patients with confirmed anaphylaxis where serum tryptase was measured within six hours from onset of symptoms and compared to baseline tryptase levels one month later revealed a sensitivity of 94% and specificity 92%.[48] In another study where tryptase was measured in 96 ED patients with anaphylaxis, beta-tryptase was detectable in just 23 patients and only 13 had elevated total tryptase levels. These results should be interpreted with caution as the study included patients who presented greater than 12 hours from the onset of symptoms. Applying current guidelines, only a minority of subjects met criteria for anaphylaxis.[49]

Currently, in most centers, serum tryptase levels are not available as a STAT study which may be a disincentive to those in the acute care setting. That stated, serum tryptase levels can help identify the cause of an atypical acute reaction of unknown etiology and is recommended as a diagnostic adjunct in cases of doubt. The significance of an individual patient's elevated value should be determined by an allergist and ideally compared to a baseline value at a follow up visit. The patient's ED visit is however the most opportune time to draw blood for tryptase analysis, and this may provide the follow-up physician with useful information.

CONCLUSION

Reviewing current data on anaphylaxis, it is evident that the definition and standardization of this diagnosis has been variable. Maintaining a high index of suspicion in patients presenting with atypical signs and symptoms can improve diagnostic accuracy and avoid poor outcomes due to misdiagnosis. Emergency physicians should be familiar with the currently recommended diagnostic criteria and the option to measure serum tryptase levels within the first six hours of presentation as a diagnostic adjunct in atypical cases.

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Spectacular Retroperitoneal Impalement

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A 47-year-old woman presented with a history of an accidental fall against a glass door at home, causing a 15 cm-wide wound on the right gluteal region and hematuria. General health was good: blood pressure115/70 mmHg with a heart rate of 100 beats/min; red cell count 4.460 x103/100 mL; hemoglobin concentration 10 g/100 ml; and hematocrit 31% .

Computed tomography of the thorax and abdomen (Figure) showed the presence of a foreign body penetrating the right gluteal region and extending along the retroperitoneum. The object had passed across the entire longitudinal diameter of the right kidney. A concomitant retroperitoneal hematoma in the right perirenal space and pelvis was present.

At emergency laparotomy a 25cm piece of glass was extracted from the gluteal wound after right nefrectomy and suture of a 2 cm laceration of the suprarenal inferior vena cava.

The postoperative course was uneventful.

Impalement injuries are rare and may occur either as a result of fall or collision of the human body against an immobile object or by means of a mobile object penetrating a stationary subject. They often pose particular challenges in surgical management. Mortality for penetrating abdominal vena cava injury is 36%-66%.[1] Admission hypotension, suprarenal vena cava injuries and association with other visceral and/or other major vascular injuries are predictive of mortality.[2]

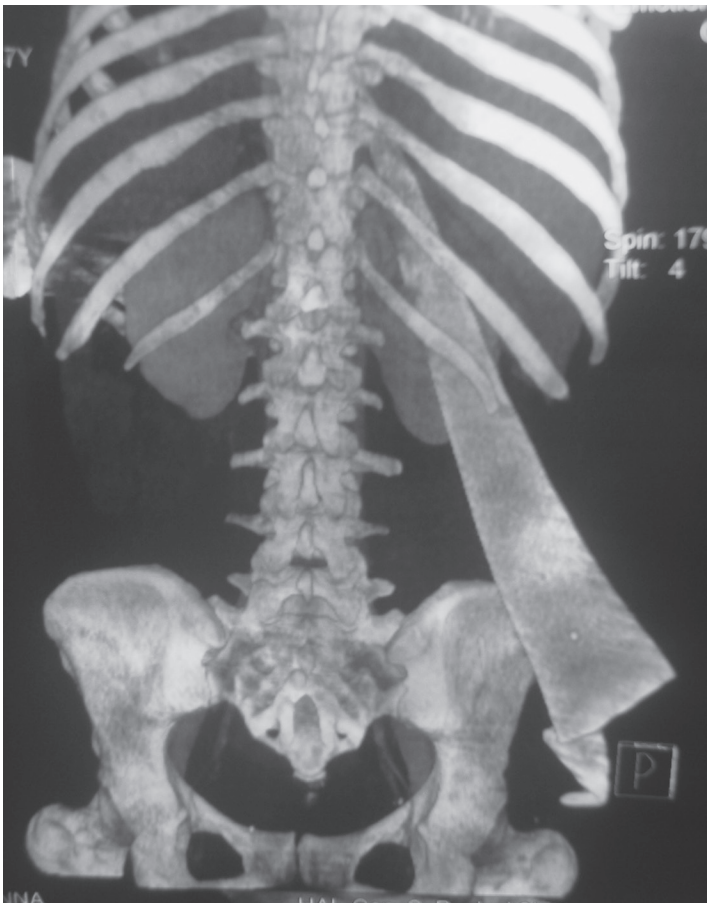

Figure. A reconstructed image of computed tomography of the thorax and abdomen with the patient in prone position, showing the piece of glass passing through the right kidney.

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Potentially Low Cost Solution to Extend Use of Early Generation Computed Tomography

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In preparing a case report on Brown-Séquard syndrome for publication, we made the incidental finding that the inexpensive, commercially available three-dimensional (3D) rendering software we were using could produce high quality 3D spinal cord reconstructions from any series of two-dimensional (2D) computed tomography (CT) images. This finding raises the possibility that spinal cord imaging capabilities can be expanded where bundled 2D multi-planar reformats and 3D reconstruction software for CT are not available and in situations where magnetic resonance imaging (MRI) is either not available or appropriate (e.g. metallic implants). Given the worldwide burden of trauma and considering the limited availability of MRI and advanced generation CT scanners, we propose an alternative, potentially useful approach to imaging spinal cord that might be useful in areas where technical capabilities and support are limited. [West J Emerg Med. 2010; 11(5):463-466.]

INTRODUCTION

While many modern computed tomography (CT) scanners contain software that can automatically produce two-dimensional (2D) multi-planar reformats (MPR) and three-dimensional (3D) reconstructions, this technology is not available in much of the developing world. Additionally, magnetic resonance imaging (MRI), which has become the mainstay of spinal cord imaging, is also difficult to obtain in many places. Commercially available 3D reconstruction technology commonly used in paleontology and engineering research can be used to perform 3D reconstructions from any contiguous series of 2D images. Worldwide, there is a large number of single and quadruple slice CT scanners and scanners otherwise unable to perform 2D MPR reformats or automatic 3D reconstructions. The ability to create 3D reconstructions from standard 2D CT images on a standard laptop may expand the useful life and use of those CT scanners. Having an MRI or CT capable of MPR reformats or 3D reconstructions is not a prerequisite to having neurosurgical capabilities but is often desired for planning surgery; as such, this software could additionally decrease the barriers to operative intervention and possibly extend the usefulness of early generation CT scanners lacking advanced software bundles for multi-planar reconstruction.

In a developing country, such as Mongolia, advanced generation CT scanners and neurosurgical support are scarce. Mongolia is about 1.7 million square kilometers—about three times the size of Texas with a population of 2.8 million people, 1.3 million of whom live in its largest city, Ulaanbaatar. This central Asian country has only 14 CT scanners and two MRI units. Of the 14 CT scanners, six are in the capitol city (Ulaanbaatar) and five of the six can write to compact discs (CD). Only one of the six CT scanners outside of Ulaanbaatar can write to CD. The two MRIs are also located in Ulaanbaatar. As of this writing, there are six neurosurgeons in Mongolia performing trauma-related operations on the brain and spine. The distribution of CT and MRI scanners there is shown in figure 1**.** Herein, we comment on the workup of a patient suspected to have Brown-Séquard syndrome to illustrate a potential strategy for imaging patients where MRI is either not available or not appropriate and/or where advanced generation CT imaging is not available.

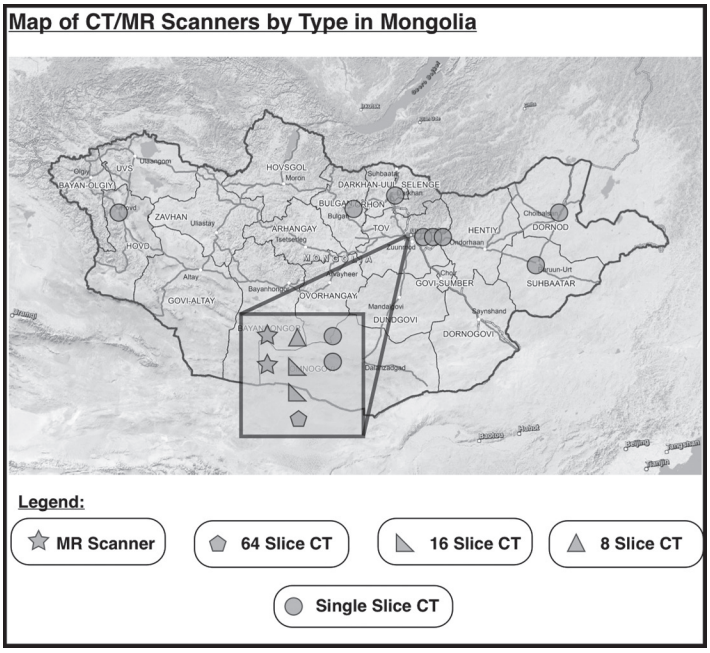

Figure 1. Distribution of advanced cross-sectional imaging capabilities in Mongolia. Of the 14 computed tomography (CT) scanning units, six are in the capital city, Ulaanbaatar. Five of six units capable of writing to compact discs are also located in Ulaanbaatar. For multi-detector CT scanners with two or more channels, 1.25mm slice thickness and 1mm reconstruction intervals are possible. There are two magnetic resonance imaging units in Mongolia, also located in Ulaanbaatar. Red lines depict the regional borders of the aimags (states) comprising Mongolia and do not represent roads. (Map provided courtesy of Dr. M. Saandari, MONMAP Engineering Services, Ulaanbaatar, Mongolia)

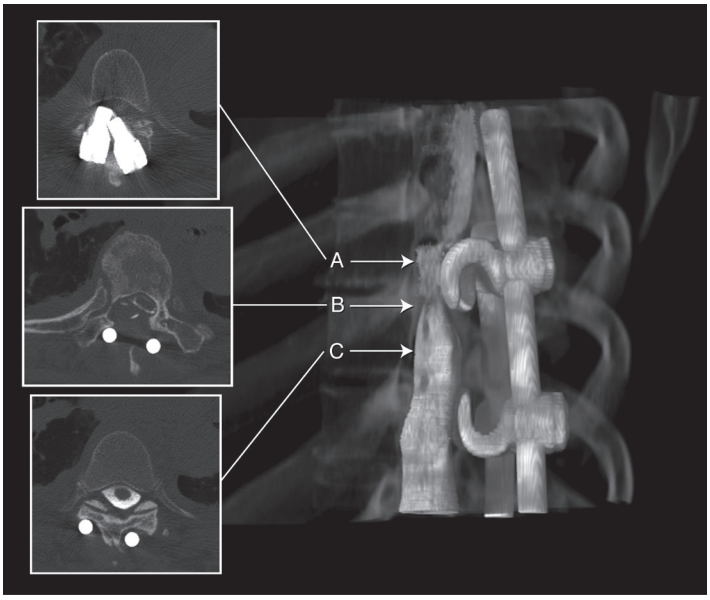

Figure 2. Two-dimensional computed tomography myelogram and corresponding 3D reconstruction of the injured spinal cord from the identical data set. Physical examination of the patient confirmed complaints with findings pathognomonic for Brown-Sequard type spinal cord compression or hemisection (A). Compression of the thecal sac is definitively demonstrated in high resolution (B). The normal thecal sac is also demonstrated (C).

METHODS

Three dimensional reconstructions were created by importing 2D CT scans (in this case, Digital Imaging and Communications in Medicine images, 1.25mm in thickness) into the image rendering program VGStudio Max 1.2.1 (http://www.volumegraphics.com). This software is one of several commercially available volumetric rendering programs that make feasible digital manipulation of CT data (Appendix A).[1] We manually grouped components of the CT scan slices, based on density and removed or made transparent undesired regions. Desired isodense regions were digitally highlighted and linked over multiple images, producing a 3D structure. This allows for manual selection and highlighting of desired image densities (tissues), thus achieving clinical discrimination of the spinal cord, spinal fluid, thecal sac and other tissues from each other and from bone. Interestingly, images can be formatted into movies, allowing the viewer to observe the 3D scans from any perspective (see web version of this manuscript and at http://www.escholarship.org/uc/uciem_westjem). Amy Balanoff, the person performing the reconstructions for this paper, is a paleontologist with no medical training and was not privy to the diagnoses of the patients we examined for publication of what was originally intended to be a series of case reports. Dr. Wintermark, a neuroradiologist, reviewed the original CT images as well as the reconstructions during the production of this manuscript. The map of Mongolia (Figure 1) was provided courtesy of Dr. Saandari (MONMAP Engineering Services Co., Ulaanbaatar, Mongolia; www.monmap.mn). Data regarding the distribution and availability of advanced cross-sectional imaging as well as neurosurgical services in Mongolia were provided by Drs. N. Saandari and T. Ganzorigt of the Mongolian Public Health Service and Achtan Elite Hospital, Ulaanbaatar, Mongolia. The CT scanner in use to image the patients shown in this report was a GE Lightspeed 16 slice CT scanner (General Electric Healthcare, Waukesha, WI).

Illustrative Case

A 63-year-old woman with bilateral Harrington rods for severe, congenital scoliosis was in a Pilates class when she felt a "pop" in her back and developed the progressive onset of lower extremity weakness over two days. Upon presentation to a university emergency department in the United States (U.S.), she complained of worsening right leg weakness to the point that she was unable to walk. On exam, she was found to have right lower extremity weakness of large and small muscle groups in flexion and extension and ipsilateral sensory deficits to light touch and proprioception in a spinal distribution pattern, with contralateral sensory dimunation to pain and temperature at approximately the same spinal level—pathognomonic for Brown-Séquard type spinal cord

hemisection or compression. The Harrington rods were MRI incompatible, so a CT myelogram was performed, with which a diagnosis of hemi-compression of the spinal cord was radiologically confirmed (Figure 2, A-C insets). She was taken to the operating room where the Harrington rods were removed from the spinal canal. The patient had nearly full recovery of motor and sensory function since the cord was compressed, not severed. In Figure 2 (main frame), we constructed the 2D CT images using the described technique. The resultant images enabled direct 3D visualization the impingement of the Harrington rods on the spinal canal, thecal sac and cord.

LIMITATIONS

To our knowledge, this is the first report suggesting this combination of image acquisition and processing. Our method has not been validated in a clinical trial alone or in comparison to other advanced cross-sectional imaging techniques, such as MRI or MPR, or compared to clinical examination alone. The current processing time for these images was about three hours and was performed manually by a single individual (AM Balanoff) not medically trained but very familiar with the software program used. Compared to the time it takes to obtain an MRI technician, radiologist and complete a scan, these times are close. Based on the adequacy of the reconstructions for lesion visualization in a subsequent case (Appendix B)**,** where the 2D CT images were without myelography contrast, it is suspected that the myelography procedure is not necessary for adequate spinal canal visualization after reconstruction. Even so, CT-myelography is actually a rather rapid procedure, involving only setup of a standard lumbar puncture, followed by injection of the contrast material (~2 minutes), transport to CT scanner and performance of the scan (~5 to 10 minutes). During reconstruction, the time required to perform digital isolations is variable. Density contrasts between bone and soft tissue are important variables in determining the degree of processing difficulty. Additionally, the digital processing software is rapidly advancing in an inverse relationship with processing time. Some patients may not be appropriate for CT-myelography, if this is desired, but it should be noted that there are no absolute contraindications to the technique and it can be performed very quickly (spinal puncture + image acquisition). As with any other invasive procedure, it is necessary to have expertise in this technique.[2] Further research and development will be required to realize or confirm the use of this technique in the appropriate clinical settings.

DISCUSSION

Worldwide there is a large number of early generation single and quadruple slice CT scanners and scanners otherwise unable to perform 2D MPR reformats or automatic 3D reconstructions. These reconstructions not only aid in the diagnosis of the acute spinal cord injury, but have become a common part of the neurosurgical pre-operative workup. The ability to create 3D reconstructions from standard 2D CT images on a standard laptop may expand the useful life and use of a large number of CT scanners. Having an MRI or CT capable of MPR reformats or 3D reconstructions is not a prerequisite to having neurosurgical capabilities, but is often desired for planning surgery; as such, this software could additionally decrease the barriers to operative intervention.

As approximately one-fourth of patients have persistent spinal cord compression after osseous spinal realignment,[3] it is sometimes important that providers achieve adequate visualization of non-osseous tissues (*e.g.* of thecal or spinal cord compression), especially when neurological deficits exist or persist in the setting of trauma or disease. While our reformats were post-*hoc* and thus did not affect management, our manual reformat could digitally remove the bony structures and highlight the desired regions, thus enabling visualization of the non-osseous structures (thecal sac, spinal canal).

The ability to use low-cost Internet-available software to process any 2D CT images of acute spinal cord injury into 3D reformats (rather than relying on MPR software bundled CT, multi detector CT or MRI) has broad implications worldwide for the evaluation and treatment of trauma victims and those with suspected acute spinal cord compression from other causes (*eg* tumor, epidural abscess or hematoma) where multi-detector CT (MDCT) scanners with bundled automatic 3D reconstruction software are not available, let alone where MRI is unavailable. In the described case, the CT scan was obtained with myelography contrast. We have subsequently performed 3D reconstructions from 2D CT images without contrast, with promising results (example shown in Appendix B).

Potentially increasing the available imaging modalities for acute spinal cord injury could be significant considering the burden of disease and healthcare costs associated with this injury type. The World Health Organization estimates that road traffic accidents, a leading cause of spinal cord trauma, will rise to third on the global burden of disease ranking by 2030.[4,5] As estimated by the National Spinal Cord Injury Statistical Center in 2009, average yearly expenses as a result of spinal cord injury (not including lost wages, productivity and fringe benefits) vary from $236,109 to $801,161 in the first year with lifetime costs between $500,000 and $3 million dollars.[5] Thus, any ability to increase the definitive characterization of acute spinal trauma and expedite its management by enhanced visualization may help decrease the healthcare and financial burden from acute spinal cord injury. Importantly, the American College of Radiology (ACR) does not list trauma as a contraindication for CT-myelography. In fact, there are no absolute contraindications to the procedure listed by the ACR, including major trauma.[2]

Three dimensional images and movies may be better for surgeons planning operative approach, especially if they

are available on mobile computers such as laptops. Such 3D images may reduce inter-observer variability and may give results that are more objective compared to 2D CT images. Not all patients are suitable for MRI. Many have metal implants, some are on ventilators, and others may be claustrophobic. CT additionally enables the neurological or orthopedic surgeon to obtain high quality bone images, which may be of equal priority. CT scanners are available worldwide, whereas MR technology is largely limited to the developed world and, even then, largely in urban and wealthier suburban areas. We note with interest that myelography is not even mentioned in the latest editions of some leading textbooks of emergency medicine and may have been prematurely eliminated from consideration by the authors and editors updating these texts,[6] Though most U.S. emergency medicine training programs and most U.S. emergency physicians work in technologically supportive settings with respect to imaging and the ability to transfer patients to higher levels of care, most of the world does not have this luxury. As we described earlier, in a developing country such as Mongolia, there is a dearth of advanced cross-sectional imaging and neurosurgical support—that which exists being concentrated in the capital city. Furthermore, emergency physicians should be familiar with their imaging options in the event a patient is not suitable for one modality or another or those modalities are suddenly not available.

CONCLUSION

The finding that high-resolution, 3D CT images of spinal cord could be obtained by applying technology and algorithms already used in engineering and paleontology to 2D CT images and processed on a standard laptop computer raises the possibility of extending the useful life and use of a large number of CT scanners worldwide, including single slice and non-MDCT scanners, and specifically those without 2D MPR reformat and 3D reconstruction capabilities. While availability of MRI or CT scanners capable of MPR reformats or 3D reconstructions is not a prerequisite to having neurosurgical capabilities, 2D MPR and 3D reconstructions have become a not uncommon part of the preoperative workup. Considering MDCTs with two or more channels can routinely produce 1.25mm slices, these software programs should be able to produce reconstructions with reasonably high accuracy, extending the use and versatility of older generation CT scanners.

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APPENDIX A: 3D Reconstruction Software
From Stanford University Biocomputation Center
http://biocomp.stanford.edu/

3-D-E
Windows-based contour editor and visualizer from Data Cell Ltd. (Platforms: PC; Cost: ~$1500)

3DVIEWNIX
3DVIEWNIX is a transportable, very inexpensive software system developed by the Medical Image Processing Group, Department of Radiology, University of Pennsylvania, Philadelphia. It has state-of-the-art capabilities for visualizing, manipulating, and analyzing multidimensional, multimodality image information. It is designed to run on Unix machines under X-windows. (Platforms: SGI, Sun, PC; Cost: unknown)

Amira
Interactive segmentation and visualisation package for biomedical images. (Platforms: SGI, Sun, Windows; Cost: $$$$)

Analyze
Provides an environment for the interactive visualisation and manipulation of 2-D, 3-D and 4-D biomedical images. An integrated set of tools is provided to allow data to be interrogated in both two and three dimensions. (Platforms: SGI, Sun, HP, DEC; Cost: $$$)

AutoDeblur
AutoDeblur performs blind deconvolution for 3d data. (Platforms: SGI; Cost: unknown)

AVS
AVS - commercial visualization package from Advanced Visual Systems, Inc. (Platforms: SGI, Sun, HP, DEC; Cost: unknown)

Oncor
Biomedical image measurement and analysis system. (Platforms: Mac, PC; Cost: $$)

Bioquant
3D reconstruction and quantitative histochemistry system. (Platforms: PC; Cost: unknown)

BOB (GVLware)
The Army High Performance Computing Research Center (AHPCRC) has been developing a set of tools to work with large time dependent 2D and 3D data sets. (Platforms: SGI; Cost: free)

C_Images 3D
3D Image analysis package by Foster-Findlay Associates (UK). (Platforms: PC (DOS, Windows), Unix (IBM, Sun, SGI); Cost: unknown)

CELLscan
A system for high-resolution 3D fluorescence microscopy. Provides image acquisition, deconvolution, and analysis capabilities. (Platforms:PC; Cost: Unknown)

CT
CT programs by Malcolm Slaney. (Platforms: Many; Cost: free)

Deltavision
Image acquisition and deconvolution software for 5-dimensional microscopy. (Platforms: SGI; Cost: unknown)

Dicer
Slicer/Dicer is a volumetric visual data analysis package. (Platforms: Mac; Cost: $)

DIP Station
Macintosh-based reconstruction package. (Platforms: Mac; Cost: unknown)

Dr. Razz
CT/MR display and analysis program for Macintosh color computers. (Platforms: Mac; Cost: free)

EM3D
Electron microscopy reconstruction software package from Stanford. (Platforms: Win, UNix; Cost: free)

EutecticSSRS
Low-end 3D reconstruction, mapping, and analysis system. Contour-based using a digitizing tablet. (Platforms: PC; Cost: $24-28k (NTS), $8-10k (NTSV))

FAST
It is a software environment for visualizing and analyzing Computational Fluid Dynamics data. (Platforms: SGI; Cost: free)

HVEM 3D
PC-based serial section reconstruction program for microscopy created by Kinnamon/Young at UColorado. (Platforms: PC; Cost: unknown)

IAP
Imaging Applications Platform is a commercial package for medical and scientific visualization. (Platforms: Most workstations; Cost: $$)

IBM Data Explorer
IBM Data Explorer. (Platforms: IBM, SGI, Sun, HP, DG; Cost: unknown)

IDL
IDL (Interactive Data Language) is a package for the interactive reduction, analysis, and visualization of scientific data and images. (Platforms: IBM, SGI, Sun, HP, DEC, PC, Mac; Cost: $$)

Image Pro
Image Pro from Media Cybernetics ($2,999). (Platforms: PC (Win3.1, NT, 95); Cost: $$$)

ImageSpace
Software environment for confocal imaging. (Platforms: SGI; Cost: unknown)

Image Volumes
Interactive image processing, contour editing, 3D reconstruction for confocal, EM, X-ray tomography, and MRI. (Platforms: SGI; Cost: unknown)

Imagist
Imagist2 from Princeton Gamma Tech- integrated microscope and analysis systems. (Platforms: Sun; Cost: unknown)

IMOD
Image modeling package used for EM tomography and serial section reconstruction. (Platforms: unknown; Cost: unknown)

IRAF
IRAF (Image Reduction and Analysis Facility). (Platforms: unknown; Cost: unknown)

KBVision
Software environment for creating image understanding applications. (Platforms: Sun, IBM, DEC, SGI; Cost: $$)

Khoros
Very large, general image processing toolkit. (Platforms: Sun, SGI, IBM, DEC, HP; Cost: free)

MacCubeView
Designed to display a texture map image of three-dimensional (3-D) data. (Platforms: Mac; Cost: shareware)

MacPhase
2D data analysis and visualization application for the Macintosh. (Platforms: Mac; Cost: unknown)

MacStereology
MacStereology is package designed to make measurements of images and to make 3-D reconstructions. (Platforms: Mac; Cost: unknown)

MCID
Image analysis and quantification mainly for fluorescence imaging. (Platforms: PC; Cost: unknown)

MEDx
Medical image visualization and analysis program for MRI, CT, PET, and SPECT. (Platforms: SGI; Cost: unknown)

MetaMorph
Integrated microscope image capture, enhancement, reconstruction, and visualization system. (Platforms: PC; Cost: unknown)
MicroMorph
MicroMorph is the software aid in learning the mathematical morphology techniques of image analysis. (Platforms: PC; Cost: Varies)
MicroVision II
MicroVision II can be used for for visualising point-sampled data volumes. produced by 3D scanning devices such as MRI, PET, CT-scanners and confocal microscopes. (Platforms: PC; Cost: unknown)
MicroVoxel
MicroVoxel is a 3D imaging package that imports data from Bio-Rad MRC-600 files, TIFF files, or raw 8-bit data. (Platforms: PC; Cost: unknown)
Montage
Montage is one of the first complete serial-section reconstruction packages and was produced at the University of Pennsylvania. (Platforms: Sun, SGI, IBM, PC; Cost: free)
Mvox
Mvox is a general purpose tool for visualization and manipulation of a wide range of 2-4D grey level/colour images and 3D surface graphics. (Platforms: SGI, HP, IBM; Cost: $$)
NCSA Tool Suite (DataSlice, Viewit, Tiller)
3D Visualization tools from the NCSA. (Platforms: Sun, SGI, DEC, IBM, Cray, Mac; Cost: free)
Neuro_Echo, Neuro_SPGR, Neuro_Lobe
Neuro_Echo aids analysis of double-echo MR brain scans from the GE Signa imager. The program uses axial scans to segment the brain scans into gray matter, white matter and CSF. (Platforms: Sun; Cost: unknown)
Neurolucida
Interactive image analysis software for neuron tracing and anatomical mapping. (Platforms: PC; Cost: unknown)
NIH Image
NIH Image has painting and image manipulation tools, a macro language, tools for measuring areas, distances and angles, and for counting things. (Platforms: Mac; Cost: free)
Nuages
This is Bernhard Geiger's (INRIA) reconstruction package. (Platforms: Sun, SGI, DEC; Cost: free)
OLPARS
On-Line Pattern Analysis and Recognition System from the PAR Government Systems Corporation. (Platforms: Sun, DEC; Cost: unknown)
Pixar
High-end visualization and rendering for movies, but also for the medical community. (Platforms: SGI; Cost: $$$)
Pixcell
Pixcell from Sandia Labs. (Platforms: Sun; Cost: free)
PV-Wave
PV-WAVE from Visual Numerics. (Platforms: unknown; Cost: unknown)
RMN
A Nuclear Magnetic Resonance (NMR) data processing program for the Macintosh. (Platforms: Mac; Cost: unknown)
Reconstruction Of Serial Sections (ROSS)
Serial-section based reconstruction and visualization system for microscopy. (Platforms: SGI; Cost: free)
SciAn
Florida State University scientific visualization package. (Platforms: SGI, IBM; Cost: free)
Semper6
General image Processing and acquisition system. (Platforms: PC, DEC, Sun; Cost: unknown)
SGI Explorer
SGI Iris Explorer. (Platforms: SGI, Cray, DEC, HP, IBM, Sun; Cost: unknown)
Sunview
Sunview - available from SunSoft. (Platforms: Sun; Cost: unknown)
SunVision
Sun Visualization software, providing SunIPLib (Image Processing), SunVoxel (volume rendering), SunART (high-quality rendering), SunGV (interactive 3D graphics). (Platforms: Sun; Cost: unknown)
Synu
UCSD reconstruction/visualization program. (Platforms: SGI; Cost: free)
The Explorer
Macintosh-based package from UCLA. (Platforms: Mac; Cost: free)
TIM
Tomographic Imaging- PC Software for 3D image processing of pixel planes. (Platforms: PC; Cost: unknown)
Theraview
No information available. (Platforms: unknown; Cost: unknown)
V
Public-domain software package for magnetic resonance imaging and spectroscopy data. (Platforms: Unix; Cost: free)
Vida
Commercial volumetric display and analysis tool for Unix. (Platforms: Sun, HP, SGI; Cost: $$$)
View
SGI-based program from UNC. (Platforms: SGI; Cost: unknown)
Vis5D
Visualization program for time-varying multi-variate 3-D gridded data. (Platforms: SGI, IBM, Sun, HP, DEC; Cost: unknown)
VisAD
Visualization program for interactively steering and visualizing scientific computation. (Platforms: SGI; Cost: unknown)
VolPack
VolPack is a portable software library for volume rendering. (Platforms: SGI, Sun, HP, DEC; Cost: unknown)
VolVis
Volume Visualization package from SUNY. (Platforms: SGI, Sun, HP; Cost: unknown)
Vox-L
MR and CT visualizer. (Platforms: unknown; Cost: unknown)
Voxblast
Voxel-based 3d volume rendering system developed by Randall Frank at the University of Iowa Image Analysis Facility. (Platforms: SGI, Sun, DEC, HP, IBM, Mac, PC; Cost: unknown)
VoxelBox
3D Volume renderer for Windows. (Platforms: PC; Cost: $)
VoxelMan 3D
Interactive atlas of skull and brain. (Platforms: unknown; Cost: unknown)
VoxelView
VoxelView software from Vital images for 3D reconstruction of images. (Platforms: SGI, Mac; Cost: unknown)
Voxtool
Voxtool from General Electric. (Platforms: PC, Unix; Cost: unknown)

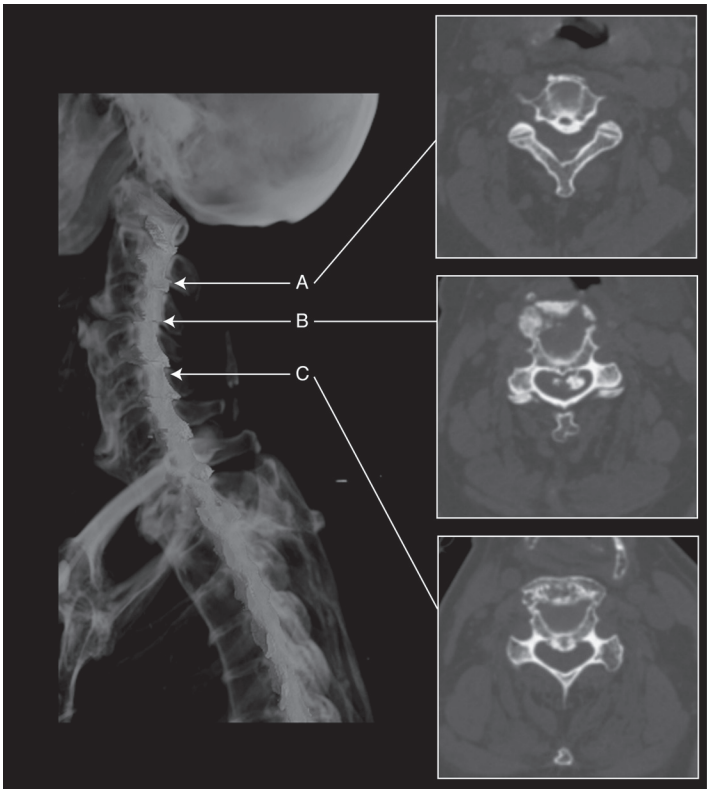
VROOM
VROOM (Vol. Rendering by Object Oriented Meth.). C++ Library. (Platforms: unknown; Cost: unknown)
Wavefront
Wavefront Data Visualizer. (Platforms: SGI, Sun, IBM, HP, DEC; Cost: unknown)
WHIP
General purpose image processing software from GW Hannaway & Associates. (Platforms: SGI; Cost: unknown)
XCOSM
X-Windows interface to Computational Optical Sectioning Microscopy. (Platforms: SGI, DEC, Sun; Cost: Free)
Zmode
Software/hardware that can convert a series of parallel MRI/CT scan images to a 3D reconstructive model in a CAD system. (Platforms: unknown; Cost: unknown)

Appendix B: Use of described technique in two dimensional computed tomography images without contrast

CASE:

A 90 year-old female fell from standing. Her family helped her into bed because she complained of feeling weak. She was transported by emergency medical services to a university emergency department where paramedics reported she was "unhelpful" getting from the bed to the gurney. On exam she was found to have complete sensory loss and motor weakness below her neck. Non-Contrast computed tomography (CT) demonstrated possible step off fracture of cervical four and five (C4/C5), with bony fragments in the spinal canal, which radiologically correlated with her clinical signs and symptoms

Post hoc, two dimensional CT images were manipulated using the described technique to produce three dimensional (3D) reconstructions (Appendix B). These reconstructions provided remarkable visualization of the spinal canal. Not only is the vertebral step off at C4/C5 seen in 3D space, but by virtually recreating and highlighting the spinal canal, the location and extent of the acute spinal lesion are easily seen.



Appendix B Figure. Two dimensional (2D) non-contrast computed tomography (CT) rendered in three dimensional (3D) using the identical data set. Physical examination of the patient confirmed paralysis from the neck, down. 3D rendering of the 2D images correctly identified division of the spinal cord that was not seen on the initial CT and only confirmed by magnetic resonance imaging the next day. A and C demonstrate normal spinal canal and thecal sac alignment. Subluxation of the vertebrae and spinal cord transection at cervical are demonstrated in B.

Targeted Needs Assessment of Off-service Residents in Emergency Medicine

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Purpose: The purpose of this study is to evaluate the needs of internal medicine residents rotating through the emergency department (ED).

Methods: A survey was distributed to 100 internal medicine residents (post-graduate years 2 and 3) from two different residency programs before the start of their emergency medicine (EM) rotation. Residents ranked the level of importance and the level of preparedness for 23 different EM topics, using a Likert-type scale ranging from 1 (least important/least prepared) to 4 (most important/most prepared). We calculated delta values (Δ) from the difference between importance and preparedness and undertook significance testing of this difference.

Results: A total of 71 out of 100 surveys were completed properly and returned. Internal medicine residents felt most ill-prepared in the areas of orthopedics, environmental emergencies, otolaryngology, airway management, and ophthalmology. The largest perceived gaps between importance and preparedness lay within the areas of airway management (Δ=1.30), ophthalmology (Δ=1.10), environmental emergencies (Δ=0.96), and orthopedics (Δ=0.96).

Conclusion: Our data suggest that internal medicine residents are inadequately prepared for EM topics that they feel are important to their education, specifically airway management, ophthalmology, environmental emergencies and orthopedics. It is quite possible that other specialty residents are also poorly prepared for similar core EM topics. These data will hopefully guide future curricular change for off-service residents in the ED. [West J Emerg Med. 2010;11(5):470-473.]

INTRODUCTION

Emergency departments (ED) throughout the country are experiencing ever-increasing patient volumes, longer wait times, strained personnel and resources, and increased pressure to reduce medical error. Teaching programs face the additional challenge of maintaining a productive educational environment for emergency medicine (EM) residents and medical students. Despite a strong desire to learn critical thinking in the ED, the educational objectives and needs of off-service residents are often overlooked.[1]

Standards in curriculum do exist for EM residents but not for off-service residents, who typically spend only one month of their residency in the ED.[1-2,3-4] This is in direct contrast to developed goals and objectives for EM residents while on off-service rotations.[5-7] Some off-service rotators attend weekly educational conferences, while others only experience bedside teaching.[8] The goal of the EM rotation is to provide off-service residents an appreciation for the limited time frame in which to complete a work-up, evaluate for emergent conditions, develop a treatment plan, communicate effectively, and make an appropriate disposition.[9-10] Coming from various types of residency programs (obstetrics and gynecology [OBGyn], internal medicine [IM], pediatrics, etc.), the learning needs for each off-service resident are unique. Identification of those needs will not only provide for a more complete educational experience, but also change physician behavior and potentially improve patient outcomes.[11] To tailor the curriculum to reflect this new educational directive, we undertook a needs assessment.

We used David Kern's[12] six-step model for curriculum

Table 1. Questionnaire snalysis: importance vs. preparedness (n=71)

Topics	Importance		Preparedness		Δ Mean	p-values
	Mean	SD	Mean	SD	M_I-M_P	(95% CI)
Abscesses	2.73	0.72	2.54	0.77	0.20	0.08 (0.02-0.42)
ACLS/shock/codes	3.97	0.17	3.23	0.74	0.74	<0.0001 (0.55-0.93)
Airway management † Ω	3.41	0.73	2.11	0.83	1.30	<0.0001 (1.09-1.50)
Allergy	3.53	0.56	2.90	0.70	0.63	<0.0001 (0.42-0.84)
Cardiology	3.99	0.12	3.40	0.71	0.59	<0.0001 (0.42-0.76)
Dermatology	3.10	0.71	2.26	0.70	0.84	<0.0001 (0.63-1.06)
Endocrine	3.86	0.39	3.41	0.65	0.44	<0.0001 (0.28-0.61)
Eare, nose, throat/dental Ω	2.61	0.79	1.82	0.66	0.80	<0.0001 (0.58-1.02)
ER procedures	3.63	0.62	2.94	0.71	0.69	<0.0001 (0.45-0.92)
Environmental † Ω	2.79	0.63	1.82	0.70	0.96	<0.0001 (0.76-1.15)
Gastrointestinal	3.96	0.20	3.66	0.48	0.29	<0.0001 (0.16-0.41)
Genitourinary emergencies	3.09	0.58	2.55	0.75	0.54	<0.0001 (0.34-0.75)
Intoxication	3.31	0.65	3.00	0.64	0.31	.0014 (0.13-0.50)
Neurology	3.66	0.59	2.74	0.65	0.91	<0.0001 (0.72-1.11)
Obstetrics/gynecology	2.64	0.90	2.14	0.80	0.50	0.0003 (0.24-0.76)
Ophthalmology † Ω	3.06	0.74	1.94	0.59	1.11	<0.0001 (0.92-1.31)
Orthopedics † Ω	2.71	0.82	1.76	0.71	0.96	<0.0001 (0.73-1.18)
Pain management	3.23	0.76	3.06	0.81	0.17	0.1529 (0.07-0.41)
Pulmonary	3.96	0.20	3.56	0.53	0.39	<0.0001 (0.26-0.52)
Psychiatry	2.83	0.78	2.69	0.81	0.14	0.2413 (0.10-0.38)
Surgical abdomen	3.53	0.65	3.13	0.67	0.40	0.0002 (0.20-0.60)
Toxicology	3.20	0.60	2.32	0.60	0.87	<0.0001 (0.67-1.07)
Vascular	3.30	0.69	2.57	0.71	0.73	<0.0001 (0.50-0.95)

† top four largest gap between importance and preparedness
Ω top five topics residents felt least prepared to manage
ACLS, advanced cardiac life support; M_I, mean of importance; M_P, mean of preparedness; *SD,* standard deviation

development as a guide and framework for this project. Step one of the six steps is to identify the problem and perform a general needs assessment. In this sense, we are beginning to identify the gap between the current approach and the ideal approach, specifically with IM residents making up the largest group of off-service rotators in the ED. These individuals do not have a standardized curriculum to focus education about EM concepts and principles. Step two in Kern's six-step model is to develop a targeted needs assessment to ensure the most relevant information is obtained from the true stakeholders, in this case IM rotators.[12] We performed a survey analysis to gather this information. Our goal was to identify areas of knowledge gaps between the learning needs of the rotating IM residents and what is provided by the current curriculum.

METHODS

From January to March 2007, surveys were distributed to 100 IM post graduate years (PGY)-2 and PGY-3 IM residents (a convenience sample from two IM residency programs) who had not previously rotated in the ED. The survey evaluated 23 EM core topics. These topics were identified in the following fashion: a group of associate or full professor ED physicians, experts in their respective EM subspecialty, created an expansive qualitative list of topics. This list was then validated in a review by a random sample of associate/full professor EM physicians in addition to IM program directors. After the review, appropriate corrections were made; the resultant product became the final topic list to be used in the study.

Surveys were distributed to PGY-2 and PGY-3 residents from two academic urban IM residency programs before the start of their EM rotations. These surveys were completely voluntary, anonymous, and had no bearing on evaluations of the residents during their rotations. To obtain a higher response rate, multiple requests were attempted via email and at noon conferences.

IM residents were asked to rank the importance they placed in and self-preparedness for 23 EM core topics. The

responses were based on a modified Likert-type scale: 1 (unimportant/poorly prepared) to 4 (extremely important/well prepared).

Only fully completed returned surveys were used as eligible data. We used a two-tailed, paired student t-test to compare means of importance versus preparedness to identify the largest gap, using an online stats calculator and Microsoft Excel 2008 for Macintosh.[8]

RESULTS

A total of 100 IM residents were given the survey, and 83 returned it for a response rate of 83%. Twelve surveys were discarded as the residents failed to complete the entire survey. Therefore, 71 surveys were deemed viable for use in this study.

The results of the study are summarized in Table 1. Demographic information of the survey respondents was not collected, as all were either PGY-2 or PGY-3 IM residents from academic programs. IM residents felt least prepared in the areas of airway management, environmental emergencies, orthopedics, ENT/dental emergencies and ophthalmology. Of the five topics, the largest gap between importance and preparedness (i.e., those most important topics that the residents felt least prepared for before their rotation) lay within airway management, orthopedics, environmental emergencies and ophthalmology.

All topics except for abscesses, pain management and psychiatry had a statistically significant difference between importance and preparedness. However, upon further statistical analysis, only airway management and opthalmology maintained a >1 Likert scale difference between importance and preparedness based on the 95% confidence interval (Table 1).

DISCUSSION

In April of 2007 the University of California at San Francisco identified five phases of curricular change. The first two phases of change included recognizing a need for change and creating a vision for a new curriculum.[14] Moving forward, a focused needs assessment is a very effective method of obtaining information for such change. Although EM programs have a specific curriculum for their residents, the challenge is to tailor education for off-service residents. While certain learning objectives are bound to overlap with current protocols, off-service residents can be unfamiliar with this material. A needs assessment successfully accomplishes the following: 1) it ascertains whether a revised curriculum is necessary; and 2) it supports collaboration between departments and residency programs in a multi-disciplinary approach, benefiting residents and strengthening interdepartmental communication.[15]

Our needs assessment demonstrates multiple areas of deficiency in the EM curriculum for IM residents. In this study, nearly every core topic received a mean score of

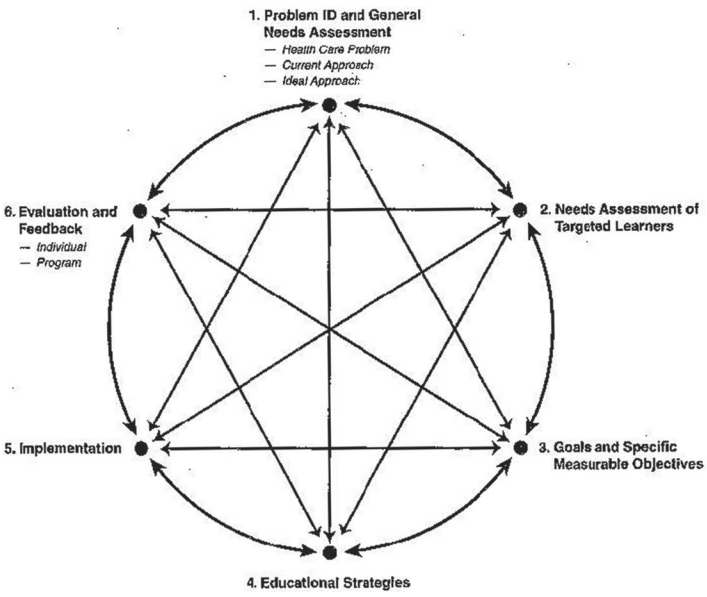

Figure 1. David Kern's six step model for curriculum development[4]

"somewhat important" to "moderately important." Airway management, orthopedics, environmental emergencies and ophthalmology had the highest significant difference between their means, indicating the largest gaps in IM knowledge base. Furthermore, airway management and opthalmology had a >1 Likert scale difference between importance and preparedness, suggesting a correlation with clinical relevance. This cut off was determined by a team of experts made up of EM and IM attending physicians through informal consensus at one of many sessions during the course of the project. The identified gaps should drive the development of goals and objectives and further education of an off-service curriculum.

LIMITATIONS

There were some limitations to this study, most notably being the population of residents used in this study. We acquired data from IM residents and not from residents of other specialties. However, it should be noted that IM residents were chosen as the initial study group as they comprised the largest population of off-service residents rotating through the ED. Also, we did not conduct a power analysis; instead, the number of residents surveyed was based on a convenience sample of the two IM residency programs. In addition, the background of the individual residents involved may differ. Although responses tended to be similar, some residents may have more experience in the ED (as a medical student or during their intern year) than others. Similarly, during their rotation, some residents may not have studied as rigorously as others. While there is access to all major EM texts in the ED, resident use may have varied.

Moreover, there are minor differences between the two IM training programs. Furthermore, residents may not be able

to appreciate the value of the learning experiences they have had thus far until they actually practice in the future and have the opportunity to test their knowledge. Finally, the educational goals of each IM resident can vary and affect their rankings of topics. The priorities of a PGY-3 entering endocrinology may vastly differ than those entering Pulmonology/Critical Care, leading to respondent bias.

This need assessment indicates two main areas of future research. It is clear that information obtained can be useful in curriculum development. In addition, such studies can easily be replicated on residents of other residency programs (i.e, surgery, psychiatry, OB/Gyn) to identify the needs of a variety of off-service rotators. We must recognize that this needs assessment is only a first step towards future curriculum change. More data from residents in other types of residency programs are necessary to gain a complete understanding of off-service rotators' needs.

CONCLUSION

A needs assessment is a vital organizational tool in developing and targeting curriculum change for individual learners. This study ascertains statistically significant needs in almost all of the areas included in the survey, with particular significance in the fields of airway management, ophthalmology, environmental emergencies, and orthopedics, which illustrate a gap between importance of the topic and level of preparedness. Furthermore, this needs assessment can act as a guide and a first step towards progressive curricular change for off-service residents in the ED.

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Emergency Medicine Residency Applicants' Perceptions about Being Contacted after Interview Day

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Objective: We sought to characterize the experiences and preferences of applicants to emergency medicine (EM) residency programs about being contacted by programs after their interview day but before the rank list submission deadline.

Methods: This cross-sectional study surveyed all applicants to an academic EM residency during the 2006-2007 interview cycle. Participation was anonymous and voluntary. We used a Web-based survey software program to administer the survey in February 2007, after rank lists were submitted. Two additional invitations to participate were sent over the next month. The instrument contained multiple-choice and free-text items. This study was submitted to our Institutional Review Board and was exempt from formal review.

Results: 240/706 (34%) of applicants completed the survey. 89% (214/240) of respondents reported being contacted by a residency program after their interview but before rank lists were due. Of those contacted, 91% report being contacted by e-mail; 67% by mail; and 55% by phone. 51% of subjects reported that being contacted changed the order of their rank list in at least one case. A majority of contacted applicants felt "happy" (58%) or "excited" (56%) about being contacted, but significant numbers reported feeling "put on the spot" (21%) or "uncomfortable" (17%). A majority felt that it is appropriate for programs to contact applicants after interview day but before the rank lists are submitted, but 39% of contacted subjects responded that contact by phone is either "always inappropriate" or "usually inappropriate." Regarding perceptions regarding the rules of the match, 80% (165/206) of respondents felt it was appropriate to tell programs where they would be ranked, and 41% (85/206) felt it was appropriate for programs to notify applicants of their place on the program's rank list.

Conclusion: Most EM residency applicants report being contacted by programs after the interview day but before rank lists are submitted. Although applicants feel this practice is appropriate in general, over a third of subjects feel that contact by phone is inappropriate. These findings suggest that residency programs can expect a majority of their applicants to be contacted after an interview at another program, and shed light on how applicants perceive this practice. [West J Emerg Med. 2010; 11(5): 474-478.]

INTRODUCTION

The National Resident Matching Program (NRMP) is a private, not-for-profit corporation established in 1952 that aims to provide an impartial venue for matching applicants' and programs' preferences for each other. In 2007 the NRMP enrolled 127 emergency medicine (EM) residency programs in the match, which offered 1,288 EM positions and filled 1,282 of those positions. Of those, 1,027 were filled with United States graduates and 234 with independent applicants. A total of 1,489 applicants applied to an EM residency program. Of

those, 1,105 were graduates of accredited U.S. medical schools and 384 were independent applicants.[1]

In its Statement on Professionalism, the NRMP outlines an expectation that all match participants conduct their affairs in an ethical and professionally responsible manner. While there are specific guidelines for certain explicit violations of match ethics listed in the Match Participation Agreement, other potential violations are less well-defined and subject to interpretation. One such prohibition concerns misleading communications. While the NRMP "permits program directors and applicants to express a high degree of interest in each other," it "prohibits statements implying a commitment." The distinction between what is an expression of interest and what implies a commitment is left up to interpretation by the program and applicant. Although statements such as "we plan to rank you very high on our list" and "we hope to have the opportunity to work with you in the coming year" are noted to be non-binding, the NRMP reports that these statements are frequently misinterpreted. Applicants are advised to not rely on them when creating rank order lists, and program directors are advised to avoid making misleading statements in their interactions with applicants.[2]

Previous publications suggest that violations of professional behavior in the match process may be common.[3-11] However, the frequency of misleading communications is unknown. In our experience advising students applying to EM residency programs, we have heard that there is wide variation in program practices regarding contacting applicants after the interview day but before rank lists are submitted. While some students report only rare contact by any means, other students report frequent communication by e-mail or phone. Both the variation in program practices, and the nature of communication (which often is interpreted as at least an "expression of interest"), can be confusing and anxiety-provoking for the applicant.

To our knowledge, there are no published descriptions of EM residency programs' practices regarding contacting applicants after the interview day, a communication practice with the potential to be interpreted as misleading and impact applicants' decisions in creating rank order lists. We sought to describe the experiences of our applicants regarding being contacted after interview day by EM residency programs, and characterize their perceptions regarding these communications.

METHODS

Study Design

This cross-sectional study surveyed all applicants to our EM residency program in the 2006-2007 NRMP cycle.

Study Setting and Population

This study was conducted at a three-year EM residency program that offered nine post-graduate year (PGY)-1 positions in the 2006-2007 cycle. During the study period, our program's policy was to not contact interviewees after the interview day. Invitations to participate in the study were offered by e-mail to all 706 individuals who had applied to our program. Of these applicants, 62.5% were male, and 37.5% were female**.** One hundred twelve applicants (16%) had interviewed at our program. To reassure applicants of anonymity and emphasize we were interested in their overall interview experience rather than their experience at our program, the survey did not ask respondents if they interviewed at our program. The geographic distribution of the 706 eligible subjects included 174 (24.6%) from the Midwest, 125 (17.7%) from the Northwest, 96 (13.6%) from the Southeast, 193 (27.3%) from the West and 118 (16.7%) foreign medical graduates.

Study Protocol

All applicants to our residency program were invited to participate in an anonymous and voluntary Web-based survey. A commercially available survey software program was used to administer the survey in February 2007, after rank lists were submitted but before match results were announced. Two additional invitations to participate were sent over the next month. This study was submitted to our Institutional Review Board and was exempt from formal review.

Measurements

The survey used a combination of multiple-choice and interval-scale type items to assess applicants' perceptions about whether they were contacted by EM residency programs after the interview day, followed by items that characterized the nature of the contact they received and their feelings about being contacted. Applicants who responded that they were not contacted were asked analogous questions assessing how they felt about not being contacted. Both groups were asked a question pertaining to their understanding of the "rules of the match." The survey also asked applicants to provide the following information: number of EM programs applied to and interviewed at; number of EM programs ranked; participation in the couples match; and ranking programs outside of EM. The survey was piloted on 10 current residents and reviewed before the study was initiated. Minor formatting and wording edits were made to avoid ambiguity and improve understandability. No significant problems were identified.

Data Analysis

The survey software reported descriptive statistics for data. The response rate was calculated as the number of applicants who responded to the question that referred to our primary research objective (*"Were you contacted, in any way, by a member of a residency program after your interview but before rank lists were due?")* divided by the number of applicants who were invited to participate. Other items were not made mandatory so that applicants who were uncomfortable or unsure answering a certain question could

Table 1. Application characteristics of respondents[Δ]

	1-5	6-10	11-15	16-20	>20
How many EM programs did you apply to?	1.7%	4.8%	9.6%	20.0%	63.9%
How many programs EM did you interview at?	10.4%	39.1%	40.0%	9.1%	1.3%
How many EM programs did you rank?	14.3%	46.5%	31.3%	7.8%	0.0%

	YES	NO
Did you participate in the couples match?	7.0%	93.0%
Did you rank programs in a field other than emergency medicine? (Not including combined programs)*	5.2%	94.8%

Δ Percentages were rounded to the first decimal place, and therefore not all numbers add up to 100%.
* This item received 229 responses. All other items in table received 230 responses.
EM, emergency medicine

Table 2. Applicant perceptions regarding method and initiator of post-interview communication

Percentages of respondents who answered that each scenario is "always" or "usually" inappropriate		
	Contacted group	Not contacted group
Phone contact	81/206 (39%)	9/24 (38%)
E-mail contact	12/206 (6%)	6/23 (26%)
Mail contact	19/206 (9%)	5/23 (22%)
Being contacted by the program director	10/204 (5%)	4/23 (17%)
Being contacted by someone who interviewed you, but not the program director	19/204 (9%)	3/23 (13%)
Being contacted by a resident who did not interview you	93/204 (5%)	17/23 (74%)
Being contacted by a faculty member who did not interview you	113/204 (6%)	17/23 (74%)
Being contacted by the residency coordinator	54/203 (27%)	7/23 (30%)

*For this item, there were a total of 206 respondents in the "contacted" group and 24 respondents in the "not contacted" group. However, not all respondents completed each subitem. Percentages are calculated from only those respondents who completed each subitem.

opt out of that question but still participate in the survey. All responses collected are reported. Percentages of respondents selecting each answer were calculated and compared between the contacted and not contacted groups.

RESULTS

Of 706 applicants invited to participate, 240 (34%) completed the survey. Not all respondents completed each item, and therefore all percentages are reported for the total number of respondents for each item. Table 1 describes the type and number of programs respondents applied to, interviewed at, and ranked. Fifty-two percent (123/237) of respondents answered that they *expected* to be contacted by a residency program after their interview but before rank lists were due; 89% (214/240) of respondents reported actually being contacted. Fifty-six percent were contacted by 3-5 programs, with a third of applicants being contacted by more than five programs and the remainder of respondents being contacted by fewer than three. Out of those who were contacted, 91% report being contacted by e-mail; 67% by mail; and 55% by phone (some applicants were contacted by more than one method, therefore numbers do not add up to 100%). Fifty-one percent reported that being contacted changed the order of their rank list in at least one case. A majority of contacted applicants felt "happy" or "excited" about being contacted, but significant numbers reported feeling "put on the spot" (21%), or "uncomfortable" (17%). Of the 25 respondents who were not contacted after the interview day, 48% reported feeling "nervous" and 48% reported feeling "disappointed" about their lack of contact. A majority of applicants in both groups (80% of contacted applicants, 73% of not contacted applicants) believed that it is appropriate for programs to contact applicants after interview day but before the rank lists are in, but 39% of contacted subjects responded that contact by phone is either "always inappropriate" or "usually inappropriate."

Table 2 demonstrates responses regarding being contacted. Understanding of the "rules of the match" is depicted for both groups in Table 3.

DISCUSSION

During the annual residency match, program directors are faced with the challenge of adhering to the highest professional standards while competing with other programs

Table 3. Applicants' understanding regarding the "rules of the match"

Percentages of applicants answering "true" to the following statements:	Contacted group	Not contacted group
It is acceptable for me to tell a program where I will rank them	165/206 (80%)	18/24 (75%)
It is acceptable for a program to tell me where they will rank me	85/206 (41%)	8/24 (33%)
It is acceptable for me to ask a program where I will be ranked	13/206 (6%)	5/24 (21%)
It is acceptable for a program to ask me where I plan on ranking them	10/205 (5%)	2/24 (8%)

*For this item, there were a total of 206 respondents in the "contacted" group and 24 respondents in the "not contacted" group. However, not all respondents completed each subitem. Percentages are calculated from only those respondents who completed each subitem.

for the most qualified applicants. Although the NRMP does provide a framework for this process, many decisions, ranging from how to select invitees, how to rank applicants, and how to communicate with top candidates after the interview day, are left up to the individual programs. Even if the nature of communication does not violate the rules of the match, program directors may risk offending applicants with contact that is either too direct, or by not providing communication that applicants expect because they are receiving it from other programs.

To avoid misleading communication, one pediatric residency program recently published their "no call policy" between interview day and the day rank lists are due, and reported that over a four-year period, 10.3% of respondents reported that a recruiting call would have caused them to rank those programs more favorably.[12] Although communication after interview day is not meant to imply commitment, these data suggest that it does influence rank order lists for a subset of applicants.

To our knowledge, this is the first cross-sectional investigation of EM applicants' perceptions about being contacted after the interview day but before the match. While over half of applicants reported that they expected to be contacted during this period, we were surprised to find that 89% actually were contacted. Although this represents a sample of the global pool of applicants, program directors can conclude that it is likely that a majority of their top candidates are being contacted by at least one other program after interview day. We have seen that the method and nature of this contact varies, but that in just over half of respondents, this communication did affect the placement of the program on their rank order list. This begs several follow-up questions: Are applicants flattered, and therefore ranking programs higher? Are they offended by the contact, and ranking them lower? Or do they perceive that they are not competitive because they were *not* contacted and thus rank the program lower in favor of other more persuasive programs?

While further studies are needed to answer these questions we did find that the contact that is presently being initiated by program directors is eliciting a variety of feelings in applicants, who report feeling everything from "happy" to "uncomfortable" due to this communication. Some programs directors may opt to have a "no contact" policy, but it is important to note that nearly half of the applicants who were not contacted felt "nervous" or "disappointed." Programs may choose to address the issue directly with applicants by presenting the program policy and philosophy regarding this practice during or before the interview day.

For those programs that continue to contact applicants after the interview day, decisions must also be made about who should do the contacting, and how it should be done. While most respondents felt comfortable with e-mail contact, over a third deemed phone contact inappropriate – notable since 55% of contacted respondents reported receiving telephone communication. Similarly, few respondents rated being contacted by an interviewer or the program director as inappropriate, while a majority responded that being contacted by a resident or faculty who did not interview them is inappropriate.

In light of the NRMP's prohibition of statements that imply a commitment, either on behalf of the program or applicant, we found applicants' responses regarding the rules of the match intriguing. Over three-quarters of applicants felt it was appropriate to tell programs where they would be ranked, and over one-third felt it was appropriate for programs to notify applicants of their place on the program's rank list. Although these practices may be common, they are not in compliance with the written rules of the match. Because they are not binding, these communications may also be misleading. If these results are applicable to a broader pool of EM applicants, and especially to applicants across specialties, they will be of interest to NRMP and medical school personnel charged with educating applicants about the rules of the match.

Our results suggest that a decision whether to contact top applicants after the interview day, and how to go about it, is indeed a decision that may cause reactions in applicants and even affect the order of their rank list. Further studies will be helpful in determining whether these results have external validity across a greater sample of applicants, and the most appropriate and ethical means by which to conduct communication with top residency candidates. This

information is needed from a practical standpoint to best use the time and resources of academic departments and from a professional standpoint to ensure that our specialty adheres to highest ethical standards during a selection process that can at times lead us to push the boundaries of our professionalism.

LIMITATIONS

Our candidate pool may differ from the general pool of EM applicants in several ways. For example, an interviewee at our program may not be representative of candidates who consider other areas of the country or prefer a four-year program. Although our general applicant pool does represent a geographically and gender diverse population, in order to reassure applicants of their anonymity we did not collect this demographic information on respondents and therefore can not determine the ways that respondents differed from non-respondents. In addition, we opted to survey all applicants rather than only our interviewees to broaden our sample, as we only are only able to interview approximately the top 15% of our applicants. We recognized a priori that this may negatively impact our response rate, because applicants who were not offered an interview may be less interested in participating in a voluntary, anonymous study administered by our program months after they were not invited to interview. However, given the lack of any data on this topic in our field, we concluded that a more representative sample was more important than a traditionally high sample size, and our resulting relatively low sample size is a limitation of the study.

CONCLUSION

Most EM residency applicants report being contacted by programs after the interview day but before rank lists are submitted. Applicant perceptions regarding this communication vary widely depending on the method of communication and who they are being contacted by. Although applicants think this practice is appropriate in general, over a third of subjects believe that contact by phone is inappropriate. Furthermore, half of our respondents reported that being contacted by a residency program changed that program's position on their rank list. These findings suggest that the decisions that residency programs make regarding their communication practices with applicants after the interview day are both important and may have a significant impact on the outcome of their match.

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Quality Improvement Practices in Academic Emergency Medicine: Perspectives from the Chairs

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Objective: To assess academic emergency medicine (EM) chairs' perceptions of quality improvement (QI) training programs.

Methods: A voluntary anonymous 20 item survey was distributed to a sample of academic chairs of EM through the Association of Academic Chairs of Emergency Medicine. Data was collected to assess the percentage of academic emergency physicians who had received QI training, the type of training they received, their perception of the impact of this training on behavior, practice and outcomes, and any perceived barriers to implementing QI programs in the emergency department.

Results: The response rate to the survey was 69% (N = 59). 59.3% of respondents report that their hospital has a formal QI program for physicians. Chairs received training in a variety of QI programs. The type of QI program used by respondents was perceived as having no impact on goals achieved by QI ($\chi^2 = 12.382$; $p = 0.260$), but there was a statistically significant ($\chi^2 = 14.383$; $p = 0.006$) relationship between whether or not goals were achieved and academic EM chairs' perceptions about return on investment for QI training. Only 22% of chairs responded that they have already made changes as a result of the QI training. 78.8% of EM chairs responded that quality programs could have a significant positive impact on their practice and the healthcare industry. Chairs perceived that QI programs had the most potential value in the areas of understanding and reducing medical errors and improving patient flow and throughput. Other areas of potential value of QI include improving specific clinical indicators and standardizing physician care.

Conclusion: Academic EM chairs perceived that QI programs were an effective way to drive needed improvements. The results suggest that there is a high level of interest in QI but a low level of adoption of training and implementation.[West J Emerg Med. 2010; 11(5):479-485.]

INTRODUCTION

Academic emergency medicine (EM) is a practice prone to medical errors due to the volume and complexity of activities that take place.[1] Factors such as crowding, resource constraints, cognitive workload, diagnostic uncertainty, high activity levels, interruptions and distractions, shift changes, poor feedback and time pressures can often lead to medical errors.[1] Emergency physicians (EP) have an especially critical role, since emergency departments (ED) are increasingly the gateway to acute care and hospitalizations. Between the years 1993 - 2003, there was a 26% increase in the number of annual visits to EDs, but a 12% decrease in the total number of departments.[2] An increase in patient demand coupled with a decrease in EDs suggests potential for further crowding, as well as corresponding reductions in physician-patient interaction times. With these increased time pressures and workloads, we propose that it is critical for EPs to focus on continual learning to improve processes of care in EDs and ensure high quality efficient care.

In addition to adapting their behavior to reflect current clinical best practices, other larger organizational issues often affect their ability to practice medicine. EPs often encounter

structural and process barriers that impact patient care. For example, structural issues in an ED that can affect quality of care include the design of the department, how it is equipped, availability of ancillary services, staffing mix, and departmental policies and procedures.[3] Process issues can also impact the quality of care delivered by EPs. For example, bottlenecks in the ED can create delays in sending and receiving information pertinent to patient care, which can result in either delayed care or misdiagnosis.[4] Physician training in quality improvement (QI) programs has the potential to prevent medical errors by training EPs to identify and correct process and systemic weaknesses. However, little is known about the impact of QI training programs on EP behavior and practice.

QI tools, such as Plan, Do, Check, Act (PDCA), total quality management (TQM), Six Sigma and LEAN, are management techniques that focus on improving processes. They are built on a foundation of constant learning by participants, adaptation to better practices and behaviors, and therefore reinforce change. As a result, most QI tools result in structural or process modifications within the organization. These tools are commonly used to identify, analyze, reduce, and monitor medical errors in healthcare organizations today.[5, 6] Several tools, such as Six Sigma and TQM, are data driven and focus on the measurement of defects and errors, while others, such as Lean and PDCA, focus on removing waste and unnecessary steps from processes.[7-10] Both TQM and Lean focus on cultural changes within the organization to improve quality.[6,11]

However, getting physicians to change their behavior is often difficult. Educational efforts such as continuing medical education (CME) are largely ineffective at changing physician behavior and performance.[12] Additionally, CME rarely trains physicians how to solve issues involving other departments where there is an impact in the quality of care provided to patients in the ED. Furthermore, physicians in academic leadership roles have often achieved their position on the basis of their clinical expertise or scientific accomplishments rather than specific management training. Physicians may lack familiarity with basic QI techniques, but are often charged with maintaining and improving the quality of care, which involves changing the behavior of other physicians. This is a difficult task if physician-managers do not have the management tools to change structures and processes that impact the effective delivery of high-quality medical care. In response, many hospitals and academic medical centers have implemented QI training programs and are familiarizing physicians with these tools in hopes to give physician leaders the skills necessary to change the system and improve quality of care. [13, 14]

Currently, there are no studies that examine the QI tools and techniques available to academic EPs. It is unclear how many EPs are being offered QI training, who is being offered the training (department chairs or practitioners) and which types of QI tools are being implemented. The purpose of this research is to assess academic emergency medicine (AEM) chairs perceptions of value, both realized and potential, of QI training programs.

METHODS

Study Design

The purpose of this project is to assess AEM chairs' perceptions of value, both realized and potential, of QI training programs. No studies published to date have assessed academic EP perceptions of the value of QI training programs. To achieve this purpose, we developed a 20 item survey instrument to assess the percentage of AEM physicians who had received QI training, the type of training they received, their perception of the impact of this training on behavior, practice and outcomes, as well as any perceived barriers to implementing QI programs in the ED. This is a mixed-methods cross-sectional survey design using close-ended items with numerical responses and open-ended items on the same survey. [15] This mixed method survey design was chosen for triangulation purposes, to add breadth and scope to the project. [16]

Study Setting and Population

The target population for this study is the chairs of academic EDs in the United States (U.S.). After obtaining Institutional Review Board approval, we gathered data from a sample of academic chairs of EM from the Association of Academic Chairs of Emergency Medicine (AACEM). This organization, comprised of the chairs of autonomous academic departments of EM in the U.S., currently has 85 members who are chairs of academic departments at Liaison Committee on Medical Education approved medical schools. We received a 69% (N = 59) response rate to the survey.

Study Protocol

Surveys were distributed to AACEM members at the annual meeting, as well as converted into an electronic form. To poll the chairs who did not attend the AACEM meeting, E-mails were sent to the AACEM list serve, asking members to participate in the survey chairs. Written informed consent of human subjects was waived by the authors' Institutional Review Board.

Measurement

Survey items were created to address the specific aims of the study. Table 1 contains a list of specific aims and the corresponding survey questions created to address them. Two questions addressing demographic information were also included to control for length of practice in EM and size of ED.

Data Analysis

We used descriptive, correlation and qualitative analyses to determine the association between perceived impact of QI training, perceived change in practice and behavior, and type

Table 1. Survey questions and corresponding aims of the study

Specific Aim	Survey Questions
1. Investigate if academic ER physicians have access to QI training programs through their respective employers, and the extent of their participation in QI programs.	1. Has **your hospital or department** adopted a formal quality improvement program for physicians? ☐ Yes ☐ No ☐ Considering in the next 6 months 3. How long ago was the quality program first implemented? ____ months ☐ NA 4. Have **YOU** recently participated in any training programs for quality improvement? ☐ Yes ☐ No 5. How many days of training did you participate in the last 12 months? 7. Approximately, how long has it been since you returned from training class? Weeks 8. Since you have returned from the training, how many specific projects or processes have been analyzed by you or your team?
2. Examine the type and perceived effectiveness of QI program training received by academic ER physicians.	2. If yes, which of the following best describes this quality program: ☐ Lean/Toyota Production System ☐ Six Sigma ☐ PDCA ☐ Total Quality Management ☐ Not sure ☐ Other, please list _____ 6. Who provided the training? ☐ Internal Trainers ☐ External Consultants ☐ Other 9. Have you achieved the goals you expected from your training? ☐ Yes ☐ No ☐ Not Sure 12. What specific impact would you say is most noticeable on your outcomes, if any? 13. Have you measured, in concrete and quantifiable terms, this change in outcomes? ☐ Yes ☐ No 14. What best describes your feelings about the return on investment from quality training? ☐ Positive ☐ Negative ☐ Neutral/Not Sure
3. Determine if and how QI training changes the behavior or practice of academic ER physicians.	10. Which of the following best describes how you feel about behavioral or process changes in your practice of medicine based on the quality training your received? ☐ I will make changes sometime in the foreseeable future. ☐ I intend to make specific changes in the next 6 months. ☐ I will make specific changes next month. ☐ I have already made specific changes to my practice. ☐ I have made changes and am working to maintain these changes. ☐ I have made changes which are now permanently engrained in my daily activities. 11. What process changes to your own medical practice or department have you initiated?
4. Examine the overall perceptions of the impact of QI training, including potential value to practice and barriers to implementation.	15. Do you feel that quality programs could have a SIGNIFICANT positive or negative impact on your medical practice or the healthcare industry? ☐ Positive ☐ Negative ☐ Not Sure 16. In your opinion, do quality programs have the greatest potential value in which of these areas (***please choose and rank the top 2***): **Rank** __Understanding and reducing medical errors __Improving specific clinical indicators __Cost savings or enhanced efficiency __Improving throughput or patient flow (e.g., reducing wait times) __Enhancing patient satisfaction __Standardizing physician care/treatment __Increased employee morale __Improving other administrative processes __Other _____ 17. Do you feel that that the medical industry has done enough to improve quality of care? ☐ Yes ☐ No ☐ Not sure
Demographic questions	18. What is the size of your emergency department, in terms of: Number of physicians_____ Number of patients seen last fiscal year_____ 19. How many years have you been practicing medicine? _____

ER, emergency room; *QI,* quality improvement

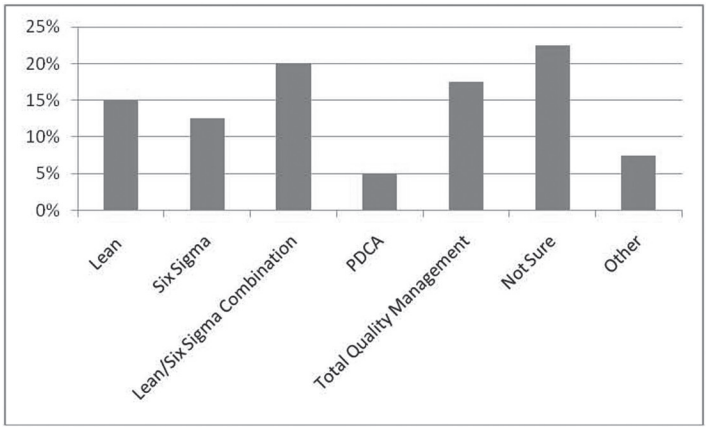

Figure 1. Type of quality improvement program used at the hospitals of academic emergency medicine chairs.
PDCA, plan, do, check, act

of training received. We used qualitative analyses to examine open-ended questions and analyzed themes of behavioral and practice changes analyzed to determine specific changes related to receiving QI training.

RESULTS

Overall, 59.3% of respondents report that their hospital has a formal QI program for physicians. A small percentage (3.4%) of respondents report that their hospital considers adopting a program in the next six months. The remaining respondents (37.3%) report that their hospital has no QI training program for physicians. Of the hospitals that have QI programs, the surveys indicate that they were implemented 20.6 months or a little less than two years ago. A majority (64.8%) of AEM Chairs who responded to our survey have not participated in a program for QI. Of the 19 respondents who participated in QI training, the average number of days spent in training was three, which did not include one outlier who reported over 30 days spent in training. On average, respondents reported it had been 18.4 weeks since returning from QI training, and that they had completed an average of 3.78 projects in that time period.

AEM chairs identified a variety of QI programs at their respective hospitals, but 22.5% chairs could not identify which type of QI program their hospital used. Figure 1 summarizes the types of QI programs identified by academic EPs.

Descriptive analyses show that the majority of respondents (63.2%) report that QI training was conducted by internal trainers. However, chi-square tests show that there is no statistically significant relationship between type of QI program implemented and internal or external trainers (χ^2=4.638; p=0.914). Additionally, the type of QI program used by respondents had no impact on goals achieved by QI (χ^2=12.382; p=0.260), whether or not changes in quality were measured (χ^2=3.656; p=0.600), or perceptions about the return on investment for QI training (χ^2=10.827; p=0.371). There was also no statistically significant relationships between who conducted the training and whether goals were achieved (χ^2=4.886; p=0.299), changes were measured (χ^2=2.825; p=0.244), or perceptions about return on investment for QI training (χ^2=4.554; p=0.336). However, there was a statistically significant (χ^2=14.383; p=0.006) relationship between if goals were achieved and AEM chairs perceptions about return on investment for QI training. If projects were

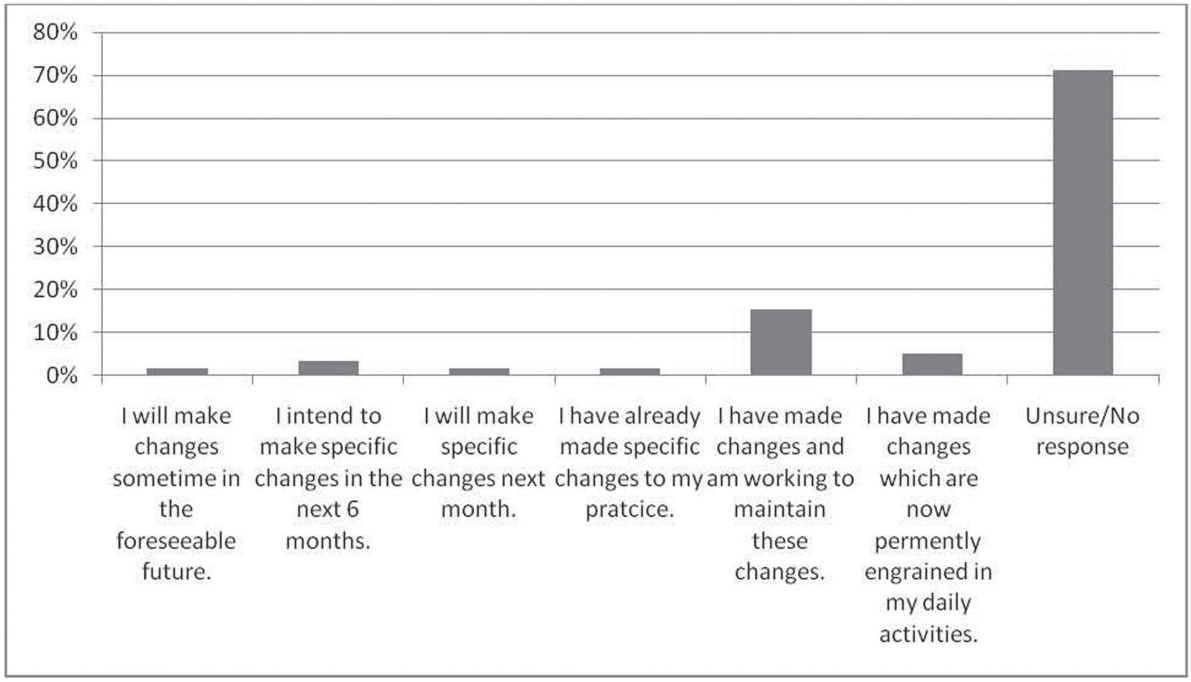

Figure 2. Academic emergency medicine chairs plans to make changes to their behavior and practice based on the quality improvement training received.

successful, then the AEM chairs were significantly more likely to have positive perceptions about the return on investment of QI training. These findings did not vary significantly by years of practice or size of ED. When asked about the specific impact of QI training that was most noticeable on outcomes, AEM chairs reported (in the order of frequency) increased: 1 efficiency, 2 patient care quality and 3 morale and teamwork. However, 16% of respondents reported no noticeable outcomes. Increased efficiency included shorter lengths of stay in the ED, fewer patients leaving before treatment, decreased supply spending, and general increased physician productivity. Improved quality of care included fewer errors related to patient hand-offs, shorter wait times for critical procedures, and better nursing care. Improved morale and teamwork, both within the ED and between the ED and other departments, were also reported.

Figure 2 summarizes respondents' plans to make changes to their behavior based on QI training.

When asked about specific changes initiated in their own practice or department, AEM chairs listed the following changes: decreased time from patient arrival to initial physician evaluation; decreased time from patient arrival to the completion of an electrocardiogram for patients with chest pain; improvement in compliance with Joint Commission core measures for pneumonia; increased compliance with airway management protocols; increasing the proper use of certain bedside tests (e.g. allowing a stool guaiac test to sit 2-3 minutes before reading); improving and standardizing end-of-shift patient hand-offs; improved compliance with Center for Medicare & Medicaid Services Physician Quality Reporting Initiative measures for stroke, myocardial infarction (MI) and pneumonia; implementation of rapid response systems for stroke and MI; creating special order sheets for pneumonia; improvements in teamwork in a "fast track" area; creation and implementation of streamlined admission and discharge processes; improvements in overall patient flow; improvements in team interactions; movement of patients to inpatient hallways to reduce ED crowding; development of rapid triage, bedside registration, and medication reconciliation processes; implementation of administrative "patient safety walk rounds"; development of a "Lean and Green" committee to improve efficiency and decrease environmental impact, creation of a process to improve the completeness of physician documentation, reduction of time from patient arrival to definitive care for patients with acute MI ("door to balloon time"); and increased follow-up for patients who elope from the department and "left without being seen" patients.

Correlation analyses show no statistically significant relationship between changes in behavior or practice and type of QI training received (χ^2=21.867; p=0.643). However, there was a statistically significant (χ^2=21.659; p=0.017) relationship between behavioral changes and type of trainers. AEM chairs who received training from internal trainers were significantly more likely to have made changes and work to maintain those changes. Analysis of variance showed there were no statistically significant differences between changes in behavior based on number of weeks since returning from class (*F*-ratio=0.39; p=0.846), years of practice experience (*F*-ratio=1.78; p=0.197) or size of ED (*F*-ratio= 0.29; p=0.907).

Table 2. Greatest potential value of quality improvement programs

	Rating average	Overall ranking
Understanding and reducing medical errors	1.69	1st
Improving patient flow/ throughput	1.68	2nd
Improving specific clinical indicators	1.47	3rd
Standardizing physician care/treatment	1.38	4th
Increased employee morale	1.33	5th
Enhancing patient satisfaction	1.25	6th
Cost savings or enhanced efficiency	1.10	7th
Improving other administrative processes	1.00	8th

When AEM chairs were asked if quality programs could have a significant positive or negative impact on their practice and the healthcare industry, 78.8% responded that the impact would be positive. Only 7.7% perceived that QI programs would have a negative impact, and the remaining 13.5% were not sure. AEM chairs also overwhelmingly (82%) responded that the medical industry has not done enough to improve quality of care, while only 6% disagreed, and 12% were unsure. Table 2 summarizes the rankings in the areas of greatest potential value of QI programs.

Correlation analyses showed no statistically significant differences in perceptions of QI program impact between physicians who had participated in training and those who had not (χ^2=2.920; p=0.232). However, data did show a strong statistically significant (χ^2=30.781; p=0.000) positive relationship between the belief that QI training programs could have a positive impact on the healthcare industry and the belief that the medical industry has done enough to improve quality of care. There was no statistical significance among overall perceptions of QI training, years of practice and size of ED.

DISCUSSION

In this study measuring the perceptions of use and value of QI training programs in AEM, we collected survey data from 69% of the 85 academic chairs in AACEM. This is the

first study of their perceptions of QI training and value. The chairs reported that QI programs are relatively new to their EDs. This finding is somewhat surprising given that some QI programs such as TQM and PDCA have been used in hospitals for over 20 years and that a majority of U.S. hospitals have adopted some form of quality management program.[17] Although most of their institutions offer training in one or more QI programs, a majority of chairs (64.8%) have not participated in any of these programs. This finding is consistent with recent research that found only about one-third of physicians have participated in system redesign efforts to improve the performance of the system in which they practice.[18] Of the chairs who participated in a QI program, most received a brief exposure provided by internal trainers. Nonetheless, many reported that they were able to successfully improve some aspect of their clinical practice using the principles they learned.

The type of QI training (Six Sigma, Lean, TQM, PDCA) received and whether training was administered by external or internal trainers did not seem to affect the chairs' perceptions of effectiveness. As might be expected, however, those who perceived that the goals of the training had been met were more likely to believe that their training program had been effective. Although this finding is not necessarily surprising, it is surprising that 41.2% of respondents who participated in training were not measuring changes in outcomes, given that Six Sigma, Lean, and TQM propose establishing goals and measuring performance in quantifiable terms.[19-20] This finding suggests that some QI programs are not being implemented correctly, and the lack of measurement of quantifiable outcomes and progress towards goals may affect perceptions of effectiveness of QI programs. Furthermore, the chairs reported that training received from internal trainers was more likely to impact their behavior and desire to continue maintain the changes that they had made. We speculate that the reason for this finding is because internal trainers are likely to serve as QI experts and role models and are more accessible than external trainers who leave after the training is complete.

We found that most chairs perceived that QI is important and has the potential for improving patient care in U.S. EDs. Further analysis of the perceptions of potential benefits by the chairs suggests that QI could help to understand and reduce medical errors and improve patient flow and cycle times, both critical measures of ED performance. When asked about specific changes made to their own practice in order to improve quality, chairs listed numerous implementations to improve quality. These changes are consistent with research that shows that QI programs are currently being used in EDs to improve throughput and reduce medical errors.[21-25] Outcomes targeted for improvement include ED workload or volume, patient wait time, ambulance diversion, patient walkout rate, length of stay, patient satisfaction, triage of patients, turn-around time of other services such as laboratory and radiology, available beds, registration, discharge processes and staffing patterns.[21, 23-25]

LIMITATIONS

There are several limitations to this study. First, the population of AEM chairs is relatively small. This limits our statistical analyses to chi-square and correlation analyses. Although we received a 69% response rate to the survey, results may have been biased. Chairs interested in QI efforts or who have received training may have been more likely to respond to the survey thereby creating a positive bias in favor of QI in the response. Additionally, the responses to the survey are opinions only and are not quantitative measurements of the programs or types of changes.

CONCLUSION

The number of EDs continues to decline while patient numbers keep increasing. The result is crowding, less patient interaction time for diagnosis and treatment, and the need for more efficient processes, practices and behaviors to improve core quality measures. Academic EDs will play a pivotal role in improving processes of care since they are generally larger facilities and treat more complex and diverse cases. This results in an increased need for EPs who can learn rapidly, and proactively improve processes of care. The implications of this research for physicians and administrators in EM are that QI efforts are perceived to have value. AEM chairs believe that QI programs were an effective way to drive needed improvements. Overall, the results suggest that there is a high level of interest in QI, but a general low level of adoption of training and implementation. Unfortunately, actual testing and demonstration of value has been minimal to date and there are very few EDs that have monitored and recorded quantifiable gains - thereby slowing the adoption of these methods. However, initiation and use of QI methods is especially important for chairs, who serve as leaders, mentors and role models to AEM physicians in the march towards healthcare quality.

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Evaluating Emergency Medicine Faculty at End-of-Shift

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Introduction: Faculty often evaluate learners in the emergency department (ED) at the end of each shift. In contrast, learners usually evaluate faculty only at the end of a rotation. In December 2007 Southern Illinois University School of Medicine changed its evaluation process, requiring ED trainees to complete end-of-shift evaluations of faculty.

Objective: Determine the feasibility and acceptance of end-of-shift evaluations for emergency medicine faculty.

Methods: We conducted this one-year observational study at two hospitals with 120,000 combined annual ED visits. Trainees (residents and students) anonymously completed seven-item shift evaluations and placed them in a locked box. Trainees and faculty completed a survey about the new process.

Results: During the study, trainees were assigned 699 shifts, and 633 end-of-shift evaluations were collected for a completion rate of 91%. The median number of ratings per faculty was 31, and the median number of comments was 11 for each faculty. The survey was completed by 16/22 (73%) faculty and 41/69 (59%) trainees. A majority of faculty (86%) and trainees (76%) felt comfortable being evaluated at end-of-shift. No trainees felt it was a time burden.

Conclusion: Evaluating faculty following an ED shift is feasible. End-of-shift faculty evaluations are accepted by trainees and faculty. [West J Emerg Med. 2010; 11(5):486-490.]

INTRODUCTION

Exceptional teaching improves learner outcomes.[1-3] Identifying good teachers and improving the skills of all teachers, therefore, have important implications for medical learners. Similarly, determining those whose skills need improvement is an obligation of program and course directors. Learners are a valid judge of teaching skills, but assessment of clinical teachers in the emergency department (ED) usually occurs at the end of a clinical rotation at a time distant from the actual teaching encounter.[4-6] Furthermore, end-of-rotation evaluations commonly focus on topics such as organization, clarity of objectives and fairness in grading, rather than on each faculty's teaching performance.[7] The result is that end-of-rotation evaluation systems may provide little specific information or feedback about the teaching performance of individual faculty. Ideally, the evaluation of clinical teachers by learners would focus on the teaching abilities of the individual teacher and would be part of a system in which enough evaluations are collected to provide reliable measures of teacher performance. Eight to 20 trainee evaluations are needed to achieve reproducible, dependable estimates of teaching performance.[4,8-12] Given that residents and students may encounter some clinicians infrequently, if rotation evaluations are the primary source for teaching evaluations, several years may be required to achieve a reliable estimate of an individual teacher's performance.[12]

The teaching and learning environment in an ED is unique and particularly challenging because patient volumes and levels of acuity are unpredictable, and trainees may be exposed to teaching faculty sporadically for different amounts of time. Although resident and student performance is often evaluated at the conclusion of each shift by supervising faculty, we are unaware of any published information that describes the evaluation of emergency medicine (EM) faculty

at the end of a shift.[13-15] We hypothesized that evaluating an instructor at the end of a teaching shift would be feasible in a busy ED. Our aim was to develop an end-of-shift faculty evaluation form that emphasized observations made in the routine conduct of clinical teaching, and was confidential and acceptable to teachers and learners.[16] In December 2007 Southern Illinois University School of Medicine (SIU SOM) changed its evaluation process, requiring residents and students rotating in the ED to complete end-of-shift evaluations of supervising faculty.

The objective of this study is to determine the feasibility and acceptance of evaluating EM faculty at the end of clinical shifts.

METHODS

Study Design

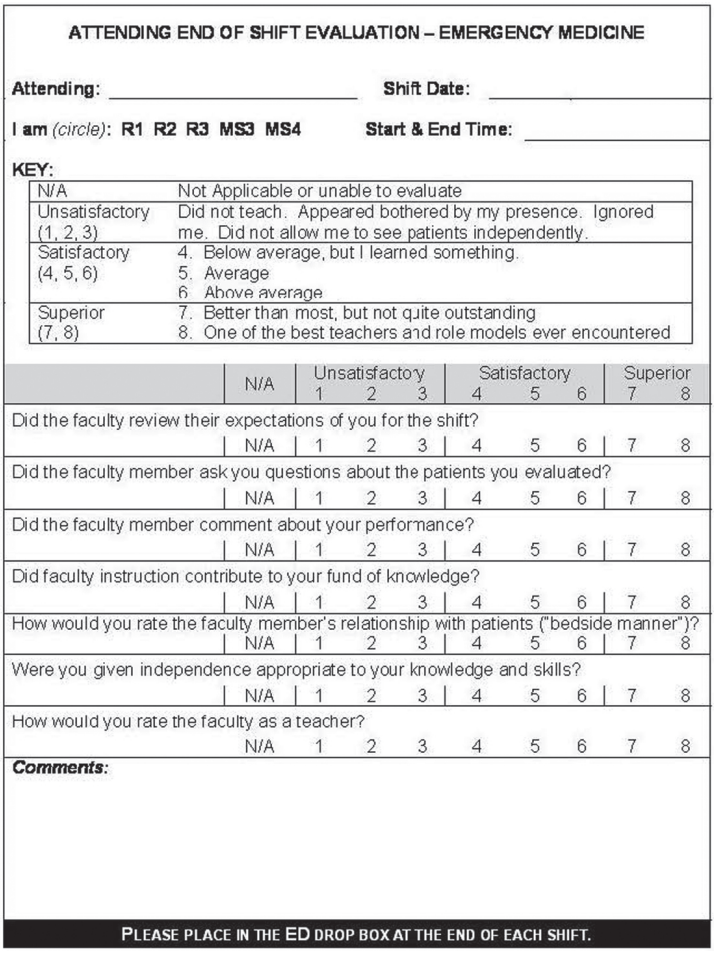
This is an observational feasibility study conducted at two medical school-affiliated teaching hospitals. The project received approval from the SIU SOM Committee for Research Involving Human Subjects and approval by the institutional review board for both hospitals and the SOM.

Study Setting and Population

SIU SOM is a community-based medical school with 72 students per class affiliated with two large tertiary care teaching hospitals. There are 25 Accreditation Council for Graduate Medical Education approved residency and fellowship programs at SIU SOM, and the Residency Review Committee approved an EM residency program in September 2009. We conducted this study at the EDs of both affiliated hospitals with a combined annual ED visit volume greater than 120,000. Two separate physician groups staff each ED, and the departments do not share faculty. Subjects were residents rotating on the EM service from the departments of Internal Medicine, Family Medicine, Orthopedics and Obstetrics and Gynecology; junior and senior students on an EM elective; and faculty supervisors in both hospital EDs.

Study Protocol

During orientation to the EM rotation, students and residents are informed they will evaluate the teaching skills of faculty at the end of each shift, and are given a pocket-sized packet of evaluation forms. They are taught how to complete the forms, and are told that the evaluations are anonymous and should be placed in a locked box in the ED at the conclusion of each shift. The authors developed the evaluation form by consensus; it has seven items rated on an eight-point Likert scale and includes space for comments (Figure 1). Four items on the form address easily observable behaviors, (for example, "Did the faculty ask you questions about your patients?"), one item asks an opinion of self learning ("Did faculty instruction contribute to your fund of knowledge?"), and one requests a global assessment ("How would you rate the faculty as a teacher?"). The specific items on the form were selected



ATTENDING END OF SHIFT EVALUATION – EMERGENCY MEDICINE

Attending: _____ **Shift Date:** _____

I am *(circle)*: **R1 R2 R3 MS3 MS4** **Start & End Time:** _____

KEY:

N/A	Not Applicable or unable to evaluate
Unsatisfactory (1, 2, 3)	Did not teach. Appeared bothered by my presence. Ignored me. Did not allow me to see patients independently.
Satisfactory (4, 5, 6)	4. Below average, but I learned something. 5. Average 6. Above average
Superior (7, 8)	7. Better than most, but not quite outstanding 8. One of the best teachers and role models ever encountered

	N/A	Unsatisfactory 1	2	3	Satisfactory 4	5	6	Superior 7	8
Did the faculty review their expectations of you for the shift?	N/A	1	2	3	4	5	6	7	8
Did the faculty member ask you questions about the patients you evaluated?	N/A	1	2	3	4	5	6	7	8
Did the faculty member comment about your performance?	N/A	1	2	3	4	5	6	7	8
Did faculty instruction contribute to your fund of knowledge?	N/A	1	2	3	4	5	6	7	8
How would you rate the faculty member's relationship with patients ("bedside manner")?	N/A	1	2	3	4	5	6	7	8
Were you given independence appropriate to your knowledge and skills?	N/A	1	2	3	4	5	6	7	8
How would you rate the faculty as a teacher?	N/A	1	2	3	4	5	6	7	8

Comments:

PLEASE PLACE IN THE ED DROP BOX AT THE END OF EACH SHIFT.

Figure 1. Attending end-of-shift evaluation form

because they are desired behaviors in our faculty teachers and viewed as relevant for both student and resident learners. We included teaching behaviors that could easily be observed in one shift and were amenable to feedback and faculty improvement. The form was not pilot tested. An administrative assistant collected the forms weekly and entered both the numerical ratings and comments in an Excel spreadsheet (Microsoft, Inc., Redmond, WA). Twice yearly, faculty receive the mean rating of their evaluations, the mean rating of their peers, and specific comments from their evaluations.

To accomplish the study objective we analyzed end-of-shift evaluations completed by residents and students during the 12-month study period. In addition, residents, students and faculty voluntarily and anonymously completed web-based opinion surveys about the new process (SurveyMonkey.com, Portland, OR). The survey was developed by consensus among the authors. The faculty survey contained four items, and the trainee survey contained five items. All survey inquiries asked for responses on a five-point Likert scale, except one. A "yes/no" response was sought for an item that asked trainees and faculty if they had prior experience evaluating or being evaluated immediately after a clinical

Table 1. Characteristics of residents and students

Residents	(n = 47)
Internal Medicine	
PGY1	22
PGY2	5
PGY3	2
Family Medicine	
PGY2	4
PGY3	8
Obstetrics/Gynecology	
PGY1	3
Orthopedics	
PGY1	3
Students	(n = 22)
MS3	11
MS4	11
Gender	(n = 69)
male	37
female	32

PGY, postgraduate years; *MS,* Medical Students

Table 2. Faculty ratings and comments on end-of-shift evaluations

Number of trainees	69
Median number of ratings/faculty (IQR)	31 (16 – 40)
Median number of comments/faculty (IQR)	11 (5 – 17)

IQR, Interquartile range

Table 3. Survey results

Faculty Survey	N* (%)
I felt comfortable being evaluated at end-of-shift	12 (86)
I feel one shift is adequate for an accurate assessment	4 (27)
I have been evaluated immediately after clinical teaching in the past	5 (33)
Overall, it bothered me to be evaluated at end-of-shift	1 (7)

Trainee Survey	N* (%)
I felt comfortable evaluating faculty at end-of-shift	31 (76)
I feel one shift is adequate for me to make an accurate assessment	13 (32)†
I felt pressured by an attending to write a good evaluation	0 (0)
The evaluations added too much time to my shift	0 (0)
I have completed similar evaluations just after a clinical experience in the past	0 (0)

Faculty survey response rate: 16/22, 73%
Trainee survey response rate: 41/69, 59%
*N = Number responding always or most of the time; Not every respondent answered every item.
†34 (83%) students felt one shift was adequate 'half the time' or 'most of the time.

experience. We included the link to the surveys in an E-mail request sent to all trainees and faculty. We decided a priori to conclude the process was feasible and acceptable if trainees completed the evaluations greater than 75% of the time and if greater than 75% of faculty and trainees indicated on the surveys they were comfortable with the process.

We performed qualitative content analysis of comments written on end-of-shift evaluations using an iterative process. One author (RK) and a research assistant reviewed and categorized the comments into strengths and weaknesses and whether they referenced modifiable behaviors (e.g. "gave good feedback") or non-specific personality or department characteristics (e.g. "smart guy" or "slow day"). They then subcategorized them into themes, and any disagreement was resolved by consensus.

RESULTS

Of the 22 faculty attendings evaluated during the study period, 18 (82%) were men and four (18%) were women. The majority of faculty (17/22, 77%) had been in practice for greater than ten years. Sixty-nine trainees (47 residents and 22 students) completed the end-of-shift evaluations. Demographic characteristics of the trainees are included in Table 1.

During the 12-month period, trainees were assigned 699 shifts, and 633 end-of-shift evaluations were collected, resulting in a completion rate of 91%. There was a median of 31 ratings per faculty (interquartile range [IQR]; 16 – 40). The majority of faculty (73%) had more than 20 evaluations. Trainees wrote a median number of 11 (IQR 5 – 17) comments per faculty (Table 2).

The response rates for the faculty and student surveys were 73% (16/22) and 59% (41/69) respectively (Table 3). The majority of faculty (86%) and trainees (76%) were comfortable with end-of-shift evaluations. When asked if one shift was enough exposure to make an accurate assessment, a minority of faculty (27%) and trainees (33%) responded "always" or "almost always," although 51% of trainees indicated that one shift was adequate "about half the time." None of the trainees had prior experience assessing faculty immediately following a clinical experience, and none found the end-of shift evaluations a time burden.

Trainees wrote 276 comments on the end-of-shift evaluations. There were 252 comments categorized as

Table 4. Content analysis of trainee comments on end-of-shift evaluations

	N	%
Strength Subcategories		
Non-specific (e.g."Great Teacher")	91	36
General personality traits (e.g. "good," "awesome," "enjoyable to work with")	49	19
Probed knowledge, explained reasoning and decisions	34	13
Permitted appropriate autonomy and independence	29	12
Professional role model	23	9
Established comfortable work environment	13	5
Cognitive attributes (e.g. "Very intelligent")	7	3
Patient attributes (e.g. "Great cases and pathology")	6	2
Weakness Subcategories		
Too busy to teach	7	29
Not enough autonomy	7	29
General personality traits (e.g. "not flexible," "irritated")	3	13
Not enough feedback	2	8
Department characteristics (e.g. "not enough patients, slow day")	5	21

Number of comments classified as strengths: 252 (91%)
Number of comments classified as weaknesses: 24 (9%)

strengths and 24 as weaknesses (Table 4). A majority (168/276, 61%) cited general, non-specific characterstics of faculty or departments, such as "pleasant to be around," or "great patients." Less than 40% (108/276) focused on specifc teaching behaviors, for example, "let me know how he was thinking," or "didn't let me do anything." Themes addressing favorable personality traits, good teaching in general, probing of knowledge and decision making, and permitting trainee autonomy were most often spontaneously reported.

DISCUSSION

We were pleased to see that in a one-year period almost three-quarters of our faculty had received more than 20 evaluations, a number that many investigators report as sufficient to make a reliable estimate of performance. Since learner evaluations of clinical teaching have a major impact on faculty self-improvement and career advancement,[4,16] it is important that they accurately reflect a teacher's effectiveness. One might question the usefulness of the end-of-shift evaluations since only 51% of learners felt they could accurately assess faculty after one shift "about half the time." Although we did not specifically measure reliability, we are encouraged with the numbers of evaluations obtained for each teacher, and our opinion is that as the numbers of daily evaluation cumulatively increase over time, the likelihood of providing reliable feedback to faculty improves. We plan to study the reliability of the process in the future. Many comments were provided on the end-of-shift evaluations, and almost 40% of these comments contained specific feedback targeting modifiable behaviors of value to teachers. More than half of the comments, however, expressed non-specific sentiments such as "great teacher" or "a pleasure to work with," which are less helpful for guiding teacher improvement. Since some trainees believe they are not taught to evaluate teaching performance, we view this as an excellent opportunity to educate students and residents in this regard.[17] We plan to enhance the orientation of learners by addressing not only how to complete the form but by including training on how to evaluate teaching, give effective feedback, and by emphasizing the importance of writing comments directed toward specific instructional behaviors.

We are unaware of any published information that addresses whether faculty evaluations completed immediately after a clinical experience are congruent with those done at the end of a rotation. One might speculate that end-of-shift evaluations, completed when the teaching encounter is fresh in memory, would provide more factual information about a teacher's effectiveness, and ratings on end-of-rotation evaluations might be less valuable if they represent a particularly memorable teaching experience, whether good or bad. Another view, however, is that an end-of-rotation evaluation may be superior to end-of-shift evaluations if it reflects a trainee's synthesis of experiences in the ED over time and takes into account comparisons with other teachers. While these points were not the focus of our project, we feel they are worthy of future investigation.

We wanted the faculty shift evaluations to be operationally feasible. We were concerned that faculty might object to being scrutinized daily or trainees might feel coerced to write a favorable evaluation after working closely with one clinician for an entire shift. We felt it was possible that trainees would not comply with the process of evaluating faculty at end-of-shift, if they found the process time consuming or objectionable for other reasons. The high completion rate and survey data demonstrated, however, that trainee assessment of teachers at the end of a shift is feasible and readily accepted by both teachers and learners in the ED. We believe that by instituting a process whereby faculty and trainees are both evaluated in the same fashion (end-of-shift) we emphasize that teaching and learning are equally important, and hope the process has had a positive impact on the educational culture in our EDs.

Ultimately, one of the most important goals of assessing clinical teaching performance is to improve the skills of weaker teachers. It has been shown that when clinical teachers are provided periodic ratings of their teaching performance together with mean ratings of their colleagues, teaching skills improve.[18] Our evaluation process has not been in place long enough to confirm these findings, but we plan to study whether sharing the data from end-of-shift evaluations along with peer

comparisons will help us provide meaningful feedback to faculty and result in improved teacher performance.

LIMITATIONS

There are limitations to this study. First, it was conducted at two large hospital EDs at one medical school, and our findings may not generalize to other institutions. Second, the study period was one year, and we did not assess the long-term acceptance of the evaluation process. Third, the participating residents were not EM residents, and there may be differences in how EM residents rate EM faculty compared to medical students and residents from other departments. Fourth, similar to most institutions, trainees were not formally taught how to evaluate faculty.[17] This lack of training may have positively or negatively influenced actual faculty ratings, completion rates of the daily evaluations, and responses on the acceptance survey.

CONCLUSION

We found that faculty end-of-shift evaluations are feasible in a busy ED and are accepted by trainees and faculty. We believe end-of-shift evaluations of faculty are potentially a valuable tool for assessing faculty teaching effectiveness and warrant further study.

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Adaptation of EPEC-EM™ Curriculum in a Residency with Asynchronous Learning

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Objective: The Education in Palliative and End-of-life Care for Emergency Medicine Project (EPEC™-EM) is a comprehensive curriculum in palliative and end-of-life care for emergency providers. We assessed the adaptation of this course to an EM residency program using synchronous and asynchronous learning.

Methods: Curriculum adaptation followed Kern's standardized six-step curriculum design process. Post-graduate year (PGY) 1-4 residents were taught all EPEC™-EM cognitive domains, divided as seven synchronous and seven asynchronous modules. All synchronous modules featured large group didactic lectures and review of EPEC™-EM course materials. Asynchronous modules use only EPEC™-EM electronic course media for resident self-study. Targeted evaluation for EPEC™-EM knowledge objectives was conducted by a prospective case-control crossover study, with synchronous learning serving as the quasi-control, using validated exam tools. We compared de-identified test scores for effectiveness of learning method, using aggregate group performance means for each learning strategy.

Results: Of 45 eligible residents 55% participated in a pre-test for local needs analysis, and 78% completed a post-test to measure teaching method effect. Post-test scores improved across all EPEC™-EM domains, with a mean improvement for synchronous modules of +28% (SD=9) and a mean improvement for asynchronous modules of +30% (SD=18). The aggregate mean difference between learning methods was 1.9% (95% CI -15.3, +19.0). Mean test scores of the residents who completed the post-test were: synchronous modules 77% (SD=12); asynchronous modules 83% (SD=13); all modules 80% (SD=12).

Conclusion: EPEC™-EM adapted materials can improve resident knowledge of palliative medicine domains, as assessed through validated testing of course objectives. Synchronous and asynchronous learning methods appear to result in similar knowledge transfer, feasibly allowing some course content to be effectively delivered outside of large group lectures. [West J Emerg Med. 2010; 11(5):491-498.]

INTRODUCTION

Over 2.4 million Americans die each year,[1] with approximately 379,000 deaths occurring in emergency departments (ED).[2] Unfortunately, the quality of care experienced by patients who are nearing death is inconsistent and sometimes poor, as physicians across multiple specialties report feeling inadequately trained to manage the special needs of patients at the end-of-life.[3-14] Terminally ill patients need health providers with excellent communication skills and knowledge of palliative medicine.[14-17]

The Education in Palliative and End-of-life Care for Emergency Medicine Project (EPEC™-EM) is a federally-funded, multi-center curriculum design and clinical research study that has developed a comprehensive training course in palliative and end-of-life care for emergency providers.[18] Although EPEC™-EM teaching materials are designed for easy dissemination to physician and nurse learners, emergency medicine (EM) educators may still encounter challenges to using this curriculum when teaching emergency palliative care to novices. To provide the EPEC™-EM course in its entirety, significant instruction time must be added to an already full resident or staff development curriculum. Also, the nature of palliative care education requires the simulated practice of new skills, which can be difficult for faculty to facilitate in large group settings.[19]

One suggested method of incorporating new course material into an existing educational program is through curriculum adaptations that use both synchronous and asynchronous learning.[20-21] Synchronous learning refers to the teaching of a group of students who all attend the same instructional session at the same time. Asynchronous learning is defined as individualized, self-directed learning that occurs away from groups of similar level learners.[20] Although asynchronous learning may afford greater flexibility when redesigning a curriculum, it is still unclear if such educational experiences are as effective as traditional synchronous instruction. Specifically, we are not aware of any studies comparing the effectiveness of synchronous and asynchronous learning in an EM residency didactic program in the United States.

The objectives of this study are (1) to describe a local adaptation of the EPEC™-EM curriculum in an EM residency program and (2) to compare asynchronous and synchronous learning in our curriculum adaptation.

METHODS

Study Design

This curriculum development project used a six-step design approach defined by Kern et al[22], as outlined in Figure 1 and further described in the study protocol. We conducted targeted program evaluation for impact objectives reflecting knowledge acquisition through a prospective case-control crossover study, with synchronous learning serving as the quasi-control.

Study Setting

This EPEC™-EM curriculum adaptation was designed and implemented for EM residents at Northwestern University, Feinberg School of Medicine. Northwestern Memorial Hospital is the primary clinical training site for the residency program, with an urban ED population of approximately 81,000 patient visits per year. An inpatient palliative medicine service is on site with 16 available beds. Terminally ill patients who routinely present to the ED for emergency and end-of-life care generally receive treatment from one of four highly active specialty services at the hospital: geriatrics, hematology-oncology, transplant surgery and heart failure. Hospice patients are occasionally transported to the ED as well.

Study Population

Subjects included a convenience sample of all EM residents in academic year 2007-08 at the Northwestern Emergency Medicine Residency, a PGY 1-4 training program. We excluded subjects if they were unavailable or unwilling to participate in an unannounced pre-test or if they were unable or unwilling to participate in the post-test. Residents were informed that de-identified pre-test and post-test performance data may be used for educational research purposes.

The EPEC™-EM Curriculum[18]

The EPEC™-EM course was developed by a national, multi-disciplinary advisory board of experts in EM, hospice and palliative medicine, geriatrics and oncology. The curriculum is comprised of 14 learning modules that reflect core cognitive domains of emergency palliative care. Replication of the entire course requires a total of 16 hours of instruction time. Course material is disseminated nationally through the "Become an EPEC™-EM Trainer" Conference, using a train-the-trainer approach in which conference attendees are taught both the course material, as well as methods to teach that material at their home institutions. The EPEC™-EM Project provides each trainer with an electronic copy of the detailed course syllabus, instructors' manual and modifiable slides sets for all lectures. Trainers are encouraged to adapt course materials to the educational needs of learners at their individual institutions. Conference attendees participate in a written examination at the beginning and end of the conference used to assess knowledge acquisition. This examination is comprised of at least three multiple choice questions per module, selected from a bank of items written and validated by the faculty of the EPEC™-EM Project.

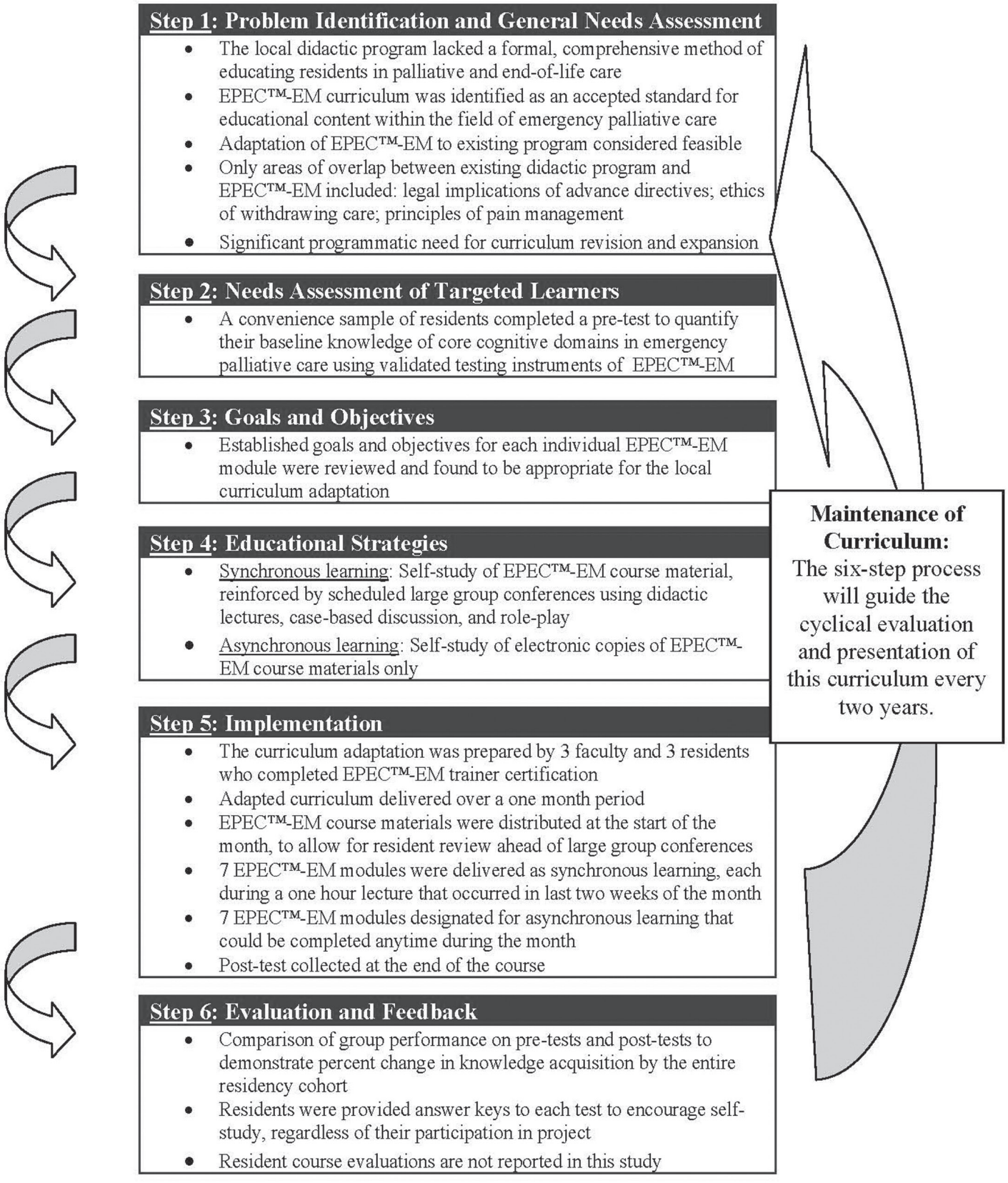

Figure 1. Summary of EPEC™-EM adaptation using Kern's *Curriculum Development for Medical Education: A Six Step Approach.*[22]

Table 1. Pre-test and post-test results by teaching method and module number

Teaching Method: Asynchronous Modules

Module Number	Subject	Pre-Test % Correct	Post-Test % Correct	Difference (% Post-test - % Pre-test)
1	Prognostication and Trajectories	57	85	+ 28
2	Rapid Palliative Care Assessment	40	77	+ 37
3	Goals of Care	80	85	+ 5
4	Advance Directives	78	91	+ 13
5	Caring for Hospice Patients	13	57	+ 44
6	Grief and Bereavement	71	98	+ 27
11	Chronic Pain	34	91	+ 57

Teaching Method: Synchronous Modules

Module Number	Subject	Pre-Test % Correct	Post-Test % Correct	Difference (% Post-test - % Pre-test)
7	Withdrawing and Withholding Care	67	97	+ 30
8	Family Witnessed Resuscitation	74	85	+ 11
9	Death Disclosure	67	93	+ 26
10	Common Symptoms	33	74	+ 41
12	Malignant Pain	40	74	+ 34
13	Complications of Cancer	26	58	+ 32
14	Last Hours of Living	38	62	+ 24

Study Protocol

We obtained local institutional review committee approval to train EM physicians in EPEC™-EM at our institution. Our study team used Kern's six-step curriculum design approach to adapt the EPEC™-EM course into our local residency didactic program.[22] [Step 1] Problem identification and a general needs assessment were completed through a review of the existing residency curriculum for palliative and end-of-life care topics, which was compared to the learning objectives of each module in the EPEC™-EM course.[18] [Step 2] Local needs assessment of targeted learners was performed with a written, multiple choice examination (pre-test) given to a convenience sample of all residents who attended conference on a single day in November 2007. The pre-test was the same 42-item examination administered to all attendees of the national EPEC™-EM conference held in Chicago, IL in August 2007. Subjects were not told of the timing or content of the pre-test before it was distributed. [Step 3] The same goals and objectives of each individual module of the national EPEC™-EM course were chosen for the new residency curriculum.[18] [Step 4] The educational strategies selected included: synchronous presentation for half of the EPEC™-EM modules using large group teaching (featuring didactic lectures, case based discussions and role playing) and asynchronous learning for half of the modules through resident review of EPEC™-EM course materials. [Step 5] The curriculum was implemented over a four-week period in March 2008. Electronic copies of the EPEC™-EM course syllabus, lecture slides and a self-study examination (post-test) were distributed at the beginning of the month. The post-test was collected in April 2008, at which time an answer key was provided to all residents, regardless of their participation in the pre-test or the post-test. The post-test was the same 42-item multiple choice examination administered at the national EPEC™-EM conference held in New Orleans, LA in February 2008. Though the pre-test and the post-test use different questions, the items tested similar learning objectives and course content. The seven modules presented for synchronous learning were chosen based on faculty preference for ease of presentation in a large group setting. Six of the seven synchronous modules were taught by physicians who had completed EPEC™-EM trainer certification at a national conference. The seven synchronous modules were each presented during an hour of conference in the last two weeks of the month to allow resident review of the EPEC™-EM course materials prior to the didactic sessions. Asynchronous modules consisted of resident self-study of unaltered electronic copies of the EPEC™-EM course media (course syllabus, instructors' guide and lecture slide sets).[18] Asynchronous modules were offered throughout the four-week curriculum and could be reviewed by the

Table 2. Group performance by teaching method

Teaching Method:	***Asynchronous Modules***		
	Pre-Test % Correct	**Post-Test % Correct**	**Difference (% Post-test - % Pre-test)**
Mean (SD)	53 (25)	83 (13)	30 (18)
Median (IQR)	57 (34, 78)	85 (77, 91)	28 (13, 44)
Teaching Method:	***Synchronous Modules***		
	Pre-Test % Correct	**Post-Test % Correct**	**Difference (% Post-test - % Pre-test)**
Mean (SD)	49 (19)	77 (15)	28 (9)
Median (IQR)	40 (33, 67)	74 (62, 93)	30 (24, 34)

resident at any time. Each module required approximately one hour of self-study. Residents who were unable to attend a synchronous module lecture due to schedule conflicts were expected to review the corresponding EPEC™-EM course media in an asynchronous fashion. [Step 6] The curriculum adaptation was evaluated through a comparison of group performance on the pre-test and the post-test. The residency coordinator de-identified individual tests prior to data analysis.

Measurements

All EPEC™-EM course materials and examinations were used with permission of the EPEC™-EM Project. We compared resident group performance for each test item on both the pre-test and post-test with group performance by attendees at the respective national EPEC™-EM conferences for which the exams were originally administered. We removed items that performed differently between the two groups from the data analysis to reduce the effect of variability among individual lecturers who may have taught course material in a way that could skew responses for any single item. A significant difference in item performance was defined as a majority of respondents correctly or incorrectly answering an item that was observed to perform in the opposite way in the comparison group. Psychometric experts employed by the EPEC™-EM Project reviewed all item performance in a meeting with the study investigators to insure accuracy of testing.

Data Analysis

Examination items were grouped by module topic. We used descriptive statistics to report group scores for the entire residency program on the pre-test and post-test for each module topic. A difference in pre-test and post-test scores was calculated for each module. We categorized modules by learning method as asynchronous or synchronous. Our primary outcome was the aggregate mean difference in pre-test and post-test scores between learning methods. We compared this difference with 95% confidence intervals with significance defined as an interval that crosses 1.0.

RESULTS

Figure 1 summarizes the major findings of each of the six curriculum development steps used in this protocol.

Of 45 eligible residents in our program, 25 (55%) were present at conference on the day of the unannounced pre-test that was used for local needs analysis; all of these residents participated in the pre-test. Thirty-five residents (78%) completed the post-test. Item analysis revealed only one post-test question that performed differently between the resident cohort and the EPEC™-EM conference cohort; we removed this post-test item from module #7 from further data analysis.

Tables 1 and 2 summarize the percent difference in pre-test and post-test scores observed for the entire resident cohort across all 14 learning modules, grouped by asynchronous or synchronous learning methods. Mean test scores of the residents who completed the post-test were: asynchronous modules 83% (SD=13); synchronous modules 77% (SD=12); all modules 80% (SD=12). Those modules that used asynchronous learning demonstrated a range of test score improvement between 5% and 57%, with a mean improvement of 30% (SD=18%). Modules presented using synchronous learning had test score improvement in a range of 11% and 41%, with a mean of 28% (SD=9%). The aggregate mean difference in pre-test and post-test scores grouped by learning method was 1.9% (95% CI, -15.3 and +19.0), demonstrating a lack of inferiority for asynchronous learning in our curriculum adaptation.

DISCUSSION

Our study illustrates a successful model for the local adaptation of a national curriculum in palliative and end-of-life care to an existing EM residency didactic program using both asynchronous and synchronous learning. We believe that our study is the first of its kind to suggest parity of knowledge transfer between asynchronous and synchronous

learning in a United States EM residency training program.

Several developments led to the need for our residency curriculum redesign. In 2006, the American Board of Emergency Medicine (ABEM) co-sponsored the creation of the American Board of Hospice and Palliative Medicine.[23] Subspecialty certification in Hospice and Palliative Medicine is now an option for all ABEM-certified physicians, and with this opportunity came an institutional desire to expose residents to new educational content. [23] In addition, training in palliative and end-of-life care has become a standard recommendation in numerous guidelines for competency-based education that address the goals of the Accreditation Council of Graduate Medical Education (ACGME) Outcome Project.[7,10,13,15,24-35] General needs analysis of our residency didactic program revealed a paucity of exposure to core cognitive domains of emergency palliative care prior to this curriculum adaptation.

The challenge of incorporating a large amount of new course material within an existing residency didactic program is not a trivial concern to educators tasked with curriculum redesign. As a recent comparison, similar challenges were encountered with the emergence of ultrasound as a necessary educational requirement for EM training programs.[36-38] Novel curricula often require the recruitment of additional faculty or the expert training of existing faculty at significant monetary and time costs. Competing educational objectives complicate the inclusion of new didactic material, especially if the required curriculum change is voluminous and inherently skills-based.

Asynchronous learning offers many potential benefits for residency directors when they redesign their didactic programs. Both a Council of Emergency Medicine Residency Directors subcommittee and the Residency Review Committee in Emergency Medicine (RRC-EM) have recommendations for the use of asynchronous learning.[20,39] Advantages of asynchronous instruction include: customization of a curriculum to an individual learner's schedule and needs; reduction in the burden of additional scheduled conference time for both resident learners and course faculty; an alternative learning style that may be preferred by younger generations of students; delivery of material to large numbers of learners in a systematic and consistent manner; practice of the life-long learning principles required of physicians; the use of faculty at other institutions when local expertise does not exist; and instant access to electronic media that can be easily revised and updated.[20,40] Disadvantages of asynchronous learning include lack of social interaction among students and limited methods of real-time feedback.[20] While there may be many compelling reasons to employ asynchronous learning, reports of the effective use of this methodology in EM education are limited.[21,40-42]

Asynchronous learning proved to be a useful method of delivering some novel palliative care education needed in our residency program. Our data suggests that asynchronous learning was similar to synchronous learning for selected course material in our population. Specifically, there was no meaningful difference in post-test scores between asynchronous and synchronous modules, with an aggregate mean difference between teaching methodologies across the entire cohort of only 1.9% (95% CI -15.3, +19.0).

Based on our general needs assessment, our population of learners was thought to be uniform in their lack of didactic and clinical exposure to core cognitive domains of emergency palliative care. Therefore, we studied the effect of our curriculum design on the overall cohort rather than each individual learner. This is an especially practical model for residency directors who need to introduce new material to an entire residency program for the first time.

Though education literature is replete with descriptions of various curricula used to teach palliative care to residents[7,24-25,28,32], none describe a method for incorporating an existing course to an EM residency program. The use of locally adapted EPEC™-EM conference materials appears to be an effective method of delivering asynchronous self-study modules for our curriculum adaptation. In our population, post-test scores improved across all EPEC™-EM domains with a mean of +29%.

As palliative and end-of-life care represents a relatively new area of focus within EM, many program directors may have difficulty identifying faculty members with the expertise to create appropriate instructional media. The EPEC™-EM curriculum provided a comprehensive and useful collection of teaching materials at a low cost of faculty training time and conference participation. In specific, we implemented the entire four-week curriculum adaptation with the assistance of three faculty members and three senior residents who were funded to attend a two-day EPEC™-EM trainer course. External faculty training via EPEC™-EM costs $745 for conference registration at 2009 rates, plus travel and requisite protected time per individual.[43] Maintenance of curriculum may be significantly less expensive if intradepartmental faculty training can occur prior to future cycles of local dissemination.

It is important to note that the method of asynchronous learning used in our study differs from that described in the ACGME program requirements for EM. As defined in the RRC-EM guidelines, "emergency medicine programs may utilize individualized interactive instruction for up to 20% of the planned educational experiences."[39] We delivered 50% of our curriculum as asynchronous learning in order to have equal numbers of asynchronous and synchronous modules for ease of data analysis in this study. Programs that adopt our approach to teaching the EPEC-EM™ curriculum should plan for no more than 20% cumulative asynchronous instruction, in compliance with current

RRC-EM requirements. Also, we did not individualize our instructional material according to resident year, as our general needs assessment indicated that our population of learners was uniform in their lack of exposure to emergency palliative medicine content. Future cycles of our curriculum can be edited for learner experience based on observed changes in our local needs assessment. It is expected that after a single cycle of instruction, the educational content would no longer be novel to all learners; the curriculum could then be tailored to intermediate and novice learners, or senior and junior residents. Lastly, the EPEC™-EM course media used in our study was not interactive, however we distributed post-test answer keys after the curriculum in an effort to provide feedback and encourage continuous self-study. The EPEC™ Project offers online versions of the original EPEC™ and EPEC™-Oncology courses that are interactive and may serve as a model for asynchronous learning that better comply with the RRC-EM guidelines.[43]

LIMITATIONS

The most significant limitation of our study is the potential for selection bias that results from both a small sample size of eligible subjects at a single residency program, as well as our protocol for pre-/post-testing. The pre-test was administered to a convenience sample of residents available on a single day of conference; the response rate might have been higher if we tested over multiple conference dates. The post-test was distributed several weeks ahead of its required due date, and it was returned by respondents at variable times before a final due date. A higher response rate was observed for the post-tests collected in this manner compared to the pre-tests, however, there is the potential that post-tests were completed either without review of the asynchronous materials or in an "open-book" or shared format by some respondents. Tests were not paired by individual resident, but rather the scores were averaged to observe aggregate group performance. We do not know which residents participated in either the pre-test or post-test, nor do we know if individual residents demonstrated any benefit from the curriculum or the pre-test itself. In addition, our analysis lacked comparison to a separate, nonintervention true control group that might have tested differently had they not received the curriculum or pre-test at all. While pre-test and post-test examinations tested learning objectives specific to a particular module, it is possible that content taught in synchronous modules may have helped subjects answer questions from asynchronous modules as well.

The testing materials that we used only assessed for knowledge acquisition. Our curriculum included goals and objectives for both new knowledge and skills; future cycles of our adapted curriculum will need to include skills assessments. We do not know if gains in knowledge were retained longer than the interval of time between the curriculum and the post-test. As comparison, we adapted our study from the national EPEC-EM™ course, which administers their validated post-tests immediately after each hourly lecture during the two-day conference. In our study the post-test was collected one month after the educational intervention, a significantly longer latency period than that used by the EPEC-EM™ Project. Future cycles of the curriculum might reveal higher pre-test scores if content was retained by the learners still in the residency program. Lastly, we did not assess health outcomes measures of patients with palliative or end-of-life care needs that might have been changed due to our educational curriculum.

CONCLUSION

EPEC™-EM adapted materials improved knowledge of core palliative medicine domains for a cohort of residents, as assessed through validated testing of course objectives. Asynchronous and synchronous learning appeared to result in similar knowledge transfer, feasibly allowing some course content to be effectively delivered outside of large group lectures. As palliative and end-of-life care emerges as an educational priority for emergency physicians, this curriculum adaptation model may be useful to other residency programs.

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Standardized Patients to Teach Medical Students about Intimate Partner Violence

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Objective: To use 360-degree evaluations within an Observed Structured Clinical Examination (OSCE) to assess medical student comfort level and communication skills with intimate partner violence (IPV) patients.

Methods: We assessed a cohort of fourth year medical students' performance using an IPV standardized patient (SP) encounter in an OSCE. Blinded pre- and post-tests determined the students' knowledge and comfort level with core IPV assessment. Students, SPs and investigators completed a 360-degree evaluation that focused on each student's communication and competency skills. We computed frequencies, means and correlations.

Results: Forty-one students participated in the SP exercise during three separate evaluation periods. Results noted insignificant increase in students' comfort level pre-test (2.7) and post-test (2.9). Although 88% of students screened for IPV and 98% asked about the injury, only 39% asked about verbal abuse, 17% asked if the patient had a safety plan, and 13% communicated to the patient that IPV is illegal. Using Likert scoring on the competency and overall evaluation (1, very poor and 5, very good), the mean score for each evaluator was 4.1 (competency) and 3.7 (overall). The correlations between trainee comfort level and the specific competencies of patient care, communication skill and professionalism were positive and significant ($p<0.05$).

Conclusion: Students felt somewhat comfortable caring for patients with IPV. OSCEs with SPs can be used to assess student competencies in caring for patients with IPV. [West J Emerg Med. 2010; 11(5):500-505.]

INTRODUCTION

Coker et al.[1] reported 29% of women have experienced physical, sexual or psychological intimate partner violence (IPV) in their lifetime. Additionally, according to the Bureau of Justice Statistics 42% of women victimized by an intimate partner sustained injuries, with females comprising 58% of murder victims.[2] Emergency departments (ED) and other primary care providers are often the entry point for individuals experiencing family violence.[3-11] Therefore, healthcare providers should play a vital role in ensuring that their patients receive the assistance they need to address violence in the home.

Recently the Institute of Medicine (IOM) compiled a comprehensive review of the current state of family violence education in the IOM's 2001 report, "Confronting Chronic Neglect: The Education and Training of Health Care Professionals on Family Violence." In addition, the IOM made specific recommendations for family violence curricular development.[4] As noted in the IOM report, basic competency skills for health providers, as recommended by the American Association of Colleges of Nursing, can serve as template for describing competency skills for all healthcare professionals.[4] In our educational setting, there had been sporadic teaching of

family violence in the M1 and M2 years**.** An informal survey of our course directors revealed three hours over four years dedicated to teaching family violence.

There is increasing commitment by the academic community to improve IPV education in the United States (U.S.). The Liaison Committee on Medical Education accreditation standards state "the curriculum must prepare students for their role in addressing the medical consequences of common societal problems, for example, [by] providing instruction in the diagnosis, prevention, appropriate reporting and treatment of violence and abuse."[12] Despite the importance, the literature is sparse with examples on how to teach this topic. Typically, the lectures are sporadic and interspersed between courses that may serve as the appropriate vector for teaching, i.e. teaching child maltreatment in pediatrics or IPV in the women's health module.[4] One university instituted formal lectures on IPV, including a mock patient evaluation, during the first year medical school curriculum.[13]

Observed Structured Clinical Examinations (OSCE) that use standardized patients (SP) have been used for over 30 years to assess clinical skills in increasingly high stakes settings.[14] Both OSCE and SPs have been shown to be effective in training and assessing core components of clinical skills for topics typically considered difficult communications. With respect to IPV, SPs have been used in the OSCE format to teach IPV skills to fourth year students rotating in the primary care setting. This technique has been shown to be an effective modality to teach them core concepts in IPV and improve clinical skills with lasting effects.[20] While competency-based evaluation is the goal on an emergency medicine (EM)clerkship, OSCE models in the emergency setting have not yet been widely developed.[21] Our review of the literature indicates that there is only one research study regarding the reliability of OSCE when applied to EM resident training in the U.S.[22] In addition, Johnson and Reynard[23], assessed OSCE as an evaluative method in Great Britain in 1994 with undergraduate students in EM. Another study in Israel developed a national domestic violence (DV) experiential training program for physicians and noted that they improved their capabilities to manage DV cases.[24]

The purpose of this study was to implement and assess an IPV OSCE module using SPs for fourth year medical students during their EM rotation. Secondary objectives were to measure competency in IPV, comfort (self-efficacy), communication skills and professionalism.

METHODS

Study Design

This was a University Institutional Review Board (IRB) approved prospective, observational study. All students provided informed verbal consent in compliance with our university IRB.

Study Methodology

We assessed IPV knowledge and skills as part of an OSCE at the end of a four-week EM fourth year rotation. All students performed one IPV SP encounter during three separate OSCE evaluations.

Study Protocol

Students received interactive didactic training during a one-hour small group session on family violence and IPV with trained faculty. Prior to the didactic training, each student's knowledge, attitudes and belief about IPV was assessed from a pre-test. The pre-test also assessed the student's comfort level in caring for IPV patients. Within several weeks of this educational session students participated in an ED OSCE piloted as a summative evaluation at the end of a mandatory EM rotation. As an adjunct to the OSCE we conducted our study of IPV skills.

The SPs received two hours of IPV training by the grant principal investigator (PI) on the SP encounter, which was adapted from Reteguiz and Cornel-Avendano's[25] workbook on SP cases. Specific items on the SP checklist included: screening for IPV, assessing safety of the victim, addressing injuries, and providing resources and counseling.

Students, SPs, and grant personnel completed the same single evaluation of the student during the SP encounter. The evaluation included communication and competency skills.

EM grant personnel served as evaluators for the SP encounter. The grant PI and Co-PIs had an average of eight years of EM training and an average minimum of 40 hours of formal IPV training. Grant personnel created the SP case and reviewed the checklist reviewed during a grant personnel meeting. The role of the evaluator included observing the history and physical (H&P) and completing the check-off list relating to the H&P. In addition, individual feedback by grant personnel was given to the student immediately after the SP exercise. Feedback was based upon the checklist, grant personnel observation of the student's communication skills, the student's physical examination technique, and the student's discussion of diagnosis and plan with the SP. The post-test was administered to assess any improvement in the student's knowledge, recognition and awareness of family violence.

Measurements

Competency

The 360-degree evaluation form, which was developed by grant personnel to assess IPV skills of fourth year medical students in the IPV OSCE station, measured student competency. The evaluation instrument included a checklist of responses that would assist faculty trained in family violence education in making a final determination of the competency level of the student to appropriately manage IPV patients. There were 25 items specific to the SP encounter, three

Table 1. Domestic violence standardized patient encounter percent totals from all fields (n=118)

Standardized Patient Checklist	No (%)	Yes (%)
Patient Care		
Screened for DV*	11.86	88.14
Assessment (Asked about…)		
Injuries*	1.71	98.29
Medical problems*	11.97	88.03
Medication use*	29.31	70.69
Whether husband was physically abuse*	11.21	88.79
Whether husband was verbally abuse*	60.87	39.13
Patient was afraid at home*	30.97	69.03
Physical Examination		
Checked arm for trauma*	2.56	97.44
Monitored fetal heart tones*	77.19	22.81
Checked body for other areas of bruising*	18.10	81.90
Document findings in chart*	89.38	10.62
Assesses for safety (Asks if …)		
Patient feels safe at home*	17.24	82.76
Firearms or other weapons in home*	84.96	15.04
Children safe in home*	43.10	56.90
Patient has emergency plan*	82.76	17.24
Communication skills		
Patient does not deserve abuse*	48.28	51.72
Acknowledged leaving is difficult*	70.69	29.31
Offer DV support and counseling*	19.13	80.87
DV in home affects future behavior of children*	87.93	12.07
DV is illegal*	87.07	12.93
Made Appropriate Referral		
Social work*	49.14	50.86
Law enforcement*	82.46	17.54
DV advocates/support groups*	38.05	61.95
Shelter/Safe house*	50.43	49.57
Hotline Number*	45.22	54.78

* Indicate missing values
DV, domestic violence

related to competency skills (patient care, communication and professionalism) and three global items (student's overall comfort, confidence and informativeness). A trained faculty, the SP and the student also completed the same evaluation form providing a 360-degree assessment of the student's performance.

Comfort

Pre- and post-test and the 360-degree evaluation measured student comfort. Grant personnel with IPV expertise developed and reviewed pre- and post-test content to ensure their face validity. The pre- and post-test were the same instrument. The 25-item checklist assessed the trainee's communication skills and comfort in working with IPV patients. The pre- and post-test were not graded, but rather compared to see a difference in response by the trainee after the SP encounter.

Table 2. Assessment by standardized patient, grant personnel and student for student's competency.

Standardized Patient – Domestic Violence Standardized Patient Encounter

Competency – Totals (%)

	Very Poor	Poor	Acceptable	Good	Very Good
Patient Care*	1.83	0.92	28.44	45.87	22.94
Empathetic Communication Skills	1.72		17.24	47.41	33.62
Professionalism	0.87		13.04	46.09	40.00

* Four missing values

Average means:
(1=Very Poor, 2=Poor, 3=Acceptable, 4=Good, 5= Very Good)
Patient Care: 3.87 (n=109)
Empathetic communication skills: 4.11 (n=116)
Professionalism: 4.24 (n=115)

Professionalism and Patient Car

Professionalism and patient care were measured by the 360-degree, 25-item checklist. Using a five point Likert scale, the SP and faculty rated the students on patient care, communication skills and professionalism.

Data Analysis

We imported the checklist information and assessment of competency from the SP, attending and student into an Excel database, and then computed frequencies, means and correlations using SAS version 8.0

RESULTS

Forty-one students participated in the SP exercise. The students' pre-test was noted at mildly uncomfortable to comfortable (2.7), with minimal change on the post-test (2.9) after the SP encounter (p=NS).

In this cohort, which includes students from 29 states and four countries, approximately 13 % are underrepresented minorities and 49% are women. Table 1 exhibits H&P findings. Although 88% of the students screened for IPV and 98% asked about the patient's injury, only 39% asked about verbal abuse and only 11% documented their findings in the chart.

SP, attending and student assessment for competency, professionalism and patient care show average to very good

composite scores (Table 2 and 3). The majority of students ranged in their communication skills from good to very good (Table 2). We analyzed the correlations analyzed using three evaluators. Correlation between overall trainee comfort level and each of the competencies (patient care, empathetic communication skill and professionalism) were positive (Table 4). Correlations when stratified by evaluators were not universally statistically significant.

DISCUSSION

With the recent emphasis on clinical competency, the use of SPs is being recognized as a useful evaluation tool to assess competency in medical schools. Currently, almost half of medical schools use SPs in clerkships and in fourth-year examinations.[26] Recently, specific classes have been developed to teach medical students these communication skills. One example is the Uniformed Services University of Health Sciences, which developed a pilot course as part of a psychiatry clerkship to improve medical student communication skills.[27]

Goals of an undergraduate EM rotation include the assessment of acutely sick and injured patients as well as experience in evaluating the undifferentiated patient.[21, 28] Many IPV victims in the ED setting will not present with IPV as their chief complaint and therefore may go unrecognized, unless students are taught to inquire specifically about IPV. Further, many patients may not present to the ED with IPV as their primary complaint but would be willing to disclose IPV if asked directly by a physician.[6] One way to assist students in considering the diagnosis of IPV is to introduce the subject early in medical student education. Using the SP encounter in IPV can be one such tool. This study sought to develop an IPV SP encounter and an evaluation tool for this educational goal.

SP encounters have several advantages. It allows for direct observation of the student, an opportunity for immediate feedback to the student by faculty, and a specific focus on the student's ability to manage IPV. In addition, students have the opportunity to ask specific questions related to IPV and are encouraged to include it as part of their differential when caring for patients. Our use of the pre- and post-test after using the SP IPV scenario did not significantly improve student comfort; however, Boulet et al[29] caution that relatively little research has been done to assess how to best set a passing standard on SP encounters and recommend that future research using SPs should include standard-setting methods. To assess or replicate research findings of published reports, journal editors, reviewers and authors should provide adequate detail when describing SP methodology.[30]

LIMITATIONS

Limitation of this study include not assessing students previous experience with IPV, either through clinical experience, didactics or personal experience prior to training.

Table 3. Assessment by standardized patient, attending physician and student for student's comfort level and informativeness overall evaluation – totals (%)

	Very Poor	Poor	Acceptable	Good	Very Good
Trainee comfort level	1.72	2.56	27.59	41.38	26.72
Trainee's confidence level	1.72	2.56	22.41	47.41	25.86
Informativeness of trainee	5.17	10.34	40.52	31.03	12.93

Average Means:
(1=Very Poor, 2=Poor, 3=Acceptable, 4=Good, 5= Very Good)
Trainee comfort level: 3.89 (n=116)
Trainee's confidence level: 3.93 (n=116)
Informativeness of trainee: 3.36 (n=116)

Table 4. Correlation with competency and trainee comfort level standardized patient – domestic violence standardized patient

Correlation:	Overall Trainee Comfort Level
Competency – patient care (n=109)	0.6382 <0.0001
Competency – empathetic communication skills (n=116)	0.6548 <0.0001
Competency – professionalism (n=115)	0.6850 <0.0001

The correlation between overall trainee comfort level and each of the competencies (patient care, empathetic communication skill and professionalism) are significant. All correlations are positive.

Note: The above correlation was run using all three evaluators. When the correlation was stratified by evaluator, the correlation was not significant between comfort and professionalism for the principal investigator (p=0.0859).

Second, due to the small sample size of this pilot study, we cannot extrapolate these findings to the entire medical school class and we don't know how these findings would persist long term. Third, the students did not have demographic markers on the OSCE pre-test and post-test that determined ethnicity and gender; thus we were unable to infer any biases based on ethnicity and gender, although a larger study should look at those demographics and how they affect the results. Fourth, we did not achieve a 100% completion rate for all the forms, which resulted in missing data. Lastly, the SP case and form has not been validated and would warrant use and repetition in other student ED rotations to test its validity and reliability.

CONCLUSION

Effective methods for training medical students in IPV are needed. Using SPs in an OSCE setting could help trainees focus on the affective elements of training (such as attitudes) in caring for patients who experience IPV. This methodology should be further developed to use as a tool to measure students' competencies in caring for patients with IPV. We found correlation among the trainee comfort level, patient care, communication skills and professionalism. In our investigation, the OSCE did not show a clinically significant improvement in students' comfort level in caring for IPV victims. The SP OSCE did help us identify likely gaps in our educational curriculum. Further studies using SP with IPV should be conducted to determine effectiveness of this educational technique within the medical student curriculum.

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Multiple Organ Transplantation after Suicide by Acetaminophen and Gunshot Wound

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Emergency physicians (EP) and medical toxicologists are integral in identifying and treating patients with overdoses. Transplant centers are expanding acceptance criteria to consider those with poison-related deaths. We present a case of a simultaneous gunshot wound to the head and an acetaminophen overdose. This case highlights the importance of EPs and medical toxicologists in recognizing the medical complexity of suicides, optimizing treatment, and timing of organ procurement. Early antidote administration and aggressive supportive care allowed the patient to be evaluated as a potential donor. EPs and medical toxicologists have integral roles in overdose patients as organ donors. [West J Emerg Med. 2010; 11(5):506-509.]

INTRODUCTION

Emergency physicians (EP) often play important roles in the initial stabilization of patients who later become organ donors. They also play vital roles in the transplantation process through recognition of potential drug overdoses. As the list of patients awaiting transplantation grows, acceptance criteria by transplant centers have expanded to consider those who have died due to drug intoxication.[1,2] Between 2004 and 2008, the Organ Procurement and Transplantation Network classified drug intoxication as cause of death in approximately 3% of all donors.[3] (Table 1).

While the vast majority of drug intoxications manifest symptoms within the first few hours, delayed or "silent toxins" exist. The classic examples of poisonings with delayed manifestations include mushroom poisoning from the *Amanita sp*. and acetaminophen. Both are hepatotoxins that may not produce symptoms for the first 12-24 hours and usually do not manifest life- or organ-threatening toxicity until 72-96 hours after the ingestion.[4]

Delays in toxicity must be considered when evaluating an overdose patient as a potential transplant donor. Acetaminophen-induced organ injury is known to cause renal

Table 1. Summary of organ donors classified as drug intoxication compared to all donors (2004-2008)

Organ	2004	2005	2006	2007	2008
Any organ	284/7984 (3.5%)	158/7593 (2.1%)	230/8019 (2.8%)	267/8085 (3.3%)	284/7984 (3.5%)
Kidney	156/6325 (2.5%)	134/6700 (2.0%)	196/7178 (2.7%)	233/7240 (3.2%)	239/7185 (3.3%)
Liver	151/6319 (2.4%)	130/6693 (1.9%)	197/7017 (2.8%)	231/6937 (3.3%)	242/6745 (3.6%)
Pancreas	42/2019 (2.0%)	40/2043 (1.9%)	42/2031 (2.1%)	63/1932 (3.2%)	59/1830 (3.2%)
Heart	57/2096 (2.7%)	43/2220 (1.9%)	57/2276 (2.5%)	91/2287 (3.9%)	81/2225 (3.6%)
Lung	27/1064 (2.5%)	23/1285 (1.8%)	26/1325 (1.9%)	55/1382 (3.9%)	45/1387 (3.2%)
Intestine	1/166 (0.6%)	2/184 (1.0%)	2/185 (1.0%)	8/205 (1.6%)	3/197 (1.5%)

*** Based on Organ Procurement and Transplantation Network Data as of May 27, 2009*

failure with or without evidence of hepatotoxicity, further complicating the evaluation of such donors.[5-8]

We describe the case of a 17-year-old male with a simultaneous gunshot wound to the head in association with an acetaminophen overdose. This case demonstrates the importance of considering the complex medical issue of suicide and optimizing patient care with supportive care and early antidote administration.

CASE REPORT

A 17-year-old male with no significant past medical history was brought to the emergency department (ED) after a self-inflicted gunshot wound to the head. In the ED the mother was specifically asked about potential overdoses. She stated that there was a recently purchased bottle of acetaminophen in the garage where her son had been working. She had asked him to bring her the bottle; approximately five minutes later, he went into another room and she heard a gunshot.

Upon arrival in the ED, the patient was intubated without medication. He had a systolic blood pressure of 130mm Hg, a pulse of 111 beats per minute, a respiratory rate of 16 via bag-assisted respirations and a temperature of 36.5°C. Physical exam was notable for a single penetrating wound to the right temporal bone. Pupils were fixed and dilated. There was no evidence of trauma anywhere else on his body. The computed tomography scan of his brain demonstrated a non-survivable head injury with multiple skull fractures, intraparenchymal, intraventricular, subarachnoid and subdural blood. Additionally, there was significant cerebral edema with evidence of tonsillar herniation. The remainder of the physical exam was consistent with brain death, with no additional signs of trauma. Initial laboratories returned with a hemoglobin, 11 gm/dL; platelets, 218 $10^3/mm^3$; sodium, 138 mEq/L; potassium, 2.9 mEq/L; chloride, 104 mEq/L; bicarbonate, 22 mEq/L; blood urea nitrogen, 12 mg/dL; and creatinine, 0.96 mg/dL. His aspartate transaminase (AST) was mildly elevated at 50 IU/L and his alanine transferase was normal at 20 IU/L. Initial international normalized ratio was 1.26. His acetaminophen level drawn at arrival was markedly elevated at 134 mg/L. The EPs initiated N-acetylcysteine (NAC) therapy and requested a medical toxicology consultation. Family expressed their interest in organ and tissue donation. The intensive care service requested input from the toxicology team with regard to immediate treatment for the patient, as well as timing and toxicological issues that could affect organ donation and transplantation.

After conversations with the family, there was no further history available regarding potential ingestions or time of ingestion. An exact time of ingestion could not be determined. The family located the bottle and found approximately 20 grams of acetaminophen missing, an amount capable of producing fulminant hepatic failure. Given the lack of overdose information with evidence of a significant ingestion, intravenous NAC was continued indefinitely. Charcoal therapy was considered, but with the unknown time of ingestion and the duration of time elapsed from pre-hospital transportation through ED resuscitation, the patient was outside the window for likely therapeutic benefit.

The process of brain death evaluation was initiated. Our institutional policy for pediatric patients (defined as <18 years of age) is to have two separate brain death exams on separate calendar days. During this period, a multidisciplinary group of pediatric intensive care physicians and medical toxicologists participated in supportive care. Initial plans for heart, lung, and pancreas donation were decided, but the viability of the kidneys and liver were unknown. The next 24 hours of laboratory evaluation is summarized in Table 2.

After the patient was declared brain dead, organs were recovered and transplanted into six different recipients. The heart, lung, pancreas and one of the kidneys were successfully transplanted, and at three months post transplant all organs were functioning well. The liver was split, with one recipient also receiving a kidney. The patient who received the right hemi-liver alone did not experience complications and had excellent allograft function at three months. The patient who received both the left hemi-liver and a kidney had a prolonged intensive care hospitalization for two months post transplant for infectious complications; however, the transplanted organs

Table 2. Laboratory trends during the process of brain death determination

Laboratory Test	15:52 Day 1	18:22	22:05	02:10 Day 2	06:00	10:20	13:00	13:45
AST (IU/L)	51	55	57	50	47	48	Brain Death Declared	45
ALT (IU/L)	20	17	20	20	19	20		20
INR	1.26	2.14	1.43	1.28	1.28	1.30		1.31
APAP (mg/L)	134	79	48	27	16	11		<10
APAP T ½ (hours)		4.59	5.17	4.92	5.08	**		

*** Half lives become less reliable in the terminal portion of the elimination phase, especially as you approach the limit of detection.*
AST, aspartate transaminase; *ALT,* alanine transferase, *INR,* international normalized ratio; *APAP,* N-acetyl-p-aminophenol

were functioning normally during the intensive care stay and at three months post transplantation.

DISCUSSION

This unique case highlights the importance of considering the complex medical issues related to suicide, recognition of a potential ingestion and early antidote administration. Additionally, this case demonstrates many toxicological issues in both potential donor and transplant recipients. There is limited data on organ recovery and transplant in donors with overdoses. The possibility of delayed manifestation of toxicity becomes more complicated when the immediate cause of death was not due to the ingestion.

There were no identified contraindications to transplant the heart, lungs, pancreas, and intestines. Several issues needed to be addressed regarding the kidneys and liver. One of these was the timing of organ recovery. No specific criteria exist for the timing of liver transplantation using a donor with acetaminophen overdose and elevated AST. While delay in recovery may be reassuring to the centers accepting the liver and kidneys, the possibility existed that the traumatic brain injury itself could trigger many pathologic processes, such as diffuse intravascular coagulation, which could affect the viability of the other organs.

Acetaminophen has been known to induce renal insufficiency in approximately 2% of overdoses.[9] There have been case reports describing kidney donation after acetaminophen overdose [10]. In some of these cases, the donors had elevated creatinine, and in one case the patient was oligoanuric for three hours prior to harvesting organs. However, the cause of death in these cases was liver failure from acetaminophen overdose. Therefore it is hard to extrapolate these results to prospectively predict if a kidney will be viable when the cause of death is unrelated.

Predicting which patients with acetaminophen overdose will develop renal failure has been difficult to elucidate beyond general risk factors for hepatic failure. A prospective study evaluating proteinuria found it was not an early marker that would progress to renal failure in acetaminophen overdoses.[11] Additionally, the onset of renal failure typically occurred between day two and day five after the overdose with peak creatinine levels on day seven.[6, 12] This was concerning given the fact that our patient was declared brain dead on day two. The majority of case reports demonstrated creatinine that had returned to baseline within one month, suggesting that renal failure is likely reversible. [12]

While information regarding acetaminophen-induced renal failure is limited, hepatotoxicity from acetaminophen is well studied. In significant acetaminophen overdoses, transaminases typically begin to rise between 18 and 30 hours, followed by signs of multi-organ involvement typically manifesting between 72 and 96 hours post-ingestion. [4] Additionally, the initiation of NAC prior to eight hours post ingestion has been shown to prevent liver failure regardless of initial acetaminophen level.[13] This patient had an unknown time of ingestion, making it impossible to determine the risk of hepatotoxicty with his first level of 134 mg/L.

Our literature search returned no published reports of liver donation after acetaminophen overdose. This is not surprising, as most patients with acetaminophen overdose either have full recovery, or death due to complications of hepatic failure. Given this lack of data, it was unclear at what time liver donation could be considered safe. Typically, in treatment of an acetaminophen overdose, therapy with NAC is initiated and transaminase levels are followed in conjunction with confirmation that the acetaminophen level becomes undetectable. However, the timing of the recovery of other organs prohibited this delay to follow the liver function.

The institutional policy regarding pediatric brain death provided the opportunity to check serial acetaminophen levels prior to declaring the patient brain dead. The half-lives listed in Table 2 range from 4.59 to 5.17 hours. As oxidative damage to the liver occurs, the ability to eliminate the drug decreases and thus prolongs the calculated half-life. Two previous studies evaluating acetaminophen half-life determinations to predict toxicity have found that half-lives less than 2.5 hours and 3 hours respectively make toxicity unlikely.[14,15] Studies have also shown that half-lives of greater than four hours put the patient at increased risk of hepatotoxicity and demonstrate the longer the half-life, the higher the rate of hepatotoxicity. [16, 17] Typically, the use of acetaminophen half-lives to predict toxicity is not recommended due to lack of specificity and multiple confounders such as ongoing gastrointestinal absorption, or co-ingestions. Given the half-lives of this patient were greater than four hours, transplantation of the liver was considered high risk.

The patient's transaminases failed to change over the 24 hours of observation prior to the declaration of brain death. Besides the possibility that not enough time had elapsed to see the transaminases rise, two additional explanations are possible. First, given our lack of knowledge regarding the time of ingestion, the initial level of 134 mg/L could have been less than a four- hour level and reflected significant continued absorption. With serial levels decreasing, this would make his ingestion low probability for hepatotoxicity. The second explanation for his lack of hepatotoxicity may be the result of the early initiation of NAC stopping hepatotoxicity from occurring.

In summary, early recognition of a potential overdose and NAC administration in the ED optimized the patient as a potential donor. The use of overdose patients as organ donors may serve as an increasing source of organs to meet the growing needs of patients awaiting transplant. It is vital that EPs and medical toxicologists play integral roles in overdose patients as organ donors.

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Seizure as Initial Manifestation of Aortic Dissection Type A

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Background: Seizure as the initial manifestation of aortic dissection is rare.

Case report: An 88-year-old female experienced a first generalized tonic clonic seizure, which was terminated with midazolam. Acute cerebral magnetic resonance imaging and angiography were non-informative. After awaking she complained about cramping pain in the right upper extremity, which was accompanied by involuntary flexion movements of the right upper extremity. Blood pressure was initially normal. Blood gases revealed metabolic acidosis and blood chemical investigations a markedly increased D-dimer. Consecutively blood pressure declined and transthoracic echocardiography showed pericardial effusion. A computed tomography scan of the thorax revealed an aortic dissection type A. The patient died 16 hours after admission after cardiothoracic surgeons had refused surgical treatment.

Conclusion: This case shows that a generalized tonic-clonic seizure may be the initial manifestation of an aortic dissection type A in the absence of thoracic chest pain and that brachyalgia may not develop earlier than with progression of the dissection. [West J Emerg Med. 2010; 11(5):510-511.]

INTRODUCTION

Seizure as the sole initial manifestation of aortic dissection in the absence of chest pain has been reported only once.[1] Here we report a second patient in whom aortic dissection type A initially manifested exclusively as generalized seizure without chest pain.

CASE REPORT

The patient is an 88-year-old female with a previous history of arterial hypertension, obstructive lung disease and bilateral total hip endoprosthesis. She was not drinking alcohol and was living well on her own in an asylum. While riding a tram on her way to a festival, she experienced a sudden onset generalized seizure with loss of consciousness and cloni of the upper and lower extremity with right-sided predominance. A dose of 15mg midazolam from the emergency physician stopped the seizure and when she arrived at the emergency department she was comatose and quadriplegic and the brain stem reflexes were absent, except for the pupils, which were widened and reacted slowly to light bilaterally. Deep tendon reflexes were generally absent and there was general muscle hypotonia.

Blood pressure was 130/80mmHg. Blood chemical investigations revealed moderate renal insufficiency, elevated liver function parameters, leucocytosis of 12.3/nl (n = 4.0-9.0/nl), slight anemia and a D-dimer of 20.0microg/ml (n <0.5microg/ml). Blood gas analysis revealed metabolic acidosis with a pH of 7.36, a base excess of -8.5, and a lactate of 2.4mmol/l. Electrocardiogram (ECG) showed sinus rhythm. Magnetic resonance image (MRI) of the cerebrum 45 minutes after the seizure did not show ischemia or intracerebral bleeding. On MR angiography no major abnormality of the vasculature was detected. Her state of consciousness improved from coma to somnolence, and she started to move her extremities.

After awakening she complained about recurrent cramping pain in her right shoulder and right upper arm, which was accompanied by automatic flexion of the right upper limb. Aortic dissection was suspected and a computed tomography (CT) of the thorax initiated. Before carrying

it out, however, she developed low blood pressure to non-measurable values and was transferred to the intensive care unit for suspected cardiac shock where hydroxi-ethyl starch and vasopressin helped to increased blood pressure. However, the right pupil widened and became non-reactive to light, and she developed left-sided hemiplegia. Echocardiography showed normal systolic function, a small right ventricle and a pericardial effusion with an embedded clot. Subsequently, a CT scan of the thorax and the aorta showed aortic dissection type A extending into the left descending aorta, the brachiocephalic trunk with occlusion of the right common carotid artery. For right-sided pain she received sufentanil with success. Carotid ultrasound eight hours after onset confirmed the complete occlusion of the right carotid artery. After two cardio-thoracic departments had refused surgical intervention the patient died without regaining consciousness, 16 hours after admission.

DISCUSSION

The patient is interesting for the epileptic seizure without chest pain as the initial manifestation of an aortic dissection type A. Such a scenario has been previously reported in a single 46-year-old patient, who presented with right hemiconvulsive movements due to ischemic right middle cerebral artery stroke.[1] The only risk factor for aortic dissection in the present patient was arterial hypertension. Whether steroids in the broncholytic spray favored the development of the aortic dissection, as has been previously reported in a patient with systemic lupus erythematosus, remains speculative.[2] Disorders predisposing for aortic dissection, such as X-linked heterotopia or Turner syndrome were excluded.[3,4]

Why seizure was the initial manifestation remains elusive. However, one could speculate that the dissection initially resulted in general cerebral hypoperfusion and thus hypoxia or stenosis of the common carotid artery, as well cerebral ischemia, which did not show up on diffusion-weighted imaging. The B1000 sequence might have been negative because the MRI was carried out too early or because ischemia was initially not intensive enough. Neither her son nor her friend reported previous seizures or syncopes. While it is conceivable that the seizure was not the consequence but the cause of the dissection, arguments against such a scenario are that she did not have a history of epilepsy (her history was negative for a cerebral lesion) nor have seizures been reported as triggers of aortic dissection. One could also speculate that the initial event was a rhythm abnormality with cerebral embolism inducing the seizure but spontaneous resolution of the clot. Worsening after the MRI could be attributed to progression of the dissection resulting in complete occlusion of the right carotid artery leading to a non-reactive right pupil and left-sided hemiplegia. Possibly, hemiplegia already existed at the initial presentation but was masked by the sedation with midazolam. However, because the pupils were reactive, though delayed, at the initial investigation, progression of the dissection during or after the cerebral MRI is more likely. Neurological manifestations are not infrequent at onset of an aortic dissection, but in the majority of the cases they are accompanied by chest pain.[5] Altogether about one third of the patients with aortic dissection and chest pain initially present with neurological manifestations.[5] Seizures occur in 3% of these patients.

This case shows that a generalized tonic-clonic seizure may be the initial manifestation of an aortic dissection type A in the absence of thoracic chest pain and that brachyalgia may not develop earlier than with progression of the dissection.

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Iatrogenic Claudication from a Vascular Closure Device after Cardiac Catheterization

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We report a case of iatrogenic claudication as a result of a misplaced percutaneous arterial closure device (PACD) used to obtain hemostasis after cardiac catheterization. The patient presented one week after his procedure with complaints suggestive of right lower extremity claudication. Computed tomographic angiography demonstrated a near total occlusion of the right common femoral artery from a PACD implemented during the cardiac catheterization. The use of PACD's to obtain rapid hemostasis is estimated to occur in half of all cardiac catheterizations. Ischemic complications as a result of these devices must be considered when evaluating post procedural patients with extremity complaints. [West J Emerg Med. 2010; 11(5):512-513.]

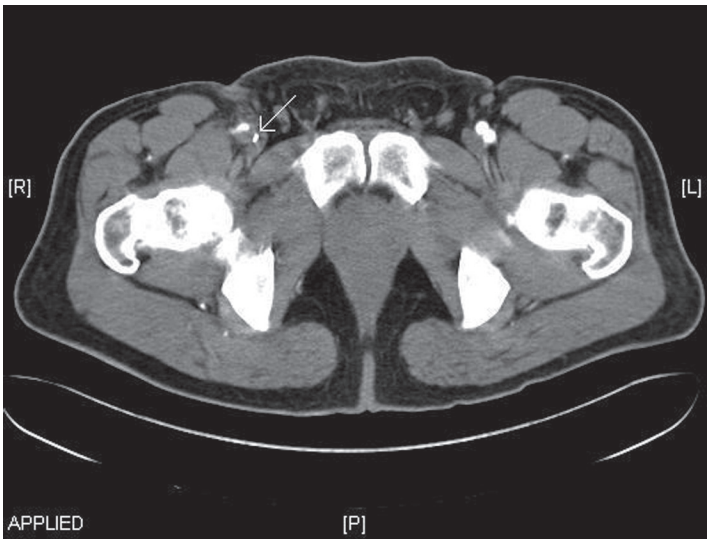

Figure 2. Computed tomography angiogram demonstrating decreased caliber of the right superficial femoral artery as a result of a partial occlusion from a misplaced percutaneous arterial closure device.

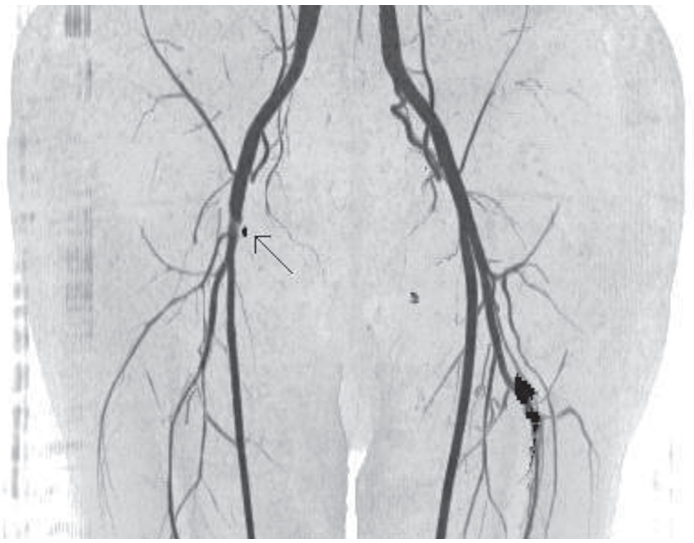

Figure 1. Computed tomography angiogram with three dimensional reconstruction demonstrating a partial occlusion of the right common femoral artery associated with a percutaneous arterial closure device.

CASE REPORT

A 44 year-old-male with a history of coronary artery disease and recent cardiac catheterization presented to the emergency department complaining of right lower extremity pain and numbness associated with ambulation. The symptoms began the day after the catheterization was performed and had progressively worsened. On presentation, the patient's vital signs were normal and he appeared comfortable. Examination of the arterial puncture site demonstrated a well-healing wound with no appreciable mass,

hematoma or surrounding erythema noted. Strong femoral pulses without bruit were present bilaterally; however, pulses were decreased distal to the femoral artery puncture site. The right lower extremity was warm to the touch without pallor or mottling and with no appreciable sensory deficit.

A doppler ultrasound of the right groin demonstrated normal flow in the right common femoral artery and vein with no evidence of a pseudoaneurysm. Subsequently, computed tomography (CT) angiography of the lower extremities was performed. The CT angiography demonstrated near total occlusion of the right common femoral artery just above the bifurcation and extending into the right profunda femoral artery associated with a percutaneous arterial closure device (PACD)[Figures 1 and 2].

The patient was admitted to the hospital and scheduled for surgical repair of the stenosis the following day. At the time of surgery, a flap from a Perclose PACD, along with a large blood clot underneath it, were found in the femoral artery. These were removed with return of equal and normal distal pulses.

DISCUSSION

PACD have been proposed as an alternative to manual compression to achieve hemostasis at the arterial puncture site following cardiac catheterization.[1,3] It is estimated that PACDs are used to achieve hemostasis in 50% of all percutaneous coronary procedures.[1] Commonly used devices employ either collagen plugs or suture-mediated closure of the arterial puncture site. The potential benefits of these devices over standard manual compression include decreased time to hemostasis, earlier ambulation and ultimately, earlier discharge of patients post catheterization.[1,3]

The commonly reported complications of closure devices include pseudoaneurysm, arteriovenous fistula, hematoma, femoral artery thrombosis and bleeding.[1,2,3] Ischemia resulting from suture-mediated devices being deployed within the artery and arterial stenosis from suture-mediated devices are less often encountered, reported in approximately 0.2% of cases in one study of over 4,500 patients.[4]

The largest case series to specifically evaluate claudication secondary to PACD in percutaneous intervention patients suggests a similar incidence.[5] In this single center study that evaluated approximately 4,000 patients over a one-year period, nine cases of iatrogenic claudication as a result of PACD placement were identified.[6] Although pain consistent with claudication in the affected extremity was the most common presenting complaint, patients also presented with primary complaints of numbness, extremity fatigue and groin pain, complicating early diagnosis. Additionally, Arterial Brachial Index (ABI) measurements were normal in two patients in the group, suggesting that ABIs at rest are not sensitive enough to rule out the diagnosis. This is likely a reflection of the proximal location of the stenosis, particularly in patients with otherwise normal circulation whose collateral blood flow may be enough to provide adequate perfusion at rest.[5] It has been suggested that performing ABIs after exercise in this group of patients would demonstrate a stenosis of clinical significance.[5]

Definitive diagnosis of post procedural arterial stenosis can be made accurately with duplex ultrasound, demonstrating increased turbulence and velocity of the affected artery in comparison to the unaffected side.[5]Alternately, magnetic resonance or CT angiography allows adequate visualization to identify an obstructive lesion.[5]

Identification of clinically significant arterial stenosis is important as surgical intervention or possibly percutaneous balloon angioplasty is required to relieve the obstruction.[5,6]

CONCLUSION

The use of PACD to obtain hemostasis following cardiac catheterization is increasingly common. Given the complications associated with their use, ischemia from improperly placed closure devices should be considered in the differential diagnosis of all patients presenting with lower extremity pain or numbness after femoral artery cannulation.

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Dolor de Pecho

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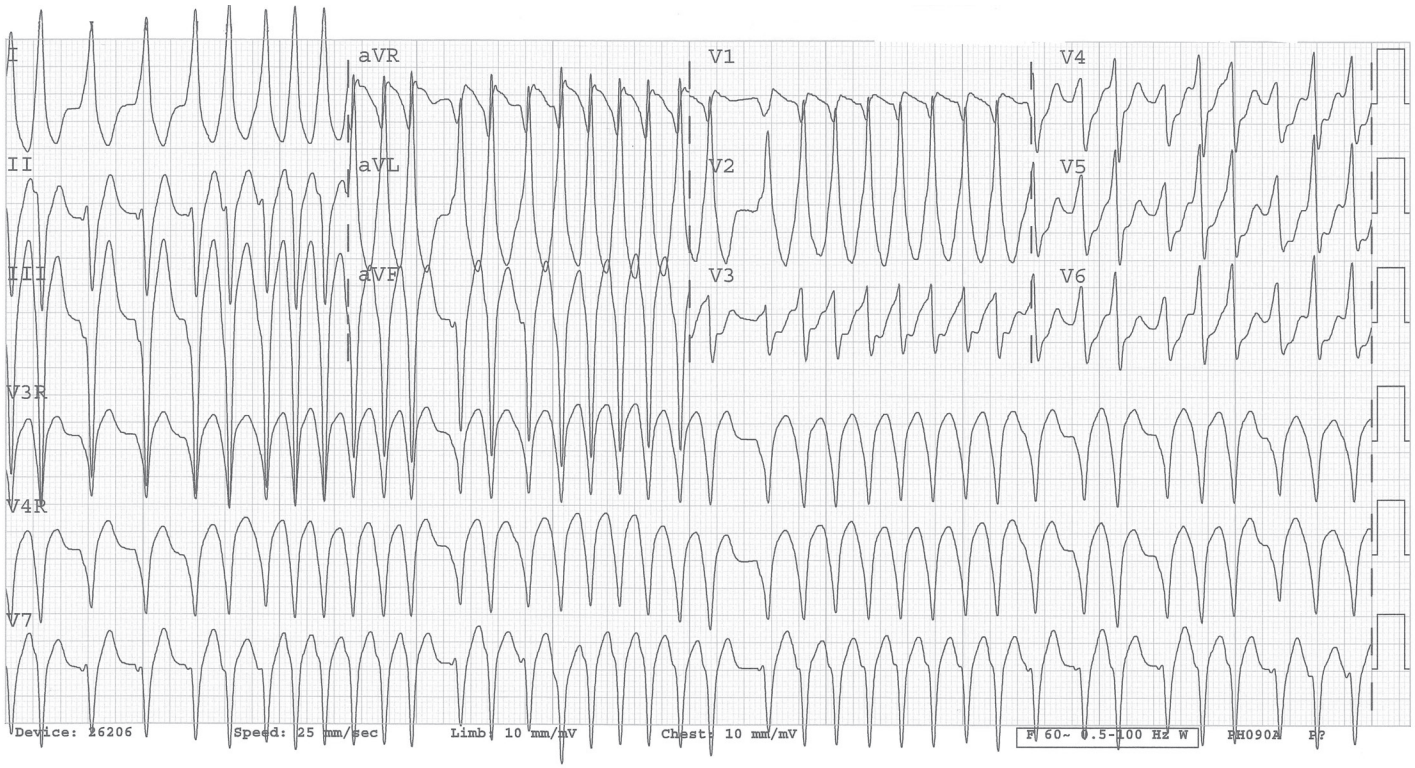
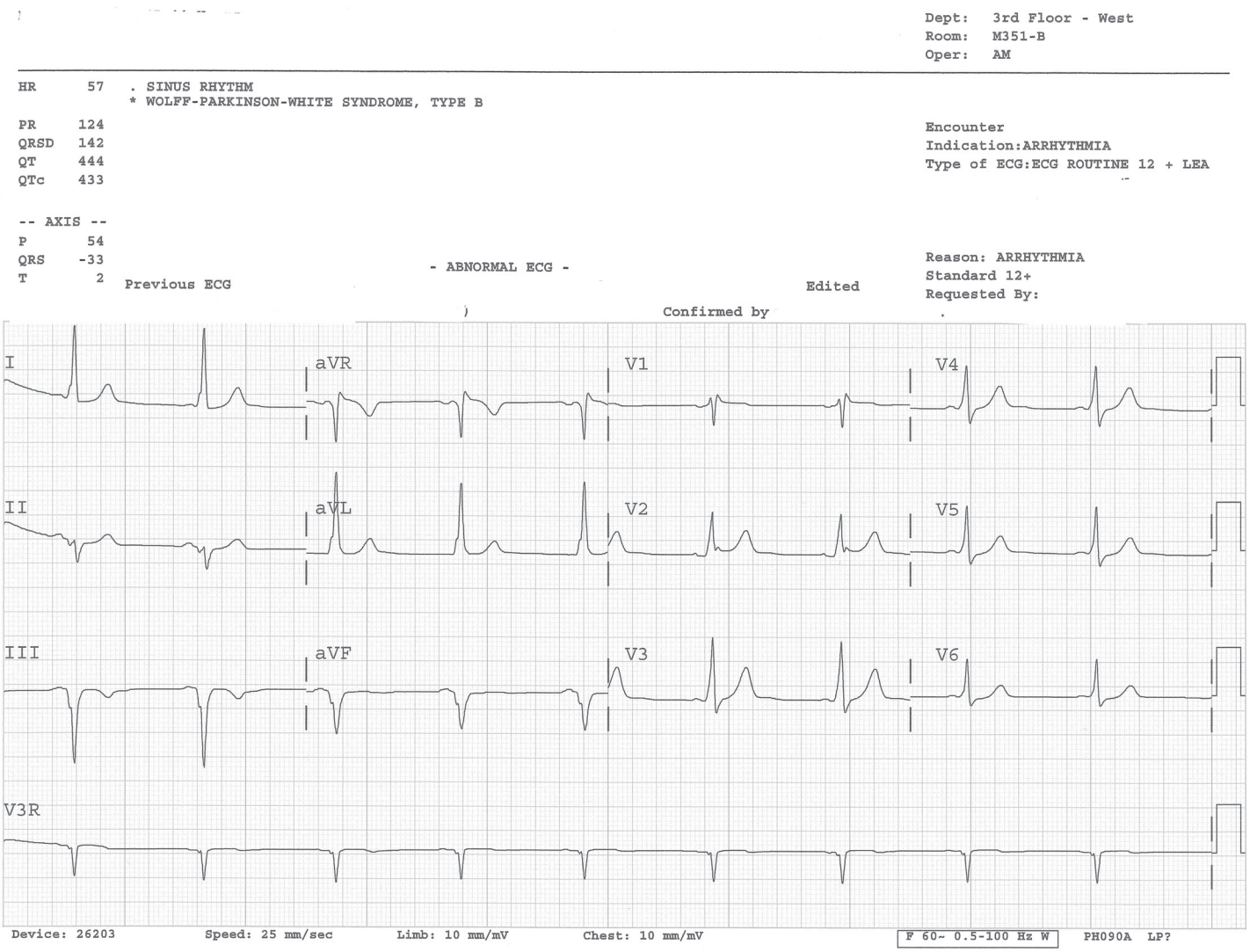
A 44-year-old Hispanic male with a history of Wolff-Parkinson-White Syndrome (WPW) presented with chest pain and palpitations that had been constant for three hours. He denied any other complaints. He reported drinking one cup of coffee daily and stated he had used cocaine about one month earlier, but denied any recent drug use. On physical exam he was sitting comfortably with a heart rate between 230 - 250 and a blood pressure of 129/58mmHg. Cardiac monitor showed a wide-complex tachycardia. The rest of his physical exam was unremarkable. Initial electrocardiogram (ECG) revealed an irregular wide-complex tachycardia, consistent with atrial fibrillation with a rapid ventricular response. The patient was started on intravenous procainamide. He remained normotensive with no QRS prolongation. After approximately 30 minutes of infusion, a repeat ECG showed resolution of his wide-complex tachycardia. The patient was admitted and taken to the electrophysiology lab, where he underwent successful radiofrequency catheter ablation of his right posterior septal accessory pathway. No further antegrade or retrograde pre-excitation was documented afterwards.

WPW is a pre-excitation syndrome resulting from a structural abnormality of the heart in the form of an accessory pathway that conducts current along this aberrant path in a reentry mechanism which can lead to ventricular dysrhythmias. All cases of wide-complex tachycardias should be presumed to be ventricular tachycardia until proven otherwise. In the case of hemodynamic compromise, cardioversion is the treatment of choice.[1,2] If the patient is stable, medical management may be considered. Procainamide is the initial drug of choice.[1,2] Care must be taken to monitor for potential side effects such as hypotension and QRS prolongation.





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Sciatic Artery Aneurysm

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A 59-year-old female with a history of diabetes mellitus presented to the emergency department complaining of three weeks of an enlarging pulsating mass to her left buttock. The patient denied any associated trauma, leg pain, back pain or previous episodes. Physical exam was remarkable for a bounding non-tender pulsatile mass over the lateral left buttock. Skin examination over this area was unremarkable. There were no sensory and motor deficits, and pulses were 2+ distally. A bedside ultrasound of the affected area revealed a pulsatile aneurismal vessel measuring 6cm. Computed tomography (CT) abdomen/pelvis with intravenous contrast confirmed a 7.8 x 4.1cm aneurysm arising from the left internal iliac artery suggestive of a persistent sciatic artery. A persistent right sciatic artery was also identified on CT of the lower extremities, although there was no evidence of aneurysm noted in that extremity (Figure 1 and 2). The vascular surgical service was consulted, and the patient underwent left sciatic aneurysm repair with a polytetrafluoroethylene interposition graft. The patient was discharged from the hospital on post-operative day three without any complications.

Persistent sciatic artery is a rare congenital vascular anomaly estimated to occur in 0.03-0.06% of the population. During embryogenesis, the sciatic artery runs along the sciatic nerve and comprises the major blood supply to the respective lower extremities. As the femoral artery is formed, the bilateral sciatic arteries start to regress. This process continues until the femoral artery completely takes over as the major lower limb blood supply, leaving only remnants of the sciatic artery.[1,2] A persistent sciatic artery may occur when there is either a failure of involution of the sciatic artery or failure of the proper development of the femoral artery during normal development. Most cases of persistent sciatic artery are clinically silent and detected only after a vascular complication. Aneurysms develop in approximately a quarter of cases, likely due to the vessel's anatomic predisposition to minor trauma with sitting. Other complications include thrombosis, embolism and rupture of the artery resulting in ischemia and pain of the lower extremity.[2]

Ultrasonagraphy and CT are the preferred diagnostic modalities for identifying a suspected sciatic artery aneurysm.

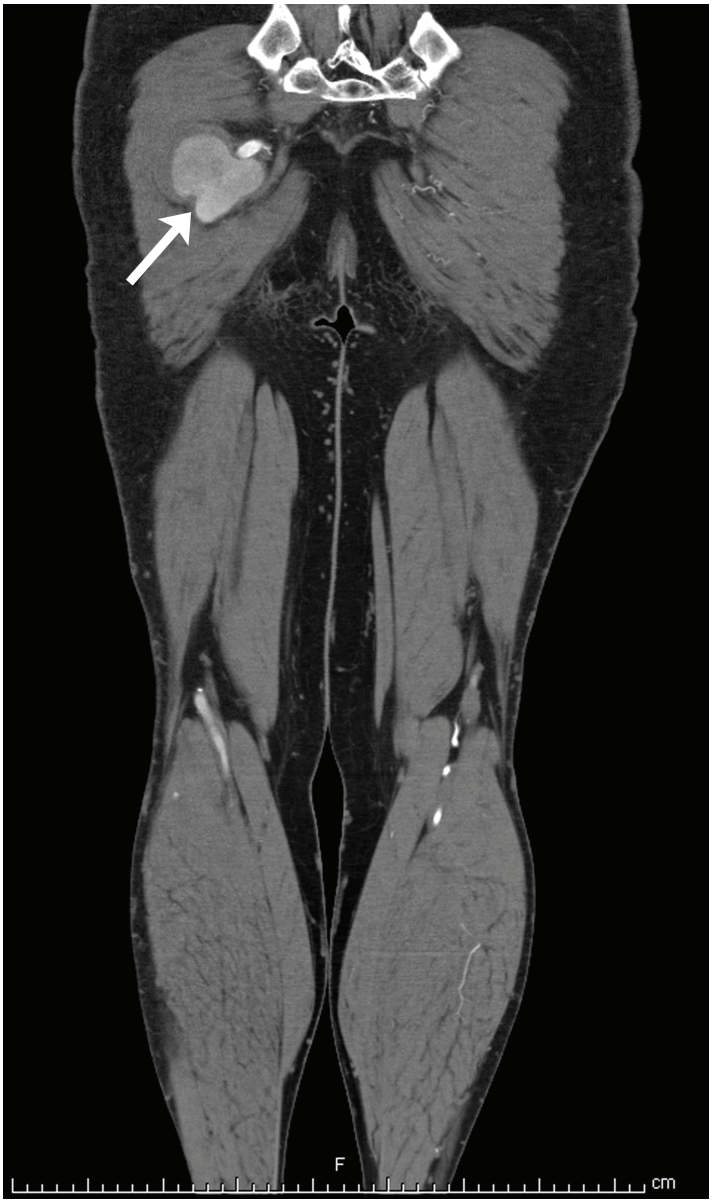

Figure 1. Computed tomography angiogram of lower extremities highlighting extent of left sciatic artery aneurysm and illustrating distal anatomy of the artery.

CT angiography is useful to delineate the proximal and distal anatomy of the vessel and assist in preoperative planning. A vascular surgeon should be consulted in all cases. Treatment options include surgical exclusion or excision of the aneurysm, endovascular stenting, and endovascular coiling.[3]

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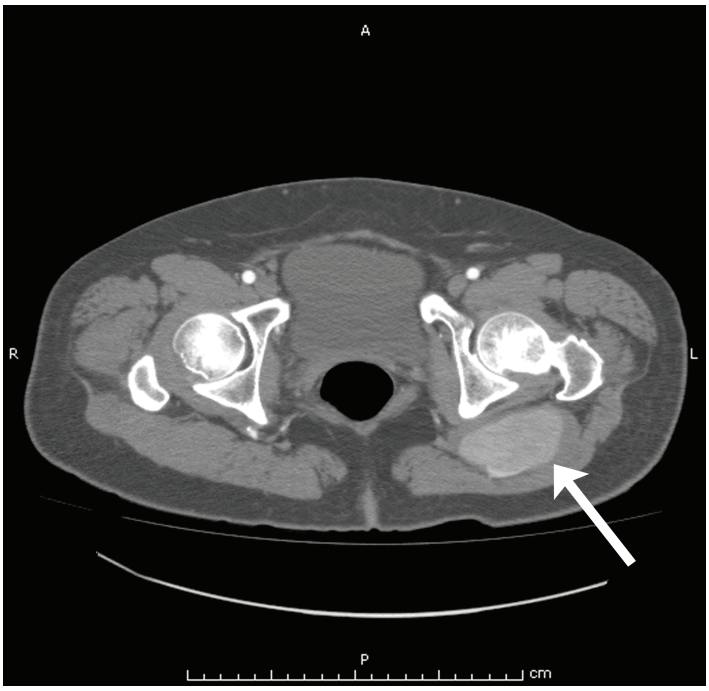

Figure 2. Computed tomography of abdomen/pelvis showing unilateral left sciatic artery aneurysm at its greatest diameters of 7.8 x 4.1cm.

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Emphysematous Pyelonephritis and Pneumo-Vena Cava

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A 38-year-old woman with insulin-dependent diabetes reported four-days of flank pain, dysuria, polyuria and urinary urgency. Vital signs included blood pressure 113/70mmHg, heart rate 135/min, respiratory rate 24/min, and temperature 102.5˚F. Exam revealed right cerebral vascular accident and suprapubic tenderness without guarding or rebound. Significant laboratory evaluations included a leukocyte count of $19.5x10^{-3}$/microlitre with 46% bands and toxic granulations. Hematocrit measured 30.9g/dL and platelets were $92x10^{-3}$/microlitre. Serum chemistries were significant for blood urea nitrogen 103mg/dL, creatinine 3.9mg/dL and lactate 7.8mmol/L. Urinalysis was nitrite positive, leukocyte esterase moderate, 8-12 leukocytes/hpf, and moderate bacteria. Urine and blood cultures were positive for pan-sensitive *Escherichia coli.* A non-contrast computed tomography (CT) abdomen image is depicted (Figure 1 and 2). The patient was treated with IV crystalloid, piperacillin/tazobactam and gentamycin, underwent percutaneous drainage, and was admitted to the intensive care unit where she suffered a prolonged course but survived to hospital discharge.

The patient has emphysematous pyelonephritis (EPN) with pneumo-vena cava. EPN is a life-threatening, necrotizing infection of the renal parenchyma, collecting system, or perinephric tissue by gas-forming uropathogens (eg. E. coli, Klebsiella, Proteus).[1] Risk factors include diabetes (>90% of patients), female gender, immunosuppression, renal disease or genitourinary obstruction.[1] Symptoms include fever, flank/back pain, dysuria, nausea/vomiting, renal failure or hyperglycemia. Disturbed consciousness, thrombocytopenia and sepsis are associated with increased mortality.[1,2] CT is the preferred imaging modality. Class I contains gas within the collecting system.[1,2] Class II contains intraparechymal gas.[1,2] In class IIIa, gas or abscess extends into the perinephric space, and in IIIb into the pararenal space. Class IV signifies bilateral or solitary kidney involvement.[1,2] Treat EPN with aggressive fluid resuscitation, broad-spectrum antibiotics targeting gram-negative bacteria, glycemic control and electrolyte maintenance. Additionally, treat class I or II disease with percutaneous drainage and class III and IV disease with percutaneous catheter placement. Nephrectomy is reserved for severe or refractory cases.[1]

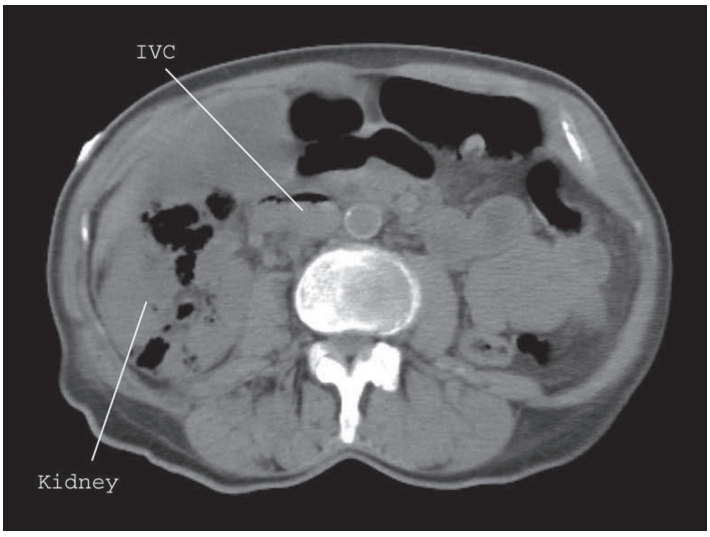

Figure 1. Abdomen computed tomography image without intravenous contrast showing right-sided emphysematous pyelonephritis with an air-fluid level in the inferior vena cava (IVC).

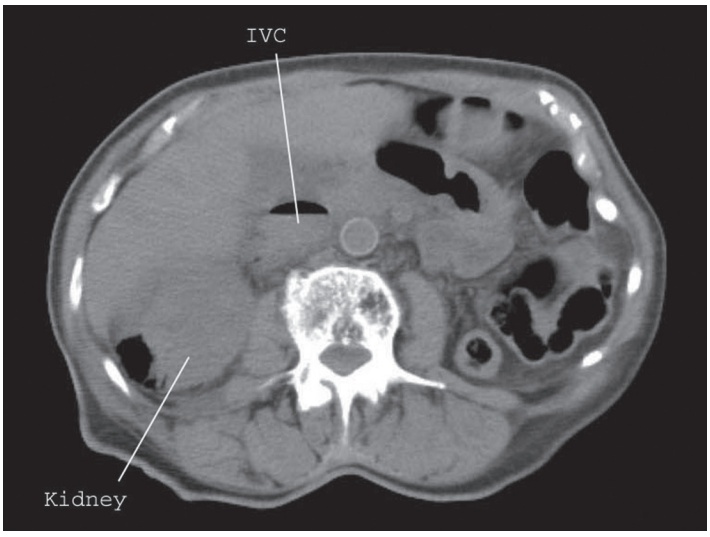

Figure 2. Additional non-contrast computed tomography image highlighting extensive emphysematous pyelonephritis with pneumo-vena cava. IVC signifies inferior vena cava.

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Torus Mandibularis

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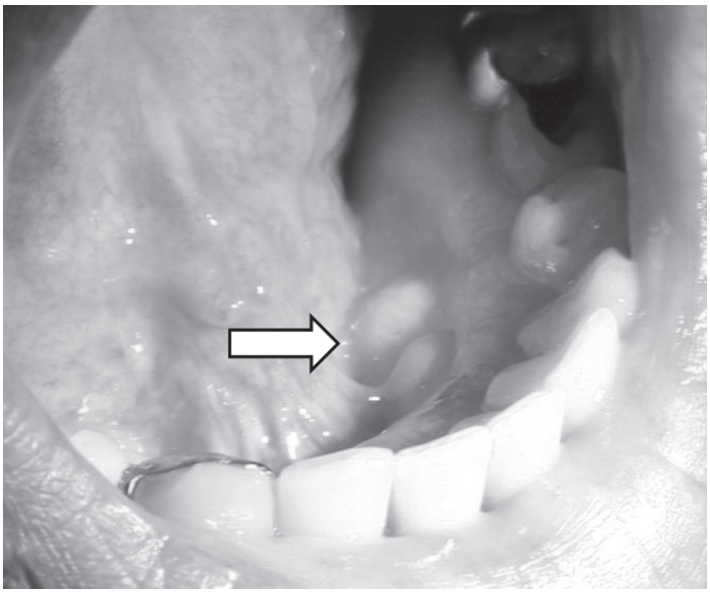

Figure. Two sublingual bony protuberences. *Used with permission of Sarah Unterman, MD, Jesse Brown VA Medical Center, Section of Emergency Medicine, Chicago, IL.*

A 61-year-old man with a history of diabetes, hypertension, hyperlipidemia and polysubstance abuse presented to the emergency department complaining of bony growths on his lower jaw. He had noticed these growths intermittently in the past. He reported pain only when his dentures were in place and food lodged against the growths. The patient denied ulceration, bleeding and drainage. He reported good compliance with dental care. On exam he had sublingual bony-appearing growths covered in normal oral mucosa. There was no lymphadenopathy. The growths were nontender and without discharge or fluctuance.

Torus mandibularis is a bony sublingual protuberance, typically near the canine and premolar teeth.[1] The etiology of tori is unclear. Possible causes include masticatory hyperfunction, continued bone growth, genetic factors and environmental factors such as diet.[1,2] The prevalence of tori has been estimated from 12.3% to 26.9% with an average age of onset typically in the fourth decade of life, and an increased prevalence in males.[2]

Tori tend to grow gradually, are usually nodular, and the majority remain less than 2mm in size.[2] They may be either unilateral or bilateral and singular or multiple.[2] Tori are usually asymptomatic, but patients may present with ill-fitting dental prostheses, mucosal ulceration or concern regarding oral cancer.[2] While it is usually unnecessary to remove tori, the most common reason for removal is interference with a dental prosthesis.[2] One case report describes a patient with large bilateral torus mandibularis resulting in intubation difficulty.[3]

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Cardiomyopathy Following *Latrodectus* Envenomation

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Latrodectus envenomations are common throughout the United States and the world. While many envenomations can result in catecholamine release with resultant hypertension and tachycardia, myocarditis is very rare. We describe a case of a 22-year-old male who sustained a *Latrodectus* envenomation complicated by cardiomyopathy. [West J Emerg Med. 2010; 11(5):521-523.]

INTRODUCTION

Widow spiders (genus *Latrodectus*) are very common, with more than 30 different species worldwide.[1] In 2008, 2,524 suspected black widow envenomations were reported to United States Poison Control Centers,[2] although this likely underestimates the true incidence of envenomation. Following envenomation, latrodectism, a syndrome characterized by severe muscular pain, abdominal pain and diaphoresis, is relatively common. More severe envenomations can result in agitation, nausea, hypertension, tachycardia, priapism and fasciculations.[1,3] Myocarditis, as manifested by chest pain, an abnormal electrocardiogram (ECG) and echocardiogram, and elevated serum troponin has only rarely been described following black widow envenomation. Furthermore, this unique entity has only been described in Europe and Saudi Arabia and involved species that are not indigenous to the United States.[4-8] To our knowledge, severe myocarditis has not previously been described following envenomation from any of the four species of *Latrodectus* spiders (*Latrodectus mactans, Latrodectus hesperus*, *Latrodectus geometricus*, or *Latrodectus variolus)* commonly found in the United States.

CASE REPORT

A 22-year-old male was transferred to our institution for toxicological evaluation of a presumed black widow envenomation.

The patient's past medical history was notable for fetal alcohol syndrome and a small congenital ventricular septal defect (VSD). He had no surgical history, except for placement of a chest tube after a traumatic injury five years prior to this presentation. He did not take any daily medications, and he denied using ethanol or illicit drugs but was a tobacco smoker of approximately one pack per day. Despite the history of fetal alcohol syndrome, he was highly functional and employed at a local store.

The patient was sitting outside on a bench at approximately 8 PM when he felt a sharp "poke" on his left thigh and saw a spider on his leg. Shortly thereafter, he developed lower back pain and abdominal pain. Tremors, diaphoresis and bilateral lower extremity paresthesias soon began. He presented to an emergency department (ED) where he was noted to have severe abdominal pain, prompting the clinicians to obtain a computed tomography (CT) of his abdomen and pelvis. His examination was notable for severe diaphoresis, periorbital edema, fasciculations and a target-like lesion over the left thigh. Throughout his 12-hour stay in the ED, he received three liters of normal saline, intravenous morphine, ketorolac, diphenhydramine and ranitidine. Because he was not improving, the decision was made to transfer the patient to our institution for toxicology evaluation.

During the transport, the patient received 100 mcg of intravenous fentanyl. Shortly thereafter, his oxygen saturation was noted to be in the mid 80s, prompting the administration of 2 mg of intravenous naloxone without improvement in the oxygenation. Supplemental oxygen was subsequently administered.

Upon arrival in the medical intensive care unit, the patient was noted to have a blood pressure of 157/94 mmHg and a heart rate of 103 beats per minute. His oxygen saturation was 89% on 4L of oxygen via nasal cannula. His exam was notable for diffuse muscle fasciculations without any muscular rigidity. He was diaphoretic and had distended neck veins with

diminished lung sounds. A chest radiograph shortly after arrival revealed diffuse pulmonary edema, and an ECG revealed an incomplete right bundle branch block with ST elevations in the precordial leads (Figure 1). Laboratory studies were notable for a troponin of 1.37 ng/mL with a CK of 243 IU/L. An arterial blood gas, obtained while breathing 10L/min of oxygen via a simple face mask revealed a pH of 7.33, pCO_2 of 42, and a pO_2 of 74.6. The patient received 20 mg of intravenous furosemide, with significant diuresis and subsequent improvement in the hypoxia. The patient received one vial of *Latrodectus* antivenom ("Antivenin [*Latrodectus mactans*], USP;" manufactured by Merck and Company) intravenously, which resulted in prompt normalization of the vital signs, and resolution of the diaphoresis, fasciculations, and pain.

Approximately two hours after arrival in the intensive care unit, and 15 hours after the envenomation, an echocardiogram revealed a left ventricular ejection fraction of 35-40% with mild to moderate tricuspid regurgitation and a right ventricular systolic pressure of 47 mmHg. No ballooning of the myocardium was noted on the echocardiogram. CT of the lungs revealed no evidence of pulmonary embolus. Repeat cardiac enzymes revealed decreasing troponin values. The patient was started on carvedilol 6.25 mg twice daily. A repeat echocardiogram 48 hours later revealed normalization of the left ventricular function and pressures. The patient was discharged home three days post envenomation.

DISCUSSION

We present a case of a severe black widow envenomation complicated by myocarditis, pulmonary edema, and a global, reversible, cardiomyopathy.

Following envenomation by the female widow spider, *alpha*-latrotoxin is the primary component of the venom, which is responsible for latrodectism.[1] *Alpha*-latrotoxin is a 120 kilodalton protein, which binds to the presynaptic neuron and results in the exocytosis of multiple neurotransmitters, including norepinephrine, acetylcholine and glutamate from the presynaptic cell.[9-11] This exocytosis occurs via both calcium-dependent and calcium-independent mechanisms.[10]

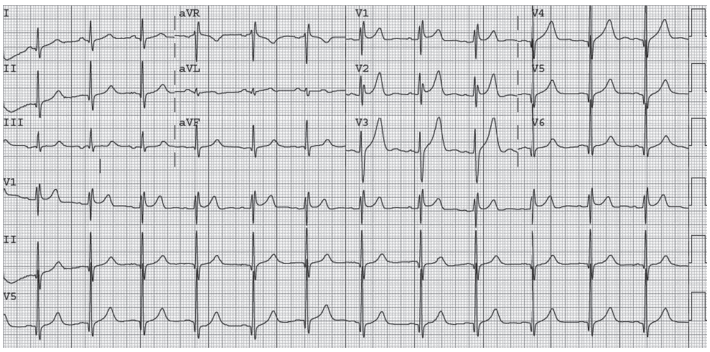

Figure 1. Electrocardiogram revealed an incomplete right bundle branch block with ST elevations in the precordial leads.

Alpha-latrotoxin can bind to the presynaptic receptor known as latrophin (also called Calcium Independent Receptor for *alpha* Latrotoxin [CIRL]). After binding occurs, the exact series of events is not known but may involve either phospholipase C signaling with IP_3 induced mobilization of intracellular calcium,[9, 12] or it might involve a different and unknown G protein/second messenger system.[10] Despite the exact intermediate steps not being known, it appears to result in the mobilization of intracellular calcium and subsequent exocytosis of neurotransmitters even in the absence of extracellular calcium.[9-10, 13] In addition, at higher concentrations, *alpha*-latrotoxin can directly form cationic channels in the cell membrane, resulting in an influx of extracellular calcium, with subsequent further release and exocytosis of multiple neurotransmitters.[10]

The exact cause of the reversible cardiomyopathy in this individual is not known. We hypothesize that the catecholamine surge produced by *alpha*-latrotoxin resulted in a myocardial stun, causing a rapidly reversible myocarditis.

As with many patients with significant *Latrodectus* envenomations, our patient had hypertension, tachycardia, diffuse back, abdominal pain and profound diaphoresis.[3] Despite not having the spider available for identification, given the constellation of symptoms and the temporal association between resolution of symptoms and the administration of antivenom, we believe this to be a black widow envenomation.

This individual did have a prior history of a congenital VSD. However, given the echocardiographic findings resolved 48 hours later, we do not believe that observed findings were the result of the VSD. Rather, we believe it was the result of the envenomation. It is not known if the prior congenital heart disease somehow predisposed him to myocarditis.

While myocarditis has been previously reported, albeit rarely, it has never been reported in North America. Given that envenomation from any member of the genus can likely produce a similar clinical picture, we do not have a clear explanation why myocarditis has not previously been described in North America, despite clearly having a large number of these spiders. Because the species of black widow differ in Europe and the United States, we believe this is the first case of myocarditis occurring following *Latrodectus hesperus* envenomation, the only *Latrodectus* species that inhabits the Southwest.

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Cholinergic Crisis after Rodenticide Poisoning

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Rodenticides have historically been common agents in attempted suicides. As most rodenticides in the United States (U.S.) are superwarfarins, these ingestions are generally managed conservatively with close monitoring for coagulopathy, and if necessary, correction of any resulting coagulopathy. However, alternate forms of rodenticides are imported illegally into the U.S. and may be ingested either accidentally or in suicide attempts. We present an unusual case of poisoning by the illegally imported rodenticide, "Tres Pasitos." The main ingredient of this rat poison is aldicarb, a potent carbamate pesticide that causes fulminant cholinergic crisis. This case is relevant and timely because carbamates and organophosphates are still used as insecticides and emergency physicians (EP) working in rural areas may have to evaluate and manage patients with these poisonings. As international travel and immigration have increased, so has the possibility of encountering patients who have ingested toxic substances from other countries. In addition, there has been increased concern about the possibility of acts of terrorism using chemical substances that cause cholinergic toxidromes.[1,2] EPs must be able to recognize and manage these poisonings. This report describes the mechanism of action, clinical manifestations, laboratory evaluation and management of this type of poisoning. The pertinent medical literature on poisoning with aldicarb and similar substances is reviewed. [West J Emerg Med. 2010; 11(5): 524-527.]

CASE REPORT

A 29-year-old male presented to the emergency department (ED) after a suicide attempt by ingesting a large amount of rat poison, which according to emergency medical services (EMS) occurred just prior to arrival. Although EMS had been told that the patient had ingested a rat poison, the exact type of rodenticide was unknown.

Upon arrival to the ED, the patient was diaphoretic and in moderate respiratory distress. His vital signs were as follows: temperature 36.0 ^{0}C, blood pressure 113/99 mm Hg, heart rate 100 beats/minute, respiration rate 28 breaths/minute and oxygen saturation 88% on room air.

On arrival he was awake but appeared to be confused and was not answering questions. Excessive secretions were noted. His neck was supple. He had respiratory distress with harsh breath sounds and rhonchi throughout both lung fields. He was tachycardic but had a regular rhythm. The abdomen was soft and non-tender with increased bowel sounds. The patient had urinated on himself. He was moving all extremities but had some muscle fasciculations. His skin was diaphoretic, but no rash or track marks were evident. He was confused, uncooperative and not speaking. The pupils were 2 mm and non-reactive to light. Cranial nerves otherwise appeared to be intact. It was difficult to assess his motor, sensory and cerebellar function because he was very uncooperative. Initially he was moving all his extremities.

An initial bedside serum glucose analysis was 186 mg/dL. Other laboratory values were as follows: serum sodium 138 mmol/L, potassium 2.9 mmol/L, chloride 101 mmol/L, bicarbonate 17 mmol/L, glucose 247 mg/dL, blood urea nitrogen 16 mg/dL, and creatinine 1.0 mg/dL. Complete blood count showed a white blood count of 12.8 × 103/μL with 58% neutrophils and 33% lymphocytes, hemoglobin level of 17.2 g/dL and platelet count of 311,000 × 103/μL. Creatine kinase (CK) was 191 U/L (40-210) and CK-MB was 1.96 ng/ml (0.0-4.99) with a CK-MB index of 1% (0.0-2.49). Troponin I level was < 0.20 μg/L (0-2). His liver function tests showed that bilirubin, AST, ALT, and lipase were all within the normal

range. Urine analysis was normal and the urine toxicology screen was negative. The coagulation profile was normal. His electrocardiogram showed sinus tachycardia without ischemic changes or QRS or QT prolongation. A plasma cholinesterase level was drawn and sent to the laboratory.

Fifteen minutes after being initially assessed, his condition rapidly deteriorated. He developed excessive salivation with large amounts of foamy white secretions, which continually spewed from his mouth, making it very difficult to keep his airway clear, even with mechanical suctioning. His oxygen saturation dropped into the low 80s, despite receiving high flow oxygen, and he was subsequently intubated. He was given 2 mg lorazepam intravenously (IV) prior to intubation to sedate him, and he was given another 2 mg of it after he was intubated.

Based on the history and physical examination findings, which were consistent with an overdose of a cholinergic agent – probably an organophosphate or carbamate – the patient was given 2 mg of atropine IV, without any effect. He was then given another 2 mg IV every five minutes until his secretions were dry. He received a total of 16 mg of atropine IV in the ED. He was also given 1 gram of pralidoxime as an IV infusion over 30 minutes. He was hydrated with intravenous normal saline and his hypokalemia was corrected with potassium chloride.

When the staff realized that he had possibly taken an organophosphate, they double gloved and donned gowns and masks. All of the patient's clothes were removed and discarded in plastic bags. He was washed with soap and water. After he was intubated, a nasogastric tube was inserted. He was lavaged and 50 grams of activated charcoal was administered down the nasogastric tube. None of the EMS or ED personnel developed any signs or symptoms of cholinergic poisoning.

After intubation and treatment with atropine, pralidoxime and lorazepam, the patient's respiratory status showed marked improvement. His oxygen saturation was 100%. He was admitted to the intensive care unit, where he did not require any further treatment with atropine or pralidoxime. He was weaned off the ventilator and extubated without difficulty on hospital day 4. He remained stable and was transferred to the medical floor where psychiatry was consulted. The patient was then admitted for attempting to suicide by ingesting a rat poison called "Tres Pasitos." Its active ingredient is aldicarb, a very potent carbamate. His initial serum cholinesterase level was 103 units/ml (normal range 350-934), confirming the clinical diagnosis. This level was not repeated, because his clinical status greatly improved.

Eventually, he was cleared by psychiatry and discharged home with appointments for close follow up in the medical and psychiatry clinics. When the patient was seen in the medical clinic one week after discharge, he had no complaints, and no evidence of residual toxicity was found on examination. No further testing was performed.

DISCUSSION

Rodenticides come in many forms with a "superwarfarin" being a common type of rodenticide used in the U.S. In 2008, 3.8% of the reports of poisonings were related to pesticides.[3] Other types of rodenticides are phosphides, phosphorus, strychnine, thallium, sodium fluoroacetate and cholinesterase inhibitors. Because cholinesterase inhibitors are no longer registered for rodenticidal use in the U.S., cholinergic symptoms and signs are uncommon in patients who report ingesting a rodencticide. Although illegal in the U.S., "Tres Pasitos" is bought and sold legally in certain Latin American countries and often imported unlawfully for sale in this country. The name "Tres Pasitos" (Spanish for "three little steps") signifies the rapid lethal effects to mice, i.e. they can only take three little steps before dropping dead. Fatal intoxication with aldicarb, the active ingredient in "Tres Pasitos," has been reported.[4] Poisonings in the U.S. from "Tres Pasitos" has occurred between 1994-1997, when the New York City Poison Control Center was consulted regarding 25 patients who developed cholinergic toxicity after ingesting "Tres Pasitos."[5] Aldicarb is also used as a potent insecticide, and poisonings from exposure to this substance in agricultural areas and toxicity from the ingestion of aldicarb contaminated food have also been reported.[6]

With increases in immigration to the U.S. and international travel, it is reasonable to assume that there may be an increase in toxic substances brought to this country from other nations. Just as we should get a travel history in patients who present with fever or diarrhea, we should also consider the possibility of poisoning by an imported toxin when evaluating a patient with an unusual toxidrome.

Concern now exists for the possibility of terrorist attacks using chemical agents. In fact, two incidents of attacks using the cholinesterase inhibitor nerve agent, sarin, have occurred in the recent past.[7,8] The actions, clinical manifestations and management of poisoning by these agents are very similar to those of pesticides, such as organophosphates and carbamates like aldicarb. Therefore, it is very important that EPs be able to quickly recognize and manage cholinergic toxicity.

Aldicarb [2-methyl-2-(methylthio)-propionaldehyde O-(methylcarbamoyl) oxime], is a very potent carbamate.[9] Aldicarb is rapidly absorbed via the gastrointestinal tract.[10] It binds to and inhibits human cholinesterase, which normally breaks down acetylcholine, resulting in an excess of aceylcholine and enhancement of its physiological effects at muscarinic, nicotinic and central nervous system (CNS) receptors causing a cholinergic crisis.[11] It inhibits both red blood cell (RBC) cholinesterase and plasma pseudocholinestrase. Aldicarb has an LD_{50} (median lethal dose) in humans of 0.8 mg/kg. It is a toxic cholinergic agent that has caused many fatalities.[12] It is especially toxic to the nervous system and is excreted completely in the urine within 24 hours.

Clinical findings of toxicity reflect effects of excessive cholinergic stimulation at muscarinic, nicotinic and CNS receptors.[13] Excessive stimulation of muscarinic receptors produces the "SLUDGE" toxidrome: salivation, lacrimation, urination, diarrhea, gastric secretions and emesis. It also produces miosis, and the "triple Bs": bradycardia, bronchospasm and bronchorrhea. Bronchospasm and bronchorrea are especially dangerous, and patients can literally drown in their own secretions. In a case series of patients in Rio de Janeiro, who were poisoned by carbamates that were illegally used as rodenticides, all victims were noted to have at least two symptoms and/or signs of muscarinic toxicity described by the SLUDGE mnemonic.[14]

Aldicarb can also cause hyperactivity at nicotinic sites, especially at the skeletal muscle junctions, causing muscle fasciculations, weakness and paralysis that may lead to significant morbidity and mortality. Hyper-stimulation at the nicotinic receptors of the autonomic ganglia may cause tachycardia, mydriasis and hypertension, instead of bradycardia, miosis and hypotension that are seen when muscarinic stimulation at these sites predominates. Tachycardia may also be due to hypoxia. This is important to consider when both evaluating and treating these patients. When treating these patients with atropine, it is important to remember that the end point for atropinization is when secretions have been dried, not the presence of tachycardia or dilated pupils.[15]

CNS toxicity often occurs with aldicarb and may be manifested as delirium, lethargy, coma or, less commonly, seizures. In one study that reviewed anti-cholinesterase poisonings, including aldicarb, the most common muscarinic symptom was diarrhea, the most common nicotinic symptom was muscle fasciculation and almost half of the patients had CNS depression with a Glasgow Coma Scale of less than eight.[16] Therefore, the authors like to use a modified DUMBELS mnemonic (diarrhea, urination, miosis, muscle fasciculations, muscle weakness, mental status changes, bradycardia, bronchorrhea, bronchospasm, emesis, lacrimation and seizures) when evaluating patients for possible toxicity from aldicarb, other carbamates or organophosphates, as it describes the muscarinic, nicotinic and CNS effects of these toxins.

The diagnosis of poisoning with an anti-cholinesterase agent, such as aldicarb, in the ED must be made clinically based on the history and/or recognition of this toxidrome. Laboratory measurement of cholinesterase activity can help to eventually confirm the diagnosis. This can also be useful in following the course of this illness and for public health and epidemiologic purposes. Two types of cholinesterases, plasma (or pseudo-cholinesterase) and RBC cholinesterase, can be measured and both of their levels are decreased by anti-cholinesterase toxins. However, although plasma cholinesterase is more easily performed by most laboratories, RBC cholinesterase is more accurate and correlates better with the severity of poisoning.[17]

Because severe anti-cholinesterase poisoning has significant morbidity and mortality, emergency management should not be delayed once the diagnosis is suspected. The most important aspect of the treatment of aldicarb poisoning is to support the airway, breathing and circulation (ABC) of the patient. Special attention must be given to the airway and breathing, as these patients may become very hypoxic from excessive secretions, bronchorrhea, bronchospasm, weakness of respiratory muscles and CNS depression. In severe cases, the patient may require intubation. In these cases the patient should be paralyzed with non-depolarizing agents, such as vecuronium, if needed, rather than succinylcholine, which is metabolized by plasma cholinesterase and may cause prolonged paralysis.[18]

After stabilization of ABCs, specific therapy involves blockade of acetylcholine effects at both muscarinic and nicotinic receptors. Atropine provides inhibition at muscarinic receptors in both the CNS and the periphery. Very large doses are often needed. Therapy is begun with a dose of 2 mg in adults and 0.02 mg/kg (minimum dose of 0.1 mg) in children. This can then be repeated every three to five minutes until drying of pulmonary secretions has occurred. An alternative way of giving atropine in very severe cases is to start with 2 to 5 mg IV in adults and 0.05 mg/kg in children and to double the dose every five minutes until secretions are dried up. As noted above, very large doses of atropine may be required, and the EP should not be afraid to use enough atropine to dry secretions. Atropine is not effective for reversing nicotinic effects. Patients can still develop respiratory failure from muscle paralysis, and these patients must be closely monitored and mechanically ventilated as needed.

The use of pralidoxime (2-PAM) in the treatment of poisoning by carbamates, including aldicarb, is somewhat controversial since, unlike organophosphates, the cholinesterase poisoned by a carbamate reactivates within a day. Therefore, pralidoxime, which markedly increases the regeneration of acetylcholinesterase and reverses both nicotinic and muscarinic toxicity, may not be needed, especially in mild to moderate poisonings. However, recent reports show that pralidoxime improves morbidity and mortality with severe poisonings from most carbamates.[9,19] It makes the patient easier to manage by decreasing the atropine requirement and by treating nicotinic toxicity. Pralidoxime therapy should therefore not be withheld in a patient with significant cholinergic toxicity, because it is thought that the poisoning may be caused by a carbamate. Benzodiazepines, such as diazepam or lorazepam, can be used to control seizures and CNS agitation.

It is also important to decontaminate patients who have aldicarb on their skin or clothing because it is rapidly absorbed through the skin. They should be totally exposed and

vigorously washed with soap and water. Anyone handling these patients or their clothing should be appropriately gowned and gloved. In the case of patients who have ingested the poison, like ours, and emesis has not occurred yet, gastric lavage with airway protection needs to be performed. Activated charcoal should also be administered through the nasogastric tube.

Although, if untreated or treated incorrectly, patients with poisoning from aldicarb can easily die, most patients do well if they are diagnosed rapidly and managed appropriately. The intermediate syndrome, muscle weakness and other neurological signs occurring after 24 hours, is rarely seen with aldicarb poisoning.[20]

Our major limitation was that we were unable to obtain confirmatory laboratory or forensic evidence that the patient ingested aldicarb. We were not able to actually get samples of the "Tres Pasitos" that he took, nor did we measure aldicarb levels or levels of its metabolites. However, based on the history, his cholinergic toxidrome, his response to the appropriate therapy and very low serum cholinesterase level, it is conclusive that he took this poison. It must be emphasized that when possible, it is very helpful to get the "bottles" when evaluating a patient with a possible poisoning or overdose.

CONCLUSION

We presented the case of a patient who ingested a rat poison, "Tres Pasitos," which was illegally imported into the U.S. This substance, which contains aldicarb, caused a life-threatening cholinergic crisis. Due to increased immigration and international travel, it should be expected that similar cases will continue to be seen in our EDs. Because our patient's cholinergic toxidrome was quickly recognized and correctly managed, he did very well.

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Penetrating Atherosclerotic Aortic Ulcer

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A 79-year-old female presented to the emergency department complaining of two weeks of dyspnea on exertion and heart palpitations. A computed tomography (CT) pulmonary angiogram was obtained to rule out pulmonary embolism, which was negative. An incidental finding of a penetrating atherosclerotic ulcer (PAU) of the descending aorta was reported (Figure 1). A focused bedside ultrasound of this structure was then performed (Figure 2).

This patient was admitted to the hospital with a vascular surgery consultation and managed with blood pressure control. She was discharged home after a negative work-up for her dyspnea with vascular surgery follow up.

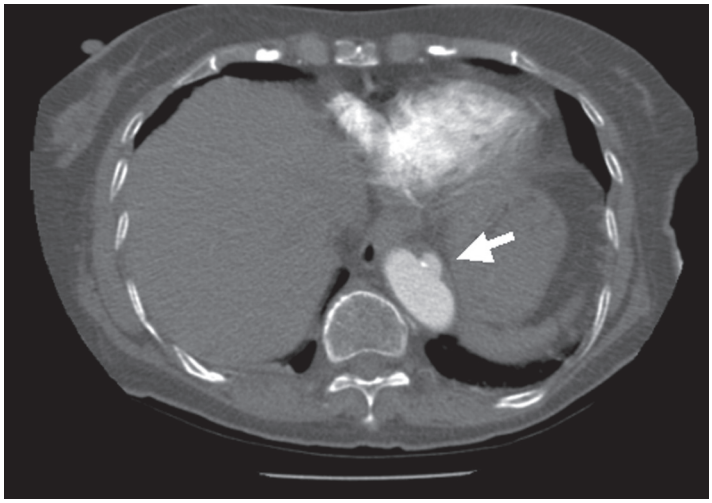

Figure 1. Computed tomography image depicting the lesion in the descending aorta.

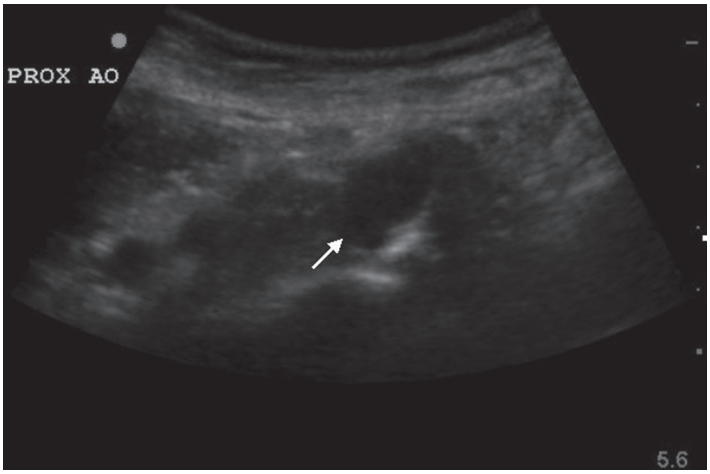

Figure 2. Ultrasound image of the proximal abdominal aorta.

DISCUSSION

PAU occurs due to ulceration of the intima layer of the aorta leading to exposure of the media. Up to 20% of patients will be asymptomatic on presentation; however, most patients complain of anterior chest or midscapular back pain.[1] PAU is uniformly associated with hypertension and presents between the seventh and ninth decades of life.[2]

Ultrasound findings of PAU are based largely upon transesophageal echocardiography describing an asymmetric out pouching of the aortic wall with jagged edges and no intimal flap.[3] In our experience the findings on bedside abdominal ultrasound of a descending PAU are similar to saccular aortic aneurysms and CT is helpful in differentiating these conditions. We believe this is the first description of PAU on bedside abdominal ultrasound in the literature.

Management of ascending PAU is emergent surgical repair while descending PAU can be managed with tight blood pressure control and repeat imaging. PAU is a rare but serious clinical entity. While the rate of rupture is as high as 40% in one series of symptomatic patients, many reports suggest a much lower rate when PAU is an incidental diagnosis.[4]

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Expressive Aphasia and Carotid Dissection

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Ultrasound images of a patient presenting to the emergency department with expressive aphasia who was found to have carotid dissection. The first image is a standard two dimensional image that depicts the internal carotid with a visible flap within the lumen. The second image is a color Doppler image showing turbulent flow within the true lumen and visible flow within the false lumen. The case and the patient's outcome are summarized along with some teaching points about carotid dissection. Also, there is some background and research on using ultrasound to help identify dissection. [West J Emerg Med. 2010;11(5):530-531.]

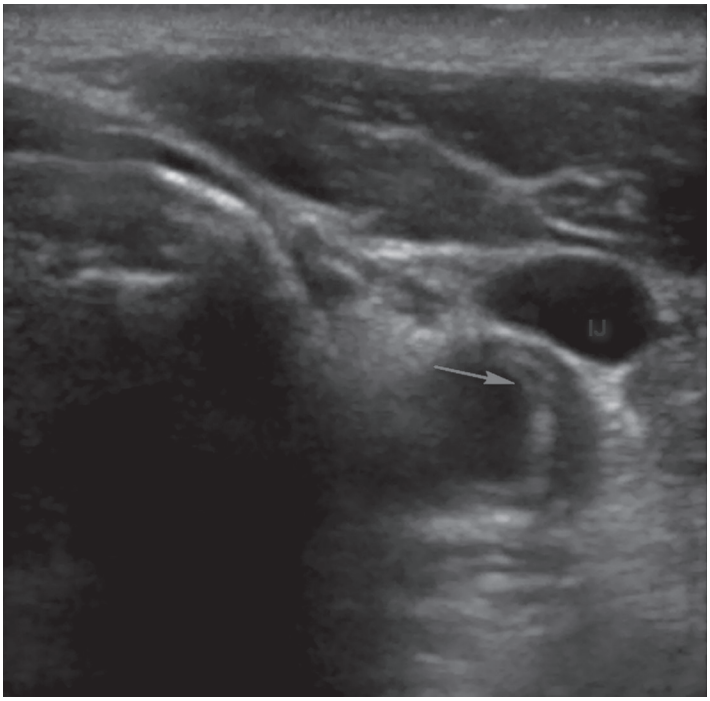

Figure 1. Ultrasound of the common carotid artery showing an intimal flap (IJ) [arrow].

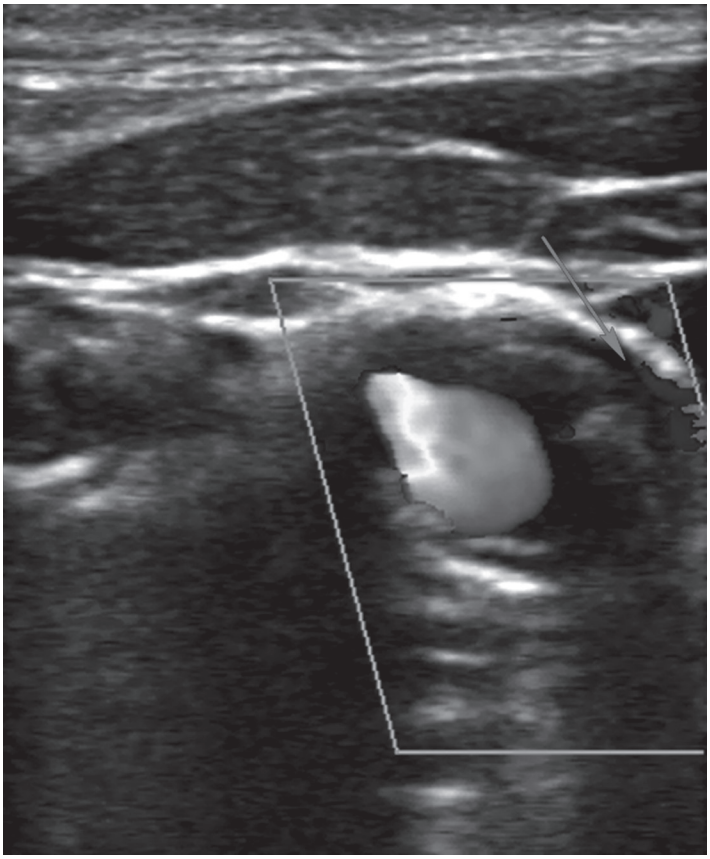

Figure 2. Color Doppler ultrasound (CDUS) showing aliasing, suggesting high velocity flow through narrowed true lumen. Flow is also noted through the false lumen (arrow).

CASE REPORT

A 78-year-old man presented to the emergency department (ED) with a five-minute episode of acute weakness, disequilibrium and dizziness that resolved without

intervention. He had a negative evaluation, including head computed tomography (CT), magnetic resonance imaging and consultations by neurology and cardiology. He was discharged the next morning with a Holter monitor but re-presented several hours following discharge with a new expressive aphasia. Bedside ultrasound and CT angiogram at re-presentation revealed carotid dissection with near complete occlusion. The patient underwent emergent stent placement of the left common and internal carotid arteries.

DISCUSSION

Classically, carotid dissection should be considered in patients who present with symptoms of a transient ischemic attack or cerebrovascular accident who are younger than 45 or have a history of neck trauma. However, dissection may occur in older populations, those without antecedent trauma and in patients of any age with connective tissue disorders. Delay in diagnosis of carotid dissection is common because dissection usually presents with headache or neck pain prior to the development of neurologic symptoms, and since tests routinely ordered to evaluate neurologic complaints (i.e. noncontrast head CT or lumbar puncture) can fail to identify dissection.[1,2] Standard two dimensional ultrasound can identify up to 72% of dissections and an additional 10% can be identified with use of color Doppler, which helps to highlight a false or double lumen. Combined with Doppler velocimetry, which is beyond the scope of the focused bedside evaluation for the emergency physician, the sensitivity is in the mid-90s.[3]

While Doppler techniques may require specialized training, they are not beyond the scope of emergency ultrasound. For carotid dissection ultrasound is very specific, but additional imaging should be obtained if the ultrasound is negative and dissection is suspected.[3-5] In the ED, carotid ultrasound may allow rapid diagnosis of dissection leading to expedited and definitive care, such as the stent in this patient and avoiding potentially harmful, time-sensitive treatments, such as thrombolysis. Future studies should evaluate the feasibility of bedside carotid ultrasound by emergency physicians.

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Intrapericardial Diaphragmatic Hernia

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An adult male presented to the emergency department complaining of two days of exertional shortness of breath and progressive chest pain. He was afebrile with a blood pressure of 135/88 mmHg, heart rate of 105 beats/minute, respiratory rate of 22 breaths/minute, and a SaO_2 of 94% on room air. There was no history of preceding trauma, surgery or known congenital defects. A chest radiograph demonstrated an enlarged cardiac silhouette (Figure 1). Computed tomography revealed the presence of herniated visceral contents within the pericardial sac (Figure 2). Surgery was consulted for operative repair of this intrapericardial diaphragmatic hernia (IPDH), which was causing his presenting symptoms.

IPDH can occur from a traumatic or congenital diaphragmatic defect of the central tendon. It is a rare complication of diaphragmatic rupture, occurring in less than 1% of cases.[1,2] Blunt trauma resulting from automobile collisions has emerged as the most common primary identified cause.[3] The mechanism in blunt abdominal trauma involves

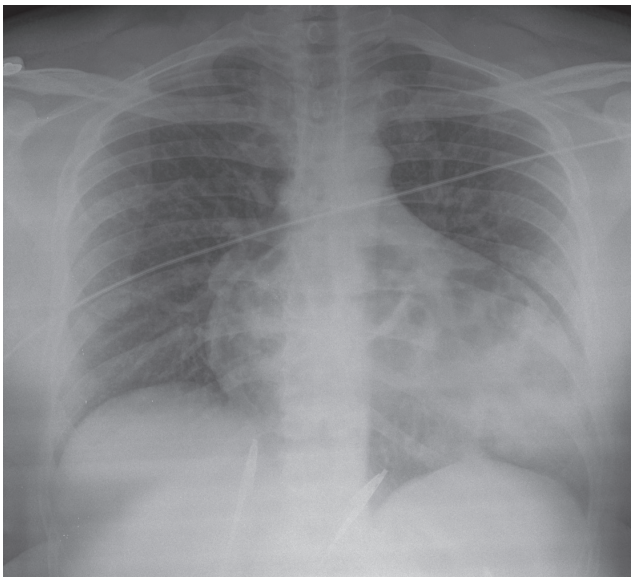

Figure 1. Chest radiograph demonstrating abnormal air shadowing over the enlarged pericardial sac.

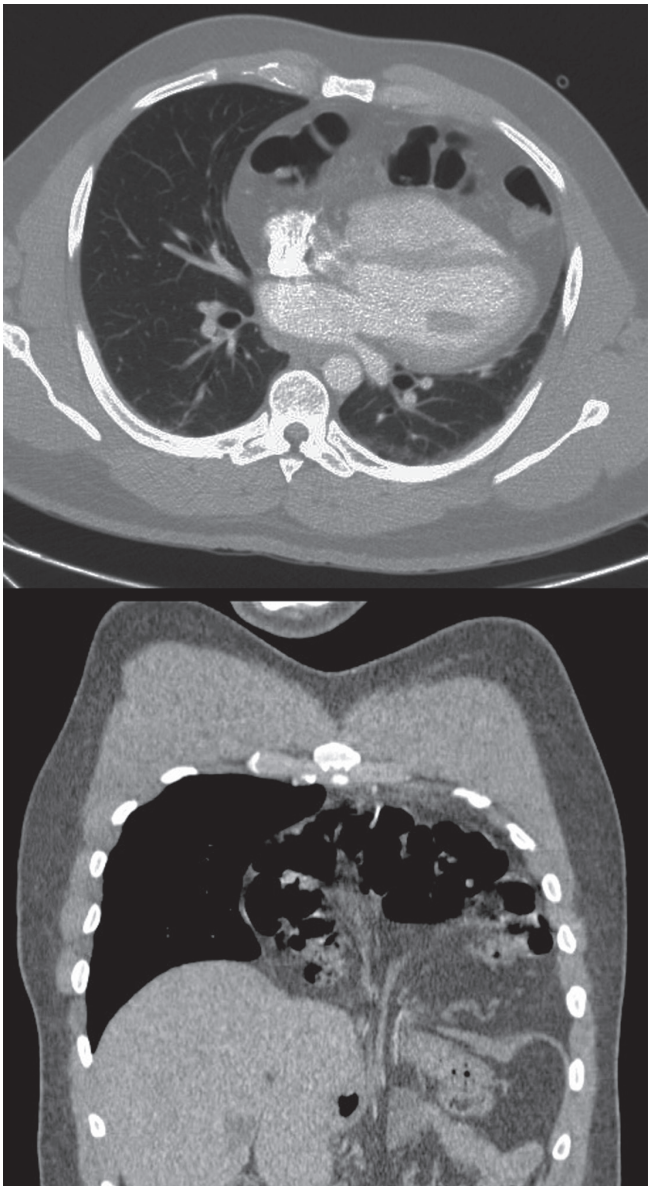

Figure 2. Transverse (top) and sagittal (bottom) computed tomography (CT) images demonstrating posterior displacement of the anterior heart by transdiaphragmatic herniated bowel.

a sudden rise in intra-abdominal pressure, leading to rupture along the right or left side of the diaphragm extending into the pericardium. The organ most frequently involved in traumatic IPDH appears to be the transverse colon, followed by the stomach and the greater omentum.[2] Symptoms of IPDH are often nonspecific cardiorespiratory and gastrointestinal complaints. Patients range from being asymptomatic to having potentially fatal cardiac tamponade. The time interval from the presumed origin of the IPDH to the time of diagnosis is quite variable for both traumatic and congenital etiologies.[1] Treatment for IPDH is surgical. A thoracic approach is recommended by most authors in cases of delayed IPDH, as this allows for easier removal of pericardial adhesions; whereas, a trans-abdominal approach is preferred for surgical closure in acute presentations to provide good access to the tear in the diaphragm.[3]

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