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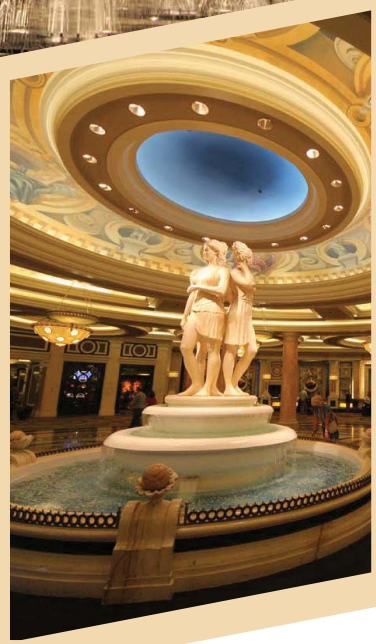

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Western Journal *of* Emergency Medicine:

Integrating Emergency Care with Population Health

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Integrating Emergency Care with Population Health

JOURNAL FOCUS

Emergency medicine is a specialty which closely reflects societal challenges and consequences of public policy decisions. The emergency department specifically deals with social injustice, health and economic disparities, violence, substance abuse, and disaster preparedness and response. This journal focuses on how emergency care affects the health of the community and population, and conversely, how these societal challenges affect the composition of the patient population who seek care in the emergency department. The development of better systems to provide emergency care, including technology solutions, is critical to enhancing population health.

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Western Journal *of* Emergency Medicine:

Integrating Emergency Care with Population Health

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Call for Papers
2015 *Academic Emergency Medicine* Consensus Conference

Diagnostic Imaging in the Emergency Department:
A Research Agenda to Optimize Utilization

The 2015 *Academic Emergency Medicine* (*AEM*) consensus conference, **Diagnostic imaging in the emergency department: A research agenda to optimize utilization** will be held on May 12, 2015, immediately preceding the SAEM Annual Meeting in San Diego, CA. Original papers on this topic, if accepted, will be published together with the conference proceedings in the December 2015 issue of *AEM*.

Diagnostic imaging is integral and beneficial to the practice of emergency medicine. Over the last several decades, emergency department (ED) diagnostic imaging has increased without a commensurate rise in identified pathology or improvement in patient-centered outcomes. Unnecessary imaging results in increased resource use and significant exposure risks. ED diagnostic imaging has become the focus of many stakeholders, including patients and various regulatory agencies. This multidisciplinary consensus conference represents the first coordinated effort to further our evidence-based knowledge of ED diagnostic imaging. This consensus conference will formulate the research priorities for emergency diagnostic imaging, initiate a collaborative dialogue between stakeholders, and align this research agenda with that of federal funding agencies.

Consensus Goal:
The overall mission of the 2015 *AEM* consensus conference will be to create a prioritized research agenda in emergency diagnostic imaging for the next decade and beyond. The consensus conference will feature expert keynote speakers, panel discussions including nationally recognized experts, and facilitated breakout group sessions to develop consensus on research agendas by topic. Optimizing diagnostic imaging in the ED is a timely topic that is relevant to all who practice emergency medicine. Furthermore, the conference content spans many other specialties (e.g. radiology, pediatrics, cardiology, surgery, internal medicine), all of which will be invited to participate in the conference to optimize the agenda and for future collaboration in order to improve emergency diagnostic imaging use.

Consensus Objectives:
1. Understand the current state of evidence regarding diagnostic imaging utilization in the ED and identify opportunities, limitations, and gaps in knowledge of previous study designs and methodology
2. Develop a consensus statement that emphasizes the priorities and opportunities for research in emergency diagnostic imaging that will result in practice changes, and the most effective methodologic approaches to emergency diagnostic imaging research
3. Explore and improve knowledge of specific funding mechanisms available to perform research in emergency diagnostic imaging

Accepted manuscripts will present original, high-quality research in emergency diagnostic imaging in areas such as clinical decision rules, shared decision making, knowledge translation, comparative effectiveness research, and multidisciplinary collaboration. They may include work in clinical/translational, health systems, policy, or basic sciences research. Papers will be considered for publication in the December 2015 issue of *AEM* if received by April 17, 2015. All submissions will undergo peer review and publication cannot be guaranteed.

For queries, please contact Jennifer R. Marin, MD, MSc (jennifer.marin@chp.edu) or Angela M. Mills, MD (millsa@uphs.upenn.edu) the 2015 consensus conference co-chairs. Information and updates will be regularly posted in *AEM*, the SAEM Newsletter, and the journal and SAEM websites.

Special Delivery

Lori Ludeman, MD University of California, Irvine, Department of Emergency Medicine, Irvine, California

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Two months into my intern year I experienced something that I thought only happened on television. It was 3 a.m. on a relatively uneventful night shift. Being one of the newest residents working that evening I expected to get the less desirable cases, and this one felt no different. A new patient showed up on the grease board: a 22-year-old female with a chief complaint of constipation.

"Sounds like a perfect intern case," said my co-R2, "nothing like a mid-shift fecal disimpaction."

As one could imagine, my expectations of something remotely interesting happening were fairly tempered. But knowing your role is important, so I marched into the patient's room to see what was going on.

As I entered the room I found the patient's mother sitting in the chair and giving off an air of no apparent concern. She nonchalantly informed me that her daughter was in the restroom. The patient had fortunately been given the "Communicable Disease" room, so she was in the only room in the department with a private bathroom. At the time it seemed rather appropriate for a constipation case, but otherwise I thought nothing of it.

That was until I told the patient that I would come and check on her when she was out and we could do an exam. The patient sounded quite concerned and yelled through the bathroom door, "Please don't go!" She continued, "I haven't gone to the bathroom in a week and I feel a lot of pressure down there. Something is wrong, something is happening!"

I felt somewhat confused at this point for what my next step would be because I figured she was just constipated and was finally able to go to the bathroom. However, she sounded legitimately scared so I knew that there must have been something more going on. I grabbed some gloves and announced that I needed to come in to make sure that she was okay.

When I entered the bathroom this young woman did not seem relieved to be getting over her constipation, but was instead screaming in apparent agonizing pain. I had just finished a month on an Ob-Gyn rotation and I was quite familiar with the face she was making. To me, it looked like she was in labor.

"Is there any chance that you are pregnant?" I asked when I made the connection. The patient responded with a fairly authoritative "no." However, as soon as I lifted up her gown, lo and behold, there was a fetus' head crowning and about to be baptized in the toilet bowl. It is unclear who was more shocked, this young woman or myself, when I exclaimed that she was not only pregnant, but was giving birth at this very moment. Luckily my prior month in labor and delivery was fresh in my mind, so I reacted immediately and carefully guided out the baby's head and lifted it from the toilet.

The patient was flabbergasted, the mother was beside herself, and I was getting over my disbelief that I had just delivered a baby in a bathroom to a woman who didn't know she was pregnant. I yelled for the Emergency Department (ED) nurse who entered the room just as surprised as to what was going on as the rest of us. I instructed the nurse to grab the attending physician and two clamps. We cut the cord, and the charge nurse brought in the warmer. The Neonatal Intensive Care Unit nurses and the OB team were there momentarily to assist. The baby had Apgar scores of eight, nine, and besides its existence being a complete and utter mystery five minutes prior, seemed perfectly healthy. We then finished the delivery of the placenta, and but for the unorthodox nature of the experience, there were no physical complications.

The complete spontaneity of this experience encapsulates emergency medicine for me. There is just something unique about the specialty. Every day can be an adventure and arriving at work you do not know what the next twelve hours will bring.

While this particular patient encounter was exciting, it also serves as a microcosm that demonstrates the challenges our healthcare system faces as a whole. It is baffling to most that this type of health illiteracy could possibly exist, yet the emergency department comes across patients like this regularly. Your average individual cannot comprehend how a woman could go through an entire pregnancy seemingly unaware of what was happening to her body, yet the structure in place for this woman seemingly fostered her ignorance.

After the emotion and excitement of the unexpected delivery had died down, I went and spoke to the patient about how it came to this. She freely admitted that she felt as if

something was wrong for a few months but was unable, or at times unwilling, to see a physician. The patient explained that she could not retain a regular primary care doctor due to a lack of insurance. Additionally, she had often gone to clinics and low-cost urgent care facilities, only to be shuffled about without any substantive medical attention. She informed me that regardless of the attempts she had made to obtain care, she always ended up in the emergency room as that was the only place she felt able to get a competent diagnosis despite her income. However, she was even reluctant to take this route due to the constant fear of receiving an oppressive bill she would be wholly unable to pay. It is unfortunate that we have people in this country who are forced to gamble with their health in this regard. Emergency departments throughout the nation must bear this burden to serve as the medical safety net for patients such as these.

The ED welcomes patients of all ages, genders, socioeconomic status, and disease processes. No matter who walks through the door you need to be competent, professional, and most importantly, ready for anything. We work closely with not only the other doctors and nurses, but police, firefighters, EMTs, and social workers. It is the quintessential team effort and you need to learn to respond, react, and effectively and efficiently lead when called upon. I believe emergency medicine is the most exciting practice area out there and feel so fortunate to be a member of the emergency family.

As it turned out, my apparent fecal disimpaction proved itself to be a fetal delivery worthy of *I Didn't Know I Was Pregnant*, and I do not think many other jobs can say that. I know that I have chosen the right career for me. This story just proves that the life of an ED physician can be fun, unique, and occasionally stressful. But ultimately there is nothing more rewarding as far as I'm concerned. If only someone would think to make a television show about the emergency room. Seems like it could be a hit.

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Compassion Fatigue is Similar in Emergency Medicine Residents Compared to other Medical and Surgical Specialties

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Introduction: Compassion fatigue (CF) is the emotional and physical burden felt by those helping others in distress, leading to a reduced capacity and interest in being empathetic towards future suffering. Emergency care providers are at an increased risk of CF secondary to their first responder roles and exposure to traumatic events. We aimed to investigate the current state of compassion fatigue among emergency medicine (EM) resident physicians, including an assessment of contributing factors.

Methods: We distributed a validated electronic questionnaire consisting of the Professional Quality of Life Scale with subscales for the three components of CF (compassion satisfaction, burnout and secondary traumatic stress), with each category scored independently. We collected data pertaining to day- versus night-shift distribution, hourly workload and child dependents. We included residents in EM, neurology, orthopedics, family medicine, pediatrics, obstetrics, and general surgery.

Results: We surveyed 255 residents, with a response rate of 75%. Of the 188 resident respondents, 18% worked a majority of their clinical shifts overnight, and 32% had child dependents. Burnout scores for residents who worked greater than 80 hours per week, or primarily worked overnight shifts, were higher than residents who worked less than 80 hours (mean score 25.0 vs 21.5; p=0.013), or did not work overnight (mean score 23.5 vs 21.3; p=0.022). EM residents had similar scores in all three components of CF when compared to other specialties. Secondary traumatic stress scores for residents who worked greater than 80 hours were higher than residents who worked less than 80 hours (mean score 22.2 vs 19.5; p=0.048), and those with child dependents had higher secondary traumatic stress than those without children (mean score 21.0 vs 19.1; p=0.012).

Conclusion: CF scores in EM residents are similar to residents in other surgical and medical specialties. Residents working primarily night shifts and those working more than 80 hours per week appear to be at high risk of developing compassion fatigue. Residents with children are more likely to experience secondary traumatic stress. [West J Emerg Med. 2014;15(6):629–635]

INTRODUCTION

Compassion is a sympathetic pity and concern for the sufferings or misfortunes of others.[1] For healthcare workers and in particular for emergency care providers, compassion is an essential foundation of their occupation, driving the sense of duty towards patients and leading to satisfaction

gained from the alleviation of pain and suffering. Without appropriate safeguards, repeated exposure to demanding interpersonal and traumatic situations can also lead to a cost of caring.[2] This cost of caring is known as compassion fatigue (CF), which is defined as the emotional and physical burden created by the additive trauma of helping others in distress and leading to a reduced capacity and interest in being empathetic towards future suffering.[3,4] This is distinct from burnout, which is defined as cumulative stress and mental exhaustion from the demands of daily life caused by a depletion of the ability to cope with the environment.[4] CF is associated with psychic exhaustion, depersonalization, and a sense of reduced personal accomplishment.[3]

CF is a multidimensional phenomenon that is assessed through three major components: compassion satisfaction, burnout and secondary traumatic stress.[5] Recent literature indicates a very high incidence of burnout among medical practitioners when compared to the general population, drawing increased attention to this issue,[6] but it is important to consider that burnout is only part of the spectrum of emotional distress encompassing CF.[5] Emergency care providers are a threatened population, as the risk of developing CF increases substantially when individuals assume the role of "first responder," are exposed to unexpected traumatic events or whose personal identity is closely associated with their profession.[7] CF can potentially trigger multiple emotions and behaviors, such as sadness, grief, chemical dependency, somatic complaints, detachment, anger and changes in belief systems. These processes have a high potential of affecting the emotional well-being as well as the professional performance of those affected.[8]

The most current research demonstrates a significant incidence of CF among healthcare providers, particularly social workers[9,10] and nurses,[11] but to our knowledge there are no studies describing the presence of CF among emergency medicine (EM) residents or other graduate medical education trainees, although there is evidence of widespread burnout in this population.[12]

Objectives

The primary aim of this study was to determine the prevalence and degree of CF in EM resident physicians through the measurement of its three components: compassion satisfaction, burnout, and secondary traumatic stress. Additional aims were to measure the association between CF and demographics, hourly workload, circadian disruption and family responsibilities; and finally to compare these findings against learner groups with different patient exposures and work styles.

METHODS

This study was approved by our institution's review board, the Graduate School of Medical Education and the program directors of each residency included in the study.

We distributed an anonymous electronic survey collecting demographic information (gender, specialty, post-graduate year of training and presence or absence of child dependents) in addition to a validated,[13] self-administered, 30-item questionnaire, The Professional Quality of Life Scale (ProQOL) version 5.[5] The ProQOL is the most commonly used measure of the positive and negative effects of working with people who have experienced extremely stressful events.[5] ProQoL5 includes subscales for the three components of compassion fatigue; compassion satisfaction, burnout, and secondary traumatic stress (Appendix 1). It has been validated in several populations and shown to have high reliability and validity for assessing CF.[13] Scoring of each subcategory ranged from 5-50. A score of 22 or less is considered "low," "average" scores range from 23-41, and 42 or higher is considered a "high" score. The participants were asked to complete the form considering the past one month for the components of the ProQOL questionnaire and the immediate previous seven days for the questions about work load and distribution. The survey was sent to residents in the specialties of EM, family medicine, general surgery, neurology, obstetrics, orthopedics, and pediatrics. We were not able to include internal medicine residents because in our institution they were already participating in a large study on burnout.

Low compassion satisfaction will increase CF while low burnout and secondary traumatic stress will decrease it. For the purposes of the ProQoL5 scale, each component is weighted as a third of the final score. The three components of CF can be interpreted individually and in combination.[5]

Statistical analyses

We summarized continuous variables as mean, standard deviation (SD) and median with range. Categorical variables were summarized as frequency counts and percentages. We evaluated associations of the compassion satisfaction, burnout and secondary traumatic stress scores with demographic features using analysis of variance, two-sample t-tests, chi-square tests, and Fisher's exact tests as appropriate.

We reported the scores as numerical variables and analyzed them as continuous data and ordinal data in three categories – high, average and low levels of compassion satisfaction, burnout and secondary traumatic stress as described above.[4] Statistical analyses were performed by a statistician using SAS software (SAS Institute, Cary, NC). All tests were two-sided and p-values <0.05 were considered statistically significant.

RESULTS

We sent the survey to 255 residents, and the response rate was 74.9%. Of the 191 surveys received, three were incomplete, leaving 188 for analysis. We summarized

demographic characteristics and CF subscale scores for the 188 resident respondents in Table 1. Fifty-three percent were men, and 18% were in EM, 45% were in a non-surgical specialty (family medicine, neurology, or pediatrics), 37% were in a surgical specialty (obstetrics, orthopedics, and general surgery). Overall, 18% worked a majority of their clinical shifts overnight during the period assessed, and one-third had child dependents. Ninety-three percent of the residents worked on average less than 80 hours per week during the seven days preceding survey completion.

Compassion satisfaction

There were 111 (59%) residents with average levels and 77 (41%) residents with high levels of compassion satisfaction; no resident had low levels of compassion satisfaction (Table 2). Specialty training showed no impact on scores as there was no difference between EM, medical specialties and surgical specialties. There was no difference in compassion satisfaction between gender, hours worked and presence of child dependents.

Burnout

There were 107 (57%) residents with low levels and 81 (43%) residents with average levels of burnout; no resident had high levels of burnout (Table 2). Similar to the previous component, there was no difference in burnout between EM residents versus other medical and surgical specialties. Mean burnout scores for residents who worked greater than 80 hours in the previous week were significantly higher than residents who worked 80 hours or less (25.0 vs 21.5; p=0.013). Mean burnout scores for residents who primarily worked overnight shifts were significantly higher than residents who did not primarily work overnight shifts (23.5 vs 21.3; p=0.022). Only 13 (12%) of the residents with low burnout scores primarily worked overnight shifts compared with 20 (25%) residents with average burnout scores (p=0.023).

Secondary traumatic stress

There were 144 (77%) and 44 (23%) residents with low and average levels of secondary traumatic stress, respectively; no resident had high levels of secondary traumatic stress (Table 2). Again, no difference in this component was observed between EM residents and other learners. Mean secondary traumatic stress scores for residents who worked greater than 80 hours during the previous week were significantly higher than the scores for residents who worked 80 hours or less (22.2 vs 19.5; p=0.048). Mean secondary traumatic stress scores for residents with child dependents were significantly higher than the scores for residents without child dependents (21.0 vs 19.1; p=0.012).

When analyzing the results as a whole, 41% of the residents were in the category of high compassion satisfaction, moderate to low burnout and secondary traumatic stress, and 59% had average levels of compassion satisfaction. No resident had high levels of secondary traumatic stress or burnout.

Table 1. Summary of features for 188 resident respondents and measures of the subscales of compassion fatigue.

Feature	N (%)
Gender (N=186)	
Women	88 (47)
Men	98 (53)
Specialty	
Non-surgical	85 (45)
Surgical	70 (37)
Emergency	33 (18)
Clinical hours per week (N=187)	
<40	20 (11)
41-60	48 (26)
61-80	106 (57)
>80	13 (7)
Primarily night shifts (N=187)	
No	154 (82)
Yes	33 (18)
With child dependents (N=187)	
No	127 (68)
Yes	60 (32)
Compassion satisfaction score	
Low	0
Average	111 (59)
High	77 (41)
Burnout score	
Low	107 (57)
Average	81 (43)
High	0
Secondary traumatic stress score	
Low	144 (77)
Average	44 (23)
High	0
	Mean ± SD (Median; Range)
Compassion satisfaction score	40.4 ± 5.4 (40; 27 – 50)
Burnout score	21.8 ± 5.1 (22; 11 – 39)
Secondary traumatic stress score	19.8 ± 4.5 (19; 11 – 33)

DISCUSSION

This study found average levels of compassion satisfaction, low levels of burnout and low levels of secondary traumatic stress among EM resident physicians, with no difference when comparing them to learners from other specialties. The lack of difference was consistent when workload and personal variables were examined, despite the distinctions in exposure and work style.

Table 2. Comparison of compassion satisfaction, burnout and secondary traumatic stress scores for 188 resident respondents according to demographic, specialty and work characteristics.

Component	Feature	Score Mean ± SD (Median; Range)	p-value
Compassion satisfaction	Gender (N=186)		0.72
	Women	40.6 ± 5.5 (41; 27 – 50)	
	Men	40.3 ± 5.2 (40; 27 – 50)	
	Specialty		0.42
	Non-surgical	40.0 ± 5.3 (40; 27 – 50)	
	Surgical	41.0 ± 5.7 (42; 27 – 50)	
	Emergency	39.9 ± 4.7 (39; 30 – 50)	
	Clinical hours per week (N=187)		0.99
	<40	40.3 ± 4.8 (39.5; 32 – 49)	
	41-60	40.5 ± 4.4(40; 31 – 50)	
	61-80	40.5 ± 5.5 (40; 27 – 50)	
	>80	40.1 ± 7.8 (42; 27 – 50)	
	Clinical hours per week (N=187)		0.81
	≤80	40.5 ± 5.1 (40; 27 – 50)	
	>80	40.1 ± 7.8 (42; 27 – 50)	
	Primarily night shifts (N=187)		0.13
	No	40.7 ± 5.3 (41; 27 – 50)	
	Yes	39.2 ± 5.6 (39; 27 – 49)	
	With child dependents (N=187)		0.27
	No	40.1 ± 5.3 (40; 27 – 50)	
	Yes	41.1 ± 5.4 (42; 31 – 50)	
Burnount	Gender (N=186)		0.69
	Women	21.9 ± 5.2 (22; 11 – 33)	
	Men	21.6 ± 4.8 (21; 12 – 37)	
	Specialty		0.60
	Non-surgical	21.7 ± 5.1 (21; 11 – 37)	
	Surgical	21.5 ± 5.0 (22; 11 – 32)	
	Emergency	22.6 ± 5.3 (22; 14 – 39)	
	Clinical hours per week (N=187)		0.09
	<40	21.0 ± 2.8 (21; 16 – 26)	
	41-60	21.3 ± 4.5 (20.5; 14 – 30)	
	61-80	21.6 ± 5.3 (22; 11 – 37)	
	>80	25.0 ± 6.0 (25; 16 – 33)	
	Clinical hours per week (N=187)		0.013
	≤80	21.5 ± 4.8 (21; 11 – 37)	
	>80	25.0 ± 6.0 (25; 16 – 33)	
	Primarily night shifts (N=187)		0.022
	No	21.3 ± 4.9 (21; 11 – 37)	
	Yes	23.5 ± 4.9 (23; 15 – 33)	
	With child dependents (N=187)		0.43
	No	21.9 ± 4.9 (22; 11 – 37)	
	Yes	21.3 ± 5.2 (21; 11 – 33)	

Table 2. Continued.

Component	Feature	Score Mean ± SD (Median; Range)	p-value
Secondary traumatic stress	Gender (N=186)		0.67
	Women	19.8 ± 4.2 (19; 11 – 29)	
	Men	19.6 ± 4.8 (19; 11 – 33)	
	Specialt		0.14
	Non-surgical	19.4 ± 4.4 (19; 11 – 30)	
	Surgical	19.5 ± 4.6 (19; 11 – 33)	
	Emergency	21.2 ± 4.7 (21; 15 – 33)	
	Clinical hours per week (N=187)		0.23
	<40	19.2 ± 3.5 (19.5; 11 – 24)	
	41-60	19.6 ± 4.2 (19; 13 – 29)	
	61-80	19.6 ± 4.6 (19; 11 – 33)	
	>80	22.2 ± 5.7 (22; 11 – 32)	
	Clinical hours per week (N=187)		0.048
	≤80	19.5 ± 4.4 (19; 11 – 33)	
	>80	22.2 ± 5.7 (22; 11 – 32)	
	Primarily night shifts (N=187)		0.45
	No	19.6 ± 4.6 (19; 11 – 33)	
	Yes	20.2 ± 4.1 (19; 14 – 29)	
	With child dependents (N=187)		0.012
	No	19.1 ± 4.1 (19; 11 – 30)	
	Yes	21.0 ± 4.9 (20; 12 – 33)	

As secondary findings, residents who worked more than 80 hours per week and those working predominantly overnight shifts appear to have a high risk of developing CF as they have significantly higher levels of burnout and secondary traumatic stress. Residents who have children experience higher secondary traumatic stress, meaning they have higher physical and emotional stress responses to their work. This may be explained as a psychological consequence of being exposed to traumatic situations that the resident fears may eventually affect his or her family dependents.

In our cohort we did not find differences related to surgical versus non-surgical specialty, post-graduate year of training or gender. This finding is important, as current literature examining the effect of decreased duty hours under the latest guidelines from the Accreditation Council for Graduate Medical Education (ACGME) has not yet clearly demonstrated a decrease in burnout.[14]

When interpreting the scale scores in combination and assessing CF, we found that 40% of EM residents had high compassion, moderate to low burnout and secondary traumatic stress. This is a favorable result and is indicative of persons who receive positive reinforcement from their work and do not suffer any noteworthy fears resulting from their work. These persons benefit from engagement, opportunities for continuing education and other possibilities for growth in their position. They are likely good influences on their colleagues and their organization. They are probably well-liked by their patients, who in turn seek out their assistance.[5]

These are encouraging findings, which are in contrast to previous studies aimed at evaluating burnout alone.[12] Given the apparent differences between the findings related to burnout and CF, it is important to differentiate both entities. Burnout arises from daily life, both personal and at work, when achievement intentions are not met leading to failure in coping strategies, while CF arises from repetitive traumatic exposures and when rescue care-taking efforts are unsuccessful. Burnout is gradual, related to reactions and leads to withdrawal from professional duties, whereas CF is acute, secondary to relationships and decreases capacity for future empathy.[7] Our results showing no differences in burnout among residents from different specialties contrasts previous data demonstrating a higher incidence of burnout among attending physicians in particular specialties.[6] Shanafelt, et al. found the highest rates of burnout among emergency physicians (nearly 70%), followed by general internal medicine, neurology, and family medicine. Significantly lower rates were observed in specialties such as pediatrics, dermatology and preventive medicine.[6]

It is important to note that our survey construct asked for hours worked during the previous week, rather than the average hours worked over a four-week period as mandated by ACGME. Therefore, our results should not

be interpreted within this context to be in violation of the ACGME duty hour guidelines.

A high score on either burnout or secondary traumatic stress can be a herald of clinical depression[15]; fortunately the EM resident respondents did not score highly in either of these two fields. We found an association between burnout and the number of hours worked in the previous week, and also higher burnout among those residents who worked predominantly night shifts. These findings may represent an area where residency programs and administrators can intervene; for example, individuals at high risk of burnout or CF may benefit from support mechanisms such as post-incident debriefing, counselors and chaplains.[7] At the same time there is a unique opportunity for the implementation of policies to prevent the development of this syndrome through personal and environmental tools. Strategies such as the development of person-workplace boundaries, mindfulness techniques and organizational evaluation by and interventions from therapists familiar with CF appear to be helpful.[16]

Coping methods for CF include enhancement of social support networks, including friends, family and colleagues; adoption of proper sleep hygiene; healthy eating habits and regular exercise.[17]

LIMITATIONS

This study has a number of limitations. First, non-response bias could affect the results, although the proportion of residents completing the survey was high (75%). Second, the design of the ProQOL questionnaire aims to address the past one month of symptoms; however for the work load variables we used the immediate past one week time frame as a way to standardize the variability from rotation to rotation; this may have created a bias towards acute symptoms. Further, we were not able to compare variables of those who answered versus those who did not because of the anonymity of the survey, and there is a possibility that the residents with the greatest risk of burnout and compassion fatigue may be less likely to take the survey. We did not evaluate many demographic variables in this study, and personal factors, such as home support, personal coping strategies, and training program factors, may also be associated with well-being. Finally, this study cannot address causality or directionality of the observed associations, given its cross-sectional design.

CONCLUSION

EM residents have rates of CF, including the components of compassion satisfaction, burnout and secondary traumatic stress, similar to residents from surgical and medical specialties. Residents working predominantly overnight shifts and those working more than 80 hours per week appear to be at high risk of developing CF related to higher burnout and secondary traumatic stress. Participants of the study with child dependents appear to have a higher incidence of secondary traumatic stress. Further research is necessary for inquiry about additional modifying factors and the consequences of CF on patient care, and for the implementation of personal strategies and institutional policies for the prevention and management of compassion fatigue.

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BE-SAFE: Bedside Sonography for Assessment of the Fetus in Emergencies: Educational Intervention for Late-pregnancy Obstetric Ultrasound

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Introduction: Late obstetric emergencies are time critical presentations in the emergency department. Evaluation to ensure the safety of mother and child includes rapid assessment of fetal viability, fetal heart rate (FHR), fetal lie, and estimated gestational age (EGA). Point-of-care (POC) obstetric ultrasound (OBUS) offers the advantage of being able to provide all these measurements. We studied the impact of POC OBUS training on emergency physician (EP) confidence, knowledge, and OBUS skill performance on a live model.

Methods: This is a prospective observational study evaluating an educational intervention we designed, called the BE-SAFE curriculum (BEdside Sonography for the Assessment of the Fetus in Emergencies). Subjects were a convenience sample of EP attendings (N=17) and residents (N=14). Prior to the educational intervention, participants completed a self-assessment survey on their confidence regarding OBUS, and took a pre-test to assess their baseline knowledge of OBUS. They then completed a 3-hour training session consisting of didactic and hands-on education in OBUS. After training, each subject's time and accuracy of performance of FHR, EGA, and fetal lie was recorded. Post-intervention knowledge tests and confidence surveys were administered. Results were compared with non-parametric t-tests.

Results: Pre- and post-test knowledge assessment scores for previously untrained EPs improved from 65.7% [SD=20.8] to 90% [SD=8.2] ($p<0.0007$). Self-confidence on a scale of 1-6 improved significantly for identification of FHR, fetal lie, and EGA. After training, the average times for completion of OBUS critical skills were as follows: cardiac activity (9s), FHR (68.6s), fetal lie (28.1s), and EGA (158.1 sec). EGA estimates averaged 28w0d (25w0d-30w6d) for the model's true gestational age of 27w0d.

Conclusion: After a focused POC OBUS training intervention, the BE-SAFE educational intervention, EPs can accurately and rapidly use ultrasound to determine FHR, fetal lie, and estimate gestational age in mid-late pregnancy. [West J Emerg Med. 2014;15(6):636–640]

INTRODUCTION

Goal-directed, focused obstetrical ultrasound (OBUS) is one of the core applications in emergency ultrasound (US). Emergency physician- (EP) performed OBUS is highly accurate in confirming a live intrauterine pregnancy and determining the estimated gestational age (EGA) in the first trimester.[1] Additionally, EP- performed early pregnancy OBUS expedites care by decreasing patient

length of stay.[2,3] While EPs perform first trimester OBUS regularly, third trimester OBUS is performed less often because third trimester emergencies are less frequently encountered in the emergency department.

The rapid evaluation of fetal heart rate (FHR), EGA and fetal lie in third trimester pregnancy is critically important to ensure the well being of both mother and fetus after traumatic injury or during emergent delivery. Historical dating and physical examination of fundal height for gestational age and fetal lie are prone to error.[4,5] Point of care US offers the advantage of being able provide the necessary fetal measurements quickly and accurately at the bedside.

Shah et al previously investigated EP-performed OBUS for fetal dating in the third trimester. While EPs are accurate in determining the gestational age in late pregnancy, little is known about the training requirements needed for EPs to achieve competency.[6] To our knowledge, this is the first study to examine the effect of a brief training intervention on the performance by EPs of third trimester OBUS for gestational age, fetal heart rate and fetal lie.

METHODS

Study Design

We conducted a prospective, observational study of EP accuracy and confidence to perform late pregnancy US after an educational intervention in 2012. Study subjects (EPs) were blinded to the true gestational age and fetal heart rate of the live models used in the training. The study waived informed consent from the university's institutional review board.

Setting and Subjects

Subjects were a convenience sample of core faculty attending physicians (17) and residents (N=14) from a new academic emergency medicine program in a large urban area in the northwestern United States. 14 of the total 18 residents in the program were present at the didactic session and participated in our study. Resident physicians were grouped into "experienced" residents who had completed a 2 week emergency ultrasound rotation, and "inexperienced" interns who had not yet completed their initial ultrasound rotation. There was also a range of experience with OBUS among the attending faculty, including some who had minimal or no prior training in OBUS, either in residency or subsequently. The study was conducted within a simulation center used for interdisciplinary training.

Intervention

The study intervention was a 3 hour educational module consisting of both lecture and hands-on didactics as part of the resident core curriculum outlined in Table 1. Specifically, 30 minutes of lecture didactics covered a general review of first trimester ultrasound including finding fetal heart rate using M-mode, measurement of crown rump length, and ectopic pregnancy. Lecture didactics in the second 30 minute session covered late pregnancy ultrasound including fetal lie and identification of the fetal head, and fetal biometry including measurement of biparietal diameter (BPD), femur length (FL), head circumference (HC) and abdominal circumference (AC). Emphasis was placed on methods of measuring BPD, highlighting proper landmarks and planes of imaging. The proctored hands-on session was 2 hours long, and subjects received individual instruction from ultrasound fellowship trained EPs at two practice stations with live models in the 2nd and 3rd trimester of pregnancy. Subjects practiced determining fetal biometry, fetal lie, and fetal heart rate using ultrasound. This educational module is called the BE-SAFE curriculum (BEdside Sonography for the Asessment of the Fetus in Emergencies).

Table 1. Details of the OBUS training course.

Didactic curriculum for OBUS educational module	Time
Mechanics of transabdominal and transvaginal OBUS	5 minutes
Normal US findings in 1st trimester pregnancy	10 minutes
US findings in ectopic pregnancy	10 minutes
Other abnormal US findings in early pregnancy (fetal demise, molar pregnancy)	10 minutes
Determining EGA by CRL	5 minutes
Measuring FHR using M-mode	5 minutes
Fetal biometry in later pregnancy (biparietal diameter, head circumference, abdominal circumference, femur length)	10 minutes
Determination of fetal lie	5 minutes
Hands-on US practice with live models 1 station TV, non-pregnant 1 station TA, non-pregnant 1 station TA, pregnant 1 testing station TA, pregnant	120 minutes

OBUS, obstetrical ultrasound; *US*, ultrasound; *EGA*, estimated gestational age; *CRL*, crown-rump length; *FHR*, fetal heart rate; *TV*, transvaginal; *TA*, transabdominal

Study Protocol

Prior to the educational initiative, participating subjects took the obstetric ultrasound quiz at www.emsono.com/acep online and submitted scores to the research assistant. After the BE-SAFE educational initiative, subjects repeated the exam with different questions online using the same website, and submitted their scores for comparison. Before and after the training session, participants also completed an online self-assessment survey of their attitudes regarding, and comfort level with, obstetric ultrasound. They were asked to rate their level of comfort on a scale from 1 (not at all confident) to 6 (very confident) for assessing each of the following using OBUS: FHR, fetal head position (HP), and estimation of gestational age (EGA). Pre- and post- test scores and survey

Table 2. ACEP obstetrical ultrasound test scores.

	Inexperienced residents (SD)	Experienced residents (SD)	Attendings (SD)
Pre-training	65.71% (20.83)	95% (5.00)	75.71% (19.89)
Post-training	90% (8.16)	95% (7.07)	92.61% (9.78)
p-value	0.007	n/a	0.168

ACEP, American College of Emergency Physicians

results were compared with descriptive statistics and non-parametric t-tests.

During the hands-on training session after completion of the proctored sessions, each subject was assessed at a final test station where time and accuracy for determining fetal heart rate, BPD, and fetal lie was recorded. Subjects presented individually to the test station and were blind to the fetal lie and true gestational age of a live pregnant model at 27 weeks gestation. Time measures were recorded from probe placement on skin to exact moment of identification of cardiac activity, completion of fetal heart rate measurement using M-mode, and again from probe placement to identification of fetal head and presentation, and to measurement of the biparietal diameter. The research assistant also recorded whether the subject needed verbal cues to complete the required measurements.

Ultrasound Measurements

At the testing and training stations, 3.5MHz curved abdominal transducers and Sonosite Edge US machines (Sonosite Inc., Bothell WA) were used for measurements. M-mode was used for measurement of the fetal heart rate. B-mode imaging was used to measure the fetal biparietal diameter as per standard convention at the level of the falx cerebri and thalamus in an axial plane with calipers placed at the outer aspect of the skull in the near field and the inner aspect of the skull in the far field.

Data Analysis

We conducted an online survey of confidence level, experience, and attitude regarding OBUS for participants both before and after the training, using the Catalyst online web survey tool (Catalyst Web Tools, Solstice Program, University of Washington IT Department, Seattle WA). We analyzed the confidence level results, as well as the pre- and post-knowledge assessment scores from www.emsono.com/acep, using both Kruskal-Wallis Analysis of Variance and Mann-Whitney U tests run using Statistica software (Statistica, StatSoft , Tulsa OK).

RESULTS

31 physicians completed the didactic BE-SAFE training session and a portion of these completed the pre and post tests (N=16) and the pre and post course self assessment survey (N=22). Of the 31 physicians, 14 were residents and 17 were attendings. Pre and post test scores on the knowledge exam provided online by EM Sono and ACEP (www.emsono.com/acep) are shown in Table 2. There was significant improvement (p=0.0007) for untrained physicians from 65.7% (SD=20.8) to an average of 90% (SD=8.16). Previously trained residents had a high pre-test average score of 95% (SD=5), which was maintained with an average post-test score of 95% (SD=7.07). The attending physician group had an average pre-test score of 75.7% (SD=19.89), which improved to an average post-test score of 92.6% (SD=9.78) (p=0.168).

There was significant improvement in physician confidence and overall perception of skill in the self-assessment survey given after the training course. Self-confidence scores for determination of FHR, HP, and EGA, respectively, increased from 4.06 (SD=1.51), 3.69 (SD=1.53), and 2.47 (SD=1.56, to an average of 5.45 (SD=0.51), 5.36 (SD=0.66) and 5.19 (SD=0.6). The self-assessment score change is shown in the Figure.

During the hands-on testing station, the average times for completion of OBUS critical skills are shown in Table 3. Estimates of gestational age were performed using BPD in 29/31 cases and femur length in 2/31 cases when the fetal head was obscured by the model's pubic bone. Estimates of gestational age based on obtained measurements averaged 28w0d (25w0d-30w6d, SD 1.36) for the patients' true gestational age of 27w0d, which is within the conventional +/- 3 week window of error for US measures of gestational age in the third trimester. All participants correctly identified fetal lie as vertex, and accurately measured the FHR at the test station.

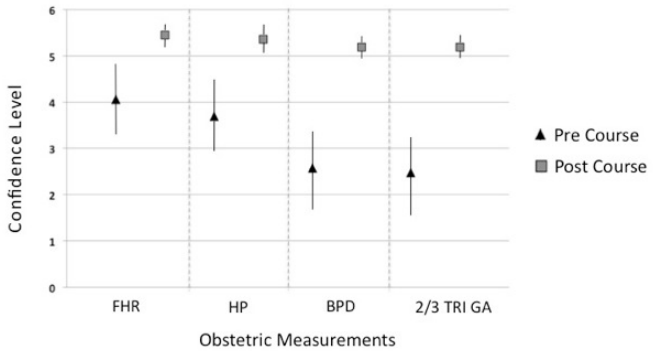

Figure. Pre and post course ultrasound confidence assessment. Improvement in confidence levels after the obstetrical ultrasound training course. FHR (fetal heart rate), HP (head position), BPD (biparietal diameter), 2/3 Tri GA (overall use of ultrasound to estimate gestational age in 2nd and 3rd trimester).

Table 3. Average time to completion of critical OBUS tasks.

OBUS task	Time
Identification of cardiac activity	9 s
FHR measurement by M-mode	68.6 s
Determination of fetal lie	28.1 s
Assessment of gestational age	158.1 s

OBUS, obstetrical ultrasound; *FHR*, fetal heart rate

DISCUSSION

Emergencies in late pregnancy can jeopardize the health of the patient and her fetus, and much of the information needed for optimal patient care may be quickly ascertained using bedside US. Despite this, there is limited published literature regarding EP performance of point-of-care sonography in second- and third-trimester pregnancy. Shah and colleagues[6] showed that EPs can accurately estimate late-term gestational age, a finding supported by our results. However, evidence-based guidelines to identify the optimal length and intensity of training in OBUS necessary for EPs to achieve competence are lacking. Our study showed that a brief training module increased EP knowledge of OBUS and improved confidence for the determination of EGA, as well as for the assessment of two additional important clinical data points: fetal lie and heart rate.

Although the utility of US for the detection of maternal injury during pregnancy has been previously demonstrated,[7] most of the literature regarding the ability of EPs has been focused on first-trimester complaints. Use of emergency US in pelvic disorders tends to focus on detection of intrauterine pregnancy to rule out ectopic pregnancy. In this setting, EP-performed US has been shown to have high sensitivity and specificity.[8,9]

Late-term fetal dating and position assessment may be of utility in the setting of shock or trauma, where the patient in extremis may not be able to provide accurate information and the decision for aggressive intervention could be determined by the gestational age of the fetus. Fetal viability begins at a gestational age of approximately 24 weeks,[10,11] often estimated by determination of fundal height. Physical diagnosis of fundal height, however, may be limited by body habitus and in the setting of trauma, by uterine rupture, making estimation of age difficult to achieve. Our training module also taught EPs to assess the fundal height by US, though the accuracy of this method was not assessed in our study and warrants future investigation.

Additionally, our study demonstrated that the entire US assessment of FHR, HP, and EGA was completed in under five minutes. When peri-mortem or crash cesarean delivery is being considered, rapid and accurate assessment of gestational age is critical for physicians facing time-sensitive decisions.

LIMITATIONS

Our study has several limitations that we have identified. We note that while a range of both resident and attending physicians with varying levels of ultrasound skills participated in the study, because this is a small convenience sample of physician subjects, the results may not be generalizable to larger audiences of EPs.

In addition, this is a live simulation-based training model, and while physician subjects were largely successful in accurate and rapid ultrasound measurements in this environment, the challenges of ultrasound use in an actual ED environment may affect the performance of these ultrasound exams.

Ultrasound measurements of gestational age in the second and third trimester may be within a 2-3 week range of the true gestational age of a fetus, even when measurements are done perfectly. In light of this fact, any study that seeks to assess accuracy of fetal biometry measurements will need to allow for normal variations in ultrasound measurements.

CONCLUSION

To conclude, we found that EPs can accurately and rapidly estimate gestational age, fetal heart rate and fetal lie in the second and third trimester after the brief BE-SAFE training intervention. This information is of value in the setting of shock or injury during late pregnancy, when the patient cannot communicate their gestational age or in the event of precipitous delivery.

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Performance Accuracy of Hand-on-needle versus Hand-on-syringe Technique for Ultrasound-guided Regional Anesthesia Simulation for Emergency Medicine Residents

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Introduction: Ultrasound-guided nerve blocks (UGNB) are increasingly used in emergency care. The hand-on-syringe (HS) needle technique is ideally suited to the emergency department setting because it allows a single operator to perform the block without assistance. The HS technique is assumed to provide less exact needle control than the alternative two-operator hand-on-needle (HN) technique; however this assumption has never been directly tested. The primary objective of this study was to compare accuracy of needle targeting under ultrasound guidance by emergency medicine (EM) residents using HN and HS techniques on a standardized gelatinous simulation model.

Methods: This prospective, randomized study evaluated task performance. We compared needle targeting accuracy using the HN and HS techniques. Each participant performed a set of structured needling maneuvers (both simple and difficult) on a standardized partial-task simulator. We evaluated time to task completion, needle visualization during advancement, and accuracy of needle tip at targeting. Resident technique preference was assessed using a post-task survey.

Results: We evaluated 60 tasks performed by 10 EM residents. There was no significant difference in time to complete the simple model (HN vs. HS, 18 seconds vs. 18 seconds, p=0.93), time to complete the difficult model (HN vs. HS, 56 seconds vs. 50 seconds, p=0.63), needle visualization, or needle tip targeting accuracy. Most residents (60%) preferred the HS technique.

Conclusion: For EM residents learning UGNBs, the HN technique was not associated with superior needle control. Our results suggest that the single-operator HS technique provides equivalent needle control when compared to the two-operator HN technique. [West J Emerg Med. 2014;15(6):641–646]

INTRODUCTION

Pain is a frequent complaint in the emergency department (ED).[1,2] Ultrasound-guided nerve blocks (UGNB) are a potentially effective means to improve pain management in the ED.[3-6] There is increasing interest in the use of UGNBs for a wide variety of ED conditions including pain control for common injuries such as hip fractures and anesthesia for invasive procedures such as shoulder reductions and abscess incision and drainage. The bulk of existing literature on education and technique for UGNBs has been conducted by anesthesiologists and refers to peri-operative applications.[7-11] However, the application of UGNBs in emergency medicine (EM) requires a distinct skill set that has to date not been extensively studied.

Two alternate needle guidance techniques are used for UGNBs – the hand-on-syringe (HS) technique and the hand-on-needle (HN) technique (Figure 1). The HN technique has traditionally been assumed to be more accurate. However,

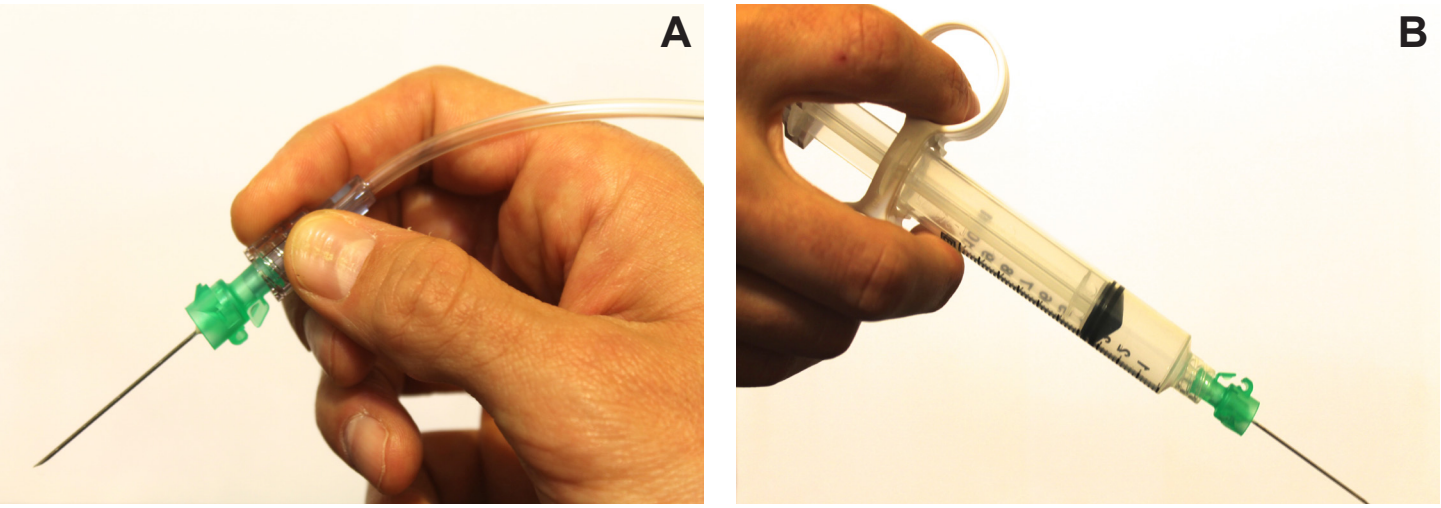

Figure 1. A, Hand-on-needle technique has the provider holding the needle hub in a pencil-like fashion while resting their hand on the body surface. B, Hand-on-syringe technique has the operator hold the syringe rather than the needle, enabling them to aspirate and inject local anesthetic without the use of an assistant.

this technique requires a second operator to inject the anesthetic and also results in the primary operator losing the tactile feedback of resistance to injection. Loss of tactile feedback could potentially make it more difficult to identify a possible intraneural needle tip placement and high-pressure injection with a subsequent increased risk of peripheral nerve injury.[12,13] In contrast, the HS technique requires only a single operator to maneuver the needle while also injecting the anesthetic, obviating the need for additional personnel and allowing the operator to maintain tactile feedback throughout the procedure. The single-operator method and ability to maintain tactile feedback make the HS technique advantageous in the ED setting. Additionally, the assumption that a two-operator HN technique confers more accuracy has, to our knowledge, never been investigated.

Our goal was to compare the HS and HN needle technique using a low fidelity, low cost partial-task simulator. Our hypothesis was that among EM residents, there would be no difference in performance between the two ultrasound (US) guided needle techniques.

METHODS

Study Design

This was a prospective, randomized trial evaluating task performance on a simulated UGNB model comparing HN and HS techniques. The local institutional review committee reviewed and approved the study.

Study Setting and Population

EM residents in their first to fourth years of clinical training were enrolled in the needle task study after providing written consent.

Study Protocol

Study participants performed a set of structured needling tasks on a standardized UGNB partial-task simulator that has been described in previous research.[14] Extra-firm tofu (10 by 8 by 4 cm) provided appropriate US visualization and firmness for minimal translational movement on needle advancement. Wooden dowels were inserted through the tofu to correspond with a modeled nerve and a modeled vessel. Residents used a linear 12-5MHz transducer (Philips HD11XE, Andover, MA) with appropriate gain and depth set by one of the study authors. Each resident used a 21-gauge needle for the HN technique and a 21-gauge needle attached to a 10 cc control syringe for the HS technique. When the participant reported having reached the appropriate target, the needle task was defined as completed. These maneuvers were designed to replicate clinical scenarios relevant to ED application of UGNBs.

A study author enrolled each resident. After a brief tutorial that included description of both HN and HS techniques, each participant was allowed to practice both needle techniques on the simple model without instruction for five minutes. Each resident was randomized to begin task performance using either the HN or HS technique again on the simple model based on odd and even enrollment. After completion of the simple model, residents in each arm crossed over and completed the difficult model task.

Each resident performed a total of six needling tasks using two UGNB models described as 1) simple and 2) difficult. The simple model simulated a technically simple UGNB in which the modeled nerve was superficial (approximately 2 cm below the surface) and distant from the modeled vascular structure (approximately 2 cm) (Figure 2). The wooden dowels that represented nerve and vessel were placed in parallel orientation. The difficult model simulated a more technically challenging UGNB in which the modeled nerve was deeper (approximately 4 cm below the surface) (Figure 3). The modeled vessel was

Table 1. Demographics and self-reported ultrasound proficiency of enrolled emergency medicine residents.

Variable	Frequency n	Frequency %
Postgraduate year		
One	6	60
Two	2	20
Three	1	10
Four	1	10
Sex		
Female	3	30
Age		
Mean	29	
Number of UGRA procedures performed*		
None	1	10
< 10	4	40
10 to 20	2	20
21 to 30	2	20
31 to 40	1	10
Number of ultrasound-guided procedures performed†		
< 10	1	10
11 to 50	6	60
51 to 100	1	10
> 100	2	20
Confidence in ultrasound‡		
Very confident	2	20
Somewhat confident	8	80
Somewhat not confident	0	0
Not confident	0	0
Confidence in UGRA‡		
Very confident	0	0
Somewhat confident	7	70
Somewhat not confident	3	30
Not confident	0	0

UGRA, ultrasound-guided regional anesthesia

* Self-reported estimate of the number of ultrasound-guided regional anesthesia procedures carried out on patients in the peri-operative or emergency department setting

† Self-reported estimate of the number of ultrasound-guided procedures performed by the subject including central and peripheral intravenous lines, thoracentesis, paracentesis, pericardiocentesis, lumbar puncture and arthrocentesis

‡ Self-report of confidence based on five point Likert scale

placed directly below the modeled nerve with a perpendicular orientation. Each resident performed the UGNB on each model with both the HN technique and HS technique.

Measures

Before completion of the study, we collected the following demographics: post-graduate year, gender, age, number of UGNBs performed, number of US-guided procedures performed, confidence in US, and confidence in UGNBs. A study author recorded parameters of task performance and needle control at the time of each task; these included missed appropriate modeled vessel, reached close proximity to appropriate modeled nerve (<5mm), advanced needle only when visualized, and time-to-task completion. Residents completed a post-task survey that included needle technique preference, confidence in UGNBs, and skills learned from tutorial.

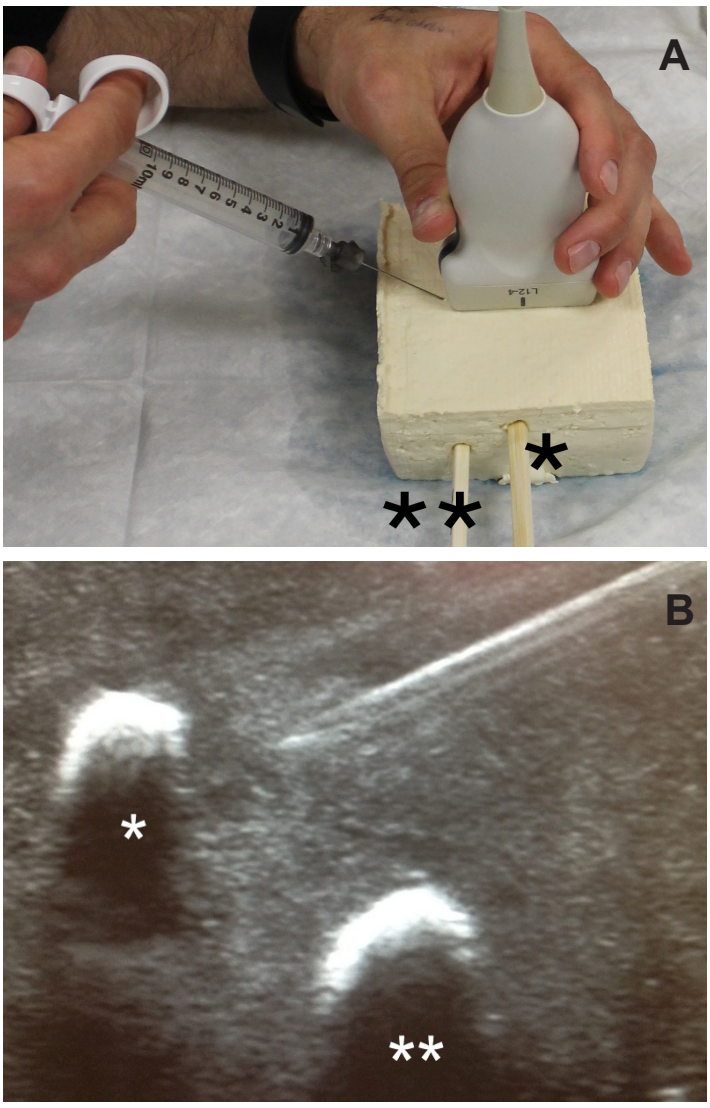

Figure 2. A, Simple phantom model made of extra-firm tofu (10 by 8 by 4cm) with two wooden dowels inserted in parallel fashion to simulate nerve (*) and adjacent vessel (**). B, Ultrasound image of simple model with modeled nerve (*) and vessel (**) with inplane needle view using a linear 12-5MHz transducer with appropriate gain and depth set by one of the study authors.

Table 2. Performance accuracy using hand-on-needle versus hand-on-syringe technique* for ultrasound-guided regional anesthesia on a simulation model.†

Variable	Simple model			Difficult model		
	Hand-on-syringe	Hand-on-needle		Hand-on-syringe	Hand-on-needle	
	n (%)	*n* (%)	p-value‡	*n* (%)	*n* (%)	p-value‡
Avoided appropriate vessel						
Yes	10 (100)	9 (90)	1	10 (100)	8 (80)	0.2
No	0 (0)	1 (10)		0 (0)	2 (20)	
Successfully targeted nerve						
Yes	10 (100)	10 (100)	1	10 (100)	10 (100)	1
No	0 (0)	0 (0)		0 (0)	0 (0)	
Advanced needle only when visualized						
Yes	9 (90)	7 (70)	0.6	8 (80)	8 (80)	1
No	1 (10)	3 (30)		2 (20)	2 (20)	
Time						
Mean	18.2	17.9	0.9	49.9	56.1	0.6
Minimum, maximum	10, 34	7, 28		18, 131	34, 100	

* The hand-on-needle technique has the operator holding the needle hub in a pencil-like fashion while resting their hand on the body surface. The hand-on-syringe technique has the operator hold the syringe rather than the needle, enabling them to aspirate and inject local anesthetic without the use of an assistant.

† Residents performed needling tasks on two simulated phantom models representing a simple and difficult ultrasound-guided regional anesthesia scenario. Residents were randomized on which needle technique to perform first and then second on the simple model. The needle technique order was then reversed for the difficult model.

‡ Categorical variables: Chi square and Fisher exact test for expected cell counts less than 5. Continuous variables: pooled variance independent t-test

Data Analysis

We stratified primary outcomes by HN technique and HS technique in both the simple and difficult model. Variables were not recorded during the initial practice period with the simple model. For categorical variables, we calculated p-values by chi square analysis and Fisher exact test if expected cell counts were less than five. For continuous variables, p-values were calculated using the pooled variance t-test. We completed analyses using Statistical Analysis Software version 9.2 (Cary, North Carolina) and Microsoft Excel (Redmond, WA).

RESULTS

Ten residents performed a total of 60 US-guided tasks. The majority were first-year residents (6/10) and male (7/10) (Table 1). Half of participants had performed less than 10 UGNBs while the majority had performed more than 10 total US-guided procedures (9/10). All participants were "very" or "somewhat" confident in US (2/10 and 8/10 respectively); however three out of 10 participants were "somewhat not confident" in UGNBs.

The HN technique did not demonstrate superior control compared to the HS technique. In both the simple model and the difficult model, no measured parameter was statistically different between the HN technique and the HS technique (Table 2). There was no difference in time to complete the simple model (HN vs. HS, 18 seconds vs. 18 seconds, p=0.93). There was no difference in time to complete the difficult model (HN vs. HS, 56 seconds vs. 50 seconds, p=0.63). Most participants were able to successfully meet each parameter. Most residents preferred the HS technique (60%, 6/10), 30% preferred the HN technique (3/10) and 10% had no preference (1/10). The majority of residents (9/10) endorsed increased confidence and knowledge of UGNBs after completion of the study.

DISCUSSION

Our results suggest that the single-operator HS technique provides equivalent needle control when compared to the two-operator HN technique among EM residents. The HS technique has two advantages in the busy ED setting. First, one provider can complete the HS technique while the HN technique requires two providers (one to control the needle, the other to inject anesthesia). Second, delegating aspiration and injection to an assistant removes the immediate tactile feedback on injection pressures that a single-operator technique affords. This is a known concern in the anesthesiology literature, and in fact there are reports of novel hand and syringe positions that would permit a single-operator technique with a standard HN apparatus.[15] These hand positions seem somewhat complex for novice practitioners.

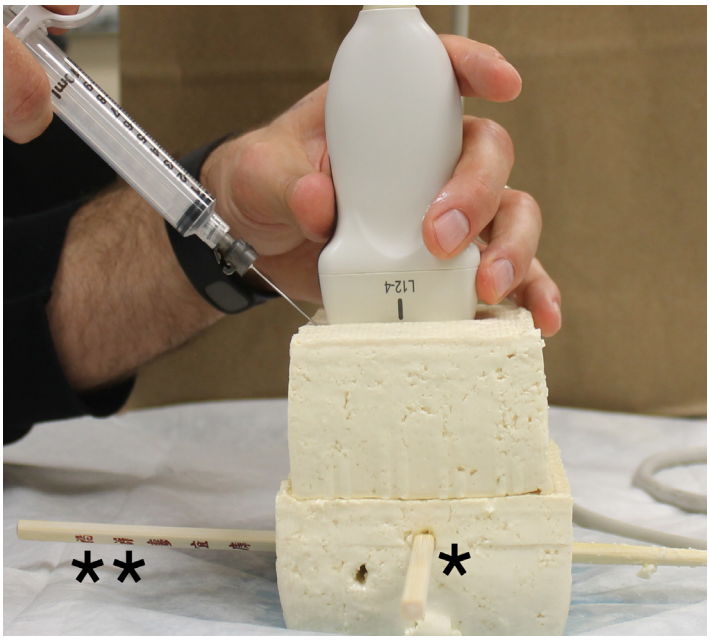

Figure 3. Difficult phantom model with hand-on-syringe approach. The simulated phantom model employed two sections of extra-firm tofu (10 by 8 by 4cm). Two wooden dowels were inserted through the tofu in perpendicular orientation to reflect a modeled nerve (*) and vessel (**). The modeled vessel was deeper and adjacent to the modeled nerve.

The HS technique would be much more appealing in the ED environment, using a commonly available control syringe to retain tactile feedback.

Our low cost, low fidelity model could be used in most domestic or international ED settings with success. Any EM provider wishing to simulate UGNB would only require a physician knowledgeable in UGNBs, an appropriate US, tofu, and wooden dowels. Partial-task simulators such as the one described in our study have been described extensively in the anesthesia literature.[7,8,10,11,16] Our study is the first to extend such simulation methods to the ED setting. UGNB needle skills are potentially transferrable to other US-guided procedures, such as central and peripheral intravenous lines, arthrocentesis and pericardiocentesis. As UGNBs become common practice in the ED setting, an UGNB curriculum will be essential to any EM residency program. We hope our study can foster additional innovative models and training curriculum to improve needle performance.

LIMITATIONS

Our study has several limitations. The phantom model used has both a flat surface that was easily positioned for an optimal needle approach and remained immobile. In actual practice, the challenges of irregular body contours and patient movements could create circumstances that we were not able to simulate in our model. Nevertheless, the partial-task phantom model simulators such as the one described in our study have been described extensively in the anesthesiology literature and likely allowed us to evaluate performance akin to best-case scenario actual practice where the patient is adequately sedated and well positioned.[8,10,11,16] Ours was a pilot study to investigate a novel question that has not been investigated previously. While statistical analysis was performed on our results including p-values, our study was not meant to detect small differences. While needle tasks were randomized, subject preference could have been dictated by order as one might expect increasing preference with increasing experience with the task. We opened study enrollment to all interested residents and there was likely some self-selection bias. However it is not directly clear how this bias would alter the generalizability of our results. Finally, the EM residents at our institution use ultrasound extensively in their training. Their comfort with US might not reflect other training sites where it is used less frequently.

CONCLUSION

For EM residents learning UGNBs, we found the HN technique was similar to the HS technique for superior needle control. The HS technique may represent an attractive alternative in emergency settings. Using a brief tutorial and a low fidelity, low cost, partial-task simulator, EM residents were able to complete both simple and difficult simulated UGNBs.

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Consensus Development of a Pediatric Emergency Medicine Clerkship Curriculum

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Introduction: As emergency medicine (EM) has become a more prominent feature in the clinical years of medical school training, national EM clerkship curricula have been published to address the need to standardize students' experiences in the field. However, current national student curricula in EM do not include core pediatric emergency medicine (PEM) concepts.

Methods: A workgroup was formed by the Clerkship Directors in Emergency Medicine and the Pediatric Interest Group of the Society of Academic Emergency Medicine to develop a consensus on the content to be covered in EM and PEM student courses.

Results: The consensus is presented with the goal of outlining principles of pediatric emergency care and prioritizing students' exposure to the most common and life-threatening illnesses and injuries.

Conclusion: This consensus curriculum can serve as a guide to directors of PEM and EM courses to optimize PEM knowledge and skills education. [West J Emerg Med. 2014;15(6):647–651]

INTRODUCTION

Much attention has been given to the role of emergency departments (ED) in healthcare and in the training of future physicians. The Macy report emphasized the need for establishing academic departments in emergency medicine (EM) in medical schools and for training in EM.[1] The Institute of Medicine's (IOM) report on emergency care highlighted issues that affect the delivery of medical care in the EM arena and raised concerns about current pediatric care.[2] Notably, pediatric patients account for more than 25% of ED visits and most do not occur in cities with specialized pediatric care.[2] As such, the IOM report emphasized the need to augment pediatric-specific training throughout the healthcare system. Most medical schools now offer experiences in EM and exposure to pediatric emergency medicine (PEM), either as a stand-alone course or as part of their pediatrics or EM courses. This earlier exposure to PEM in medical school provides an invaluable opportunity for students to learn about the unique challenges and complexities of children with acute, undifferentiated complaints.

There have been numerous medical student curriculum statements and revisions related to EM and pediatrics.[3-7] Both a third- and fourth-year EM student curriculum have been published by members of Clerkship Directors in Emergency Medicine (CDEM).[3-5] Although there are concepts and content applicable to PEM in each, neither includes pediatric-specific topics. The Council of Medical Student Education in Pediatrics (COMSEP) pediatric clerkship curriculum addresses

Table 1. Pediatric emergency medicine (PEM) topics/complaints to be covered in PEM/EM clerkships.

Topic	PEM course	EM course with pediatric exposure	Overlap topics with EM national curricula
General approach to pediatric patient	X	X	
Complaints that students should evaluate clinically			
Respiratory difficulty	X	X	X
Fever	X		
Abdominal pain/vomiting	X		X
Altered mental status	X		X
Trauma/musculoskeletal injury	X		X
Complaints to which students should be exposed			
Limp	X		
Crying child	X		
Headache	X		X
Ingestion	X		X
Shock/cardiac arrest	X		X

EM, emergency medicine

pediatric emergencies and corresponding diagnoses that should be covered in the core pediatric clerkship, and those that should be mastered outside of the core clerkship, but does not specify which should be covered during a PEM or EM clerkship.[7] We therefore created a consensus curriculum that indicates which PEM chief complaints and conditions should be covered during PEM rotations, and which should be covered in EM rotations with exposure to pediatric patients.

METHODS

A committee was convened by CDEM in conjunction with the Pediatric Interest Group of the Society of Academic Emergency Medicine (SAEM) to develop a medical student curriculum in PEM. The group consisted of eight EM and/or PEM physicians from six institutions. Members possessed dual board certifications in pediatrics and EM (1), EM and PEM (2), or pediatrics and PEM (5). All members had served as a course director in the third or fourth year of medical school training at their institution. The committee met from June 2010 to June 2011 during announced public meeting at national conferences (ACEP, SAEM) to allow other educators to participate via teleconferences several times throughout the year and by email on routine basis. The group used Kern's model for the development of a curriculum and followed the National Institute of Health guidelines for consensus building to determine the appropriate student audience for the curriculum and to formulate the content that should be included in the PEM curriculum.[8-9] The group reviewed prior published curricula in EM and pediatrics, along with resources from the Liaison Committee on Medical Education (LCME) and Accreditation Council for Graduate Medical Education (ACGME) to assist in establishing the audience, goals and objectives, and knowledge content.[3,4,7,10-11] In establishing content, the group reviewed the frequency with which complaints are seen in the ED, prior exposure and knowledge base from previous clerkships, and topic relevance within PEM.[12]

RESULTS

After review of the current published national curricula, several opportunities existed for development of a PEM student curriculum. The consensus was that the curriculum should be targeted to the fourth-year medical student completing a four-week course in PEM, taking advantage of the knowledge and skills students had obtained during their core pediatric clerkship and potentially an EM clerkship. The group also concluded that certain PEM topics could be addressed in an EM clerkship with a PEM component. These topics would address the current absence of PEM topics in the current CDEM national curricula. Therefore, a two-tiered system was built for the curriculum: 1) topics for a fourth-year medical student course in PEM, and 2) topics that should be covered in an EM clerkship with a PEM component.

The working group then focused on the development of specific goals and objectives that would guide the experience of the four-week PEM course. To promote continuity between undergraduate and graduate medical education, the group composed objectives based on ACGME core competencies (Appendix). These objectives can be assessed through observation on shifts, standardized and virtual patients, self-directed learning, simulation, and other means.

Subsequently, the committee focused on knowledge content. In evaluating topics that were felt to be important

Table 2. Specific conditions by system that students should evaluate clinically or be exposed to during a pediatric emergency medicine (PEM) course and their applicability with national EM curricula.

Condition	Evaluate during PEM course	Exposure during PEM course	Align with EM curricula
Neurological			
a. Head injury	X		X
b. Seizure		X	
c. Apparent life threatening event		X	
Ear/nose/throat			
a. Otitis media	X		
b. Upper respiratory infection	X		
c. Pharyngitis	X		
Respiratory			
a. Asthma	X		X
b. Bronchiolitis		X	X
c. Croup		X	X
Cardiac			
a. Cardiac arrest		X	X
Gastrointestinal			
a. Gastroenteritis	X		
b. Dehydration	X		
c. Intussusception		X	X
d. Pyloric stenosis		X	X
Musculoskeletal			
a. Extremity fracture	X		
b. Nursemaid's elbow		X	
Genitourinary			
a. Sexually transmitted disease		X	X
b. Abuse		X	X
c. Testicular torsion		X	X
Dermatologic			
a. Viral exanthem	X		
b. Henoch-Schönlein purpura		X	
c. Tinea		X	
Psychiatric			
a. Behavior/emotional disturbance	X		X
Endocrine			
a. Hypo/hyperglycemia	X		X

for the fourth-year student completing a PEM course, the committee realized there were several features of PEM that needed to be considered:

1. Patients typically present with complaints/symptoms, rather than a diagnosis.
2. The evaluation and management of pediatric patients is affected by their unique anatomy, physiology, and psychosocial development.
3. Certain complaints are so frequently encountered in PEM that they should be included in this curriculum.
4. Complaints and diagnoses have seasonal variability.
5. Pediatric patients are at greater risk for medication and treatment errors.

The committee agreed that a general approach to the undifferentiated pediatric patient was an essential component of a PEM curriculum to address factors #2 and #5 above. The committee developed its knowledge content on a chief complaint perspective, rather than a disease process, to address factor #1. Ten complaints were agreed upon (Table 1). These complaints were divided into two categories: 1) complaints students would be expected to evaluate firsthand in the ED, and 2) complaints to which students should be exposed (in a clinical, didactic, simulation, or other environment). This classification was developed due to the seasonal nature of PEM, the frequency the complaint is encountered, and the unique pathophysiology of certain disease process to pediatrics.

While specific complaints appear repeatedly in the ED (e.g fever), predicting which specific diagnoses a student will encounter cannot be assured, especially given the seasonal variability in PEM (e.g. bronchiolitis). The group, however, agreed that students completing a PEM course should have an

understanding of the presentation, diagnosis, and management of specific diagnoses in PEM. The group compiled a list of specific disease processes in a similar fashion as the complaints, those to be evaluated clinically and to be exposed via other educational modalities. These disease processes are divided by organ system in Table 2.

The group also considered procedures that fourth-year medical students should experience during a PEM course (Figure). Procedures selected are those performed frequently in the care of pediatric patients in most EDs. The committee felt the procedural education should address indications, contraindications, complications, appropriate equipment, explanation of the procedure to families and patients, elements of consent when required, and aftercare, in addition to the specifics of performing the procedure.

Finally, after completing the development of the PEM course content, the content was reviewed and compared to national EM curricula.[3-5] Many areas of overlap were noted between the knowledge content areas of complaints and procedures. The committee felt two content areas within the PEM curriculum should be addressed by EM rotations with pediatric exposure: 1) Approach to the pediatric patient and 2) Respiratory difficulty. The committee, therefore, recommends that an EM course with a PEM component incorporate these topics into their curriculum. Given the amount of overlap in the complaints in both the national EM curricula and our consensus curriculum, EM course directors may want to consider exploring pediatric perspectives of these common complaints as part of their curriculum (Table 1).

1. Venous access ^
2. Lumbar Puncture ^
3. Bladder Catheterization ^
4. Laceration Repair ^
5. Abscess Incision and Drainage^
6. Splinting^
7. Dislocation Reduction

Figure. Procedures to which students should have exposure during pediatric emergency medicine course (^Procedures that align with National EM Curricula[1,2]).

DISCUSSION

As with any medical course, the experience that may be provided and the content that could be covered can be daunting. One of the greatest challenges in developing this curriculum was determining the topics to be covered. Multiple factors led to this challenge, such as differing educators' perspectives on topic importance, expectations of what a medical student should know and be exposed to, and consideration of institutions resources and patient volumes. Ultimately, some course directors may place higher importance on some complaints/conditions which are not listed here. The committee attempted to balance essential PEM topics (shock, cardiac arrest, trauma) with more frequently encountered complaints (respiratory difficulty, abdominal pain), and complaints that have unique pediatric considerations (limp, crying child). As for the procedures, the committee attempted to identify procedures performed frequently in all EDs and appropriate for a medical student level of training. Other procedures, such as procedural sedation and bedside ultrasound, may not be performed at all institutions for pediatric patients and were therefore omitted from the recommended curriculum. A future goal of the committee will be to seek feedback from course directors about the curriculum content and implementation for purposes of determining if the curriculum needs revision, as was done with the EM national curriculum.[2,3]

Implementation of this curriculum at individual institutions will undoubtedly be affected by the specifics of the ED, institution resources and strengths, patient population and location, seasonal variability of conditions, among other variables. By limiting complaints and diagnoses in the "should evaluate clinically" to those most frequently encountered complaints in EDs, the committee hoped to prevent any conflict with LCME standards for individual course directors. LCME educational standards state that a course must ensure that students have some way of seeing expected diagnoses if not encountered clinically.[10] By classifying complaints and diagnoses as "should have exposure," individual course directors can use strengths of their institution to develop ways to expose students to the less frequently seen complaints. In order to provide further resources, CDEM plans to develop resources that can help course directors incorporate this curriculum and ensure students are exposed to all conditions/diagnoses.

Lastly, the ACGME has developed milestones which pediatric and EM residency programs are incorporating in the evaluation of their residents.[13,14] The AAMC is in the final stages of developing entrustable professional activities (EPAs) for medical students.[15] Many of the Level 1 residency milestones and student EPAs are based on the learner's ability to accurately obtain a history, perform a physical exam, and to develop an appropriate differential diagnosis and plan. The milestones expect learners at the beginning of residency to be able to recognize abnormal vitals and begin the process of recognizing higher acuity patients. The nature of PEM and the objectives of this curriculum will allow course directors

and faculty to observe a student's ability to initially evaluate a patient, from history to differential, while developing a plan of care for certain complaints in PEM. To address the need of learners to begin to recognize higher acuity patients, the approach-to-pediatric-patients topic will need to encompass the range of abnormal vital signs, the art of recognizing the subtle findings in children that suggest sicker patients, among other components. Therefore, this curriculum should allow course directors to evaluate learners in these areas, but will also provide students further opportunity to develop the skills residency programs expect of them upon entry. These areas also need to be addressed in future evaluation of this curriculum's adoption by course directors and feedback about its contents.

LIMITATIONS

The curriculum is the consensus result of a working group of eight educators. The recommendations presented here may vary with different members or with a larger number of committee members. Future feedback on the curriculum will need to address this limitation. Also, this curriculum will need to be incorporated by course directors based on their own institution's strengths and resources. Each institution will have differing abilities to support the curriculum. CDEM plans on developing online resources for institutions and students to use to address topics in the curriculum, which may assist in institutions with lower pediatric volume or more limited resources.

CONCLUSION

Given the role of the ED in the care of children, biopsychosocial factors specific to children, and the lack of a national medical student curriculum in PEM, a consensus curriculum was created by a subcommittee of CDEM and SAEM Pediatric Interest Group. This consensus curriculum can serve as a guide to directors of PEM and EM courses to optimize PEM knowledge and skills education. The committee hopes that by standardizing the curriculum of PEM rotations, the recognition of the uniqueness of emergently ill and injured children will begin at the medical student level, and continue throughout training and practice.

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Appendicitis During Pregnancy with a Normal MRI

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Abdominal pain frequently represents a diagnostic challenge in the acute setting. In pregnant patients, the gravid abdomen and concern for ionizing radiation exposure further limit evaluation. If undiagnosed, appendicitis may cause disastrous consequences for the mother and fetus. We present the case of a pregnant female who was admitted for right lower quadrant abdominal pain. Advanced imaging of the abdomen and pelvis was interpreted to be either indeterminate or normal and a diagnosis of acute appendicitis was made on purely clinical grounds. This patient's management and a literature review of diagnostic techniques for acute appendicitis during pregnancy are discussed. [West J Emerg Med. 2014;15(6):652-654]

CASE REPORT

A 22-year-old G2P0 pregnant female at 10+6 weeks estimated gestational age presented to the Emergency Department (ED) with a chief complaint of right lower quadrant abdominal pain. The patient's past medical history included a right hemorrhagic ovarian cyst resulting in laparoscopy and a missed abortion requiring dilation and curettage. Forty-five minutes prior to ED presentation, the patient reported acute onset abdominal pain and nausea. The pain was non-radiating, constant, sharp, cramping, rated 6 out of 10 on a pain scale, and was unrelated to oral intake or movement. The patient denied vomiting, fevers, chills, diarrhea, melena, hematochezia, dysuria, vaginal discharge, or vaginal bleeding. She endorsed having similar symptoms during her previous miscarriage and ovarian cyst rupture.

Initial physical examination revealed an anxious appearing woman with the following vital signs: temperature, 99.2°F (37.3°C); blood pressure, 135/84 mm Hg; pulse, 92 beats/min; respiratory rate, 18 breaths/min; and oxygen saturation; 99% on room air. Notable physical exam findings included tenderness to palpation in the right lower quadrant with voluntary guarding. No rebound tenderness, peritoneal signs, or palpable masses were elicited. The remaining physical exam was unremarkable. Laboratory testing revealed: a bicarbonate level of 20 mmol/L but an otherwise normal basic chemistry and hepatic panel; white cell count, 9.9 K/μL; hemoglobin, 11.7 G/dL; and platelets, 218 K/μL. Urinalysis showed no signs of infection.

Initial pelvic and abdominal ultrasounds were unable to visualize the appendix and were otherwise unremarkable. Due to her pregnancy and the risk of radiation exposure, magnetic resonance imaging (MRI) was selected over computed tomography (CT) as the next imaging modality. The MRI revealed a normal appendix without inflammation and a 3.7cm cyst on the left kidney. Over the course of the patient's ED stay she received 1.5L of 0.9% normal saline, IV morphine, and ondansetron. She tolerated a trial of oral intake and her pain greatly improved. Given her negative workup, she was discharged home with the diagnosis of abdominal pain and nausea with vomiting. She was instructed to return to the ED if her abdominal pain or symptoms worsened.

Twenty-four hours after discharge the patient returned to the ED with right lower quadrant abdominal pain worse than the previous day's pain that radiated to the umbilicus and was associated with continued nausea. The physical examination was notable for right lower quadrant tenderness with voluntary guarding but no rebound tenderness or peritoneal signs. As before, the remainder of the physical exam was unremarkable. On readmission, laboratory testing revealed: a basic chemistry panel within normal limits except for a bicarbonate level of 21 mmol/L; white cell count, 9.2 K/μL; hemoglobin, 12 G/dL; and platelets 209 K/μL.

Repeat transabdominal pelvic ultrasound demonstrated an intrauterine pregnancy without pathology. Considering her

atypical presentation coupled with unremarkable laboratory and imaging studies, the general surgery and gynecology services were consulted, and a diagnostic laparoscopy was planned to rule out appendicitis versus ovarian torsion.

Post-surgical pathology revealed an acutely inflamed appendix. The patient tolerated the procedure well and was discharged from the hospital on post-surgical day two. The patient recovered from appendectomy without complications and had an otherwise unremarkable pregnancy that resulted in the birth of a healthy girl via spontaneous vaginal delivery at 38+4 weeks of gestation.

DISCUSSION

Acute abdominal and pelvic pain in pregnant patients can be caused by a wide range of conditions, of which appendicitis is the most common nonobstetric surgical emergency.[1-5] Fetal mortality is as high as 37% if the maternal appendix perforates,[4,6] and surgical delay of greater than 24 hours results in a 66% increase in the rate of appendiceal perforations.[5,7] Thus, early and accurate diagnosis of appendicitis in pregnant patients is critical to prevent adverse outcomes to both mother and fetus.

Diagnosing appendicitis in pregnant patients is often complicated by atypical clinical presentations. The most common presenting symptom of appendicitis during pregnancy is right lower quadrant pain.[3,4,8] Fever and leukocytosis are less reliable markers of acute pathology than in patients who are not pregnant.[2,3,6] Additionally, while controversial, the repositioning of the appendix during pregnancy may thwart visualization and identification in imaging studies.[2,3,5,6]

Ultrasound is widely used as the initial imaging modality in the evaluation of right lower quadrant pain during pregnancy due to its availability, rapidity, and lack of ionizing radiation.[5,6] Limitations include dependency on operator experience and a finite field of view that may be restricted further by obesity or gravid anatomy.[5,6,9] For example, in several studies among pregnant patients, the appendix could not be identified even when appendicitis was proven on pathology.[10,11] Overall among pregnant patients, sensitivities range from 36% to 100% and specificities range from 33% to 99% when compared to the gold standard of surgical pathology in the diagnosis of appendicitis.[2,5,8,11]

MRI represents another radiographic technique without ionizing radiation that is considered safe during pregnancy.[5,6,10] In pregnant patients suspected to have acute appendicitis, most studies find MRI sensitivities and specificities to be 80-100% and 93-98%, respectively, when compared to surgical pathology.[2,4-6,10] One smaller study with 19 patients demonstrated lower MRI sensitivity of 50%, although it had a specificity of 100%.[12] The use of MRI in this population has been shown to reduce rates of both negative laparotomy and perforation.[10] Additionally, MRI frequently identifies an alternative diagnosis for abdominal pain when appendicitis is not present.[8-10]

In the ED setting, MRI is particularly effective in ruling out appendicitis. Several studies suggest that MRI has a 100% negative predictive value when the appendix is visualized.[2,6,10] Nikolaidis et al. studied cases with a nonvisualized appendix on CT and found that even without visualizing the appendix, other findings consistent with acute appendicitis such as abscess formation and fat stranding often existed.[13] Although comparable studies of nonvisualized appendix on MRI have not been performed, the diagnostic performance of CT and MRI in the evaluation of appendicitis during pregnancy have yielded similar results.[5,14]

CONCLUSION

Appendicitis during pregnancy increases morbidity and mortality of both the mother and fetus. Due to the physical and physiological changes of pregnancy, the presentation of appendicitis can be highly variable. Ultrasound is often the initial diagnostic imaging technique due to its accessibility, although it has demonstrated less than ideal sensitivities and specificities in pregnant patients. MRI can be effectively used to assist in the evaluation of abdominal pain during pregnancy and has nearly 100% negative predictive value for appendicitis. However, as this patient demonstrated, a detailed history, physical examination, proper discharge instructions, and a recognition that no imaging modalities are perfect remain essential in the diagnosis of acute appendicitis in pregnancy.

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Pyocystis and Prostate Abscess in a Hemodialysis Patient in the Emergency Department

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The urinary tract is an often forgotten and under-appreciated source of infection in anuric hemodialysis patients. Bladder abscess, also called pyocystis, is a severe complication of low urinary flow that can be difficult to detect, leading to delays in treatment and increased morbidity. The emergency physician should maintain a high suspicion for pyocystis, which can be quickly diagnosed by bedside ultrasound. We report a case of a hemodialysis patient with an initially minor presentation who developed sepsis secondary to pyocystis and prostate abscess. [West J Emerg Med. 2014;15(6):655-658]

CASE REPORT

A 57-year-old African American male patient with past history of hypertension and long-standing end-stage renal disease (ESRD) on maintenance hemodialysis through a left upper extremity arteriovenous fistula presented to the emergency department (ED) complaining of penile pain and discharge for one day. He denied any other significant complaints, including fever, chills, nausea, vomiting, abdominal pain, or rectal pain. He reported that he has been anuric for many years, but on the day prior to presentation, the patient began experiencing a scant amount of thick urethral discharge. The patient denies any sexual contact for at least two years, trauma, or any similar episodes in the past.

In the emergency department, initial vital signs were: heart rate 68, blood pressure 149/83, respiratory rate 18, temperature 98.9 Fahrenheit, and oxygen saturation 99% on room air. Abdominal examination found no distention or tenderness, and there was no costovertebral angle tenderness. Genitourinary examination confirmed a scant amount of urethral discharge without any additional discharge or tenderness on penile palpation. There was right-sided inguinal lymphadenopathy. There were no lesions, scrotal tenderness, or scrotal swelling. A digital rectal exam was performed due to concern for prostatitis, which revealed a prostate that was enlarged, boggy, and tender to palpation.

A urethral swab of the discharge fluid was obtained for gram stain, culture, and polymerase chain reaction assay for gonorrhea and chlamydia DNA. Resistance to swab passage in the distal urethra was noted. Due to concern for prostatitis and sexually transmitted infection, the patient was given a single-dose treatment regimen of ceftriaxone, azithromycin, and metronidazole, with a plan to prescribe ciprofloxacin for outpatient treatment of prostatitis. However, approximately 60 minutes after the urethral swab was performed, the patient then developed a large amount of purulent drainage from the urethra, which was cultured. Repeat vital signs at that time revealed a heart rate of 120, blood pressure 160/100, respiratory rate 22, and temperature 101.7 Fahrenheit establishing a diagnosis of early sepsis, which was initially thought to be secondary to pyelonephritis in the setting of anuria.

Intravenous access, labs, and blood cultures were obtained, and the patient was started on vancomycin and piperacillin/tazobactam. A computed tomography (CT) of the abdomen and pelvis was obtained to evaluate the patient for a differential diagnosis of pyelonephritis, nephroureterolithiasis, and pelvic abscess. The patient was hospitalized, and the departments of urology and nephrology were consulted. Because the bladder had partially decompressed spontaneously, the urologist initially advised against Foley catheter placement in the ED.

CT with intravenous contrast was performed, revealing a heterogeneous, thick walled bladder consistent with pyocystis in the setting of copious urethral discharge of purulent fluid. CT also demonstrated communication between the posterior

bladder wall and the seminal vesicles and a large prostatic abscess (Figure 1). After the patient's admission to the hospital, the urologist placed a Foley catheter for further bladder irrigation and drainage. After successful drainage of the prostatic abscess through a percutaneous drain placed by interventional radiology, the Foley catheter was removed.

Cultures of the discharge fluid and of the prostatic abscess after drain placement both revealed E. coli with resistance to ampicillin, gentamicin, tetracycline, tobramycin, and trimethoprim/sulfamethoxazole, and susceptibility to cephalosporins, carbapenems, fluoroquinolones, and piperacillin/tazobactam. Blood cultures were unremarkable. Stool cultures were performed by the inpatient team, which were also unremarkable. The patient recovered and was discharged on a two-week course of ciprofloxacin with urology follow up.

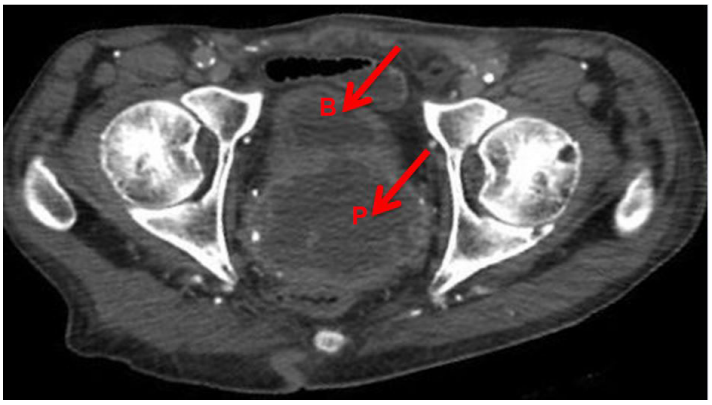

Figure 1. Axial computed tomography demonstrates persistent abscess within the bladder and prostate after spontaneous urethral drainage, with communication between the bladder (B) and prostate (P) abscesses.

DISCUSSION

In the United States, ESRD is a growing problem, with 593,000 people being treated for ESRD at the end of 2009.[1] This trend represents almost a 600% increase in the prevalence of ESRD over the past 30 years, which is due to the combination of the ability of dialysis therapy to substantially extend patients' lifetimes and the persistence of poorly controlled hypertension and diabetes in the population.[2] By 2011, more than 400,000 of these patients were being treated with hemodialysis.[3] Patients with complications of ESRD and hemodialysis are frequently evaluated in EDs. In 2010, there were over one million ED visits by patients on dialysis.[4]

Infection is a common cause of ED visits among patients with dialysis-dependent ESRD, leading to 0.46 admissions per patient-year.[5] These trends are expected to continue, increasing the frequency with which we evaluate and treat patients with complications of ESRD and hemodialysis. By 2015, the prevalence of patients with ESRD has been predicted to exceed 700,000.[6]

Loss of renal function concomitantly leads to oliguria or anuria, creating defunctionalization and inadequate washout of the urinary bladder due to low flow through the urinary system. This low-output state is a recognized risk factor for bladder complications.[7-10]

The most common complication of the defunctionalized bladder due to urinary diversion is pyocystis, but the exact incidence of this complication in the anuric hemodialysis-dependent patient population is unknown.[11] Pyocystis, also termed vesical empyema, may develop in the defunctionalized bladder due to accumulation of cellular debris and secretions that later become infected because the bladder is not evacuated.[7,12] Whereas urinary tract infections consist of inflammation and infection of the organ system, pyocystis represents an evolution of infection into an intravesical abscess due to inadequate urinary flow to maintain bladder washout. For unknown reasons, patients with pyocystis can often present without fever, leukocytosis, or typical symptomatology.[8-9] It is postulated that alterations in cell-mediated immunity due to uremia, diabetes and visceral neuropathy, or other chronic disease result in impairment of the patient's ability to develop inflammatory signs and symptoms, as in this case.[13]

The rate of pyocystis in patients with supravesical urinary diversion is reported in different studies to be 7%-67% and required emergency cystectomy in up to 30%.[12] Complications related to the defunctionalized bladder, including urethral bleeding, urethral pain, spasms, and infection occur in more than 50% of patients.[11,12,14-17] Patients with a surgically placed communication between the urinary tract and the external environment are intuitively more prone to infection. However, the urinary system may be an under-appreciated source of significant infections in dialysis patients being evaluated in the ED. Over a three-year period, 11.6% of hemodialysis patients were found to develop symptomatic urinary tract infection, defined as the presence of culture-positive urine accompanied by dysuria, flank pain, suprapubic pain, cloudy urine, hematuria, or fever.[18] The urinary system has been implicated as the primary source in 6-10% of cases of bacteremia in dialysis-dependent patients, typically due to gram-negative organisms that are associated with higher mortality.[19,20]

These data suggest that urinary tract infections tend to develop insidiously, avoiding detection in the ED until they become more advanced. The medical literature on hemodialysis patients with pyocystis contains only case reports and is unable to quantify the incidence and prevalence of this infectious complication.[7-9,21,22] We were unable to find any reported cases of pyocystis associated with prostatic abscess in a hemodialysis-dependent patient.

This case highlights the difficulty in establishing timely diagnosis and treatment of urinary tract infections before such complications develop, as this patient was under frequent medical supervision through hemodialysis while his bladder and prostate abscesses progressed. Diagnosis of urinary tract infections in anuric hemodialysis-dependent patients is made more difficult due to the inability to obtain urine for analysis and culture. A lack of accompanying inflammatory signs and

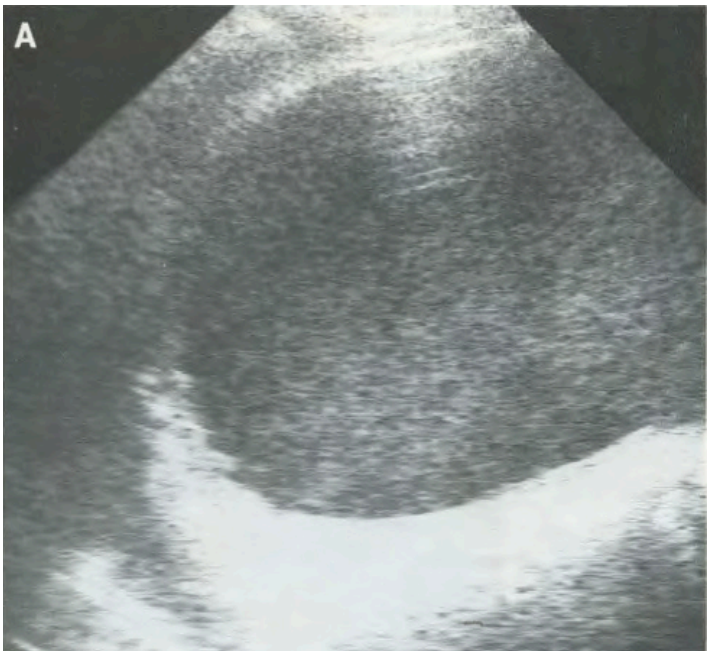

Figure 2. Sagittal ultrasound of the bladder in a patient with pyocystis reveals complex heterogeneous fluid within the urinary bladder. Reprinted with permission, courtesy Elsevier from Tung and Papanicolaou. *J Can Assoc Radiol*. 1990.

symptoms can further cloud the clinical picture.[13] Bedside ultrasonography by the emergency physician could easily demonstrate a distended bladder with complex fluid (Figure 2) or perinephric fluid collections. [3] Together with the rest of the physical exam, these easily obtained ultrasound findings would help direct the physician's workup in considering the need for bladder catheterization in an anuric patient or CT of the abdomen and pelvis.

Treatment of pyocystis includes resuscitation and parenteral antibiotics covering gram-negative bacteria. Although oral antibiotics have been effective in treating symptomatic urinary tract infections in the hemodialysis-dependent population,[18] the nature of pyocystis as an abscess formed within the bladder necessitates bladder drainage, parenteral antibiotics, and consideration of bladder irrigation with bactericidal solutions.[8,9,12,21] Successful treatment has been reported with bladder irrigation solutions containing silver nitrate, chlorhexadine, acetic acid, or nitrofurantoin.[12] Further source control may be accomplished by transurethral cystoscopy, suprapubic cystostomy,[21,23] Spence urethrovaginal fistula,[7] or cystectomy. Cystectomy is avoided where possible, especially in hemodialysis patients in whom future kidney transplantation is considered a possibility.

Complication of the pyocystis with abscess extension into neighboring tissues, as in this case, necessitates further intervention to establish source control. Earlier detection and treatment of the developing pyocystis may have halted progression of infection and spared the patient the morbidity, discomfort, and cost of the prostate abscess and subsequent percutaneous drainage.

CONCLUSION

Hemodialysis patients are frequently evaluated in the emergency department due to severe chronic illness. Pyocystis is a major complication of anuria that can be difficult to detect due to the inability to obtain urine samples and a diminished ability to mount appropriate inflammatory signs and symptoms in chronic dialysis patients. Bedside ultrasonography can be used in the ED to establish a rapid diagnosis and expedite treatment with antibiotics, catheter decompression, and specialist consultation.

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Blunt Trauma Patient with Esophageal Perforation

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Traumatic perforation of the esophagus due to blunt trauma is a rare thoracic emergency. The most common causes of esophageal perforation are iatrogenic, and the upper cervical esophageal region is the most often injured. Diagnosis is frequently determined late, and mortality is therefore high. This case report presents a young woman who was admitted to the emergency department (ED) with esophageal perforation after having fallen from a high elevation. Esophageal perforation was diagnosed via thoracoabdominal tomography with ingestion of oral contrast. The present report discusses alternative techniques for diagnosing esophageal perforation in a multitrauma patient. [West J Emerg Med. 2014;15(6):659-662]

CASE

A 33-year-old woman was transported to the ED by ambulance after having jumped from the second story of a building in a suicide attempt. She was conscious on arrival. Patient evaluation revealed the following: Glasgow Coma Scale, E4M6V4; blood pressure, 104/65 mmHg; heart rate, 124 beats/min; breathing, 28 breaths/min; and oxygen saturation, 99%. Bilateral periorbital ecchymosis, superficial skin lesions approximately 2 and 3 cm in size in the right frontal area, and pain/tenderness above the left zygoma and the left clavicle were present. There was no shortness of breath or chest pain. The only pain was present in the left paravertebral region at the T3-4 level, and there were no other lesions on her back. Minimal tenderness was present on abdominal examination. Other physical examinations were normal. Bedside ultrasound (FAST)

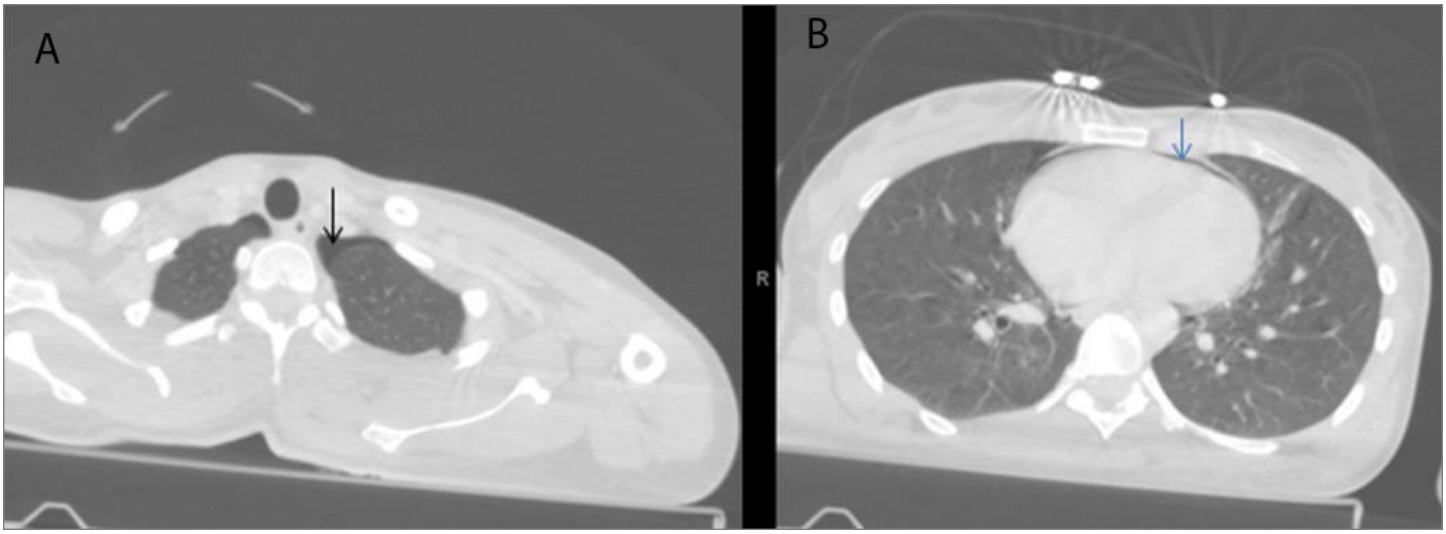

Figure 1. Thoraco-abdominal computed tomography showing pneumothorax, A, and pneumopericardium, B.

revealed no intra-abdominal or pericardial fluid, although left kidney contusion was suspected. Bedside chest radiograph revealed suspected pneumomediastinum. Hemoglobin level was 13.6 g/dL, and hematocrit level was 39.6%. Intravenous contrast enhancement for thoracoabdominal spiral computed tomography (CT) was performed and revealed bilateral minimal pneumothorax, pneumomediastinum, pneumopericardium, left kidney contusion, left transverse process fractures in the L3-4 vertebra, and non-displaced fracture at the left clavicle (Figure 1). A cortical contusion in the left frontal lobe and fractures in the superior aspect of the right lateral orbit, at the level of the frontotemporal junction on the right and in the anterior wall of the maxillary sinus, were determined on cerebral and maxillofacial CT. A left transverse process fracture was present in the T1 vertebra on cervical CT. Bedside echocardiography detected ejection fraction, and valves were normal; there was no pericardial effusion. Endoscopy was initially planned to exclude esophageal rupture, but alternative tests were then considered due to difficulties positioning the patient. Due to multiple fractures, the standing position required for contrast esophagography was not possible, and the patient was examined in the supine position. The patient ingested non-ionic contrast material in a supine position, and thoracic CT was performed at the time of swallowing. Contrast material extralumination from the esophagus was observed, and esophageal rupture was diagnosed (Figure 2). The patient was admitted to the general surgery department. Conservative treatment for esophageal perforation was performed with a nasogastric tube and intravenous antibiotherapy (ampicillin sulbactam 4x1.5 g and metronidazole 3x500 mg). Endoscopy revealed a probable area of perforation in the posterior hypopharynx. Esophagography with intense contrast material was performed in the anterior and lateral planes. No evidence of contrast leakage or compromised esophageal wall integrity was detected (Figure 3). Fiberoptic bronchoscopy revealed no perforation at the tracheal or bronchial levels. No additional symptoms were encountered throughout observation, and the patient left the hospital of her own volition on the fifth day.

DISCUSSION

Esophageal perforation is one of the most frequent causes of thoracic trauma-related mediastinitis. Iatrogenic causes are the most common in the etiology.[3,4] The mechanism involved in blunt trauma-related esophageal rupture is unclear. The most common theory is that, as in Boerhaave syndrome, perforation occurs in the weakest area of the esophagus.[5] Perforation can also occur when the esophagus is trapped between the sternum and thoracic vertebrae in association with fracture or compression of the thoracic vertebrae.[6] Only a T1 transverse process fracture was present in the current case, and the region of the esophagus with contrast leakage was inferior to the carina. Therefore, the probable mechanism was thought to involve a rise in intraluminal pressure.

Figure 2. Thoracic computed tomography with oral contrast enhancement showing extraluminal contrast material from the esophagus.

Figure 3. Normal esophagography.

The most frequently observed symptoms in esophageal perforation are dysphagia, odynophagia, chest pain, and shortness of breath. No specific physical symptoms are associated with the early period. The most commonly observed finding is subcutaneous emphysema.[4] In the current patient, the single finding present was back pain in the left paravertebral area. The absence of any skin lesion, deformity, or crepitation that might have accounted for pain in that region led to suspicion of esophageal perforation. When possible causes of the minimal pneumothorax, pneumopericardium, and pneumomediastinum observed on thoracic CT were investigated, the sternum and scapula were healthy, while stable bone fractures were present in the transverse processes in the clavicle and vertebra. No pulmonary contusion or bronchopulmonary lesion was seen. All of these negative findings caused suspicion, and the patient was evaluated for esophageal perforation in the early period. Esophageal perforation might have been easily overlooked had even one of these injuries been present in the patient.

Review of the literature revealed that esophageal perforations are frequently diagnosed late and that the associated mortality is high.[2,7] Early diagnosis reduces mortality. However, suspicion is first necessary for early diagnosis. When esophageal rupture is suspected, diagnosis is often determined with contrast esophagography, chest radiograph, thoracic CT, or upper gastrointestinal system endoscopy. Imaging with Gastrografin is recommended in stable patients and has a false negativity rate of 36%.[1,8] However, since multi-trauma patients are monitored on a trauma board and in a supine position in the early period, contrast esophagography, which must be performed while standing, is often not possible. Because chest radiograph has high sensitivity but low specificity for esophageal rupture, its contribution to diagnosis is limited. Upper gastrointestinal system endoscopy is often not an option in the ED. In addition, the endoscopy procedure is contraindicated in patients with cervical injury and wearing a neck brace, and the procedure is technically difficult. There was no direct evidence of esophageal perforation on the first contrast thoracic CT. Endoscopy could not be performed at the beginning both for technical reasons and because our multi-trauma patient could not stand. The patient ingested non-ionic contrast material, and CT imaging was performed at the time of swallowing. Contrast leakage was observed and esophageal perforation was diagnosed.

Successful treatment of esophageal perforations depends on the size of the rupture, time to diagnosis, and underlying diseases.[1,9] Patients must be started on wide spectrum antibiotics. Primary surgery has been recommended as the gold standard in the past, although conservative treatment has been recommended for select patients in recent years.[1,3] The present patient was stable and monitored conservatively since she was diagnosed in the early period.

CONCLUSION

Esophageal perforation should be included in the differential diagnosis of patients presenting to the ED with pneumomediastinum, pneumopericardium, or pneumothorax. If multiple trauma is present and neither contrast esophagography nor upper gastrointestinal system endoscopy can be performed, then performing thoracic CT with non-ionic contrast material may be a good diagnostic alternative.

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Quincke's Disease: Isolated Uvulitis

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A 27 year-old previously healthy man complained of sudden onset of gagging and foreign-body sensation that awoke him. He reported one day of nasal and sinus congestion. He had become concerned when he saw his extremely enlarged uvula while looking in a mirror (Figure). He had no fever, throat pain, or difficulty breathing, swallowing, or speaking. Prior to going to bed, he had taken an over-the-counter cold and allergy medication which he had taken previously without any adverse effects; he was not taking any other medications. He was admitted to the intensive care unit overnight for close observation and treated with nebulized racemic epinephrine, intravenous antihistamines and steroids. Empiric antibiotics directed against the most common infectious agents, *Haemophilus* and *Streptococcus* species were given.[1] He had rapid improvement in his symptoms over the next 24 hours and was discharged home. Uvulitis can be caused by mechanical trauma, chemical or thermal injury, infection, or angioedema of immunologic or non-immunologic origin.[2]

Figure. Enlarged uvula.

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Haff Disease: Rhabdomyolysis After Eating Buffalo Fish

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Haff disease, rhabdomyolysis after ingesting certain types of fish, was first reported in 1924 in Europe. There have been a limited number of cases reported in the United States. We present the case of a patient who presents with symptoms of rhabdomyolysis after eating cooked buffalo fish purchased at a suburban grocery market. [West J Emerg Med. 2014;15(6):664-666]

INTRODUCTION

Fish consumption is considered part of a healthy diet. Fish is lower in total calories, saturated fat and total fat than a comparable amount of red meat. However, like all food products, there are potential illnesses associated with the consumption of fish. Common illnesses known to be associated with fish consumption in the United States include Scombroid and Ciguatera poisoning and are well known to emergency medicine (EM) physicians, but Haff disease is unfamiliar to most. A rare consideration, it is important to recognize the symptoms that occur with Haff disease because the treatment of the rhabdomyolysis requires specific interventions, primarily larger amounts of intravenous fluid than those used to replace the fluid loss from the vomiting and diarrhea associated with more common fish poisonings.

Chest pain accompanying the presentation of Haff disease may be confused with aortic dissection or cardiac ischemia. This may result in extensive, invasive and expensive testing for conditions that the patient does not have. We present the case of a patient who developed rhabdomyolysis after ingestion of cooked buffalo fish. The patient's initial presentation included back and chest pain prompting concern for a possible aortic dissection. Despite the sporadic nature of the presentation of this etiology for rhabdomyolysis, Haff disease must be considered in the differential diagnosis so that appropriate treatment can be initiated.

CASE REPORT

An otherwise healthy 34-year-old white female presented to the emergency department (ED) with one-hour history of back pain. The pain began gradually in the center of her thoracic spine at the level of T7-T8 and progressively became worse. She described the pain as a severe dull pain, constant, radiating through to the chest, up the back into the neck and down the back into both buttocks. She attempted to relieve the pain by soaking in warm water; when that was unsuccessful her family member brought her to the ED. She denied history of back pain, trauma, fever, abdominal pain, paresis, paralysis, urinary retention, or paresthesias.

On initial examination, the patient was uncomfortable and moaning. Vital signs were blood pressure 155/90 mm Hg, pulse rate 82 beats/min, respiratory rate 20 breaths/min, and temperature 36.2 degrees C (97.1 F). She was mildly tender over the mid thoracic spine. Heart sounds were regular, pulses were equal in both extremities and bilaterally in the groin, and no other abnormalities of the physical exam were found.

Electrocardiogram performed upon arrival was interpreted as normal sinus bradycardia, rate of 58 bpm, with nonspecific ST segment and T-wave changes. Laboratory evaluation revealed hemoglobin 13.6 g/dL (12.0 to 15.3 g/dL), WBC 11.0 X 10^3/μL (4.0 to 11.0), platelet count 286 X 10^3 /μL (150 to 450 X 10^3 μ/L), sodium 141 mmol/L (135-145 mmol/L), potassium 3.3 mmol/L (3.5-5.1 mmol/L), chloride 106 mmol/L (98 - 109 mmol/L), bicarbonate 29 mmol/L (23 to 31 mmol/L), blood urea nitrogen 13 mg/dL (6 to 26 mg/dL), creatinine 0.83 mg/dL (0.5 to 1.20 mg/dL), and glucose 120 mg/dL (70 – 99 mg/dL). Troponin level was <0.01 ng/mL (<0.01 ng/mL = Expected range for 99% population), myoglobin was 7534 ng/mL (28 – 72 mg/mL) and creatine kinase 2336 IU/L (24 –170 IU/L). Urinalysis revealed large blood by dipstick with 31 to 50 RBCs (patient was menstruating), negative results for nitrite and leukocyte esterase. Urine toxicology was negative for illicit drugs, and

Table. Symptoms of Haff Disease cases, United States, 1997, 2001, 2013, 2014.

Symptom (n=20)	Number of reports
Myalgia	10
Muscles stiffness	5
Pain to light touch	6
Dry mouth	3
Painful breathing	2
Shortness of breath	9
Chest pain	14
Profuse sweating	8
Nausea or vomiting	13
Numbness of thighs	1
Numbness of whole body	1
Brown urine/hematuria	3
Back pain	4
Stomach cramps	1
Diarrhea	1

the urine pregnancy test was negative. Chest radiograph was negative for any lung pathology, mediastinum was normal width and no pathology was seen on the thoracic vertebrae. Computed tomography angiogram of the chest was normal; no aortic dissection was found.

An intravenous catheter was inserted when blood was drawn for laboratory evaluation. Hydromorphone 0.5 mg and diazepam 2.5 mg was intravenously given for pain relief and normal saline was begun at 150 ml/hour. Approximately one hour after arrival the patient complained of aching all over and then began to vomit, undigested food with no blood. She mentioned to the staff that a friend with whom she had had dinner had called her and told her that she was also ill. The patient explained that they had eaten fish that her friend had purchased at a local market and cooked for dinner. It was buffalo fish (Ictiobus).

After reviewing the laboratory values, the rate of intravenous normal saline was increased to 300 ml/hour. The patient was further questioned for an etiology of the rhabdomyolysis and an ingestion of a toxin was considered. An Internet search was performed looking at buffalo fish and rhabdomyolysis, and information on Haff disease was identified. The Illinois Poison Control Center was notified. The Illinois Poison Control Center subsequently contacted the Cook County Board of Health and all buffalo fish were removed from the local market.

The patient was admitted to the hospital for continued hydration. On day two the creatine kinase peaked at 30,549 IU/L, approximately 19 hours after arrival. Blood urea nitrogen and creatinine remained normal. Creatine kinase levels began to decline, and the patient was discharged on day three.

DISCUSSION

Back pain is a common complaint of patients who present to the ED, and the most common etiology is musculoskeletal. The differential for back pain is extensive and etiologies range from benign to life-threatening. Our patient had several "red flags" in her history; sudden onset, associated symptoms of nausea and vomiting, and radiation to the chest. Rarely do musculoskeletal causes of back pain occur with a pinpoint time of onset without a precipitating event. Radiation to the chest is concerning for an aortic dissection even without other physical findings. The accompanying nausea and vomiting were considered as possible symptoms of either a cardiac or gastrointestinal etiology.

Rhabdomyolysis is caused by the breakdown of skeletal muscle with the subsequent release of cell contents into the blood. Myoglobin, a muscle cell protein, circulates to the kidneys where it is filtered. Myoglobin can precipitate in the renal tubules, causing obstruction and acute renal failure. The symptoms of rhabdomyolysis are nonspecific; muscle weakness, pain, and light to dark brown urine. The etiology of rhabdomyolysis is also diverse: congenital metabolic myopathies, prolonged immobilization, trauma, exertion, high-voltage electrical injury or lightning injury, heat and cold injury, drugs and toxins, infections, electrolyte abnormalities, connective tissue disorders, rheumatologic disorders, endocrine disease, tissue hypoxia and ischemia as well as various miscellaneous causes.[1]

An outbreak of an unknown illness was first reported in 1924, in which the victims had unexplained severe muscular rigidity. It was named Haff disease because the cluster of victims occurred near the shores of Konigsberg Haff (Haff means shallow lagoon) in East Prussia.[2-4] Recent ingestion of fish was identified as a common characteristic in all individuals that had become ill, although the species of fish differed - burbot, eel, and pike. Outbreaks resembling Haff disease have been reported in Sweden, Russia, China, and Brazil.[2,6,7] Haff disease was first reported in the U.S. in Texas in 1984 with only 23 cases reported in the U.S. between 1984 and 2001.[3,5] All victims had eaten buffalo fish except for two who had ingested salmon in North Carolina and nine who had ingested crayfish in Louisiana. Two more cases were reported in New York in 2013 in which there was one death reported.[8] Again, buffalo fish was implicated as the source of the illness of the New York patients.

Haff disease is defined as illness in a person with unexplained rhabdomyolysis who has eaten fish within 24 hours before symptom onset.[3] Complaints of muscular pain and stiffness are the major symptoms of the clinical presentation. Approximately 50% of patients complain of chest pain.[5] Other predominant symptoms are nausea or vomiting, shortness of breath, profuse sweating, and pain to light touch. Dry mouth, dyspnea, numbness of thighs or whole body, brown urine, back pain, and stomach cramps are seen less frequently.

Levels of creatine kinase (CK) and myoglobin are elevated. The median time to onset is approximately eight hours. CK levels reaching five times normal are considered diagnostic for rhabdomyolysis. Myoglobinuria is typically present. Acute renal failure and disseminated intravascular coagulation are known complications of the disease, but the mortality rate is approximately is 1%. The fatal New York patient's case was complicated by hypertension and intracerebral hemorrhage.[8]

It is believed that a toxin contained in the fish, although one has not been isolated at this time, causes Haff disease. It is theorized that the toxin is similar to palytoxin. Palytoxin is a potent vasoconstrictor, which has been found in several marine species such as sea anemones and soft coral. It known to cause rhabdomyolysis, as well as excessive sweating, abdominal pain, nausea, diarrhea, cardiac arrhythmias, renal failure, paresthesias, dysthesias, muscle tremors, and spasms.[5] However palytoxin is found in marine fish, not freshwater fish. Haff disease has only been reported in the U.S. in patients who have ingested freshwater fish or shellfish. An infectious etiology is considered less likely because all fish involved in the reported cases were cooked. That also suggests that the toxin is heat stable and cooking does not eliminate it. Patients with Haff disease have demonstrated moderate leukocytosis, although they remain afebrile.[1]

The treatment for rhabdomyolysis caused by Haff disease is supportive. The patient should remain adequately hydrated to prevent acute renal failure. Intravenous rates of normal saline should be approximately 200 – 300 ml/hour with further increases of rate depending on urine output and clinical condition. Hyperkalemia, hypo or hypercalcemia, hyperphosphatemia, and hyperuricemia are known complications of rhabdomyolysis. Serum electrolytes and renal function should be measured serially and treatment should proceed accordingly. Urine alkalinization is recommended as treatment for rhabdomyolysis, although definite conclusion of its benefit has not been proven. Mannitol has sometimes been employed but also remains controversial at this time.[2] The Illinois Poison Control Center did not recommend the administration of bicarbonate for urinary alkalinization in our patient; her creatinine remained normal throughout her hospitalization with adequate hydration.

With the use of the Internet, the diagnosis of Haff disease was determined to be the most likely etiology of our patient's rhabdomyolysis. Haff disease should be added to the differential of rhabdomyolysis, although the exact toxin causing rhabdomyolysis is not known at this time. Cases of Haff Disease should be reported to the local poison control center or board of health so that the suspected source, freshwater fish, can be removed and tested, thus preventing further cases.

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Complex Thoracic Aortic Dissection

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A 50-year-old man presented with sudden onset abdominal pain and non-productive cough. Past medical history was significant for hypertension, treated with hydrochlorothiazide, azilsartan and a beta-blocker. Cardiovascular exam was notable for soft diastolic murmur in right second intercostal space and an abdominal bruit in umbilical region. A chest radiograph revealed a left mediastinal mass (Panel A, Arrowhead). Contrast enhanced computed tomography (CT) of the chest and abdomen revealed a Type 1A, complex thoracic aortic dissection originating at the aortic root (Panel B, four lumens: True lumen [1], acute dissection [2], Sub acute dissection [3] and chronic dissection [4] respectively). The dissection extended down to the mid iliac arteries bilaterally (Image not shown). The patient was transferred to tertiary care center and underwent an aortic root replacement.

CT is the most utilized imaging modality for the diagnosis of aortic dissection.[1] The advantages of CT are ready and widespread availability in the emergency department setting, rapid image acquisition, minimal patient discomfort, and sensitivity and specificity approaching 100% with multidetector CT.[2] A negative CT may also identify alternative causes for the patient's clinical presentation. Limitations of CT include false positives from motion artifact in non-electrocardiogram gated scans, false negatives from poor contrast opacification due to cardiac failure or thrombosed false lumen, and identification of intimal flap in only 70% of cases.[3,4]

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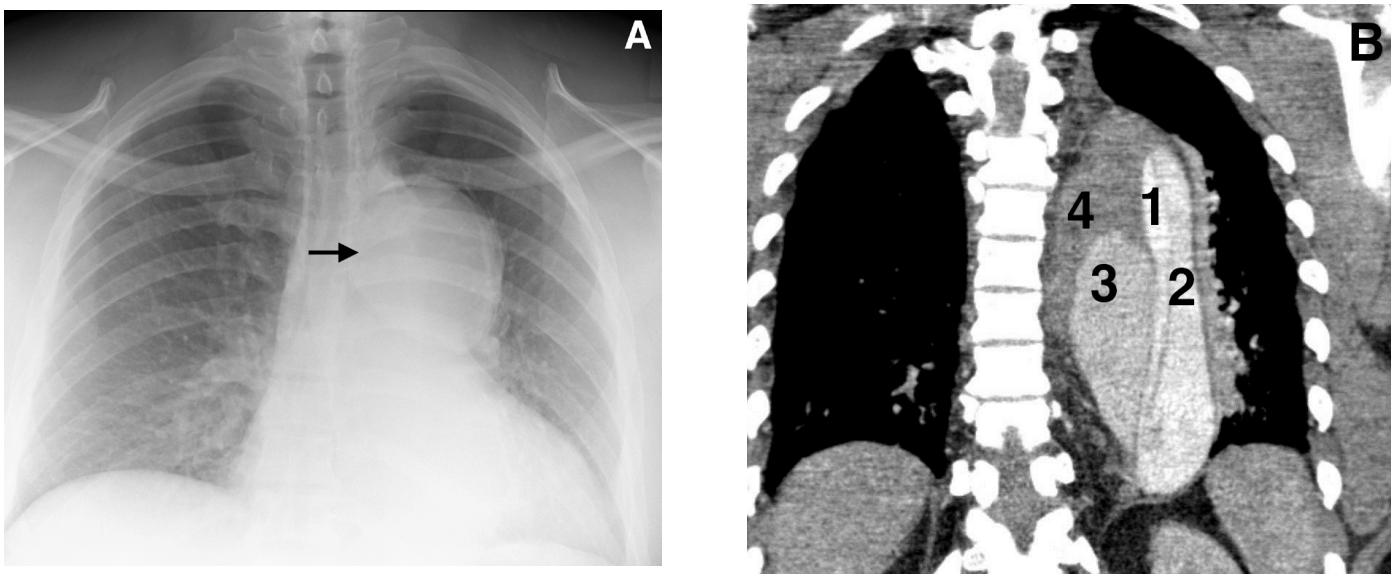

Figure. A, Chest radiograph revealing a left mediastinal mass. B, Complex thoracic aortic dissection originating at aortic root. 1) true lumen 2) acute dissection 3) acute dissection 4) chronic dissection

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Who's Boarding in the Psychiatric Emergency Service?

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Introduction: When a psychiatric patient in the emergency department requires inpatient admission, but no bed is available, they may become a "boarder." The psychiatric emergency service (PES) has been suggested as one means to reduce psychiatric boarding, but the frequency and characteristics of adult PES boarders have not been described.

Methods: We electronically extracted electronic medical records for adult patients presenting to the PES in an urban county safety-net hospital over 12 months. Correlative analyses included Student's t-tests and multivariate regression.

Results: 521 of 5363 patient encounters (9.7%) resulted in boarding. Compared to non-boarding encounters, boarding patient encounters were associated with diagnoses of a primary psychotic, anxiety, or personality disorder, or a bipolar manic/mixed episode. Boarders were also more likely to be referred by family, friends or providers than self-referred; arrive in restraints; experience restraint/seclusion in the PES; or be referred for involuntary hospitalization. Boarders were more likely to present to the PES on the weekend. Substance use was common, but only tobacco use was more likely associated with boarding status in multivariate analysis.

Conclusion: Boarding is common in the PES, and boarders have substantial psychiatric morbidity requiring treatment during extended PES stays. We question the appropriateness of PES boarding for seriously ill psychiatric patients. [West J Emerg Med. 2014;15(6):669-674]

INTRODUCTION

When patients in the emergency department (ED) require psychiatric hospitalization, but inpatient beds are unavailable, they may be converted to inpatient status while remaining in the ED and awaiting transfer. This status is known as "boarding." Boarding among medical patients is associated with adverse outcomes including increased mortality.[1-4] For psychiatric patients, boarding negatively impacts patient care, patient and staff safety, and health care expenditures.[5-7]

The increasing use of boarding for psychiatric patients reflects a number of factors – ED processes[7,8]; reduced inpatient psychiatric bed capacity and mental health financing; inefficient use of affordable community-based care; law enforcement processes; and legal standards for emergency care.[5,6,9] Shrinking bed capacity is a national problem[6,10,11] and pronounced in our state of Washington, which has lost almost 16% of its inpatient beds since 2000, even as its population has grown by 14%.[12,13]

It has been suggested that specialized care through a psychiatric emergency service (PES) may speed patient flow,[14] and reduce hospitalization and boarding rates,[6,9] but the frequency of boarding in a PES remains unreported. And, adult PES boarders have not been described. Knowing who is boarding in the PES is essential for addressing the implications of psychiatric boarding, including care needs of patients with unexpectedly prolonged stays in the ED. We describe the extent of adult patient boarding in the PES of an urban, safety-net hospital and clinical characteristics of these patient encounters.

METHODS

Study Setting and Population

The study setting is an academically-affiliated urban safety-net hospital with a Level I Trauma Center. The ED sees approximately 60,000 annual patient encounters of which about 5,000 are seen in the PES. The PES is a physically separate space with 10 rooms and is staffed 24 hours a day by dedicated on-site attending and resident psychiatrists, mental health nurse practitioners, nurses, and social workers. Patients may be directed to the PES directly from triage or from the general medical ED. Patients transferred to the PES are presumed to be medically appropriate for potential admission to an inpatient psychiatry unit. Referrals are not excluded on the basis of age or diagnosis (eg, developmental disability). When PES patients require intensive medical evaluation or treatment, they are transferred to the general ED. The PES' treatment aims are acute stabilization and transfer to appropriate ongoing care.

In the PES, patients are placed on boarding status after the patient has been deemed to require admission and authorized for requisite funding (by private insurers or, for uninsured patients, the county), but no hospital bed is available in the community. Thus, only lack of disposition precipitates conversion to boarding status. Boarding does not presume a particular length of stay has been met. Boarders remain in the PES and are followed by PES providers while awaiting transfer.

Study Design

We retrospectively reviewed electronic medical records for all consecutive patients 18 years or older seen over a 12 month period (June 1, 2011, through May 31, 2012). All data were collected as part of routine care. We analyzed data by encounter, which better reflects the frequency of boarding initiation and is consistent with prior literature.[15,16] The Institutional Review Board at the University of Washington approved this study.

Study Measures and Data Analysis

Data were electronically extracted from our hospital's central medical record data repository (Amalga Unified Intelligence System SP3, Microsoft, 2011) using SQL Server Management Studio 10.50.2500 (Microsoft, 2008) and matched with patient encounter information from PES nursing logs stored in Excel (Microsoft, 2007). For each encounter, boarding status and physical restraint or seclusion use was obtained from nursing logs, the only available record for these data. Age, sex, and International Classification of Diseases (ICD)-9 billing codes for selected psychiatric diagnoses were obtained from the electronic medical record. The source that referred the patient to the PES was extracted from the clinician's medical record note or, if missing there, the nursing logs. Substance use was presumed negative unless there was a relevant ICD-9 code, positive toxicology screen, or note by the clinical provider in the medical record. "High utilizers" were defined as patients with more than four visits over the preceding three month period.[17] In Washington State, county-designated health professionals (rather than PES clinicians) authorize involuntary hospitalization; we report on clinician-initiated requests for involuntary hospitalization, which are recorded in nursing logs and not necessarily granted. Race-ethnicity and insurance status were not available.

Clearly erroneous or missing data (e.g., nonsensical arrival dates, missing sex) were reviewed and corrected if possible through chart review by the first author. We conducted two-tailed Student's t tests to test for differences in characteristics between boarders and non-boarders. A multivariate regression, adjusted for random effects to account for patients making several encounters over the study period, was also conducted. We conducted analyses with Stata version 12 (StataCorp LP, 2011).

RESULTS

We analyzed 5363 PES patient encounters (3681 unique patients) over one year after excluding 92 encounters with minors. Five hundred twenty-one patient encounters (9.7%, 466 unique patients) were converted to boarding status while in the PES. Boarding episodes lasted a median of 27.2 hours (range 0.3-143.0, IQR 34 hours). Data were complete except for 63 patient encounters (1.2%) missing source of referral and 154 non-boarder encounters (2.9%) missing ICD-9 diagnostic codes. There was no statistically significant difference between boarders and non-boarders in whether source of referral was missing ($p=0.421$). We used 5,151 encounters (96%) without missing data in the multivariate regression model; no missing values were imputed.

The table describes characteristics of and differences between boarding and non-boarding encounters. In multivariate analysis, boarding encounters were associated with patients' referral to the PES by a party other than the patient; arrival on or just after the weekend; or arrival in restraints. Boarding encounters were more likely to involve physical restraint or seclusion in the PES or referral for involuntary hospitalization. Most boarding encounters (74%) involved a patient diagnosed with primary psychosis or bipolar manic/mixed episode. Boarder encounters were also more likely associated with primary anxiety disorders or personality disorders. Substance use was common among all patients – tobacco use was more common among boarding encounters and alcohol use less common.

DISCUSSION

Nearly one in ten PES encounters resulted in boarding status. Many characteristics of psychiatric boarders were consistent with their need for hospitalization – including higher rates of psychotic disorders, personality disorders, and physical restraint and seclusion than among non-boarders. This substantial burden of illness among boarders

Table. Characteristics of psychiatric emergency services (PES) patient encounters by boarding status.

	Boarder encounters n(%)[a]	Non-boarder encounters n(%)[a]	All encounters n(%)[a]	Test of difference[b]	Multivariate regression OR (95% CI)[c]	
Total	521(9.7)[d]	4842(90.3)[d]	5363(100)[d]		All encounters	Encounters referred for involuntary hospitalization
Characteristic						
Age (mean, ±SD)	39.3(±12.7)	39.0 (±12.4)	39.1(±12.4)	p=0.667	1.01 (1.00-1.02)	1.00 (0.99-1.02)
Sex (male)	326(62.6)	3132(64.7)	3458(64.5)	p=0.338	0.93 (0.70-1.23)	0.97 (0.68-1.37)
Source of referral to PES[e]				p<0.001		
Self	119(23.2)	2370(49.5)	2489(47.0)		*Ref*	*Ref*
Police or jail	101(19.7)	413(8.6)	514(9.7)		1.39 (0.90-2.15)	1.02 (0.60-1.74)
Other	293(57.1)	2004(41.9)	2297(43.3)		1.53 (1.11-2.09)	1.05 (0.70-1.56)
Arrived to PES Sat/Sun/Mon	261(50.1)	1723(35.6)	1984(37.0)	p<0.001	2.15 (1.65-2.80)	3.75 (2.53-5.57)
High utilizer (≥4 visits/quarter)	8(1.5)	262(5.4)	270(5.0)	p<0.001	0.55 (0.20-1.50)	0.57 (0.17-1.91)
Arrived to PES in physical restraint	237(45.5)	1086(22.4)	1323(24.7)	p<0.001	1.55 (1.14-2.12)	1.17 (0.80-1.70)
Experienced physical restraint or seclusion in PES	223(42.8)	546(11.3)	769(14.3)	p<0.001	2.04 (1.48-2.82)	2.20 (1.48-3.27)
Referred for involuntary hospitalization	437(83.9)	757(15.6)	1194(22.3)	p<0.001	20.80 (14.61-29.62)	--
ICD-9 Diagnoses[f]						
Primary psychotic disorder	263(50.5)	1008(21.5)	1271(24.4)	p<0.001	3.93 (2.85-5.43)	3.07 (2.02-4.67)
Bipolar mania/ mixed	120(23.0)	209(4.5)	329(6.3)	p<0.001	5.31 (3.49-8.08)	5.16 (2.94-9.06)
Primary depressive disorder	51(9.8)	731(15.6)	782(15.0)	p<0.001	0.95 (0.62-1.46)	0.97 (0.57-1.64)

Table. continued

	Boarder encounters n(%)[a]	Non-boarder encounters n(%)[a]	All encounters n(%)[a]	Test of difference[b]	Multivariate regression OR (95% CI)[c]	
					All encounters	Encounters referred for involuntary hospitalization
Primary anxiety disorder	90(17.3)	580(12.4)	670(12.9)	p<0.001	1.81 (1.24-2.65)	1.91 (1.17-3.12)
Personality disorder	123(23.6)	510(10.9)	633(12.2)	p=0.002	2.13 (1.51-3.01)	2.19 (1.39-3.45)
Developmental delay	17(3.3)	43(0.9)	60(1.2)	p<0.001	1.94 (0.79-4.77)	3.14 (0.94-10.52)
Dementia	7(1.3)	33(0.7)	40(0.8)	p=0.113	3.28 (0.96-11.19)	2.44 (0.47-12.67)
Substance use						
Alcohol	92(17.7)	1507(31.1)	1599(29.8)	p<0.001	0.60 (0.43-0.84)	0.63 (0.42-0.97)
Cocaine/ amphetamine	164(31.5)	1443(29.8)	1607(30.0)	p=0.427	1.06 (0.78-1.44)	1.04 (0.70-1.53)
Marijuana	140(26.9)	1094(22.6)	1234(23.0)	p=0.028	1.18 (0.86-1.62)	1.00 (0.67-1.49)
Opioid	44(8.5)	456(9.4)	500(9.3)	p=0.468	0.98 (0.60-1.59)	0.99 (0.53-1.84)
Phencyclidine	6(1.2)	38(0.8)	44(0.8)	p=0.378	1.30 (0.37-4.56)	0.79 (0.15-4.35)
Tobacco	155(29.8)	340(7.0)	495(9.2)	p<0.001	4.35 (3.06-6.19)	4.45 (2.72-7.29)
Any substance	301(57.8)	2978(61.5)	3280(61.2)	p=0.095	--	--

[a] Percent refers to share of all patients for whom applicable data were available.
[b] Two-tailed Student's t-test is reported for age as (t_{df}), p.
[c] The multivariate regression model among all encounters used 5,151 encounters; the model among only those patients referred for involuntary hospitalization utilized 1162 encounters. Both were highly statistically significant ($p < 0.01$) and adjusted for random effects based on patients presenting multiple times. Referral source from police/jail or "other" were tested against self-referral by patient. Variables reaching statistical significance ($p<0.05$) are in bold.
[d] Percent refers to share of all PES encounters.
[e] 63 encounters (8 boarders and 55 non-boarders) were missing referral data. "Other" includes referrals from friends, family, or outpatient providers including physicians or case managers.
[f] 154 non-boarder encounters (3% of all encounters) were missing an ICD-9 diagnosis. Primary psychotic disorders include schizophreniform, schizophrenia, schizoaffective, and delusional disorders; primary depressive disorders include unipolar or bipolar depression; primary anxiety disorders include generalized anxiety, posttraumatic stress, obsessive compulsive, panic, somatoform, adjustment disorders, or anxiety not otherwise specified.

is challenging to treat in emergency settings, which lack the physical environment, therapeutic milieu, programming, and consistent provider teams of an inpatient unit.

That high PES use was less common among boarding encounters likely reflects our use of a definition suspected to identify "acutely sick" patients experiencing a discrete illness episode.[17] Upon hospitalization, these patients are no longer at risk for returning to the PES; remaining high utilizers likely present repeatedly without an indication for hospitalization.

These observed differences should not be interpreted as "predictors" of boarding, as prior studies have suggested among pediatric patients.[16,18] These differences reflect the indication for psychiatric hospitalization, and the placement of a patient on boarding status in this setting is most immediately consequent of the lack of inpatient bed availability when the decision is made to hospitalize. (Thus were boarders in this study more likely to arrive on or after the weekend when there are fewer discharges from inpatient psychiatry units.) Rather than for prediction, these results are valuable for alerting clinicians to the morbidity among psychiatric boarders.

Aside from its large sample with few missing data, there are several strengths to this study. The inclusion of all adult patients reduces the risk of sampling error or bias. We used multiple data sources to better describe this population. Finally, the use of electronic data abstraction minimizes error introduced by manual chart reviews.

LIMITATIONS

This retrospective chart review is limited to data collected for clinical care. We could not compare our data sources to others as a check of validity, and there are no other reports to which to compare our conclusions. Information on clinical decision-making and patients' course of care in the PES was not available, including the use of laboratory or radiology testing or medication administration. We lacked data on race/ethnicity, housing, insurance status, or outpatient resources available to patients. This population may not generalize to other locales due to variations in practice and funding.

CONCLUSION

Although it has been suggested that a PES may reduce psychiatric boarding, boarding remained common in this PES census. Serious psychiatric illness was frequent among adult PES boarders.

These findings can orient clinicians to psychiatric patients' needs while boarding – for instance, interventions for PES boarders might include intensified efforts to reduce restraint/seclusion, behavioral treatments for psychosis or impulse dysregulation, or assessment and treatment of nicotine withdrawal. These data also remind practitioners to evaluate for substance use in all patients referred for psychiatric evaluation. Future studies can help further clarify the role of a PES in reducing boarding.

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Exploring Real-time Patient Decision-making for Acute Care: A Pilot Study

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Introduction: Research has described emergency department (ED) use patterns in detail. However, evidence is lacking on how, at the time a decision is made, patients decide if healthcare is required or where to seek care.

Methods: Using community-based participatory research methods, we conducted a mixed-methods descriptive pilot study. Due to the exploratory, hypothesis-generating nature of this research, we did not perform power calculations, and financial constraints only allowed for 20 participants. Hypothetical vignettes for the 10 most common low acuity primary care complaints (cough, sore throat, back pain, etc.) were texted to patients twice daily over six weeks, none designed to influence the patient's decision to seek care. We conducted focus groups to gain contextual information about participant decision-making. Descriptive statistics summarized responses to texts for each scenario. Qualitative analysis of open-ended text message responses and focus group discussions identified themes associated with decision-making for acute care needs.

Results: We received text survey responses from 18/20 recruited participants who responded to 72% (1092/1512) of the texted vignettes. In 48% of the vignettes, participants reported they would do nothing, for 34% of the vignettes participants reported they would seek care with a primary care provider, and 18% of responses reported they would seek ED care. Participants were not more likely to visit an ED during "off-hours." Our qualitative findings showed: 1) patients don't understand when care is needed; 2) patients don't understand where they should seek care.

Conclusion: Participants were unclear when or where to seek care for common acute health problems, suggesting a need for patient education. Similar research is necessary in different populations and regarding the role of urgent care in acute care delivery. [West J Emerg Med. 2014;15(6):675-681]

INTRODUCTION

The emergency department (ED) is increasingly the healthcare setting where patients seek acute unscheduled care,[1] with visits outpacing population growth, especially among disadvantaged populations.[2] Expanding insurance coverage with healthcare reform will likely further increase this

trend.[3] However, nearly all of the information regarding ED utilization is gathered from patients in the ED itself or from administrative data related to ED visits.[4-8] We know patients perceive acute care differently than providers,[9] but our lack of knowledge regarding patients' real-time decision-making makes it difficult to best meet their needs. This is particularly salient when discussing acute care needs of low-income populations who use the ED at higher rates than others.[5]

Community-based participatory research (CBPR) has been suggested as a strategy to improve the health and well-being of communities and eliminate health disparities.[10] CBPR represents a potentially useful strategy to understand populations known to be frequent ED users and collecting real-time patient data could help inform efforts to improve acute care. Since 80% of adults in the U.S. send text messages, this presents one promising option to gather information in the context of a patient's usual life, prior to seeking acute care.[11-13]

The objectives of this pilot study were to: 1) understand when participants decide if healthcare is needed, primarily for low-acuity conditions; 2) describe where patients choose to seek care for different conditions; 3) examine factors influencing decision-making; and 4) examine how preferences and perceptions influence decision-making.

METHODS

We used a community-based participatory research (CBPR) strategy to conduct a mixed methods evaluation of real-time patient decision-making for common acute conditions. We formed a steering committee comprised of University of Michigan researchers, a member of the "Villages of Parkside" (TVP), an urban, government-subsidized community, and a representative of Friends of Parkside (FOP), a non-profit community organization affiliated with TVP. The steering committee guided the research project from inception to completion and met on a regular basis to design and plan the study, recruit and enroll participants, discuss data collection and assess results. The University of Michigan researchers conducted data analysis, with frequent meetings with the full steering committee to discuss the presentation and interpretation of results. Key principles of CBPR emphasizing equal partnership between all members and building capacity within communities guided this study.[10,14] Our mixed methods approach was designed to use quantitative data to inform our focus group discussion guide and assist in analyzing our qualitative findings consistent with the "following a thread" strategy.[15,16]

Participants were recruited by FOP by texting TVP members through a previously established database of cell phone numbers, distribution of flyers and word-of-mouth referrals. Only adults affiliated with TVP who had a primary care provider and text-messaging capabilities were eligible for participation. Two recruitment meetings were held by researchers to explain the study, collect demographic information, and obtain written informed consent. Due to the exploratory, hypothesis-generating nature of this research, we did not perform power calculations, and financial constraints only allowed for 20 participants.

We created ten hypothetical acute care vignettes, patterned after the ten most common acute care complaints seen in U.S. primary care clinics.[17] Each vignette was designed to be texted to participants (e.g., "You've had a sore throat for 4 days and feel sick"). To assess the proportion of participants who would pursue care and where they would seek it, participants were asked to respond "ER" if they would seek care in the ED, "MD" if they would seek recommendations from their primary care provider (PCP), or "Nothing" if they would not seek care. Additionally, each participant was instructed to give a brief explanation of why s/he chose that response. To control for possible automated responses to our texts, we sent four anchoring vignettes: two designed to prompt an ED visit (stroke and severe trauma), and two designed to prompt a PCP visit (vaccination and nevus evaluation). We sent each participant two text messages per day over six weeks. Questions were sent at different times of day and categorized as either regular PCP "on hours" (Monday-Friday 8:00 AM to 5:00 PM) or "off hours" (Monday-Friday 5:00 PM-10:00 PM, Saturdays and Sundays). Participants were paid $1 for responding ER, MD or nothing to each text and another $1 for texting a brief explanation. Table 2 displays all of the vignettes texted to participants.

We used a focus group to understand survey responses and better comprehend the decision-making process for acute conditions. All participants were invited and encouraged to participate in the focus group. The focus group was led by a moderator (AS) and facilitated by an assistant moderator (WG), audio recorded and transcribed.[18,19] We designed an interview guide to help moderators explore: 1) how participants decide if healthcare is needed; 2) how participants decide where to seek healthcare; 3) factors influencing decision-making; and 4) how preferences and perceptions of the ED and PCP clinic influence decisions (Appendix).

The focus group was transcribed verbatim by a professional transcriptionist and reviewed for accuracy. We used inductive qualitative techniques informed by thematic analysis.[18,19] Transcripts were reviewed line by line to identify prominent concepts and ideas to draft preliminary coding categories. These initial findings were reviewed, coding categories were created, and themes were added and clarified as a team. Four researchers (TC, EC, WG, AS) engaged in an inductive process of reading and manually coding the transcript. Codes were further clarified and a codebook with definitions was developed.

The full steering committee reviewed results in frequent meetings and discussions, using memos to identify emerging themes and describe relationships among coding categories. The final coding scheme and analysis of the findings were reviewed, and disagreements were discussed until consensus was reached. We organized the results using the coding

Table 1. Study population, n=20.

Ages (years)	
Range	19 - 62
Average	34.3
Females	17 (85%)
Race/ethnicity	
Black	20 (100%)
Education	
<High school	4 (20%)
High school equivalent (GED)	2 (10%)
High school graduate	1 (5%)
Some college	11 (55%)
College graduate	2 (10%)
Work status	
Student	4 (20%)
Employed	7 (35%)
Unemployed	9 (45%)
Insurance	
Medicaid	12 (60%)
Private	5 (25%)
No insurance	3 (15%)
Primary care physician visits/year	
0	4 (20%)
1 to 10	12 (60%)
11 to 20	3 (15%)
>20	1 (5%)
Emergency department visits/year	
0	8 (40%)
1 to 5	11 (55%)
6 to 10	1 (5%)

scheme structure and illustrated the themes with representative quotations. To increase the validity of our qualitative data, we performed "member checking" where the overall results of the study were presented to participants. Each participant indicated that the results included and accurately represented their viewpoints.

RESULTS

Our sample (n=20) comprised primarily of African American women (85%) and Medicaid recipients (60%), the majority of whom had visited the ED in the last 12 months (Table 1). We received text survey responses from 18/20 recruited participants, as two lost cell phone service prior to the beginning of our data collection. We received responses for 72% of our text message vignettes with a similar proportion of responses sent "on hours" and "off hours." Most commonly participants chose "nothing" (48% of vignettes) indicating they would not have sought care for the hypothetical text scenarios, next most often they would have sought primary care (34%) and less frequently (18%) ED care (Table 2). This did not differ when stratified by time of day; in fact, more participants responded they would have sought ED care during "on hours" compared to "off hours."

Twelve of our participants contributed in the focus group. Five general themes were identified through inductive analysis of the focus group and assessment of open-ended text responses (Table 3). These themes helped us to understand how participants decide if care is needed and where to seek it when necessary. It became clear through our text responses and focus group discussion that participants were not confident when they should seek medical care.

Participants considered the severity and length of symptoms to be the primary factors driving the need to seek care, but did not mention the types of symptoms as a key reason to receive medical evaluation. For example, one participant stated:

> "If you were sick, like you really, really can't take it, then you go; other than that it's home remedies."

After deciding to seek care, participants were unclear where they should seek evaluation. As one participant noted: "... it's hard to tell… a lot of people don't know." They preferred seeing a physician with whom they had an established relationship, but reported difficulty arranging PCP appointments.

Participants perceived the ED as overcrowded, expensive and a venue for over-testing, stating:

> "When you go to emergency, you get chest x-ray; you get CAT scan, you get all of that and you still get no solution. And then you get this bill."

Participants also felt ED providers did not offer the time and attention they desired, by expressing:

> "You're there like three, four, five hours and then you go in there, they check you out for like two minutes and then you have been there for five hours to get a two minute result and they send you home."

Though our study was not designed to assess urgent care centers, participants continually brought up this option for acute care. Overall, urgent care centers, while not specifically defined by participants, were described as sites of care not affiliated with a hospital or a PCP clinic and were perceived positively. Participants felt urgent care centers were more accessible than their PCP and had more predictable wait times than the ED, which translated into more time spent with the provider.

DISCUSSION

Our pilot study helps to understand how patients assess the need for care and where they choose to seek it. Participants were unable to define clear indications to seek care at an ED, with the exception of severe trauma. We found participants were more likely to stay home or seek care from a PCP, even during "off-hours," than to seek ED care. The

Table 2: Hypothetical low-acuity vignettes texted to participants. Responses are stratifed by those who would choose to seek emergency department care (ED), primary care evaluation (PCP) or no care. Proportions may exceed 100% due to rounding.

	ED	PCP	No care
10 common low-acuity medical scenarios			
Your stomach has been hurting since last night. You threw up twice today.	4 (5%)	18 (23%)	57 (72%)
You've had a sore throat for 4 days and feel sick.	12 (15%)	34 (42%)	36 (44%)
You've felt sick and had a fever for two days.	22 (27%)	22 (27%)	38 (46%)
You've had a cough, runny nose and headache for 3 days.	8 (10%)	20 (26%)	49 (64%)
You've had a throbbing headache for 3 hours.	9 (10%)	5 (5%)	78 (85%)
You have a red itchy rash on your legs, it has been there for 4 days.	10 (14%)	38 (52%)	25 (34%)
You hurt your back picking up a child 2 days ago and it still hurts to move.	18 (23%)	23 (30%)	36 (47%)
You slipped walking up the stairs and injured your knee. It is swollen and painful to walk.	38 (49%)	15 (20%)	24 (31%)
You've had a runny nose for 5 days and now your right ear is hurting.	11 (15%)	49 (65%)	15 (20%)
You slipped in the bathroom, injured your back, it hurts to lie down and when you bend over or twist.	12 (17%)	44 (62%)	15 (21%)
All low-acuity scenarios	144 (18%)	268 (34%)	373 (48%)
Scenarios designed to prompt a PCP visit			
You need a flu shot for your new job.	7 (9%)	65 (82%)	7 (9%)
You have had a mole on your leg for 10 years and are now concerned it needs to be evaluated.	7 (9%)	45 (56%)	29 (36%)
All PCP scenarios	14 (9%)	110 (69%)	36 (23%)
Scenarios designed to prompt an ED visit			
All of a sudden you can't move your right arm or leg and you can't speak normally.	72 (94%)	2 (3%)	3 (4%)
You fell down the stairs your head is bleeding, you are confused and you can tell your leg is broken.	60 (98%)	1 (2%)	0 (0%)
All ED scenarios	132 (96%)	3 (2%)	3 (2%)

majority of research and discussion surrounding ED utilization emphasizes who should *not* be there, but does not clarify who should. Our study identifies a lack of clarity on the part of patients regarding when to seek care and where to receive it. These findings are consistent with previous studies showing many patients seek ED services for conditions that could be treated in other settings.[20]

Contrary to previous studies, our participants were not more likely to seek medical care based on the time of day[21] and did not seek ED care more often during "off-hours."[22] This may be a result of our real-time data collection method, demonstrating that time of day played less of a role than other considerations when deciding where to seek care. Also, though our study was not designed to evaluate urgent care centers, it became apparent that our participants preferred this site of care to the ED and a PCP clinic for common low-acuity conditions.

Our pilot project also demonstrates text messaging as a feasible and acceptable alternative to paper surveys, especially appropriate in understanding real time decision-making. Text messaging during random times of the day and evening might more closely simulate subject responses to sudden unexpected events, such as an illness or injury. This method may therefore better reflect the decision whether and how to seek medical care under real-life circumstances, than a paper survey in a quiet environment at an expected time.

More research is needed to understand if our findings hold true in other populations, but based on our results, emergency medicine has an opportunity to identify and establish clear indications for patients to seek care in an ED. Once a consensus is reached, this information can be disseminated to communities and patients to help them understand when acute care is needed in an ED versus another setting. It has been suggested that solutions may be best found looking at system failures instead of patient factors.[23] Therefore, collaborating with other specialties, policy makers and administrators may be necessary to clarify the role of the ED in the broader health system. Additionally, the role of urgent care clinics requires further evaluation and strategic planning to optimize our ability to care for common acute conditions. Lastly, despite the trend of increasing ED use, even patients known as frequent users of the ED may have an unfavorable impression of emergency department services; this requires future inquiry and understanding.

Table 3: Focus group themes with representative quotes to understand how patients decide if care is needed and where to seek it.

Themes	Representative quotes
Factors impacting the decision to seek care	"If you were sick, like you really, really can't take it, then you go; other than that it's home remedies."
	"Some of them try to be strong and with religion and stuff like that."
	"I decide by the length of time that I'm sick and if I keep taking the over the counter medicines and if it keeps coming back, then I will go."
	"But if I don't know, then I want to go to the place that I have the most confidence in which, if I have a good MD, then it would probably be there but the ER would be next because they have more medical doctors on hand."
	"I want you [the doctor] to tell me what is really going on with me. ...Just tell me what's really wrong and help me to fix the problem."
	"You know, a lot of time the cost plays a big factor whether you go to either place."
	"That plays a lot because you won't go to no hospital because you don't got the money."
	"...it matters and if you don't got no insurance or if you've got a copay and all that because everybody don't have like $75 or $25..."
Identifying an emergency	"...if somebody came in and got shot in the neck 20 times."
	"Like you broke something; you've got a bone sticking out of your arm."
	"...you have a seizure and you wake up and you don't know where you at, stuff like that. Then you would go to the hospital."
	"...if you fell down and your head is bleeding or something and you're going to go to the hospital and do something about that"
	"...but it's hard to tell when you got broken bones because a lot of people don't know."
Perceptions of sites of care	*PCP*
	"I would prefer to go to my physician but a lot of times when I am ill you will call them and they will say, well, I can't see you for two or three days "
	"...I prefer to go to my MD because they know me and they have my records."
	"I had the hardest time getting in there but now that I'm in, it's so good because they take care of everything...But it's hard getting in there. I had to know somebody who knew somebody who knew somebody on the inside."
	ED
	"Like I guess you fear death or something like that, you know, in hospitals."
	"That's why people don't like to waste their time because you're there like three, four, five hours and then you go in there they check you out for like two minutes and then you have been there for five hours to get a two minute result and they send you home."

Table 3. Continued.

	"...but if you're not feeling well you don't want to go to emergency knowing you will be there for four hours before someone can see you."
	"When you go to emergency, you get chest radiographs; you get CAT scan, you get all of that and you still get no solution. And then you get this bill."
	"Well, if we go to emergency—from my experience, they are going to run all types of tests."
	Urgent Care
	"...but if you can't get in your clinic because you don't have an appointment, then, you know, we would just wait until after the five because 1) it's closer and 2) we couldn't get to our clinic."
	"At the urgent care I think they give you more time and they are more prone to do like real life suggestions because they don't want you to keep having to come back."
	"…I will drive to Detroit to go to the same urgent care because I know my needs are going to be met. I'm not going to get all these prescriptions; I'm going to pay my one copay..."
Priorities to improve acute health care	"I would say the number one thing is being able to get the same treatment no matter what kind of insurance you got or if you have no insurance at all. Being able to get the same thing as the person who got Blue Cross and Blue Shield and you got Medicaid."
	"…a good doctor that will care about you instead of what insurance you have."
	"Give me a good MD that I can go see and not just to treat me but can treat my whole family."
	"So if my MD had better hours and later times for walk ins and stuff like that, I think that would be—it would make me go there because he know my medical history and can better diagnose me and my son."
	"And some of the transportation, you do have to call two or three days in advance like to make an appointment. But if you are sick then, you know…"
Difficulty navigating system	"Some hospitals won't share their xrays and records of that patient with another hospital."
	"They did all the radiographs and then sent him over to Saint John's over here and they did the same radiographs."
	"...I write the check for the copay. So we end up having to be transferred to another hospital that took care of pediatrics and I got another bill for…another copay."
	"So it's like I am doing a circle to find the right person to go to. And I'm getting told to go this place while actually I'm supposed to be at this place. And this place is sending me back to the other place but the other place is not letting you in the door. So it's a big circle. Nobody knows who you are supposed to go see."

PCP, primary care provider; *ED*, Emergency Department

LIMITATIONS

Similar to any small study, the findings from our pilot study may not generalize to other communities and populations. Our findings need to be confirmed in different populations with larger samples. We used hypothetical vignettes to understand participant decision-making and it is possible that participants' actual behavior could differ from their responses. Our study also used very brief hypothetical clinical vignettes, which may make it difficult to determine the seriousness of symptoms. Similarly, we did not send text messages between 10PM and 8AM because our community partners felt this would not be well received by participants

and text messages would likely not receive a response during these hours. Therefore, our study does not address behaviors regarding acute care visits during these times.

CONCLUSION

In our sample, participants were unclear when or where to seek care for common acute health problems, suggesting a need for future research and patient education regarding this matter. Our participants preferred the urgent care over going to the ED or PCP, and there is a need for a greater understanding of the role of the urgent care in acute care delivery.

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Implementation of a Team-based Physician Staffing Model at an Academic Emergency Department

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Introduction: There is scant literature regarding the optimal resident physician staffing model of academic emergency departments (ED) that maximizes learning opportunities. A department of emergency medicine at a large inner-city academic hospital initiated a team-based staffing model. Its pre-interventional staffing model consisted of residents and attending physicians being separately assigned patients, resulting in residents working with two different faculty providers in the same shift. This study aimed to determine if the post-interventional team-based system, in which residents were paired with a single attending on each shift, would result in improved residents' learning and clinical experiences as manifested by resident evaluations and the number of patients seen.

Methods: This retrospective before-and-after study at an academic ED with an annual volume of 52,000 patients examined the mean differences in five-point Likert-scale evaluations completed by residents assessing their ED rotation experiences in both the original and team-based staffing models. The residents were queried on their perceptions of feeling part of the team, decision-making autonomy, clinical experience, amount of supervision, quality of teaching, and overall rotational experience. We also analyzed the number of patients seen per hour by residents. Paired sample t-tests were performed. Residents who were in the program in the year preceding and proceeding the intervention were eligible for inclusion.

Results: 34 of 38 eligible residents were included (4 excluded for lack of evaluations in either the pre- or post-intervention period). There was a statistically significant improvement in resident perception of the quality and amount of teaching, 4.03 to 4.27 (mean difference=0.24, p=0.03). There were non-statistically significant trends toward improved mean scores for all other queries. Residents also saw more patients following the initiation of the team-based model, 1.24 to 1.56 patients per hour (mean difference=0.32, p=0.0005).

Conclusion: Adopting a team-based physician staffing model is associated with improved resident perceptions of quality and amount of teaching. Residents also experience a greater number of patient evaluations in a team-based model. [West J Emerg Med. 2014;15(6):682-686]

INTRODUCTION

Duty-hour restrictions imposed on resident physicians challenge residency programs to develop clinical experiences that meet patients' needs as well as trainees' educational requirements. The implementation of work hour rules forces residency programs to maximize learning opportunities for their residents. The Residency Review Committee in Emergency Medicine (RRC-EM) has adopted a 60-hour

clinical work week, which is more restrictive than the 80-hour limit of the American College of Graduate Medical Education (ACGME).[1] Emergency medicine residency programs are therefore confronted with a need to take full advantage of a limited amount of time to teach physicians-in-training. Little has been published about the effect of emergency department (ED) physician staffing models on learners' attitudes and perceptions.

In 2012, our EM residency program, located at an academic medical center, adopted a new resident staffing model for our ED. The previous staffing model included two faculty physicians, one senior resident, two interns, and one "swing" resident. The two faculty physicians geographically split the 30-bed acute ED. Urgent care patients are seen in a separate part of the studied ED; the described staffing changes did not affect the urgent care area. A senior resident in his or her final year of EM training supervised the two interns. Patients were assigned to the interns on an alternating basis. The swing resident, a PGY2 or PGY3+ resident, took responsibility for the most critically ill patients in the ED to decompress the workload on the interns by assuming responsibility for a fraction of the patients initially assigned to them. Because the attending physicians' bed assignments were determined geographically and the interns were assigned patients on an alternating basis, each intern had the opportunity to work with two faculty physicians on the same shift. The original staffing model is depicted in Figure 1.

Since the swing resident was not directly assigned patient beds but was expected to self-select patients, the amount of intern load-leveling was highly dependent on the efficiency, speed, and motivation of the swing resident. A highly efficient resident was obviously more likely to lessen the interns' patient load. The number of patients seen by a resident on a shift has been shown to be directly related to perceived stress.[2] We realized that the line of responsibility needs to be clearly delineated, because communication in a busy ED is complex,

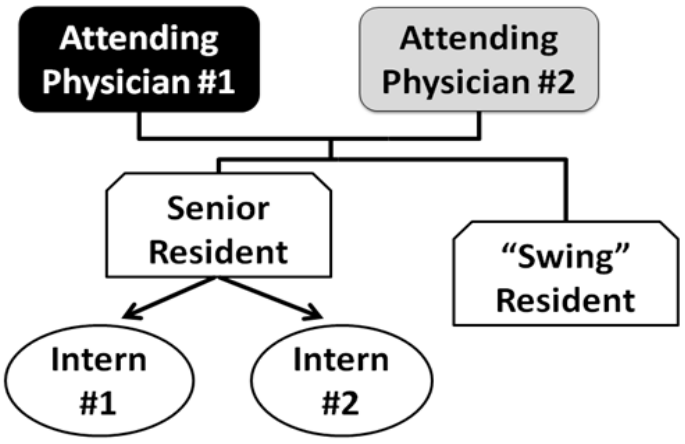

Figure 1. Pre-intervention staffing model.

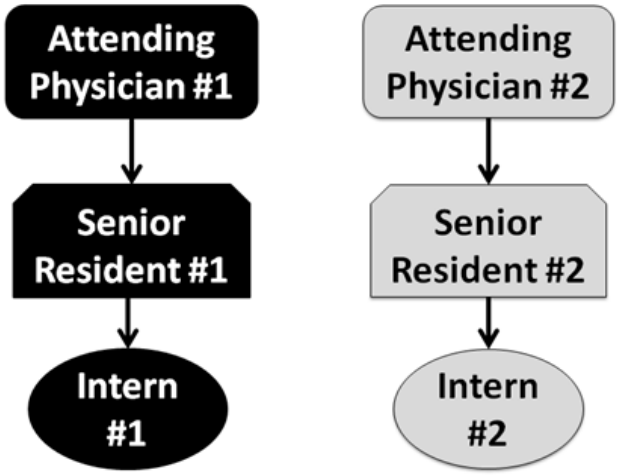

Figure 2. Post-intervention staffing model.

requiring multiple interactions among staff members for each patient.[3] In this model, only the attending was confined geographically, making it difficult for nurses to identify which resident was assigned to an individual patient. Finally, because residents worked with two attending physicians at the same time, the learning environment was less conducive to individualized instruction.[4,5]

After soliciting input from residents, nursing staff, and faculty physicians, we designed a new staffing model, which was implemented in June 2012. In this new team-based approach, the ED is divided geographically between two teams. Each team consists of an attending physician, an upper-level (PGY2 or PGY3+) resident, and an intern. The new staffing model is depicted in Figure 2. We hypothesized that this new team-based system would improve residents' learning and clinical experiences, as manifested by higher rotation evaluation scores. We further hypothesized that the elimination of the "swing" resident, in favor of a second senior resident responsible for a defined set of ED beds, would result in an increase in patient exposure as manifested by higher patients seen per hour. This article describes the effects of the change in ED staffing.

METHODS

Study Design

This retrospective before-and-after study was based on de-identified data that were collected from an electronic resident evaluation system and an electronic patient tracking system. The study design was reviewed and approved by our institutional review board.

Study Setting and Population

The study site is a 30-bed urban academic ED with 52,000 patient visits per year and a 20% admission rate. We include in the study EM residents who worked in our ED between

1. The amount of clinical experience I obtained this rotation was:
2. The amount of responsibility and autonomy I was given for making patient care decisions and providing care was:
3. The quality and amount of supervision provided by attendings and senior residents was:
4. The quality and amount of teaching provided by attendings and senior residents was:
5. Overall, the attendings and senior residents treated me fairly and with respect and made me feel "part of the team":
6. Overall the rotation was:

Figure 3. Resident evaluation questions examined in this study in which all responses were on a scale of 1-5: 1, poor; 2, below average; 3, average; 4, above average; 5, exceptional.

November 12, 2011, and April 28, 2013, with at least one rotation in both the pre- and post-intervention periods.

Study Protocol

In EM residency program, all residents evaluate each of their rotations. We obtained data for this study using an Internet-based electronic evaluation tool, E*Value (Minneapolis, Minnesota), which solicits and collects resident evaluations every 4 weeks. Data were de-identified and examined in aggregate so as to not attribute any evaluation score to an individual.

The new team-based staffing model was implemented on June 24, 2012, the beginning of an academic year. Evaluations submitted by residents rotating in the ED between November 14, 2011, and June 23, 2012, were considered pre-intervention evaluations. Residents are assigned to the ED on 4-week block rotations; a total of eight 4-week blocks were included in the pre-intervention period. Three 4-week block rotations (June 24 to September 16, 2012) following institution of the new staffing model were considered a washout period to minimize effects introduced by staff members' adjustment to the change and the "July phenomenon," the tendency toward increased errors and decreased hospital efficiency at teaching hospitals at the start of the academic year.[6] Evaluations completed during the eight 4-week blocks between September 17, 2012, and April 28, 2013, were considered the post-intervention group.

Additionally, we determined the number of patients seen by each resident in the pre-intervention and post-intervention periods using a reporting function available through the study site's electronic patient tracking system FirstNet (Cerner, North Kansas City, Missouri). Resident work hours were retrieved via an electronic physician shift scheduling software OnCall (Spiral Software, Newton, Massachusetts).

Measures

A five-point Likert scale was used to query all residents about their experience in the ED at the conclusion of their rotation. The questions that are the focus of this study are listed in Figure 3, as is the scale used by the residents to indicate their responses. The quantity of patient exposure by residents was measured as patients per hour (PPH).

Data Analysis

We included in the final analysis evaluations and PPH by residents who rotated in the ED in both the pre-intervention and post-intervention. The mean Likert scale scores for evaluations completed by the residents and PPH were calculated. We determined mean differences and corresponding 95% confidence intervals (CIs) between both periods among all residents using paired sample t-tests. Statistician 2.0 (xlQA, Melbourne, Australia) was used for data analysis.

RESULTS

Out of 38 residents who were in the program during both the pre- and post-intervention periods, evaluations were completed for both periods by 34 residents. To allow for paired sample t-tests, we included in the study analysis only those 34 residents who rotated in the ED in both periods and completed evaluations.

The mean Likert scale scores are presented in Figure 4. Following the initiation of the team-based staffing model, there was a statistically-significant increase in the mean scores for the query regarding the quality and amount of teaching, which improved from 4.03 to 4.27 (mean difference=0.24, p=0.03). There were non-statistically significant trends toward improved mean scores for all other queries.

Residents (PGY-2+) saw more patients following the initiation of the team-based model (Table). Prior to the team-based staffing system, residents saw an average of 1.24 PPH, with an increase to 1.56 PPH post-intervention (mean difference=0.32, p=0.0005, 95% confidence interval [0.17 to 0.47])).

DISCUSSION

In today's EM environment, characterized by high patient acuity, increasing patient volumes, and an emphasis on fast throughput, the time available for individual patient care and clinical education is often limited.[7] This constraint is particularly important in the chaotic environment of the ED, where workloads are unpredictable and physicians are interrupted frequently.[8,9] Team-based learning is a powerful

Table. Resident productivity as measured by patients evaluated per hour (mean difference=0.32, p=0.0005).

Patients per hour	Pre-intervention	Post-intervention
Mean	1.24	1.56
SD	± 0.36	± 0.39

SD, standard deviation

pedagogical tool that has been classically applied to didactic teaching.[10] Incorporating this type of educational tool into the clinical setting may improve residents' clinical experience and education. By applying a vigorous qualitative analysis to self-reports, we have identified several areas that residents perceive as improved after moving to a team-based physician-staffing model.

EM residents value participation in the work environment, focused learning moments, repetitive teaching cycles, and intense learning experiences.[11] We feel that the structure of the clinical work environment, specifically using the physician-staffing model, might have a significant impact on learners' attitudes and perceptions about their clinical experience.

Qualitative reports and expert opinion regarding improvements in medical education have been well documented.[12] In this study, moving from a staffing model led by senior residents to one based on teams trended toward a higher number of favorable responses to subjective questions related to residents' clinical experience in the ED. Significant improvements were found in subgroups related to patient care decisions, clinical experience, and teaching.

Our residents' evaluations of their experience generally trended towards improved scores following the initiation of a team-based model. In our previous staffing model, the swing resident managed the most critically ill patients in the ED. In the team-based model, a number of changes could account for residents' improved attitudes about their clinical experience. First, team leaders were upper-level residents paired with a single attending and intern throughout an entire shift, which reduced confusion related to patient assignment during a busy clinical shift. Second, team leaders were expected to see a higher volume of patients during a given shift, as they were given a large and specific geographic responsibility within the ED (in contrast to the previous model's swing resident, who assumed care for patients at his or her own pace). And, third, having an intern available in the team-based structure allowed the senior resident to share tasks, such as arranging follow-up, calling consults, and documenting patient care. Having the option to share these responsibilities might enhance residents' perceptions of their clinical experience.

Perceptions of teaching quality significantly improved when the swing and team-based approaches were compared. A number of previous studies found that faculty members have a limited amount of direct interaction and observation of EM residents.[13,14] We believe the team-based staffing model allows a higher-degree of interaction between faculty physicians and residents, increasing teaching efficiency. Managing patients using a team-based approach also encourages residents to discuss patient care decisions together more frequently, which encourages active participation, learning, and more efficient communication of "teachable moments" among multiple learners. Many of these techniques have been described as effective learning techniques.[15]

Additionally, there was a significant improvement in the number of patients seen by the residents (PGY-2+) following the initiation of the team-based model. In the previous model, the swing resident could self-select his patients. Individual resident motivation and efficiency likely affected the number of patient evaluations. In the team-based model, however, the two senior residents geographically split the ED, reducing the ability of slower residents to select a fewer number of patients.

Further research by our department will likely incorporate more specifically intern-level experience. The electronic patient tracking system used in our ED during the study period allowed associating only residents (PGY-2+) to patients. Interns were therefore not included in the resident productivity analysis. Since our patient tracking system now records patients evaluated by interns, how the educational experience of these first-year physicians is affected by staffing model changes can be more readily examined. The addition of a teaching resident in the staffing model, whose role is to provide more comprehensive and complimentary instruction

Evaluation Category	Pre-Intervention	Post-Intervention	Mean Difference	p
Clinical Experience	4.32	4.37	0.05	0.63
Decision-Making	4.20	4.36	0.16	0.07
Supervision	4.28	4.38	0.10	0.16
Teaching	4.03	4.27	0.24	0.03
Part of Team	4.32	4.47	0.15	0.08
Overall	4.32	4.39	0.07	0.32

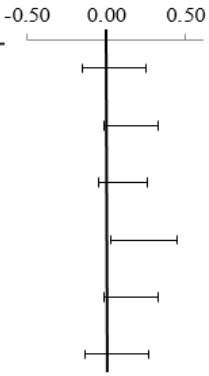

Figure 4. Mean evaluation responses by residents are shown. Each category corresponds to the questions in Figure 3 posed to each resident, who responded using a five-point Likert scale. Mean differences between the pre-intervention and post-intervention periods are calculated and 95% confidence intervals shown on the right.

of interns and medical students, will likely be studied.

LIMITATIONS

A significant limitation of this study is that we used a non-validated survey tool to measure residents' responses. Our findings are based on self-reported perceptions and therefore do not directly measure any quantitative outcomes within the chosen survey categories. Although the ACGME Common Program Requirements mandate that resident feedback be used in assessing multiple aspects of a residency program's educational experiences,[16] there is currently no uniform approach to obtaining such evaluative measures. The observed effects in resident perceptions of their ED educational experience may have varied had the queries been worded differently. The survey instrument used in this study, however, has been used at our institution for the last five years, allowing the program to internally ascertain trends. As a further limitation, residents were also not required to complete the survey until the rotation ended, so recall bias might have influenced their responses. Also, the increase in number of patients seen in the post-intervention staffing model may be a reflection of the improved efficiency expected of residents who are farther into their training program. Finally, this study did not examine effects on patient outcomes.

CONCLUSION

Data are scarce regarding the effect of physician staffing models on residents' attitudes and perceptions about their clinical experience. Our results demonstrate that adopting a team-based physician staffing model can improve residents' perceptions about their educational experience. Our study also demonstrated that a team-based model was associated with an increased number of patient evaluations as compared to a staffing model in which residents could self-select their patients. We hope that the results from this study will be helpful in the development of ED physician staffing models that improve the teaching environment.

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Reducing Patient Placement Errors in Emergency Department Admissions: Right Patient, Right Bed

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Introduction: Because lack of inpatient capacity is associated with emergency department (ED) crowding, more efficient bed management could potentially alleviate this problem. Our goal was to assess the impact of involving a patient placement manager (PPM) early in the decision to hospitalize ED patients. The PPMs are clinically experienced registered nurses trained in the institution-specific criteria for correct unit and bed placement.

Methods: We conducted two pilot studies that included all patients who were admitted to the adult hospital medicine service: 1) 10/24 to 11/22/2010 (30 days); and 2) 5/24 to 7/4/2011 (42 days). Each pilot study consisted of a baseline control period and a subsequent study period of equal duration. In each pilot we measured: 1) the number of "lateral transfers" or assignment errors in patient placement, 2) median length of stay (LOS) for "all" and "admitted" patients and 3) inpatient occupancy. In pilot 2, we added as a measure code 44s, i.e. status change from inpatient to observation after patients are admitted, and also equipped all emergency physicians with portable phones in order to improve the efficiency of the process.

Results: In pilot 1, the number of "lateral transfers" (incorrect patient placement assignments) during the control period was 79 of the 854 admissions (9.3%) versus 27 of 807 admissions (3.3%) during the study period (P<0.001). We found no statistically significant differences in inpatient occupancy or ED LOS for "all" or for "admitted" patients. In pilot 2, the number of "lateral transfers" was 120 of 1,253 (9.6%) admissions in the control period and 42 of 1,229 (3.4%) admissions in the study period (P<0.001). We found a 49-minute (352 vs. 401 minutes) decrease in median LOS for "admitted" ED patients during the study period compared with the control period (P=0.04). The code 44 rates, median LOS for "all" patients and inpatient occupancy did not change.

Conclusion: Inclusion of the PPM in a three-way handoff conversation between emergency physicians and hospitalist providers significantly decreased the number of "lateral transfers." Moreover, adding status determination and portable phones for emergency physicians improved the efficiency of the process and was associated with a 49 (12%) minute decrease in LOS for admitted patients. [West J Emerg Med. 2014;15(6):687-692]

INTRODUCTION

Lack of inpatient capacity is the single most important factor associated with emergency department (ED) crowding.[1] Consequently, more efficient bed management can potentially alleviate ED crowding and reduce overall ED length of stay (LOS). This is particularly true in institutions such as ours, where boarding of inpatients in the ED is a significant problem. The determination of proper bed and unit placement for admitted patients is typically guided by hospital-specific protocols. For example, a peritoneal dialysis patient with pneumonia may be admitted to the Renal Floor with nurses trained to handle dialysis care, rather than on the respiratory floor based on the diagnosis of pneumonia. Lack of adherence to protocols may cause "waste" associated with improper bed and unit placements. Unnecessary hand-offs and delays in treatment by improper bed assignment may adversely affect quality patient care and satisfaction. These concerns prompted an organization-wide project in our 650-bed institution to expedite the admissions process to the hospital medicine service, which accepts more than three quarters of all admissions. Our hospital is a Level I trauma and tertiary care referral medical center. The ED has an annual volume of 110,000 visits and supports a training program in emergency medicine with 36 residents. It is also the training site for medical students and rotating residents from other specialties.

The criteria for assigning admitted patients to inpatient beds are not only complicated, but may also change over time. It became evident that admitting hospitalists and emergency physicians (EP) in our institution were insufficiently trained and informed to uniformly follow the protocols. A project was undertaken to assess the impact of involving a patient placement manager (PPM) early in the decision to hospitalize. The PPMs are clinically experienced registered nurses who are trained in the institution-specific criteria for correct unit and bed placement depending on the admission diagnosis and acuity level. Their specialty practice experience (typically in critical care, telemetry nursing or supervisory roles) supports decision-making related to placing patients in the right bed at the right level of care. In order to facilitate their task, the PPMs were trained in determining status (observation versus inpatient) and level of care (intermediate or intensive care unit versus floor bed) using InterQual (McKesson Company®), our hospital's case management support tool. This clinical decision support tool is used as a guide for case managers to answer questions about appropriate levels of care and resource use.[2]

Our goal was to systematically improve communication and decision making via a single three-way phone call that involved the EP, hospitalist and PPM. The purpose was to provide the appropriate hand-off and also determine the appropriate unit/bed selection for all hospital medicine patients admitted through the ED. At the same time, it was important to ensure that any changes minimized delays to ED departure as studies have shown that such process changes may otherwise be associated with increased inpatient LOS and inpatient cost.[3]

METHODS

We conducted two pilot studies that included all patients who were admitted to the adult hospital medicine service: 1) 10/24 to 11/22/2010 (30 days); and 2) 5/24 to 7/4/2011 (42 days). The first pilot study was intended to assess feasibility, to serve as a "training" period for the PPMs and providers and to uncover additional opportunities for process improvement. We expected efficiency to improve in the second pilot as changes were implemented and the PPMs were fully trained in the decision support tool. Each pilot study consisted of a baseline control period and a subsequent study period of equal duration. Standard procedure was followed during the control periods i.e. the ED attending physician would decide upon admission and page the admitting adult hospitalist physician. The patient's presentation, admitting diagnosis and assignment to observation versus inpatient status was discussed by phone or in person. In a separate process, a PPM received this information electronically from the ED and found the patient a bed.

During each study period, a direct three-way phone call was instituted between the PPM and the emergency and admitting hospitalist physicians at the time of the admission decision. As a first step during pilot 1, the EP paged the PPM with only the patient name, medical record number and admitting diagnosis, and an initial triage conversation (by phone or in person) took place between these two individuals. In pilot 2, the patient information was sent directly to the PPM by electronic page and the initial triage conversation was omitted. After obtaining the admission information, the PPM paged the hospitalist with an expected response time of 15 minutes or less. The PPM then participated in a three-way telephone conversation that included the EP and the hospitalist to discuss the patient presentation, working diagnosis, indication for admission and plan of care. After consensus was reached, the patient information was placed electronically into the bed management software by the PPM and the initial bed assignment was provided.

We hypothesized that this process would improve our ability to get patients to the right bed the first time and would decrease the need for "lateral transfer" after the patient arrived on the initially designated floor. The definition of a "lateral transfer" was improper assignment resulting in transfer of the patient to a different floor within six hours of arrival on an inpatient unit. The designation of improper patient assignment was based on acuity or nursing unit according to hospital protocols. An example would be a patient requiring telemetry monitoring that arrives on a unit that does not have this capability. Patients that required a higher level of care due to progression of disease - that could not have been predicted in the ED - were excluded at the discretion of the PPM. Moreover, we measured differences in median LOS, inpatient occupancy and observation versus inpatient status changes between control and study periods.

In the first pilot study, we gathered data for a 15-day control period (10/24/10 to 11/7/2010) before the intervention

Table 1. Results of pilot study 1, which examined the feasibility of using nurses trained in the criteria for correct unit and bed placement.

Outcome measure	Control period Oct 24 –Nov 7, 2010 15 days 4,436 total visits 1,102 total admissions	Study period Nov 8-22, 2010 15 days 4,397 total visits 1,066 total admissions	p-value
Total emergency department (ED) visits	4436	4397	
Total # admissions (% of all visits)	1102 (24.8%)	1066 (24.2%)	0.51
# Admissions to hospital medicine (% of all admissions)	854 (77.4%)	807 (75.7%)	0.32
# Lateral transfers (% of admissions to hospital medicine)	79 (9.3%)	27/807 (3.3%)	< 0.001
ED length of stay (LOS), minutes All patients [median (min, max)]	244 (184, 298)	241 (178, 290)	0.69
ED LOS, minutes All admitted patients [median (min, max)]	391 (311, 506)	402 (313, 548)	0.56
Inpatient occupancy [median (min, max)]	29.7 (14.0, 39.9)	31.3 (22.7, 41.3)	0.82

and a 15-day study period (11/8/2010 to 11/22/2010) after the PPMs became involved directly in the admission process. For each period, we measured the numbers of: 1) registered visits, 2) total admissions (inpatient and observation), 3) admissions to hospital medicine and 4) "lateral transfers." In addition, we measured: 5) LOS for "all" and "admitted" patients and 6) inpatient occupancy. Median LOS in minutes was measured as the time from arrival to departure for home (discharged patients) or inpatient floor (admitted patients). We calculated inpatient occupancy as the median number of patients per day per floor that occupied 11 inpatient floors that accepted hospitalist patients.

In the second pilot, we collected data for a 21-day control period (5/24/2011 to 6/13/2011) prior to intervention and a 21-day study period (6/14/2011 to 7/4/2011) during which the PPMs were again involved directly in the admission decision. In this pilot, the decision regarding status, i.e. either observation or inpatient admission, was added as a measure using InterQual admission criteria. In addition, the initial triage conversation between PPMs and ED physicians was omitted and the latter were provided with portable phones for call back; in the first pilot study, the major complaint by EPs was time spent waiting for calls. This change enhanced their "buy-in" and their ability to continue work while waiting for calls. For each period, we repeated measurement of the outcomes listed in pilot 1. Moreover, we measured the number of code 44s, i.e. patients with change from inpatient to observation status after admission.

Patient identifiers were not recorded with any data. For LOS outcomes, we compared study and control periods using the Wilcoxon rank-sum test on the mean LOS per day. The median and range (minimum to maximum) are reported for each study group. The Chi-square test was used for comparison of study periods on dichotomous outcomes. We performed all analyses in Stata (version 12.1, College Station, TX). The study was approved by the local institutional review committee.

RESULTS

In the first pilot (two 15-day periods), the numbers of total and hospital medicine admissions were not statistically significantly different between during the control period (1,102 and 854) and the study period (1,066 and 807) (Table 1). The number of "lateral transfers" admitted to hospital medicine during the control period was 79 of the 854 admissions (9.3%) versus 27 of 807 admissions (3.3%) during the study period (P<0.001). We found no statistically significant differences in median inpatient occupancy or ED LOS for "all" or for "admitted" patients.

During the second pilot (two 21-day periods), the numbers of total and hospital medicine admissions were again not statistically significantly different between during the control period (1,572 and 1,253) and the study period (1,591 and 1,229) (Table 2). The number of "lateral transfers" resulting from admissions to hospital medicine was 120 of 1.253 (9.6%) in the control period and 42 of 1.229 (3.4%) in the study period (P<0.001). A reduction in the number of "lateral transfers" was therefore duplicated in the second pilot. In addition, we found a 49-minute (352 vs. 401 minutes) decrease in median LOS for "admitted" ED patients during the study period compared with the control period (P=0.04). The code 44 rates, median LOS for

Table 2. Results of pilot study 2.

Outcome measure	Control period May 24-June 13, 2011 21 days	Study period June 14-July 4, 2011 21 days	p-value
Total emergency department (ED) visits	6576	6476	
Total # admissions (% of visits)	1572 (23.9%)	1591 (24.6%)	0.38
# Admissions to hospital medicine (% of all admissions)	1253 (79.7%)	1229 (77.2%)	0.09
# Lateral transfers (% of admissions to hospital medicine)	120 (9.6%)	42 (3.4%)	< 0.001
# Code 44s (% of admissions to hospital medicine)	36/1253 (2.9%)	32/1229 (2.6%)	0.69
ED length of stay (LOS), minutes All patients [median (min, max)]	271 (225, 317)	262 (225, 304)	0.51
ED LOS, minutes All admitted patients [median (min, max)]	401 (284, 468)	352 (282, 457)	0.04
Inpatient occupancy [median (min, max)]	30.2 (19.2, 40.2)	27.9 (17.8, 39.8)	0.55
Inpatient occupancy [median (min, max)]	29.7 (14.0, 39.9)	31.3 (22.7, 41.3)	0.82

"all" patients and inpatient occupancy did not change.

DISCUSSION

Communication failures during the transition from ED to inpatient care has been identified as a major source of error in diagnosis, treatment, and disposition.[4,5] In some models of care, hospitalist physicians successfully facilitate appropriate placement of ED patients with positive outcomes.[6,7,8] In large, complex organizations, however, proper bed assignment and placement of inpatients is often delegated to case management in collaboration with ED and admitting physicians. With the use of clinical decision support tools, case managers are successful in determining the proper status and bed placement of hospital admissions (full inpatient admission or 23-hour observation) in collaboration with physicians.[9,10] Moreover, failures in communication resulting in improper patient placement can significantly impact a hospital's bottom line financial performance.[11,12] A coordinated and objective process through a bed management center staffed by clinically experienced nurses can significantly decrease the number of avoidable hospital days, decrease denials of payment by payers and increase net revenue.[13,14]

In our study, adding the PPM to the handoff conversation between EPs and hospitalist providers significantly decreased "lateral transfers" or assignment errors in patient placement. Changing the process of admission was associated with a decrease in "lateral transfers" in both pilots. In pilot 2, omission of an initial triage call, and, the addition to the intervention of status determination, further training, and portable phones for EPs was associated with a 49-minute (12%) decrease in LOS for admitted patients. The plausible explanation is that moving patients to a different bed/floor after they have initially been placed on an inpatient unit requires a lot of re-work and impedes efficient transfer of ED admissions to the floor. Outfitting EPs with portable phones and eliminating the initial two-way triage phone call may also have contributed.

The "waste" due to incorrect patient placement assignments occurred in over 9% of admissions during the control periods. Based on their subjective assessment, PPMs excluded from the number of "lateral" transfers patients with an unexpected deterioration in condition. This occurred in only a small minority of cases. Saving time and effort on the inpatient side may therefore have expedited the admissions process. This occurred despite no significant changes in inpatient occupancy or the numbers of ED visits or admissions between study and control periods. We believe that a 9% "lateral" transfer rate is significant in a large, complex teaching institution where ED boarding is a ma-

jor problem and the ED LOS for admitted patients is long. The same concerns may not apply to institutions where ED boarding is not an issue and the choices for inpatient beds are limited e.g. intensive care unit versus floor bed.

The additional expense incurred in permanently adopting our process included approximately $6,000 for the purchase of 10 portable phones for the providers. Moreover, we hired an additional 1.7 RN FTEs to consistently staff the PPM role at a total cost of approximately $216,000 in salaries plus benefits. Per our hospital finance department, a conservative estimate of the expense for housekeeping, PPM and nursing time as well as supplies totaled $106 for every improper assignment. The process change resulted in estimated annualized institutional savings of $232,000 assuming that the gains could be sustained.

LIMITATIONS

We encountered a number of barriers during this pilot. Suboptimal staffing of PPMs and large volumes of calls at once to the hospitalist led to delay in call backs to EPs. The ED staff perceived this as adding delays to patient flow and care, and a waste of EP time may have been a hidden cost as well. PPMs may not have been able to determine if a "lateral" transfer to a higher level of care was due to progression of disease that could not have been predicted in the ED – rather than an assignment error in placement. We believe that this reason for "lateral" transfer occurred in only a small minority of cases. Moreover, we have no reason to believe that the number of patients who were "lateral" transfers because of deterioration in condition was greater in number during the control periods than during the study periods.

We did not quantify delays experienced in the admissions process during the study periods; however, the perception of the EPs was that addition of portable cell phones in the second pilot significantly alleviated interference with their workflow and prevented delays in call backs from hospitalists. Inpatient occupancy was measured during the control and study periods, but we did not measure inpatient LOS. We also did not measure patient, nursing or physician satisfaction with these changes, but expect patient satisfaction to increase with fewer "in-house" transfers needed after admission from the ED. We did not perform a formal cost-effectiveness analysis.

CONCLUSION

In our institution, including the PPM in the three-way handoff conversation between EPs and hospitalist providers significantly decreased the number of "lateral transfers" or assignment errors in patient placement. Moreover, eliminating the initial PPM/ED physician triage call plus adding status determination and portable phones for EPs to the intervention resulted in a 49-minute (12%) decrease in LOS for admitted patients. This occurred despite no change in inpatient occupancy and the number of ED admissions.

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Motor Vehicle Crash-Associated Eye Injuries Presenting to U.S. Emergency Departments

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Introduction: Motor vehicle crashes (MVCs) are a leading cause of injury in the United States (U.S.). Detailed knowledge of MVC eye injuries presenting to U.S. emergency departments (ED) will aid clinicians in diagnosis and management. The objective of the study was to describe the incidence, risk factors, and characteristics of non-fatal motor vehicle crash-associated eye injuries presenting to U.S. EDs from 2001 to 2008.

Methods: Retrospective cross-sectional study using the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) from 2001 to 2008 to assess the risk of presenting to an ED with a MVC-associated eye injury in relation to specific occupant characteristics, including age, gender, race/ethnicity, disposition, and occupant (driver/passenger) status.

Results: From 2001 to 2008, an estimated 75,028 MVC-associated eye injuries presented to U.S. EDs. The annual rate of ED-treated eye injuries resulting from MVCs declined during this study period. Males accounted for 59.6% of eye injuries (95% confidence interval [CI] 56.2%-63.0%). Rates of eye injury were highest among 15-19 year olds (5.8/10,000 people; CI 4.3-6.0/10,000) and among African Americans (4.5/10,000 people; CI 2.0-7.1/10,000). Drivers of motor vehicles accounted for 62.2% (CI 58.3%-66.1%) of ED-treated MVC eye injuries when occupant status was known. Contusion/Abrasion was the most common diagnosis (61.5%; CI 56.5%-66.4%). Among licensed U.S. drivers, 16-24 year olds had the highest risk (3.7/10,000 licensed drivers; CI 2.6-4.8/10,000).

Conclusion: This study reports a decline in the annual incidence of ED-treated MVC-associated eye injuries. The risk of MVC eye injury is greatest among males, 15 to 19 year olds and African Americans. [West J Emerg Med. 2014;15(6):693-700]

INTRODUCTION

Motor vehicle crashes (MVCs) are one of the leading causes of injuries in the United States (U.S.) and impose a large economic burden on the healthcare system.[1,2] MVCs present unique eye injury risk factors such as rapid changes in velocity, potential broken glass exposure, airbag deployment, lack of occupant restraint use, and other foreign body exposure.[3-8] However, recent epidemiological studies of MVCs have not examined ocular injuries presenting to emergency departments (EDs) in the U.S. (Table 1). A better understanding of the risk factors for MVC-related ocular injuries would aid clinicians in the diagnosis and management of MVC eye injury victims. We describe herein the characteristics of MVC-associated eye injuries presenting to United States (U.S.) EDs.

METHODS

This study received local institutional review committee

Table 1. Recent nationwide studies of motor vehicle crash-associated eye injuries in the United States

Author	Population	Study size (# Eye injuries)	Study design	Variables measured	Conclusions
Armstrong et al (present study)	NEISS-AIP	221,091,934 (75,028)	Retrospective	Characteristics of eye injuries presenting to EDs, occupant status, occupant gender age race/ethnicity disposition	Injury incidence decreasing over time, Increased risk among 15 to 19 year olds, males, African Americans. Decreased risk among 0 to 4 year olds and among elderly
McGwin and Owsley (2005)[3]	NASS-CDS	66,941,420 (1,200,131)	Retrospective	Characteristics of eye injury, airbag deployment status, seatbelt status, occupant status, occupant gender age height weight, vehicle characteristics	Injury incidence increasing over time, greater risk with airbag deployment, increased age, female, crash severity, high ΔV. Decreased risk with heavier weight occupant or seatbelt use
Duma et al (2005)[5]	NASS-CDS	2,413,347 (82,405)	Retrospective	Characteristics of eye injury, full-powered vs depowered airbag, seatbelt status, occupant status, occupant height age weight seat position, crash ΔV	Depowered airbags have decreased risk of eye injury, greater risk of injury among driver, increased risk with depowered airbag if greater weight or increased ΔV
Duma and Jernigan (2003)[15]	NASS-CDS	12,429,580 (24,605)	Retrospective	Characteristics of orbital fractures, airbag deployment status, seatbelt status, occupant status, occupant gender age height weight, crash ΔV	Airbags decrease incidence and severity of orbital fractures
Hansen et al (2003)[16]	NASS-CDS	11,494,824 (289,279)	Retrospective	Characteristics of airbag vs non-airbag injuries, age, dynamic modeling of elderly vs young eye injuries	Eye injury incidence and severity increases with increasing age and associated lens stiffness causes increased stresses in ciliary body
Duma et al (2002)[4]	NASS-CDS	10,770,828 (238,263)	Retrospective	Characteristics of eye injury, airbag deployment status, seatbelt status, occupant status, occupant gender age height weight, use of eyewear, crash ΔV	Airbags reduce severity of eye injury but increase rate of corneal abrasions, greater risk of injury among drivers and light weight occupants

The National Electronic Injury Surveillance System – All Injury Program (NEISS-AIP) and the National Automotive Sampling System – Crashworthiness Data System (NASS-CDS) are United States injury datasets. ΔV represents a change in velocity during a motor vehicle crash.

exemption; review was not indicated for use of the NEISS-AIP database. This study adhered to the Declaration of Helsinki and all federal and state laws.

Data Source

The National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) is a database containing national, weighted, annualized estimates for non-fatal injuries treated in U.S. EDs.[9] Data from 66 of the 100 NEISS hospitals with both trauma and non-trauma center EDs are included in the NEISS-AIP. These hospitals each have an ED with a minimum of six beds, are open 24 hours per day, and are used as a nationally representative, stratified probability sample of the roughly 5,000 hospitals in the U.S. with an ED of the same parameters. Each year, the NEISS-AIP collects data on approximately 500,000 non-fatal injury- and consumer-related cases. The NEISS-AIP defines non-fatal injuries as bodily harm resulting from severe exposure to an external force, substance, or submission.

Hospitals in the NEISS-AIP network provide data from injury-related ED cases daily. Each case report consists of coded variables describing characteristics of the injury, including demographic information, disposition upon ED discharge, principal diagnoses, primary body part affected, and the locale where the injury took place. Coders only report ED injury cases to the NEISS-AIP if specific mechanistic, diagnostic, and mortality criteria are met.[10] NEISS-AIP quality assurance coders code the cause, assault-relatedness, and transportation- and traffic-relatedness of each injury. The NEISS-AIP defines traffic-related injuries as those precipitating from MVCs occurring on a public highway, street, or road as opposed to any other location. Causes of injury are classified into major external cause and intent-of-injury groupings from the International Classification of Disease (ICD) 9-CM. We chose this national dataset over other potential databases due to its focus on ED-injury case data, which our study sought to address.

Table 2. Demographics of United States emergency department visits from 2001-2008, including motor vehicle crash and eye injury data.

Characteristic	Sample size	National estimates (95% Confidence Interval)[a]		Percent of ED visits	Rate per 10,000
Total ED Visits					
Male	2,045,386	121,597,423	(105,544,620-137,650,226)	55.0%	8,394.8
Female	1,627,955	99,450,992	(86,848,538-112,053,445)	45.0%	6,650.0
Unknown	759	43,519	(22,642-64,397)	0.0002%	-
Total	3,674,100	221,091,934	(192,415,800-249,768,068)	100%	7,509.9
Total MVC ED cases					
Male	174,335	9,734,788	(8,034,67-11,434,889)	45.3%	672.1
Female	204,542	11,760,691	(9,661,377-13,860,004)	54.7%	786.4
Unknown	85	3,778	(1,603-5,953)	0.0002%	-
Total	378,962	24,499,257	(17,729,204-25,269,310)	100%	730.3
MVA eye Injury cases					
Male	763	44,702	(36,534-52,870)	59.6%	3.1
Female	551	30,326	(24,547-36,085)	40.4%	2.0
Total	1,314	75,028	(62,103-87,953)	100%	2.5

[a]National estimates derived utilizing NEISS-AIP weighted frequencies.
[b]Rate of injury calculated using national population estimates from US Bureau of the Census, January, 2005.
ED, emergency department, *MVC*, motor vehicle crash, *MVA*, motor vehical accident

Data Analysis

This was a retrospective cross-sectional study using the NEISS-AIP database to examine eye injuries sustained by occupants of MVCs treated in EDs from 2001 through 2008 (the most recent year data were available at time of analysis).[9]

The inclusion criteria for this study were cases where the "eyeball" was identified as the primary body part injured and where "motor vehicle occupant" (MV-occupant) was identified as the precipitating cause of injury. Motorcycle and pedestrian injuries were excluded from our study.

We derived national injury estimates using the sample weights representing the inverse probability of selection for each case seen in the 66 NEISS-AIP hospitals. Weighted counts of injuries serve as representative numbers for national injuries and are derived from the NEISS-AIP dataset. We estimated projected incidences of injury along with their associated 95% confidence intervals (CIs) using STATA SE, version 10.0 (STATA Corporation, College Station, Texas, USA). The program's Survey commands (svy) are capable of accounting for the sampling weight structure present in the NEISS-AIP database. The types, dispositions, and mechanisms of eye injuries, as well as the race and ethnicity of patients, were tabulated. We created figures using Microsoft Excel, version 14.2.3. The program's 'Add Trendline…' linear regression function was used to create associated trendlines.

We determined rates of injury among the general population using national population estimates from the U.S. Census Bureau.[11] The estimated population data for July 1, 2004, and July 1, 2005 were averaged, yielding a population estimate for January 1, 2005, the midpoint of our study. We used U.S. Census Bureau data for annual as well as race and ethnicity population estimates where appropriate.

We determined rates of injury specifically among drivers in MVCs using both NEISS-AIP national estimates of MVC-related eye injuries among drivers and U.S. Department of Transportation Federal Highway Administration estimates of licensed drivers in the U.S.[12-14] The NEISS-AIP records the driver (and passenger occupant) status of ED-treated injury cases. We averaged the estimated U.S. licensed driver population data for 2004 and 2005, yielding an estimate for January 1, 2005, the midpoint of our study.

RESULTS

From 2001 to 2008, an estimated 221,091,934 (95% confidence interval [CI] 192,415,800-249,768,068) ED visits due to non-fatal injury occurred in the U.S., of which 21,499,257 (CI 17,729,204-25,269,310), or 9.7%, were due to MVCs (Table 2). An estimated 75,028 (CI 62,103-87,953) cases, representing 0.3% of MVC ED visits, involved an injury to the eyeball. Motor vehicle crash patients presented to EDs at an estimated rate of 730.2 cases per 10,000 people (CI 602.2-858.3/10,000), while MVC-associated eye injuries presented to EDs at an estimated rate of 2.5 cases per 10,000 people (CI 2.1-3.0/10,000). Males presented to EDs more often with MVC eye injuries (59.6%; CI 56.2%-63.0%).

The estimated annual incidence of MVC-associated eye injuries presenting to EDs are presented in the figure. The annual estimated rate of MVC-associated eye injuries

Table 3. Age breakdown of motor vehicle crash-associated eye injuries treated in U.S. emergency departments, 2001-2008.

Age	Sample size	National estimates (95% Confidence Interval)[a]	Percent of ED visits	Rate per 10,000 people[b]
0 to 19	440	20,773 (16,056-25,489)	27.7%	2.5
20 to 29	310	18,152 (14,792-21,512)	24.2%	4.5
30 to 49	382	23,840 (18,435-29,246)	31.8%	2.8
50 to 69	146	9,964 (7,720-12,208)	13.3%	1.7
70 +	35	2,278 (1,240-3,317)	3.0%	0.9
Unknown	1[c]	21.4 (0-64.2)	0.03%	-
Total	1,314	75,028 (62,103-87,953)	100%	2.5

[a]National estimates derived using NEISS-AIP weighted frequencies.
[b]Rate of injury calculated using national population estimates from US Bureau of the Census, January, 2005.
[c]National estimates based on less than 20 actual cases and may not be statistically stable.
ED, emergency department

varied substantially from year to year, though a distinct decreasing trend was observed. A 20% decrease was also seen in the nationally estimated number of ED visits from all MVC injuries over the eight-year period (a reduction from 100.3/10,000 people to 79.8/10,000 people).

The age breakdown of ED-treated MVC-associated eye injury patients is detailed in Table 3. The estimated rate of MVC eye injuries peaked in the 15- to 19-year-old age group (5.8/10,000; CI 4.3-6.0/10,000) and then decreased with increasing age (not presented in table). Children less than

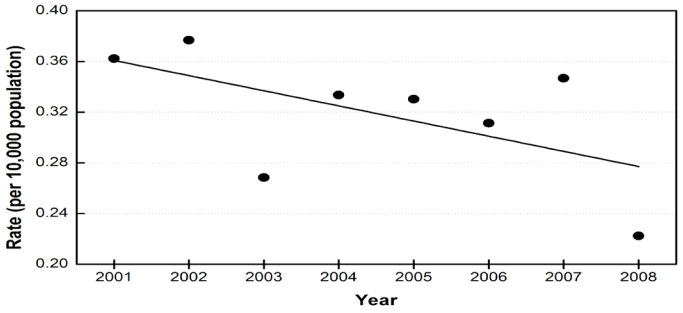

Figure. Rates of eye injuries due to motor vehicle crashes treated in United States emergency departments.

*****National estimates derived utilizing NEISS-AIP weighted frequencies. Rate of injury calculated using national population estimates from US Bureau of the Census, January, 2005. Trendline created using Microsoft Excel's 'Add Trendline…' linear regression function.

Table 4. Rates of motor vehicle crash-associated eye injuries among licensed drivers in the U.S.

Age	Sample size	National estimates (95% Confidence Interval)[a]		Rate per 10,000 licensed drivers[d]
16-24	160	9,656	(6,839-12,472)	3.7
25-34	134	9,181	(6,853-11,509)	2.5
35-44	104	6,407	(4,303-8,511)	1.6
45-54	85	6,435	(4,499-8,371)	1.6
55-64	42	3,013	(1,815-4,211)	1.1
65-74	10[c]	601	(122-1,081)	0.4
75+	8[c]	759	(97.4-1,421)	0.6
Total	547	36,222	(28,553-43,891)	1.8

[a]National estimates derived using NEISS-AIP weighted frequencies.
[c]National estimates based on less than 20 actual cases and may not be statistically stable.
[d]Rate of injury calculated using the number of estimated licensed drivers in the US, estimated by US Department of Transportation Federal Highway Administration, January, 2005.

five years of age had the lowest estimated rate of MVC eye injuries (0.8/10,000; CI 0.4-1.2/10,000).

Table 4 details the estimated rate of ED presentation of MVC-associated eye injuries per licensed driver in the U.S. The rate of eye injury was highest in the 16 to 24 age group (3.7/10,000 licensed drivers; CI 2.6-4.8/10,000) and decreased with increasing age; in the 65 to 74 age group, however, the number of eye injuries reported was too low to provide stable estimates.

We list race and ethnicity data for MVC-associated eye injury cases in Table 5. They are presented as percentages of ED cases where race and ethnicities were known and recorded in the NEISS-AIP. The white non-Hispanic population had the greatest estimated incidence of eye injuries during our study period (59.6%; CI 45.8%-73.4%). Taking U.S. race and ethnicity population estimates into account and excluding the 'other non-Hispanic' category, the estimated rate of MVC eye injury was highest among African Americans (4.5/10,000; CI 2.0-7.1/10,000) and was lowest for Asian non-Hispanics (0.9/10,000; CI -0.3 to 2.0/10,000).

Further MVC victim- and crash-characteristics (diagnosis, disposition, occupant status) are presented in Table 6. The most common diagnoses were contusion/abrasion (61.5%; CI 56.5-66.4%), foreign body (19.7%; CI 15.5-23.9%), and hemorrhage (4.1%; CI 2.6-5.6%). The majority of patients were treated and released from the ED (94.9%; CI 92.8-97.0%). Drivers suffered the majority of MVC eye injuries (62.2% excluding unknown; CI 58.3%-66.1%) as compared to passengers.

The rates of elderly MVC eye injuries were decreased across all diagnostic categories except for 'hemorrhage,' though the number of eye injuries reported per diagnosis

Table 5. Race and ethnicity breakdown of motor vehicle crash-associated eye injuries treated in U.S. emergency departments, 2001-2008.

Race/ethnicity	Sample size	National estimates (95% Confidence Interval)[a]	Percent of ED visits (excluding unknown)	Rate per 10,000 People[b]
White Non-Hispanic (NH)	494	33,919 (23,997-43,842)	45.2% (59.6%)	3.1
African American	338	16,284 (7,057-25,512)	21.7% (28.6%)	4.5
Hispanic	105	4,474 (2,153-6,796)	6.0% (7.9%)	1.1
Asian NH	18[c]	1,050 (-344-2,444)	1.4% (1.8%)	0.9
American Indian NH	8[c]	911 (-724-2,546)	1.2% (1.6%)	4.1
Other NH	12[c]	266 (-7.96-540)	0.4% (0.5%)	6.6
Unknown	339	18,123 (8,056-28,190)	24.2%	-

[a]National estimates derived using NEISS-AIP weighted frequencies.
[b]Rate of injury calculated using national population estimates from US Bureau of the Census, January, 2005.
[c]National estimates based on less than 20 actual cases and may not be statistically stable.

in each age category was often too low to provide stable estimates (data not presented).

DISCUSSION

To our knowledge, this is the first study to characterize and identify risk factors associated with ED-treated nonfatal MVC-associated eye injuries using a national ED database. This study underscores the importance of several trends that differ from previous literature on MVC-associated eye injuries: a recent decline in the incidence of ED-treated injuries, a decreased risk among the elderly, and an increased risk among males, adolescents (age 15 to 19) and African Americans.[3-5,15-16]

We found that the incidence of ED-treated MVC-associated eye injuries decreased during our study period. In contrast, McGwin and colleagues[3] cited an increasing trend in the risk of eye injuries from MVCs; however, their study did not focus specifically on ED-treated injuries, surveyed a different time period (1988-2001), and used a different injury database. The mandated inclusion of dual front-seat airbags in passenger cars during their study period resulted in higher rates of minor MVC-eye injuries (i.e. corneal abrasions) despite a simultaneous reduction in severe MVC-eye injuries.[4,5,17] Advanced frontal airbag systems, mandated in model year 2006, represented an improvement over previous airbag technologies in their ability to sense occupant size, seat position, seatbelt use, and crash severity so as to deploy airbags at an appropriate level of power.[18,19] The advanced

Table 6. Patient and crash characteristics of motor vehicle crash-associated eye injuries treated in U.S. emergency departments, 2001-2008.

Characteristic	Sample size	National estimates (95% Confidence Interval)[a]	Percent of ED visits (excluding unknown)
Diagnosis			
Contusion/abrasion	843	46,114 (36,592-55,636)	61.5%
Foreign body	227	14,801 (11,632-17,971)	19.7%
Hemorrhage	58	3,095 (1,658-4,531)	4.1%
Laceration	42	2,712 (1,397-4,027)	3.6%
Conjunctivitis	34	2,219 (1,108-3,331)	3.0%
Hematoma	14[c]	1,032 (123-1,941)	1.4%
Burn chemical	7[c]	693 (26.5-1,359)	0.9%
Puncture	4[c]	274 (-51.7-599)	0.4%
Burn not specified	2[c]	126 (-108-359)	0.2%
Strain/sprain	1[c]	119 (-119-357)	0.2%
Burn thermal	1[c]	21.4 (-21.5-64.2)	0.03%
Other	81	3,823 (2,400-5,246)	5.1%
Disposition			
Treated/released	1,248	71,201 (58,745-83,656)	94.9%
Hospitalized/ transferred/observed	59	3,576 (1,891-5,260)	4.8%
Other[e]	7[c]	252 (-21-525)	0.3%
Occupant status			
Driver	547	36,222 (28,553-43,891)	48.3% (62.2%)
Passenger	453	21,812 (17,069-26,556)	29.1% (37.5%)
Other specified	3[c]	162 (-82-407)	0.2% (0.3%)
Unknown/ unspecified	311	16,831 (12,743-20,919)	22.4%
Total	1,314	75,028 (62,103-87,953)	100%

[a]National estimates derived using NEISS-AIP weighted frequencies.
[c]National estimates based on less than 20 actual cases and may not be statistically stable.
[e]'Other disposition' includes against medical advice/left without being seen and unknown.

airbags may have decreased MVC eye-injury risk in our study period.

An estimated 9,280 to 11,600 eyeball injuries occur in the U.S. as a result of MVCs annually.[3] Our annual incidence of ED-treated MVC eyeball injuries fell within this predicted range with the exception of our 2003 (7,793 injuries) and 2008 (6,769 injuries) data. Hence, our findings suggest that the majority of MVC eyeball injuries occurring in the U.S. were seen in EDs.

Males in our study were at the greatest risk of suffering an ED-treated MVC eye injury, which is contrary to another MVC eye injury study but is consistent with males being injured more often in MVCs.[3,14] The increased risk of MVC injury among males has been linked to a higher incidence of loss-of-control crashes and a greater incidence of speeding.[20] Crashes of increased severity and with larger changes in velocity have been associated with an increased risk of MVC eye injury.[5]

While both drivers and passengers of vehicles involved in MVCs may sustain eye injuries, drivers were treated in EDs at a higher rate during our study period. This trend is echoed in the existing MVC eye injury literature.[3-5,21] After accounting for the relative abundance of drivers at risk of MVCs when compared to passengers, however, the relative risk of MVC-associated eye injury was found to be the same for both drivers and passengers.[3]

Adolescents aged 15 to 19 had the highest rate of MVC-associated eye injuries presenting to EDs. Among licensed drivers, those in the 16- to 24-year-old age group were found to have the highest rate of MVC eye injury visits. Previous studies have identified both young drivers (16 to 35 years of age) and older drivers (>43 years of age and >66 years of age) as being at the greatest risk of MVC eye injury.[3,16,22] Our results may be due to the increased rate of MVC among adolescents and young adults, which has been attributed to driving inexperience in the youngest age groups, an increased likelihood of undertaking risky driving practices, and a decreased use of seat belts.[23-27]

Researchers have hypothesized that mechanical changes that occur in the aging eye predispose older patients to an increased risk of MVC-associated eye injury and to different injury diagnoses and outcomes.[16,28] However, we found that after the age of 18, the risk of presenting to an ED with a MVC eye injury decreased with increasing age. Indeed, the elderly population had the lowest rate of MVC eye injury per person among adults. The elderly also had the lowest rate of MVC eye injury across nearly all diagnostic categories. Several explanations may account for our results. First, elderly persons increasingly forego driving motor vehicles voluntarily as they age.[29-30] Second, many states require elderly persons to undergo in-person license renewal as well as visual acuity and driving testing, which allows states to limit licensing of high-risk elderly drivers.[31-33] Lastly, elderly patients have the highest rate of seat belt use, a behavior known to decrease eye injury risk.[7,34] These findings are especially important in light of the rapidly increasing population of elderly individuals in the U.S.[35]

Our study found that African Americans had the highest rate of ED-treated MVC eye injuries. Praevious studies have found that African Americans use seat belts less often than other racial and ethnic populations, a practice shown to increase the risk of MVC eye injury.[3,7,36]

Similar to previous studies, we identified corneal abrasion/contusion, foreign body and hemorrhage as the most common ED-treated ocular diagnoses resulting from MVCs, especially after the deployment of an airbag.[3-7,37-40] While the NEISS-AIP is unable to provide detailed information regarding foreign body and hemorrhage diagnoses, existing case reports and reviews document the injury variability within these broad diagnostic categories.[40-44]

LIMITATIONS

The findings reported in this study should be considered in light of several limitations. First and foremost, the NEISS-AIP database only reports injuries presenting to U.S. EDs, which may skew our results toward more serious eye injuries. It is unknown what proportion of MVC-associated eye injuries present to non-ED healthcare settings, but our study suggests that the majority of MVC-related eye injuries are seen in EDs. Second, the severity, visual outcomes, and long-term morbidities of injuries were not available in the NEISS-AIP database for evaluation. Third, injuries to the ocular adnexal tissues were coded as injuries to the "face" within the NEISS-AIP database, making it difficult to study these injuries specifically. Fourth, the NEISS-AIP is more likely to record cases of isolated ocular trauma as opposed to eye injury cases that occur as a secondary diagnosis or that occur during multi-trauma, unless the principle multi-trauma diagnosis is determined to affect the eyeball. This may result in an underestimation in both the number of and the severity of MVC eye injuries presenting to EDs in our study. Similarly, victims whose injuries were coded in the NEISS-AIP as affecting "25-50 percent body" or "all body parts," instead of "eyeball" may have sustained eye injuries, but we did not include these cases in our study. Additionally, the NEISS-AIP does not record the specific anatomic area of the eye affected by injury (i.e. cornea, vitreous, retina). Lastly, using the entire U.S. population as the denominator in rate calculations results in an underestimation of true incidence of injury, as this calculation assumes that the entire population is a vehicle occupant and that all individuals are at equal risk of MVC eye injury.

CONCLUSION

In summary, we report a decline in the rate of ED-treated MVC eye injuries in the U.S. and identify an increased risk among males, 15 to 19 year olds, and African Americans. Understanding and further investigating risk factors associated

with ED-treated MVC eye injuries will aid emergency medicine clinicians in diagnosis and management, and should guide future prevention strategies.

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Self-Cannibalism: The Man Who Eats Himself

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Self-mutilation is a general term for a variety of forms of intentional self-harm without the wish to die. Although there have been many reports of self-mutilation injuries in the literature, none have reported self-cannibalism after self-mutilation. In this article we present a patient with self-cannibalism following self-mutilation.

A 34-year-old male patient was brought to the emergency department from the prison with a laceration on the right leg. Physical examination revealed a well-demarcated rectangular soft tissue defect on his right thigh. The prison authorities stated that the prisoner had cut his thigh with a knife and had eaten the flesh. [West J Emerg Med. 2014;15(6):701-702]

BACKGROUND

Self-mutilation is a general term for a variety of forms of intentional self-harm without the wish to die. Cutting one's skin with razors or knives is the most common pattern of self-mutilation, followed by genital and ocular self-mutilation.[1] Although there have been many reports of self-mutilation injuries in the literature, none have reported self-cannibalism after self-mutilation. We present a patient with self-cannibalism following self-mutilation.

CASE PRESENTATION

A 34-year-old male patient was brought to the emergency department (ED) from the prison with a laceration on the right leg. Physical examination revealed stable vital signs and a well-demarcated rectangular 7x11 cm (7 mm thick) soft tissue defect on his right anterior thigh area (Figure 1). Although calm in appearance, he did not respond to physicians' questions. The prison authorities reported that he had cut his thigh with a knife and had eaten the flesh about one hour after cutting the tissue. They also added the prisoner had done the same thing to his left arm a year ago.

After administration of tetanus vaccine and 1 gr cefazoline sodium, the wound was repaired under local anesthesia, leaving the defect open for secondary healing (Figure 2). Psychiatric evaluation was also done in the ED. The patient was not under psychiatric care despite several occasions of self-harm behavior. Diagnosed with psychotic disorder, the patient was transferred to a closed psychiatric ward.

DISCUSSION

Self-mutilating injuries are encountered predominantly in male patients in the ED.[1,2] This pattern of behavior is seen in patients with personality, acute and chronic psychotic, major affective, and gender disorders. Self-harm behavior is primarily encountered in patients with personality disorders, especially in those with borderline personalities.[3] Favazza postulated that this behavioral pattern is an effort to rid oneself of depersonalization, guilt, rejection, hallucinations, sexual involvements and complex emotional states.[4] Self-harm behavior represents a rescue attempt triggered under circumstances in which expression of aggression is inhibited. Our case is a typical example of this behavior, seen frequently among prisoners.[3] Authors cite that sexual, physical or emotional abuse and biological causes (alcoholism, depression and anxiety disorders) are important underlying factors in the etiology of self-harm behavior, abuse being

Figure 1. The cut in the patient's right anterior thigh.

Figure 2. The laceration was sutured and left for secondary healing.

the most important.[5,6] Self-cutting is the most common type of self-injurious behavior. Cutting injuries to the wrists and arms are the most frequently encountered locations due to accessibility, although a myriad of different injury locations have been recorded.[7]

A variety of major self-mutilation attempts have been cited in the literature. Erdur et al. reported a 27-year-old patient with schizophrenia who amputated his tongue and penis.[1] Ahsaini et al. published a report of a 40-year-old man who presented in hemodynamic shock after eviscerating both testes with his fingernails.[8] Michopoulos et al reported a 66-year-old man who had been mutilating his fingers for the last six years.[5] This behavior started as nail biting and continued on to severe finger mutilation, resulting in loss of the terminal phalanges of all fingers in both hands. Koh and Lyeo wrote of a 20-year-old patient with schizophrenia who enucleated his own eye.[9]

Our patient was challenging in that he was a prisoner and not very cooperative, which hampered a thorough psychiatric evaluation. A presumptive diagnosis of psychosis was based on the patient's indifferent attitude, limited cooperation, low-toned speech with short questions and answers, mystic delusions, auditory and sensory delusions – hearing commands and inappropriate affect. Self-harm behavior is seen primarily in patients with borderline and antisocial personality, major affective, and gender disorders and substance abuse.

The fact of being imprisoned, along with possible secondary gains such as getting away from prison for admission to hospital due to "illness," and lighter sentencing penalties, may have led the patient to engage in such behavior. Therefore, further investigation in terms of simulation, personality disorders and substance abuse is necessary.

Self-mutilation associated with self-cannibalism is a rare condition. It can be due to a severe mental disorder such as schizophrenia. It could also be the result of a personality disorder or a malingering secondary behavior to get a lesser criminal penalty.

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Color Doppler Ultrasound-guided Supraclavicular Brachial Plexus Block to Prevent Vascular Injection

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Ultrasound-guided nerve blocks are quickly becoming integrated into emergency medicine practice for pain control and as an alternative to procedural sedation. Common, but potentially catastophic errors have not been reported outside of the anesthesiology literature. Evaluation of the brachial plexus with color Doppler should be standard for clinicians performing a supraclavicular brachial plexus block to determine ideal block location and prevention of inadvertant intravascular injection. [West J Emerg Med. 2014;15(6):703-705]

INTRODUCTION

Emergency physicians (EP) are more commonly performing ultrasound-guided brachial plexus nerve blocks, yet avoidable pitfalls have not been published in the emergency medicine literature. Color Doppler evaluation of the brachial plexus, in addition to standard gray-scale imaging, should be performed before injecting anesthetic to reduce the possibility of inadvertent vasculature puncture. Emergency department (ED) indications for ultrasound-guided brachial plexus blocks include humerus fractures, elbow dislocations, complex wound care, burns and as an alternative to procedural sedation for upper extremity abscess drainage.[1] Two classic locations where brachial plexus blocks are performed are (1) between the scalene muscles (in the interscalene groove) and (2) above the clavicle adjacent to the subclavian artery (supraclavicular approach). Vasculature can mimic proximal nerve roots (circular and anechoic) during gray-scale ultrasound evaluations, making color Doppler imperative when sonographically evaluating the brachial plexus.[2] Inadvertent vascular puncture and injection may lead to hematoma formation,[3] incomplete analgesia from limited anesthetic spread[4] and/or local anesthetic systemic toxicity (LAST) (especially when using bupivicaine) resulting in potentially fatal cardiac and neurologic complications.[5] We present a case in which sonographic color Doppler evaluation of the brachial plexus in the supraclavicular location identified an aberrant vessel, and may have prevented inadvertent vascular puncture.

Figure 1. Plain film imaging indicating a comminuted mid-shaft humeral fracture.

CASE REPORT

The patient was a 27-year-old male who had suffered a comminuted fracture of the humerus secondary to a gunshot wound (Figure 1). The patient continued to complain of severe pain, despite extremity immobilization, and intravenous

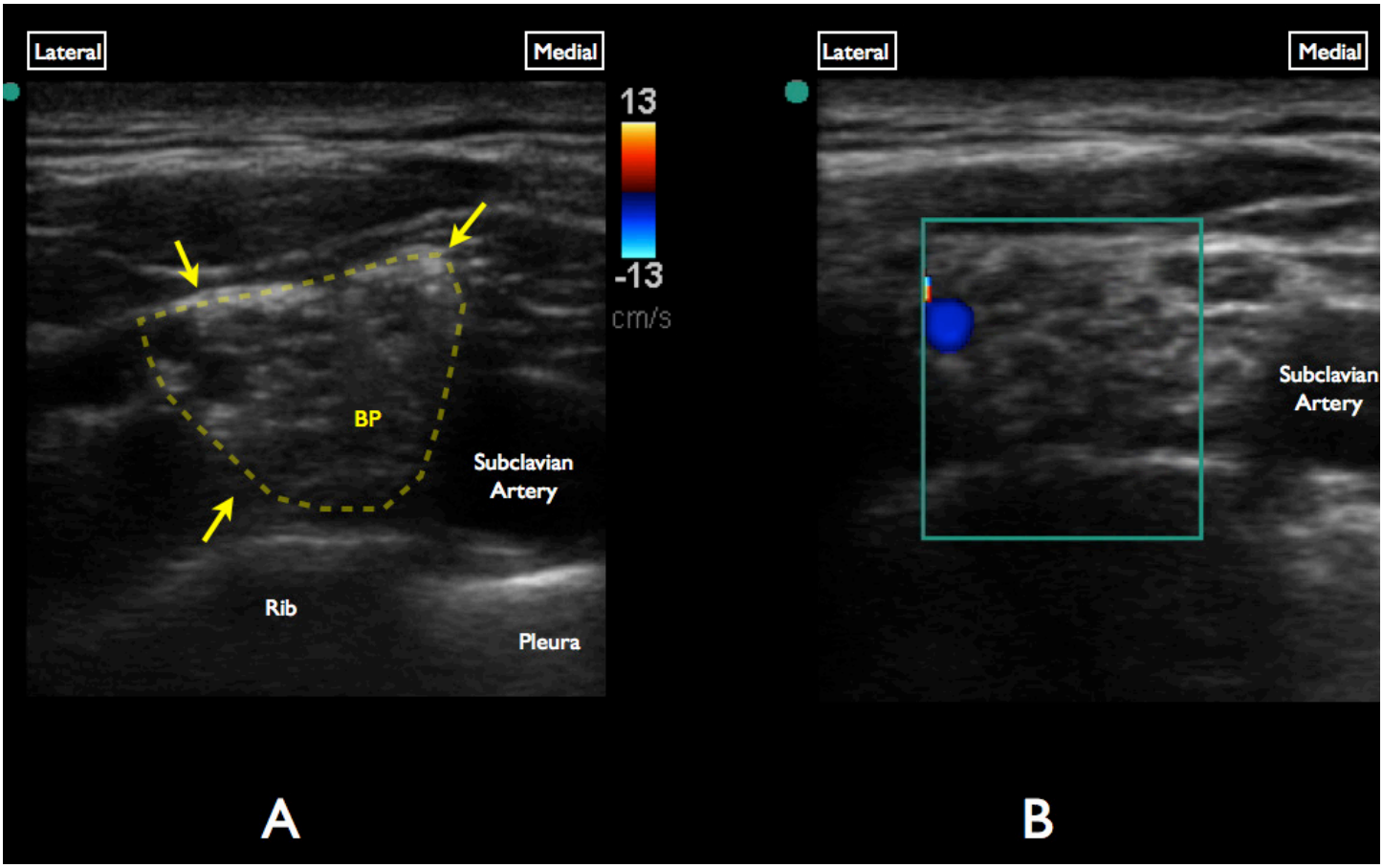

Figure 2. A, Gray-scale evaluation of the supraclavicular brachial plexus . Note the anechoic/circular nerve bundles (yellow arrows) lateral to the subclavian artery. B, Color Doppler interrogation of the brachial plexus demonstrates a vascular structure at the superolateral aspect of the brachial plexus.

opioid medications. The anterior neck (both interscalene and supraclavicular regions) was scanned in preparation for an ultrasound-guided brachial plexus nerve block. The supraclavicular fossa was chosen because of the relatively superficial location of the nerve bundles. The brachial plexus was initially identified with gray-scale imaging in the supraclavicular fossa using a high-frequency (10-5 MHz) linear probe (Sonosite™, Bothell, Washington) (Figure 2a). Subsequently, color Doppler evaluation of the brachial plexus in the supraclavicular fossa noted the presence of an aberrant vascular structure at the lateral corner of the brachial plexus (very near to the location where anesthetic deposition was planned given needle trajectory with a lateral to medial in-plane approach) (Figure 2b). Ultrasonographic evaluation with both gray-scale and color Doppler at the interscalene location demonstrated a clear path without risk of vascular puncture. Using a 40 mm 25 gauge needle, 10 mL of 0.5% bupivicaine was injected safely in the interscalene groove. The patient reported a rapid and dramatic reduction of pain, facilitating discharge with oral pain medications and expedited orthopedic referral.

DISCUSSION

Gray-scale imaging is commonly the primary method for sonographic evaluation of the brachial plexus. Aberrant vasculature detection has been detailed in the anesthesia literature when color Doppler is added to the sonographic evaluation at both the interscalene and supraclavicular locations, yet not mentioned in reports in emergency medicine.[1,6] In healthy normal subjects, the presence of arterial and venous branches adjacent to or running directly through the brachial plexus in both the supraclavicular and interscalene regions is very common, with prevalence as high as 86% and 90%, respectively.[7] One case report describes the brachial plexus divided in half by an artery in the supraclavicular fossa.[8] Small non-compressible arteries are known to mimic the appearance of nerve bundles in the brachial plexus and thus use of color Doppler is considered standard.[2]

EPs considering integrating ultrasound-guided nerve blocks of the brachial plexus should be aware of the necessity of color Doppler evaluation prior to selecting the optimal needle path and location of anesthetic placement. Accidental vascular puncture and anesthetic deposition can lead to serious complications (specifically LAST), and can be avoided with a thorough sonographic color Doppler interrogation of the brachial plexus at both the interscalene and supraclavicular location.

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Renal Rupture Following Extracorporeal Shockwave Lithotripsy

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A 41-year-old woman presented to the emergency department with a chief complaint of hematuria three days status post extracorporeal shockwave lithotripsy. The patient described a three-day history of worsening left-sided abdominal pain immediately following the procedure. She denied any fever, chills, changes in bowel habits, hematochezia, increased urinary frequency, urinary urgency, or dysuria.

Physical exam revealed tenderness to palpation in the left upper quadrant, left flank and periumbilical region with mild guarding. Laboratory studies revealed an anemic patient with downward trending hematocrit (red blood cell count of 3.41 10^6/μL, hemoglobin of 10.6 g/dL, and a hematocrit of 31.3% down from 43% a week and a half prior). Urinalysis revealed red and cloudy urine with 3+ leukocytes.

A chest radiograph was unremarkable. A computed tomography of the chest, abdomen, and pelvis showed a laceration to the lateral aspect of the mid left kidney with a hematoma measuring 3.2 cm in thickness (Figure). The patient was subsequently admitted to the hospital for monitoring and discharged on day nine. [West J Emerg Med. 2014;15(6):706-707]

DISCUSSION

Extracorporeal shockwave lithotripsy (ESWL) is a widely used treatment for symptomatic renal and ureteral stones, most effective with stones in the renal pelvis and upper ureter less than 1.5 cm in size.[1] Complications include incomplete stone fragmentation, hypertension, and decreased effective renal plasma flow.[2] In more severe cases, ESWL can lead to renal rupture or hematoma.[3] As seen with our patient, symptoms of renal rupture include persistent flank pain, decreased hemoglobin, mild fever, tenderness, and guarding.[4-6] Hematoma following ESWL may be detected by non-contrast computed tomography.[3,4] Most patients with kidney rupture only require supportive care.[4-6] Surgical intervention or embolization is reserved for severe cases.[4,6]

Figure. Computed tomography of the abdomen three days following extracorporeal shockwave lithotripsy and laser lithotripsy procedures showing a laceration to the lateral aspect of the mid left kidney (black arrow) and a hematoma on the posterior and lateral borders of the left kidney (H).

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Impact of Post-Intubation Interventions on Mortality in Patients Boarding in the Emergency Department

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Introduction: Emergency physicians frequently perform endotracheal intubation and mechanical ventilation. The impact of instituting early post-intubation interventions on patients boarding in the emergency department (ED) is not well studied. We sought to determine the impact of post-intubation interventions (arterial blood gas sampling, obtaining a chest x-ray (CXR), gastric decompression, early sedation, appropriate initial tidal volume, and quantitative capnography) on outcomes of mortality, ventilator-associated pneumonia (VAP), ventilator days, and intensive care unit (ICU) length-of-stay (LOS).

Methods: This was an observational, retrospective study of patients intubated in the ED at a large tertiary-care teaching hospital and included patients in the ED for greater than two hours post-intubation. We excluded them if they had incomplete data, were designated "do not resuscitate," were managed primarily by the trauma team, or had surgery within six hours after intubation.

Results: Of 169 patients meeting criteria, 15 died and 10 developed VAP. The mortality odds ratio (OR) in patients receiving CXR was 0.10 (95% CI 0.01 to 0.98), and 0.11 (95% CI 0.03 to 0.46) in patients receiving early sedation. The mortality OR for patients with 3 or fewer interventions was 4.25 (95% CI 1.15 to 15.75) when compared to patients with 5 or more interventions. There was no significant relationship between VAP rate, ventilator days, or ICU LOS and any of the intervention groups.

Conclusion: The performance of a CXR and early sedation as well as performing five or more vs. three or fewer post-intubation interventions in boarding adult ED patients was associated with decreased mortality. [West J Emerg Med. 2014;15(6):708-711]

INTRODUCTION

Emergency physicians (EP) frequently care for intubated and mechanically ventilated patients while these patients board in the emergency department (ED) waiting for an intensive care unit (ICU) bed.[1,2] As the volume of critically ill patients in the ED continues to rise,[1,3] defining optimal ED care is becoming increasingly important. There are several post-intubation interventions commonly performed in the ED, which include ventilator management, initiation of sedation, gastric decompression via orogastric tube (OGT) placement, arterial blood gas (ABG) analysis, performance of chest X-ray (CXR), quantitative capnography, and

elevation of the head of the bed to greater than 30 degrees. Head elevation was found to significantly reduce the rate of ventilator-associated pneumonia (VAP).[4] The effects of the other six interventions individually and as a group on patient outcomes have not been well studied. McGillicuddy et al examined the utility of CXR in identifying malpositioned endotracheal tubes; however, they did not investigate the impact that CXR performance had on patient outcome.[5] Lung protective strategies (LPS) have a clear role in patients with acute respiratory distress syndrome (ARDS) when initiated in the ICU.[6,7] Despite data that suggest a high prevalence of acute lung injury (ALI) in mechanically ventilated patients in the ED, initiating LPS early after intubation in the ED has not been studied.[8] Several studies suggest that using LPS in patients without ALI may decrease lung injury, although this hasn't been studied in a heterogeneous ED population.[9-11] Similarly, the use of quantitative capnography now has a level 1A recommendation for mechanically ventilated patients in the 2010 American Heart Association guidelines,[12] as well as a 1A recommendation in guidelines published in *Respiratory Care*.[13] However, no study to date has shown a clear outcome benefit of quantitative capnography. Studies examining the utility of ABG analysis, gastric decompression, and initiation of sedation with regard to patient outcomes are similarly lacking.

The purpose of our current study was to better delineate the association between performance of post-intubation interventions in the ED and patient outcomes to guide optimal care of these patients in the ED. We hypothesized that performance of each of the six interventions, as well as an increasing numbers of interventions, would be associated with improved outcomes including decreased mortality, VAP rate, ventilator days, and ICU length-of-stay (LOS).

METHODS

This retrospective study used an existing database, collected by trained research assistants using standardized forms and blinded to the hypotheses, of all patients intubated in the ED of a large, urban, tertiary-care, teaching hospital from November 14, 2009, to June 1, 2011, and was approved by the institutional review board. The study site ED, with an annual census during the study period of approximately 84,000 patients, had a dedicated respiratory therapist, an emergency medicine residency program, a 26% admission rate, and accounted for over 50% of all hospital admissions. Of the admitted patients, 65.5% were classified as boarding (no bed assignment two hours after admission orders), with an average boarding time of 2.9 hours. Trauma patients were cared for in a unit separate from the ED. Post-intubation care during the study period was at the discretion of the treating emergency physician without a standardized bundle of care. Patients were included in the study if they were in the ED for greater than or equal to two hours post-intubation (boarding) and were managed primarily by the ED team. They were excluded if they had incomplete data, were made "do not resuscitate" (DNR), or were primarily managed by the trauma service. Additionally, we excluded patients who underwent a major surgical procedure within six hours of intubation so that we would not confound medically managed ICU patients with surgical patients.

Statistical Analysis

Patients were evaluated for each individual type of ED intervention performed and categorized into two groups (performance of intervention and non-performance of intervention). For the individual continuous variables of ICU LOS and ventilator days, we tested the differences in mean duration between the two groups using the non-parametric Wilcoxon rank sum test since the normality assumption was not satisfied. We used chi-squared and Fisher's exact tests to investigate the difference between the two groups for categorical outcome variables of mortality and VAP rate. A p-value of <0.05 was considered a significant difference between the two groups.

We used multivariate logistic regression analysis, adjusted for illness severity using sequential organ failure assessment (SOFA) and acute physiology and chronic health evaluation II (APACHE II) scores, to examine the relationship between the six interventions and the categorical outcomes (mortality and VAP rate), and to determine if an increasing number of interventions (1-3 vs. 4 vs. 5-6) was associated with improved outcomes. This grouping was based on a relatively small number of patients receiving one, two, or six interventions, leaving too few patients for meaningful comparison (Table 1). A multivariate linear regression model was used for the continuous outcomes (ventilator days and ICU LOS), and was similarly adjusted to control for illness severity using SOFA and APACHE II scores.

RESULTS

We reviewed a total of 317 charts; of these, 148 were excluded (112 DNR, 16 incomplete data, 20 surgery within 6 hours of intubation), leaving 169 patients in our cohort. Of

Table 1. Number and percentage of patients receiving interventions.

Number of interventions	Number of patients receiving interventions	Percentage of patients receiving interventions
1	1	0.6%
2	8	4.7%
3	30	17.8%
4	51	30.2%
5	75	44.4%
6	4	2.4%

Table 2. Multivariate logistic regression of interventions with mortality and VAP adjusted for SOFA and APACHE II score.

Intervention	% Receiving intervention	Mortality odds ratio (95% CI)	VAP odds ratio (95% CI)
CXR (in the ED)	96.4%	0.10 (0.01, 0.98)	0.29 (0.02, 4.33)
OGT (in the ED)	84%	1.59 (0.26, 9.73)	0.70 (0.12, 4.18)
Early sedation (within 30 min.)	83.4%	0.11 (0.03, 0.46)	0.82 (0.14, 4.95)
ABG (in the ED)	76.9%	0.62 (0.14, 2.69)	1.25 (0.19, 4.33)
Appropriate tidal volume (6-10 cc/kg)	71%	1.54 (0.37, 6.45)	1.70 (0.32, 9.15)
$EtCO_2$ (in the ED)	5.9%	<0.001 (<0.001, >100)	1.09 (0.12, 10.11)

VAP, ventilator-associated pneumonia; *SOFA*, sequential organ failure assessment; *APACHE II*, acute physiology and chronic health evaluation II; *CXR*, chest x-ray; *OGT*, orogastric tube; *ABG*, arterial blood gas; *ED*, emergency department

these, 154 patients survived; 15 died and 10 developed VAP, resulting in a mortality rate of 8.8% and VAP rate of 5.9%. Mean duration on the ventilator was 3.4 days and mean ICU LOS was 5.4 days.

In the group receiving a CXR, mortality was significantly lower than in the group not receiving a CXR, OR 0.10 (95% CI 0.01 to 0.98). Similarly in the group given sedation within 30 minutes, mortality was significantly lower than in the group not receiving sedation within 30 minutes, OR 0.11 (95% CI 0.03 to 0.46). There was no significant difference in mortality for the other 4 interventions (Table 2). There was no significant relationship between VAP rate, ventilator days, or ICU LOS and any of the intervention groups individually.

Patients who received fewer interventions (3 or fewer) had a significantly higher mortality rate when compared to the group with 5 or more interventions OR 4.25 (95% CI 1.15 to 15.75) (Table 3). There was no significant difference in VAP rate, ventilator days, or ICU LOS between the two groups.

DISCUSSION

To our knowledge, this is the first study to examine the outcome impact of post-intubation care in the ED setting. We chose to study boarding patients as opposed to all intubated patients to allow sufficient time for all six interventions to be performed. Prior studies have examined the effect of boarding on ICU outcomes such as mortality, VAP, as well as ICU LOS, and have found an association between increased ED LOS with poor outcome.[14,15] These results have also been replicated in studies evaluating boarding and mortality for all admissions to the hospital.[16] Additionally, two studies evaluating individual outcomes such as medication errors and delay in treatment times both showed an increase in adverse outcomes.[17,18] In our study, the increased mortality rate in patients with fewer interventions may similarly be due to crowding leading to less vigilant monitoring and care of intubated patients. Our finding of decreased mortality with performance of an increasing number of post-intubation interventions is an important step in better elucidating optimal post-intubation ED care. It is unclear whether this association of increased interventions with improved mortality is due to the actual interventions performed or instead serves as a surrogate marker for attention paid toward these patients. Future study to determine if an ED intervention, such as a bundle of care or checklist to improve performance of post-intubation interventions and the impact of this intervention on outcomes, may be warranted.

Table 3. Mortality odds ratio by number of interventions adjusted for SOFA and APACHE II score.

Number of interventions	Mortality odds ratio (95% CI)
1-3 vs 4	4.10 (0.94, 17.92)
4 vs 5-6	0.98 (0.20, 4.68)
1-3 vs 5-6	4.25 (1.15, 15.75)

SOFA, sequential organ failure assessment; *APACHE II*, acute physiology and chronic health evaluation II

LIMITATIONS

Notable limitations of this study include its retrospective, single-center study design. The total sample size available for analysis was also small (169 patients), and there was a low overall mortality in our study compared with prior studies evaluating mortality amongst patients intubated in the ED.[19] Additionally, as patients who were made DNR were specifically excluded from our study, it is possible that we underestimated the impact ED interventions had on mortality. Our goal in excluding patients who were DNR was to eliminate the possibility that their outcome was based on withdrawal of care rather than ED management. Finally, although we attempted to control for illness severity in the groups receiving or not receiving specific interventions by adjusting for SOFA and APACHE II scores, it may be that other undetermined variables contributed to the change in mortality.

CONCLUSION

Initiating sedation within 30 minutes and obtaining chest radiograph post-intubation in adults intubated and boarding in the ED were associated with lower mortality. Performing five or six post-intubation interventions in adults intubated and boarding in the ED was associated with lower mortality compared to performing three or less interventions. Post-intubation

interventions in adults intubated and boarding in the ED were not associated with VAP rate, ventilator days, or ICU LOS.

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Mirror Image Artifact Mimicking Heterotopic Pregnancy on Transvaginal Ultrasound: Case Series

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Vaginal bleeding in early pregnancy is a common emergency department complaint. Point-of-care ultrasound is a useful tool to evaluate for intrauterine ectopic pregnancy. Emergency physicians performing these studies need to be cognizant of artifacts produced by ultrasound technology, as they can lead to misdiagnosis. We present two cases where mirror-image artifacts initially led to a concern for heterotopic pregnancies but were excluded on further imaging. [West J Emerg Med. 2014;15(6):712-714]

INTRODUCTION

Vaginal bleeding and abdominal cramping are very common complaints in pregnant patients presenting to the emergency department (ED). Ectopic pregnancies make up 1.5-2% of all pregnancies.[1] However, the prevalence of ectopic pregnancy among women who present to the ED in the first trimester with pain or vaginal bleeding approaches 16%.[2] Although a large majority (97%) of these ectopic pregnancies tend to be in the fallopian tube,[3] a small percentage have more obscure locations, making their diagnosis more challenging. Additionally, hemorrhage from ectopic pregnancy is the leading cause of pregnancy-related maternal death in the first trimester and accounts for 4-10% of all pregnancy-related deaths.[3,4]

Over the last 10-15 years, diagnostic ultrasound (US) modalities have incrementally improved. This technological advancement, coupled with the increased awareness of ectopic pregnancies among emergency physicians (EP), has caused a drastic increase in the incidence of this condition. It has led to earlier diagnosis and a decreased mortality rate. Between 1980 and 2007, 876 deaths were attributed to ectopic pregnancy. The ectopic pregnancy maternal mortality ratio declined by 57% between 1980 to 1984 and 2003 to 2007, from 1.15 to 0.50 deaths per 100,000 live births.[5]

Heterotopic pregnancy is the combined presence of intrauterine and extrauterine pregnancies. It was considered a rare event, occurring in approximately 1 in 30,000 patients, until assisted reproduction techniques became prevalent. With the advancement of assisted reproduction, the incidence of heterotopic pregnancy rose to 1 in 100 pregnancies.[6] With such a remarkable increase in the incidence of heterotopic pregnancy, there are instances when the initial US may not be diagnostic. Sonographers must be aware of the limitations of US and of artifacts that can falsely appear as alternate diagnoses or pathology. We propose two cases where heterotopic pregnancy was considered on initial US due to mirror artifact; however, with further imaging this diagnosis was excluded.

CASE REPORT

Case 1

A 25-year-old G4P0A3 female presented to the ED with lower abdominal pain and vaginal bleeding for three days. The patient was eight weeks gestation by dates and had not seen her obstetrician for pregnancy testing or confirmatory ultrasound. She denied any methods of assisted reproduction and had three previous spontaneous abortions. She had no other past medical history and took no medications or illicit drugs. Her abdominal pain was constant, non-radiating, and had no exacerbating or alleviating factors. She complained of associated nausea without vomiting, lightheadedness or dizziness. She denied trauma.

The patient's vital signs on arrival were within normal limits. Her urine HCG was found to be positive. Physical

Figure 1. Longitudinal transvaginal ultrasound demonstrating intrauterine pregnancy on the left and the mirror-image artifact on the right of the image.

Figure 2. Longitudinal transvaginal ultrasound image yielding intrauterine pregnancy on the left and mirror-image artifact on the right.

examination revealed a young female without pallor in a mild amount of distress from pain. Pelvic examination demonstrated no tenderness or lesions, the cervical os was closed and there was no bleeding at the time of the examination. Her hemoglobin and hematocrit were 14 g/dL and 39.6% respectively. Serum HCG was found to be 36,940 mIU/ml. The blood type was O positive. She subsequently underwent point-of-care (POC) transabdominal sonography, which yielded inconclusive images. POC transvaginal sonography showed a gestational sac with yolk sac, consistent with an intrauterine pregnancy. A second gestational sac with yolk sac was also visualized posterior to the bladder (Figure 1). The diagnosis of heterotopic pregnancy was considered.

Case 2

A 32-year-old G1P0 female about seven weeks gestational age by dates, presented to the ED with sharp left upper quadrant and periumbilical abdominal pain for two weeks duration. Past medical history was significant for gastritis, diverticulitis and herpes simplex virus infection. Her only medication was valacyclovir. The pain was intermittent and associated with nausea and vomiting. There were no exacerbating or alleviating factors. She denied lightheadedness, dizziness or vaginal discharge. She had seen her obstetrician earlier that morning, where she had a transabdominal ultrasound that did not visualize an intrauterine pregnancy. As a result, the patient was sent to the ED to be evaluated for ectopic pregnancy.

In the ED, she was well appearing and in a mild amount of distress. Her vital signs were normal. She continued to complain of left upper quadrant and periumbilical abdominal pain. Physical examination demonstrated a diffusely tender abdomen with the focus of pain in the left upper quadrant, without rebound or guarding. Pelvic examination yielded left adnexal tenderness with a closed cervical os. The rest of her physical examination was unremarkable. Her urine HCG was positive and she was given metoclopramide for her nausea with some relief.

Her laboratory results yielded a hemoglobin of 13 g/dL and hematocrit of 36.2%. Her serum B-HCG was 92,246 mIU/mL. Her urinalysis was normal. A focused POC transvaginal US was performed by an EP. It showed a single intrauterine pregnancy with heart rate of 151 beats per minute. However, a second gestational sac with yolk sac was seen adjacent to the uterus. The diagnosis of heterotopic pregnancy was again considered (Figure 2).

Case Conclusion

On further imaging with POC US of both patients, the second gestational sac would disappear when imaged from differing positions. Considering these findings, a mirror-image phenomenon, a previously described sonographic artifact, was suspected.[7]

Both patients were discharged with close follow-up after an obstetrics consultation in the ED. Both patients were instructed to see their obstetrician in 1-2 days and were put on pelvic rest. The patient in Case 1 followed up in 3-4 days at which time her B-HCG was found to be 65,838 mIU/ml. Ultimately the patient was diagnosed with fetal demise. The patient in case 2 had a normal delivery.

DISCUSSION

US artifacts are created by the machine's interpretation of returning echoes but do not correspond to the actual anatomy of the patient. These artifacts are often misleading and result in misdiagnosis.[7] They may originate from within the patient, an external source, or as a result of attenuation, refraction, or operator error.

Mirroring is when two identical images appear on both sides of a strong reflector. US assumes that sound is traveling in a straight line, and the depth of the reflector is proportional to the time it takes for the US beam to reach and return to the reflector.[8] However, when the US beam hits a strong reflector and changes direction, the timing is not an accurate measure of the depth. As a result, duplication of objects may occur.

We believe the mirror image artifacts above were due

primarily to an over-distended bladder. When the bladder is over distended the uterus is pushed up into the abdomen and lies along the psoas muscle. As described by Kremkau,[9] the psoas muscle thereby acts as a reflective surface causing the mirror artifact.

Mirror image artifact is commonly seen in the liver leading to duplication of hepatic structures caused when the diaphragm acts as a strong reflector.[10] Mirror image artifacts have also been described in transcranial doppler ultrasonography[11,12] and cardiac imaging.[13] As with all artifacts, changing the transducer orientation or patient positioning causes the mirror-image artifact to resolve.

To our knowledge, few cases of mirror-image artifact during transvaginal sonography have been reported. Sonographers and EPs must be cognizant of this artifact to avoid a false positive misdiagnosis of heterotopic pregnancy.

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Ultrasound Detection of Superior Vena Cava Thrombus

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Superior vena cava (SVC) syndrome is most commonly the insidious result of decreased vascular flow through the SVC due to malignancy, spontaneous thrombus, infections, and iatrogenic etiologies. Clinical suspicion usually leads to computed tomography to confirm the diagnosis. However, when a patient in respiratory distress requires emergent airway management, travel outside the emergency department is not ideal. With the growing implementation of point-of-care ultrasound (POCUS), clinicians may make critical diagnoses rapidly and safely. We present a case of SVC syndrome due to extensive thrombosis of the deep venous system cephalad to the SVC diagnosed by POCUS. [West J Emerg Med. 2014;15(6):715-718]

INTRODUCTION

Superior vena cava (SVC) syndrome, first described by William Hunter in 1757 in a patient with syphilitic aneurysm,[1] is defined as a constellation of symptoms that result from the decrease in vascular flow within the SVC. Traditionally, this has been understood to mean a drop in blood flow due to extrinsic compression of the SVC, usually from a thoracic tumor or other rigid structure within the thorax. Bronchogenic carcinoma, typically small or squamous cell, is responsible for nearly 80% of all cases of SVC syndrome, and lymphoma accounts for 15% of cases; yet spontaneous thrombus, infections, and iatrogenic etiologies are also described.[2-4] The formation of venous thrombi secondary to pacemaker leads and central venous catheters is also a well-documented phenomenon.[5,6]

Several different anatomic factors contribute to the development of SVC syndrome. Principally, it is a relatively thin-walled vessel with low intravascular pressure, making it easy to compress. Subsequent compression impedes flow, which may contribute to thrombus formation, particularly if there is a thrombogenic foci already present, such as a central venous catheter. Additionally, there are a number of rigid and semi-rigid structures abutting the SVC, including vertebrae, ribs, and the aorta, which can cause compression.[7,8]

Imaging modalities, such as computed tomography (CT), are rapid, standardized, and give a detailed view of large areas. However, they nearly always require transport away from the resuscitation area and its resources. Point-of-care ultrasound (POCUS) is a versatile imaging modality that is instantly available at the bedside, can be performed real-time in conjunction with resuscitation efforts, and can be performed serially without harmful ionizing radiation exposure to the patient or provider. Diagnosis of SVC syndrome with POCUS has not been previously described. This diagnosis is usually confirmed via traditional angiography, CT angiography, or magnetic resonance imaging (MRI).[9-11]

As such, the following is a case presentation of SVC syndrome due to extensive thrombosis of the deep venous system cephalad to the SVC diagnosed by POCUS.

Figure 1. Patient demonstrating sharp line of demarcation inferior to nipples separating pallor (inferior) and plethora (superior).

CASE REPORT

A 71-year-old male with a past medical history of acute promyelocytic leukemia (PML) and diffuse large B-cell lymphoma currently undergoing chemotherapy, presented to the emergency department (ED) via ambulance with a chief complaint of progressively worsening shortness of breath over the past three days. He experienced an acute worsening of this symptom accompanied by a gradual onset of upper body cyanosis beginning that morning.

Upon initial examination, the patient was in severe respiratory distress, speaking in three-word sentences. Initial vital signs were the following: blood pressure 124/94 mmHg, pulse 100 beats per minute, respiratory rate 28, temperature 97.9 F, SpO2 97% on 15 L/min non-rebreather mask. His head and upper torso had a generalized cyanotic appearance with a remarkably sharp demarcation line approximately at the nipples (Figure 1). Neck exam showed jugular venous distension without thyromegaly. The pulmonary exam revealed tachypnea, bilateral wheezing and the use of intercostal and supraclavicular accessory muscles. The abdomen was soft, mildly tender, distended, without masses, and with diminished bowel sounds. Extremity and neurologic exams were unremarkable.

Initial attempts at obtaining peripheral intravenous access proved exceedingly difficult despite obviously visible vasculature. After gaining peripheral access, several nurses noted difficulty in drawing blood and flushing medications and saline. POCUS was immediately performed to evaluate for the cause of his acute dyspnea and to locate vessels for vascular access, including a limited trans-thoracic echocardiogram, extended focused assessment with sonography for trauma (EFAST), evaluation of the inferior vena cava for preload and bilateral internal jugular veins (IJV) assessments, for projected central venous access.

The echocardiogram showed a small pericardial effusion without evidence of tamponade with a grossly normal ejection fraction. The EFAST revealed absence of pneumothorax and a moderately large amount of free fluid in the abdomen consistent with previously known ascites. The vascular ultrasound (US) examinations (Figures 2-5) showed an inferior vena cava that collapsed more than 50% with each respiration, suggesting a central venous pressure of less than 8 mm Hg[12]; assessment of the IJVs demonstrated bilateral thromboses with extension into the subclavian and axillary veins bilaterally. There was no thrombosis in the right femoral vein and because of lack of functional IV access, a triple lumen central line was then placed under US guidance to allow resuscitation and treatment. Normal saline was administered with improvement in the patients' symptoms.

The electrocardiogram was without ischemia, and a chest radiograph was without acute pathology. Once the patient was stabilized, a CT of the head, neck and chest showed thrombus within the left innominate, right and left subclavians, and superior vena cava with total occlusion of the distal superior vena cava at the level of the cavo-atrial junction (Figure 6). These correlated with the POCUS findings and confirmed the cause of SVC syndrome. After discussion with the patient's primary oncologist and his family, the decision was made to transition the patient to comfort care measures and he was transferred to the medical ward. He expired later that evening due to respiratory arrest.

Figure 2. Ultrasound image demonstrating clot in right IJ (star). *IJ*, internal jugular

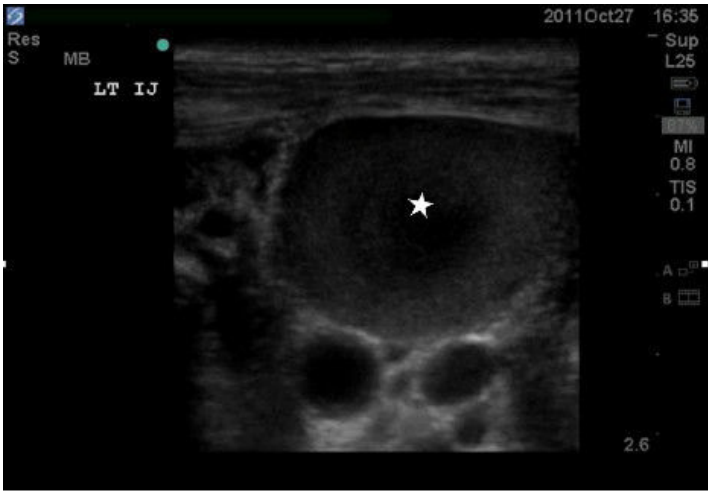

Figure 3. Ultrasound image demonstrating clot in left IJ (star). *IJ*, internal jugular

DISCUSSION

Our case represents a novel report in the medical literature demonstrating the utility of POCUS in the ED as the diagnostic modality of bilateral IJV thromboses. An added benefit of POCUS was demonstrated in our case – the directed guidance of venous access to the appropriate, patent femoral vein, which allowed treatment and resuscitation of the patient. Upper extremity IV access was non-functional in this patient due to obstruction from the SVC thrombosis, but the IVC was found to be patent on US as well as the femoral vein distal, which was cannulated using real-time ultrasound guidance.

SVC syndrome with unilateral IJV thrombosis is a rare occurrence, with bilateral IJV thromboses being rarer still.[13] Literature searches via PubMed, Google Scholar, Cochrane

Figure 4. Ultrasound image demonstrating clot in right axillary vein (star).

Figure 5. Ultrasound image demonstrating clot in left axillary vein (star).

Review, and Ovid using the terms "bilateral internal jugular vein thrombus," "bilateral internal jugular vein thrombosis," and "bilateral internal jugular vein thromboses" revealed multiple case reports demonstrating diagnosis of the thrombus via CT, MRI and US; however, none of the articles reported ED POCUS as the diagnostic modality. Few cases mentioned US as the initial diagnostic modality and these were radiologist-performed inpatient studies.[14]

Risk factors for thrombosis of the SVC include a history of malignancy, trauma, recent surgery, central venous access, retropharyngeal or deep space neck infections, hypercoagulability or known existing thrombi, and polycythemia. The more rapid the compression of the vessel, the more quickly symptoms occur due to lack of collateral vessel development. Physical exam findings of SVC syndrome most commonly include facial swelling with venous engorgement of the neck, trunk and upper extremities, dyspnea, orthopnea, cough, headache, nausea, and dizziness. Other complaints include a palpable cord or mass, fever, chest pain, visual disturbances, or seizures.[15-19] Upper body cyanosis tends to be a late and ominous sign. Possible complications include pulmonary embolus, thrombophlebitis, airway edema, pseudotumor cerebri, superior sagittal sinus thrombosis, coma, and death.

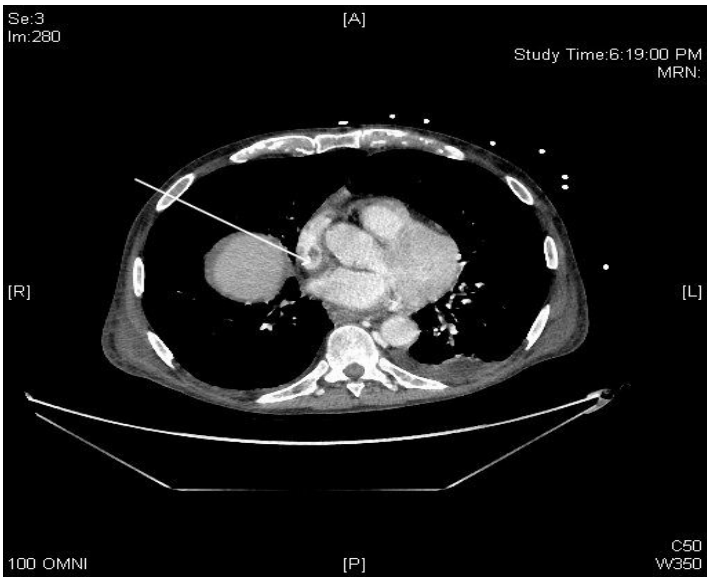

Figure 6. Computed tomography image demonstrating filling defect in SVC distal to central venous port tip (arrow).
SVC, superior vena cava

Many diagnostic modalities exist including US, CT, magnetic resonance imaging, and contrast venography. CT is the gold standard and is the confirmatory radiographic modality of choice.[20] As seen in this case, in the hands of an appropriately trained emergency physician, POCUS identified the extensive thromboses and helped plan the course of action for vascular access in this critically ill patient (femoral venous access). This information was timely and invaluable in the resuscitation of this patient who was too sick to travel to radiology for consultative imaging. Additionally, a number of other bedside ultrasounds were performed including an echocardiogram and an EFAST exam, giving critical information about cardiac function, volume status, and abdominal free fluid – all within minutes of arrival. In our patient, POCUS proved to be an invaluable tool.

Treatment typically consists initially of supportive care, head elevation, rest, supplemental oxygen, anticoagulation with the consideration of thrombolytics, clot retrieval. Some have advocated the use of diuretics and glucocorticoids. Identifying and treating the underlying cause, such as radiation and/or chemotherapy for malignancy, or antibiotics for underlying infection or thrombophlebitis, is also critical.[15-19] All unnecessary catheters or other thrombogenic foci should be removed.

In summary, the rare occurrence of SVC syndrome due to thrombosis of the SVC is most commonly associated with vein cannulation, surgery, and malignancy. Although the SVC itself may be difficult to image with US, the diagnosis can be inferred readily at the bedside in the hands of the emergency physician, as evidenced in this case by identification of bilateral IJ and axillary thromboses. Though

operator-dependent, POCUS is becoming an increasingly available and used resource. As more providers become adept at performing these exams in both stable and unstable patients, our hope is that patient safety and outcomes correspondingly improve.

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From the Heart: Interatrial Septal Aneurysm Identified on Bedside Ultrasound

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A 61 year-old man presented to the Emergency Department for one day of nonspecific chest pain. Bedside echocardiogram performed by the emergency physician revealed normal systolic cardiac function but also showed a large (> 10mm) bicornuate interatrial septal aneurysm (IASA) projecting into the right atrium (Figure 1, Video 1). There was no evidence of intraatrial thrombus. A formal echocardiogram performed later that day confirmed the diagnosis and also detected a patent foramen ovale (PFO) with a left-to-right shunt that reversed with Valsalva maneuver. [West J Emerg Med. 2014;15(6):719–720]

DISCUSSION

Given the increasing use of point-of-care echocardiography in the emergency department, clinicians should learn to recognize common cardiac malformations such as IASA, a congenital lesion with a prevalence between 2-10%.[1] While familiar to cardiologists, the presence of an IASA may surprise the emergency physician, as few if any case reports have appeared in the emergency medicine literature. The basic differential diagnosis to consider for IASA should include thrombus, intracardiac tumor, and Chiari network (a web-like embryonic remnant in the right atrium).[2]

Though usually benign, IASAs have been associated with cryptogenic stroke in younger patients (< 55 years).[3,4] They are thought to facilitate thrombus formation via stasis and provocation of atrial arrhythmias. IASAs are also highly associated with PFO, and the combination of the two lesions may increase stroke risk in a synergistic fashion.[5,6] Anticoagulation is typically initiated as secondary prevention in patients with a history of stroke or as primary prophylaxis in patients with a visualized atrial thrombus.[7–9]

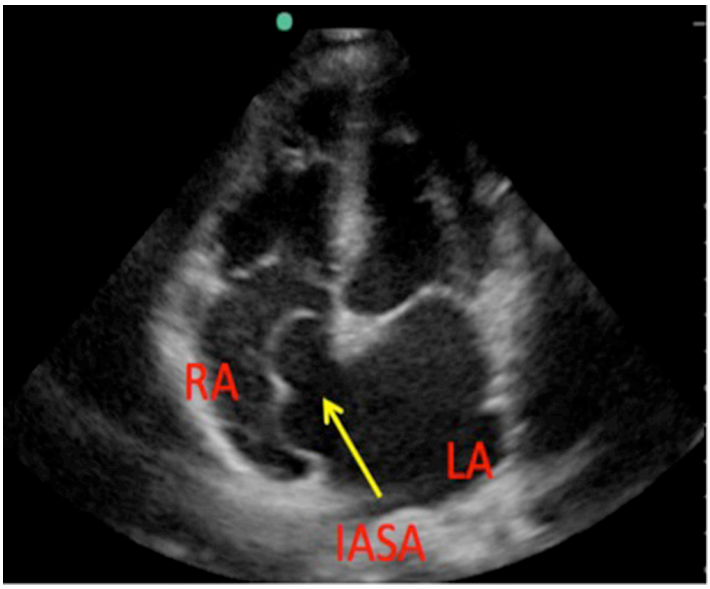

Figure. Four-chamber apical view demonstrating a large interatrial septal aneurysm.
RA, right atrium; *IASA*, interatrial septal aneurysm; *LA*, left atrium

Video. Normal systolic cardiac function and a large bicornuate interatrial septal aneurysm (IASA) projecting into the right atrium (RA).

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5th Annual National Update on Behavioral Emergencies

Topics (Tentative) Thursday December 11 (Day 1)
Working with Law Enforcement
What is New in Medical Clearance
Suicide and Substance Use
Deadly Disorders in Psychiatric
New Drugs of Abuse
Difficult Behavioral Disorders
Excited Delirium
Pediatric Psychiatric Illness
Case Management in the Emergency
Intellectually and DD
Geropsychiatric Issues
Medication Update
Appropriate Treatments in the ED/PES
Agitation Tx Delirium and Dementia
New Treatments for Agitation
Successful Restraint Reduction
Who Can Go Home with Suicide
Dealing with Psychiatric Boarders

Topics (Tentative) Friday December 12 (Day 2)
Reduction of Frequent Users
Working with EMS
Role of Community Mental Health
Nursing Issues of Caring for Behavioral Emergencies
Mobile Care and Crisis Management
Training in Behavioral Emergencies
Medical Records in HIE
Legislative issues
Wall Time Collaborative
Models of Care
ED Tool Kit
Billing and Reimbursement
EMTALA
Scientific Session

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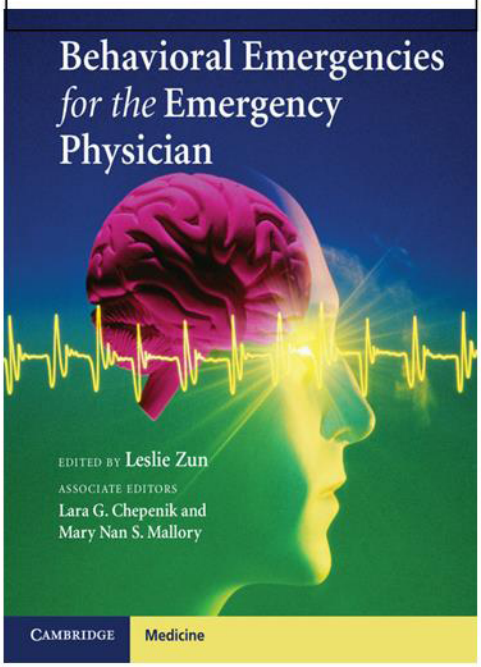

Invited Speakers

Doug Rund
David Hinton
Peter Gutierrez
Kim Nordstrom
Frank Lovecchio
Lara Chepenik
Gary Vilke
Joanna Kowalik
Sheri Richardt
Jennifer Walthall
Jack Rozel
Jon Berlin
Rachel Glick
Lara Chepenik
Scott Goldstein
Ken Thompson
Anne Maton
Pablo Sadler
Kurt Isenberger
Laura Zaremba
B Bartleson
Scott Zeller
Junji Takeshita
Richard Wild
Michael Wilson
Eric Katz
Seth Powsner

Pre-Conference Course on Dec 10th Sponsored by IBHI

Course Director
Leslie Zun, MD, MBA
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