**TABLE OF CONTENTS**

**ORIGINAL RESEARCH**

265 Is a Video Worth a Thousand Words? Educating Preclinical Medical Students on Sterile Scrubbing, Gowning, and Gloving Virtually and In-Person  
Ashlie A. Elver, B.S., Maxwell C. Braasch, MPH, Stefano Byer, B.S., Lisa Gilmer, M.D., Kevin J. Sykes, Ph.D., MPH, Chad Tuchek, M.D., Peter DiPasco, M.D., FACS, FSSO

269 Treatment of Cardiac Surgical Wounds with Silver Dressings  
Ashlie A. Elver, B.S., Katy Wirtz, RN, BSN, Jinxiang Hu, Ph.D., Emmanuel Daon, M.D.

273 Trends in Internet Safety Education by Healthcare Providers  
Gary King, M.D., Thuy Bui, MPH, Julian Dedaux, Ph.D., Carolyn R. Ahlers-Schmidt, Ph.D., Kari Harris, M.D.

277 A Disclosure about Death Disclosure: Variability in Circulatory Death Determination  
Christopher P. Robinson, D.O., M.S., Suzanne L. Hunt, M.S., Gary S. Gronseth, M.D., Sara Hocker, M.D., Eelco F.M. Wijdicks, M.D., Ph.D., Alejandro A. Rabinstein, M.D., Sherri A. Braksick, M.D.

282 Emergency Action Planning in School-Based Athletics: A Systematic Review  
Riley Hedberg, B.S., William Messamore, M.D., Ph.D., Tanner Poppe, B.S., Armin Tarakemeh, B.A., Rick Burkholder, M.S., ATC, Trent Carter, M.S., ATC, Bryan Vopat, M.D., Jean-Philippe Darche, M.D.

**CASE REPORT**

287 Clot in Transit and Pulmonary Artery Percutaneous Mechanical Thrombectomy  
Scott E. Janus, M.D., Jamal Hajjari, M.D., Tarek Chami, M.D., Mohamad Karnib, M.D., Mohammed Najeeb Osman, M.D.

290 Brushing up on Brush Borders: Intestinal Spirochetosis Diagnosis and Management  
Is a Video Worth a Thousand Words? Educating Preclinical Medical Students on Sterile Scrubbing, Gowning, and Gloving Virtually and In-Person

Ashlie A. Elver, B.S.¹, Maximilian Braasch, MPH¹, Stefano Byer, B.S.¹, Lisa Gilmer, M.D.¹,², Kevin J. Sykes, Ph.D.¹, MPH¹,², Chad Tuchek, M.D.¹,³, Peter DiPasco, M.D., FACS, FSSO¹,⁴, ⁵

¹University of Kansas School of Medicine, Kansas City, KS
²Department of Pediatrics
³Department of Otolaryngology – Head and Neck Surgery
⁴Department of Neurosurgery
⁵Department of Surgery

ABSTRACT

Introduction. Programs that offer early exposure to surgery for medical students foster interest in and positive perceptions of surgery. The COVID-19 pandemic led to suspension of these activities at our institution, the University of Kansas School of Medicine. In response to the lack of virtual alternatives, a pilot virtual surgery enrichment program was implemented for first-year students in place of in-person surgical exposure. The aim of this study was to compare the efficacy of in-person and virtual-based surgical education programs to expose preclinical medical students about the surgical realm of medicine.

Methods. First-year medical students participated in either a virtual (Group A) or in-person (Group B) week-long surgical enrichment program. Group assignments were dictated by COVID restrictions on each of our three medical school campuses: Salina, Wichita, and Kansas City. Pre- and post-surveys with a 14-question multiple-choice assessment of surgical knowledge were distributed to participants. Paired Wilcoxon Signed Rank tests and Mann-Whitney-U tests were used for statistical analysis.

Results. There were 14 participants in Group A and 7 participants in Group B. Both groups improved significantly from pre- to post-assessment score. (Group A, \( p = 0.01 \); Group B, \( p = 0.04 \)). There was no difference between groups in the magnitude of score improvement from pre- to post-assessment (\( p = 0.59 \)).

Conclusions. This pilot program demonstrated that virtual platforms can be a method to provide meaningful clinical experiences in surgery to preclinical medical students restricted from clinical activities. Further development of mentorship in virtual surgical programs and assessment of subjective experience is needed.

INTRODUCTION

The first two years of medical school, termed “preclinical years,” are traditionally didactic based. Many schools offer structured programs for students to participate in clinical areas of interest early in their training to facilitate career exploration. In surgery, early exposure to positive experiences and mentorship are important influences on the decision to pursue surgery as a career.¹² Also, early clinical participation in surgery improves surgical knowledge and performance in the operating room (OR) during surgery clerkships.³

Unfortunately, the coronavirus pandemic led to suspension of clinical activities for students who were deemed non-essential personnel.⁴ While clinical activities are core to third and fourth-year medical students completing clinical clerkships, they are lower educational priority for first and second-year students during the didactic portion of their training. However, structured programs facilitating early exposure to surgery have become a part of the standard model of a well-rounded medical education.⁵ To address this gap in preclinical education, a virtual surgical enrichment program (VSEP) was created.

Virtual platforms seemed a far-fetched method to deliver quality surgical education, but have demonstrated successful performance measures in new virtual surgical clerkships, and even generated interest to pursue surgical careers.⁶ The opportunities for preclinical students to participate in surgery remain limited. It is nonetheless critical to provide students with these opportunities. Virtual pilot programs for surgical education, such as the one described in this paper, must be developed and expanded to restore pre-existing standards in medical education.

METHODS

Scholarship, Enrichment, and Remediation (SER) week is a required shadowing program in the pre-existing curriculum of first and second-year students at our institution and occurs at the end of each systems-based academic block (seven total).² Students spend the week immersed in clinical areas of interest with faculty and residents in the specialty of their choosing. One group of first-year medical students (MS-1s) who choose surgical specialties for their SER week in December 2020 were invited to participate in this study. No predetermined study enrollment goal was set. With the unpredictable changes in clinical activities available to students during the COVID pandemic, the priority was capturing as many students at one point in time instead of enrolling students over multiple months to reach a specific study size, as the former could add unintended confounding bias to our results. A VSEP alternative was created for MS-1s who were restricted from in-person clinical activities. This was designated Group A. Students who participated in-person, as a result of differences in COVID protocols across our three campuses, were designated Group B. This cohort was thought to represent the usual standard of SER week and served as the control for the purposes of this study.

Design of Virtual Platform. The VSEP was designed with three major components. First, Group A students were asked to watch an educational video with technical skills about sterile scrubbing, gowning, and gloving. Second, students joined surgical teams each day for virtual rounds. Third, an intra-operative video stream was assembled for students to observe surgeries in real time with a mechanism to ask questions.

The primary objective of this study was assessment of surgical knowledge after participation in virtual or in-person surgical SER week. Students in Group A primarily gained this knowledge from the educational video on sterile scrubbing, gowning, and gloving. This video was created in collaboration with institutional experts in surgery and medical education, and operating room (OR) staff educators. The video was distributed electronically to preclinical students via a sharable link to the unlisted video on YouTube™ (https://youtu.be/xy2FwPjgJEA).

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: https://creativecommons.org/licenses/by-nc-nd/4.0/)
Only students in Group A had access to this digital content. Students in Group B acquired surgical knowledge from in-person OR experiences with faculty, residents, and staff on their respective surgical specialties.

Pre- and Post-Survey. An pre- and post-survey was distributed before and after surgical SER week in December 2020. Both surveys included an identical 14-question multiple choice assessment of surgical knowledge that was created by the authors in collaboration with institutional experts. Each multiple choice item was associated with an image demonstrating proper or improper sterile technique. Additional data collected in the surveys were age, gender, previous OR experience and education, and interest in surgical careers before and after SER week. Informed consent for this study was obtained when the pre-survey was distributed to participants. Participants were informed of the study purpose, main outcomes, anticipated benefits, and lack of risks of participation.

The primary outcome of this study was assessment of surgical knowledge, as measured by the 14-question multiple choice assessment in the pre- and post-survey. The secondary outcome was interest level in surgery, as measured in the pre- and post-survey.

Statistical Analysis. Chi-square and two-tailed t-test were performed to analyze categorical and continuous variables, respectively. Paired Wilcoxon Signed Rank Test was used to determine improvement of assessment score from pre- to post-survey in each group. The Mann-Whitney U Test was used to compare pre- and post-assessment scores across groups, and assess differences in magnitude of change in pre- and post-scores between groups. A p value of < 0.05 was determined to be statistically significant. The data were analyzed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp, Armonk, New York). Approval to conduct this study was obtained from our institutional review board and declared exempt from human subject review.

RESULTS

There were 65 MS-1s who participated in surgical SER week in December 2020. There were 14 respondents (28%) of the 50 students who participated in the pilot VSEP, this was designated Group A. There were 7 respondents (46.7%) of the 15 students who participated in-person, this was designated Group B. The overall response rate was 21/65 (32.3%).

Respondent characteristics are displayed in Table 1. There were no significant differences in demographics or previous OR experiences. Exposure to prior OR education was not different between groups, including attendance at surgical skills workshops (p = 0.16) or specific training in sterile scrubbing, gowning, and gloving (p = 0.47). Interest to pursue surgical careers was not statistically significant between groups before (p = 0.40) or after (p = 0.19) participation in SER week.

Score improvement from pre- to post-assessment of surgical knowledge is displayed in Table 2. The assessment scores of all study respondents improved significantly after participation in surgical SER week (95% CI: 11-29; p = 0.001). Additionally, assessment scores of respondents in Group A (95% CI: 7.1-29; p = 0.01) and Group B (95% CI: 20-39; p = 0.04) improved significantly from pre- to post-assessment.

Comparison of pre- and post-assessment of surgical knowledge between Group A and Group B (p = 0.44) or the post-assessment score between Group A and Group B (p = 0.13). There was no statistically significant difference in the magnitude of score improvement between groups (p = 0.59).

Table 1. Characteristics of 21 respondents in surgical SER week in December 2020.

<table>
<thead>
<tr>
<th></th>
<th>Group A n = 14</th>
<th>Group B n = 7</th>
<th>p valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)b</td>
<td></td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>Attended surgical education workshops</td>
<td>6 (43)</td>
<td>6 (86)</td>
<td>0.16</td>
</tr>
<tr>
<td>Number of previous OR experiencesb</td>
<td>3 [0 - 6.25]</td>
<td>3 [0 - 8]</td>
<td>0.79</td>
</tr>
<tr>
<td>Previously scrubbed into a surgery</td>
<td>2 (14)</td>
<td>0</td>
<td>0.28</td>
</tr>
<tr>
<td>Previously educated on sterile scrubbing, gowning, and gloving</td>
<td>6 (43)</td>
<td>3 (43)</td>
<td>0.47</td>
</tr>
<tr>
<td>Yes</td>
<td>6 (43)</td>
<td>3 (43)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3 (21)</td>
<td>3 (43)</td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>5 (36)</td>
<td>1 (14)</td>
<td></td>
</tr>
<tr>
<td>Interest in pursuing surgical careers at the beginning of this surgical experience</td>
<td></td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td>Very interested</td>
<td>8 (57)</td>
<td>6 (86)</td>
<td></td>
</tr>
<tr>
<td>Somewhat interested</td>
<td>5 (36)</td>
<td>1 (14)</td>
<td></td>
</tr>
<tr>
<td>Not interested</td>
<td>1 (7.1)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Interest in pursuing a surgical career at the conclusion of this surgical experience</td>
<td></td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td>Very interested</td>
<td>9 (64)</td>
<td>7 (100)</td>
<td></td>
</tr>
<tr>
<td>Somewhat interested</td>
<td>3 (21)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Not interested</td>
<td>2 (14)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: SER, Scholarship, Enrichment, and Remediation; OR, operating room.

a p < 0.05 statistically significant
b Median [interquartile range]

Table 2. Pre- and post-assessment scores in 14 virtual and 7 in-person SER week respondents in December 2020.

<table>
<thead>
<tr>
<th></th>
<th>Median pre-assessment score (%)</th>
<th>Median post-assessment score (%)</th>
<th>p valuea</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both groups (n = 21)</td>
<td>50 [39 - 61]</td>
<td>71 [64 - 79]</td>
<td>0.001</td>
<td>11 - 29</td>
</tr>
<tr>
<td>Group A (n = 14)</td>
<td>50 [36 - 59]</td>
<td>68 [57 - 73]</td>
<td>0.001</td>
<td>7 - 29</td>
</tr>
<tr>
<td>Group B (n = 7)</td>
<td>57 [43 - 64]</td>
<td>71 [64 - 86]</td>
<td>0.004</td>
<td>20 - 39</td>
</tr>
</tbody>
</table>

Abbreviations: SER, Scholarship, Enrichment, and Remediation.

a p < 0.05 statistically significant
The virtual platform was effective in teaching surgical knowledge, similar to what was found in virtual surgery clerkships.6 The interest in surgery did not change or differ between groups. Therefore, neither experience was superior to the other for the primary and secondary outcomes of this study. The lack of change in interest level was reported by other in-person surgical immersion programs from the literature.8-10 One such reason may be the selection bias introduced by students choosing to participate likely are interested in surgery already. Interestingly, more students who were not interested in surgery participated virtually. This suggested that the easy accessibility and low-pressure nature of virtual platforms may attract wider audiences.

This study did not explore the subjective experience of the students or the perception of mentorship. Mentorship is a key aspect of early clinical experiences. Multiple strategies are available to enhance mentorship in the virtual setting, including allocating time for student and resident “hangouts” for questions and advice.4 Incorporation of a mentorship focus in virtual-based surgical education should be a goal of these modalities and warrants further attention.

This study was limited by a small sample of 21 participants over a short, one-week surgical experience. However, varying local restrictions of the three campuses at the study institution created a pragmatic opportunity to compare a virtual pilot program to an in-person experience. Although it appeared that virtual-based surgical educational experiences may be reliable methods of education of select surgical competencies, further studies are needed to explore this trend with larger groups, and thus, higher statistical power.

This study was the first known to have assessed preclinical students’ ability to learn basic surgical competencies through in-person or virtually based surgical education experiences using an objective measure of competency assessment. While not validated, the objective knowledge assessment in this study was constructed carefully with input from expert surgeons, surgical educators, and medical educators. This new measure was superior to gauging knowledge merely on participant self-reported confidence in their knowledge of this topic. Assessing procedural skills, such as sterile scrubbing, gowning, and gloving techniques, with an assessment based on images of individuals demonstrating proper or improper technique, was preferred over assessing a procedural skill with text alone. This added tremendous value to the visually based assessment tool used in this study. While it would have been beneficial to perform an in-person assessment of these procedural skills instead of a picture-based assessment, that was not possible due to pandemic related infection control measures, such as limited in-person exposures and social distancing in the clinical learning environment.

The generalizability of this study was limited by a small sample of 21 participants over a short period of time. However, the authors intended the study design to be completed with a single cohort of as many participants as possible. This was because of the evolving pandemic and changing student restrictions introduced bias into including future cohorts after December 2020. Despite this, the sample size of this study was sufficient to address the primary and secondary study aims adequately. The overall response rate was low and unequally distributed among groups. The fact that virtual learners were less likely to participate may allude to a lower motivation to acquire technical skills that lack immediate relevance. It was possible that in-person learners felt a stronger desire to be prepared for their performance in the OR. The addition of in-person skills assessment to virtual learning should be explored to improve motivation.

CONCLUSIONS
The use of readily available video-based technology can be applied through programs such as described in this paper to facilitate experiential participation of students in different areas of medicine. A virtual surgical education program to teach scrubbing, gowning, and gloving for students was as effective as an in-person educational program as measured by the study’s knowledge assessment. This study demonstrated a virtual surgical education program can provide a quality educational experience for students without access to in-person programs due to resource limitations caused by financial constraints, limited local expertise, or a pandemic. In addition, these results showed that some clinical content can be taught effectively prior to an in-person educational session, thus allowing in-person education to build more on foundational concepts and focus on application in clinical settings.

REFERENCES


Keywords: medical education, pilot projects, coronavirus, medical students, operating rooms
TREATMENT OF CARDIAC SURGICAL WOUNDS WITH SILVER DRESSINGS

Ashlie A. Elver, B.S.¹, Katy Wirtz, R.N., B.S.N.², Jinxiang Hu, Ph.D.¹,², Emmanuel Daon, M.D.¹,⁴
¹University of Kansas School of Medicine, Kansas City, KS
²University of Kansas Health System, Kansas City, KS
³University of Kansas School of Medicine, Kansas City, KS
⁴Department of Biostatistics and Data Science
⁵Department of Cardiovascular and Thoracic Surgery

ABSTRACT

INTRODUCTION

Mediastinitis is a deadly surgical site infection (SSI) after cardiac surgery. Although rare, mortality is as high as 47%. Best practices for infection prevention to eliminate this deadly complication must be identified. Surgical dressings impregnated with silver have been shown to reduce SSIs in other surgical specialties. The aim of this study was to determine if the routine use of silver surgical dressings is beneficial to prevent mediastinitis after cardiac surgery.

METHODS

A single-center retrospective study was performed on patients who underwent sternotomy from 2016 to 2018 at the University of Kansas Medical Center. Prior to June 2017, all cardiac surgical patients were treated with gauze surgical dressings and designated as Group A. The routine use of silver-impregnated surgical dressings was implemented in June 2017; patients after this change in practice were designated as Group B. Patient characteristics and rates of deep and superficial sternal wound infections (SWI) were compared.

RESULTS

There were 464 patients in Group A and 505 in Group B. There were seven SWIs in Group A (7/464, 1.5%) and five in Group B (5/505, 1%; p = 0.57). Of these, there was one deep SWI per group (p = 0.61) and six superficial SWIs in Group A compared to four in Group B (p = 0.74). Severe COPD was higher in Group A (p = 0.04) and peak glucose was higher in Group B (p = 0.02).

CONCLUSIONS

The analysis conferred no benefit with silver-impregnated surgical dressings to prevent mediastinitis. Choice of gauze surgical dressings may be preferable to reduce cost.

KANS J MED 2021;14:269-272

INTRODUCTION

Surgical site infection (SSI) is a burdensome healthcare-associated infection (HAI) affecting nearly all surgical operations, with potentially devastating outcomes. Specifically in cardiac surgery, patients are susceptible to superficial and deep sternal wound infections (SWI), noted by some to occur in 8.49% of sternotomies. Deep sternal wound infection (DSWI), or mediastinitis, is the most serious SWI and has mortality rates reported as high as 47%. Many efforts were made to optimize infection prevention strategies that became standard of care resulting in a 32% decrease in infection rates from 2008 to 2012. Some of these strategies included skin and nares decontamination, antibiotic prophylaxis, strict perioperative glucose control, and surgical closure techniques (i.e., figure-of-eight, Robicsek). Despite this, the incidence of DSWI remains unacceptably high at 0.5% to 6% and warrants further investigation.

Contamination of the sternal wound by normal skin flora is an important route for infection in the postoperative period. Pathogens can gain access to deeper tissues when dehiscence is present due to the normal breathing mechanics at the destabilized wound. Theoretically, reducing the bioburden around the incision in the postoperative period could interrupt this process and allow time for wound healing. Guidelines for infection prevention focus on the pre- and intra-operative periods; while less clear guidance is given in the postoperative period. In this situation, exogenous routes seeding deep tissue infections after leaving the operating room deserve further consideration.

One idea gaining popularity in postoperative wound care is the use of silver surgical dressings to harness the natural bactericidal and bacteriostatic properties of silver. Silver has long been used successfully in device coating and chronic wound and burn care, and more recently has shown promising results to prevent SSI. The mechanism of silver-impregnated surgical dressings presents an opportunity to decontaminate the incision while the sternum heals. Early reports were compelling, and one study noted zero cases of mediastinitis after replacing gauze with silver dressings. But the reproducibility of these findings was variable, and the pursuit of high-quality data slowed down. However uncertain, the potential to save one patient from suffering this complication instituted a department wide change to use silver dressings in all cardiothoracic surgical patients.

Cost-conscious care is a principle of high-value healthcare. Benefit-cost analysis evaluates the benefits of interventions with their costs, such as postoperative silver dressings at this institution. The immediate cost of silver dressings is $26.82 for each sternal dressing. The potential benefits are mitigating future costs of mediastinitis and reduced morbidity and mortality for patients. The aim of this study was to evaluate this intervention and its ability to achieve the intended goal of reducing postoperative complications at this institution.

METHODS

This single-center study was approved by the institutional review board at the University of Kansas Medical Center. A retrospective cohort study was performed on adults 18-years-old and older who underwent sternotomy for cardiac surgery from June 2016 to June 2018. Patients with active infection at the time of operation and those undergoing open heart transplant were excluded due to higher susceptibility to infections. Left ventricular assist device placements were excluded because sternal incisions are not uniformly performed in these cases. Sternotomy incisions were treated with gauze dressings (GD) in all patients before June 2017; this was Group A and served as the control group. Sternotomy incisions after June 2017 were treated with silver-impregnated dressings (SD) after a department wide change in practice was implemented; this was Group B and served as the treatment group. All operations were performed by board-certified cardiothoracic surgeons and patients received the same perioperative infection prevention protocol aligned with institutional standards. GD used in Group A were replaced on postoperative day two and removed on postoperative day three or until wound was dry. CarraKlenz™ wound cleanser (Medline

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: https://creativecommons.org/licenses/by-nc-nd/4.0/)
Industries, Northfield Illinois) was used during dressing changes. Commercially available SD used in Group B were removed on postoperative day seven as recommended by the manufacturer (Argentum Medical, Geneva Illinois).

Sternal wound infections were diagnosed by surgeons according to the criteria from the U.S. Centers for Disease Control and Prevention. The superficial sternal wound infection (SSWI) involved tissue above the fascial plane with at least one of the following: 1) purulent drainage; 2) organisms isolated from the wound; 3) tenderness, swelling, or heat present and wound opened by surgeon; or 4) diagnosis by surgeon. DSWI or mediastinitis, involved tissue below the fascial plane (with or without infected retrosternal space) and met at least one of the following: 1) purulent drainage; 2) wound dehiscence or opened by surgeon; or 4) diagnosis by surgeon. SWI was diagnosed by surgeons according to the criteria from the U.S. Centers for Disease Control and Prevention.

Table 1. Comparison of baseline characteristics between patients who received gauze surgical dressings before June 2017, and patients who received silver-impregnated surgical dressings after June 2017.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Gauze dressings Group A, N = 464</th>
<th>Silver dressings Group B, N = 505</th>
<th>p valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>Mean (± Standard Deviation)</td>
<td>Mean (± Standard Deviation)</td>
<td></td>
</tr>
<tr>
<td>Sex, female</td>
<td>128 (27.6)</td>
<td>160 (31.7)</td>
<td>0.16</td>
</tr>
<tr>
<td>Current smoker</td>
<td>260 (56)</td>
<td>291 (57.6)</td>
<td>0.62</td>
</tr>
<tr>
<td>Severe COPD</td>
<td>39 (8.4)</td>
<td>26 (5.1)</td>
<td>0.04a</td>
</tr>
<tr>
<td>Diabetes</td>
<td>177 (38.1)</td>
<td>170 (33.7)</td>
<td>0.15</td>
</tr>
<tr>
<td>Hypertension</td>
<td>386 (83.2)</td>
<td>410 (81.2)</td>
<td>0.42</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>361 (77.8)</td>
<td>400 (78.2)</td>
<td>0.59</td>
</tr>
<tr>
<td>Dialysis</td>
<td>17 (3.7)</td>
<td>13 (2.6)</td>
<td>0.33</td>
</tr>
<tr>
<td>Emergent operation</td>
<td>35 (7.5)</td>
<td>44 (8.7)</td>
<td>0.51</td>
</tr>
<tr>
<td>Valve procedure</td>
<td>190 (41)</td>
<td>193 (38.2)</td>
<td>0.38</td>
</tr>
<tr>
<td>Blood products</td>
<td>186 (40)</td>
<td>189 (37.4)</td>
<td>0.40</td>
</tr>
<tr>
<td>Peak glucose, mg/dL</td>
<td>179.1 (41.3)</td>
<td>186.9 (62.1)</td>
<td>0.02</td>
</tr>
<tr>
<td>Cardiac bypass time, min</td>
<td>106.5 (46.6)</td>
<td>109.1 (53.2)</td>
<td>0.41</td>
</tr>
<tr>
<td>Peak creatinine, mg/dL</td>
<td>1.6 (1.6)</td>
<td>1.5 (1.5)</td>
<td>0.45</td>
</tr>
<tr>
<td>Ventilation time, hour</td>
<td>17.4 (46.9)</td>
<td>206.6 (48.6)</td>
<td>0.30</td>
</tr>
<tr>
<td>Length of stay, days</td>
<td>8.1 (5.9)</td>
<td>7.6 (5.3)</td>
<td>0.19</td>
</tr>
</tbody>
</table>

SWI developed in seven patients in Group A (7/464, 1.5%) and in five patients in Group B (5/505, 1%; p = 0.57). Of these, six wounds in Group A and four wounds in Group B were classified as superficial (p = 0.74). One wound in both Group A and Group B was classified as deep (p = 0.61; Table 2).

Table 2. Incidence of sternal wound infections (SWI) in patients who received gauze surgical dressings before June 2017, and patients who received silver-impregnated surgical dressings after June 2017.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Gauze dressings Group A, N = 464</th>
<th>Silver dressings Group B, N = 505</th>
<th>p valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total SWI</td>
<td>7 (1.5)</td>
<td>5 (1)</td>
<td>0.57</td>
</tr>
<tr>
<td>Deep</td>
<td>1 (0.4)</td>
<td>1 (0.2)</td>
<td>0.61</td>
</tr>
<tr>
<td>Superficial</td>
<td>6 (1.3)</td>
<td>4 (0.8)</td>
<td>0.74</td>
</tr>
</tbody>
</table>

*p < 0.05, statistically significant
DISCUSSION

The interest in silver dressings in cardiac surgery began when Huckfeldt reported a reduction in SWIs with SD down to zero compared to traditional gauze in adult cardiac patients. Adding to the interest, Totaro demonstrated the addition of SD in patients with mediastinitis refractory to wound vacuum-assisted closure caused wound cultures to turn negative. This prompted further investigation. In 2016, a randomized control trial was conducted in pediatric patients undergoing sternotomy for cardiac surgery to compare silver and gauze dressings. No infections occurred in either group and the authors concluded silver and gauze were equally effective. More recently, Raman also reported no difference between silver and gauze in a single center retrospective study of adult cardiac patients. The findings reported in the literature were variable, making the clinical significance of SD unclear.

Our study did not indicate benefit with the use of SD to prevent mediastinitis or even superficial sternal infections. The incidence of infection in our study population was similar to what was reported in the literature, and like Raman, we were not able to reproduce the promising results reported by Huckfeldt in 2004. This may suggest institutional-specific bias present in Huckfeldt’s study. However, without randomized controlled trials in the adult cardiac population, the benefit remains unclear.

Our study results could have been influenced by the differences between study groups noted at baseline. Patients with COPD are known to be at increased risk of developing SWI. We had significantly more patients with severe COPD in Group A, which could have exacerbated the observed benefit in Group B. Strict glycemic control during the perioperative period is known to reduce the risk of developing SWI. We noted a significantly higher peak glucose level in Group B compared to the control, which could have underestimated benefit of SD. However, the peak glucose level did not exceed the level associated with elevated risk (< 200 mg/dL). Thus, we do not believe either of these differences would have changed the results in a meaningful way.

Our study was limited by its retrospective nature and lack of randomization. Over the duration of the study, it was possible that small changes in practice could have introduced confounders. The overall incidence of mediastinitis was low in both study groups making it difficult to draw conclusions in this retrospective study. This was a single-center study and results may not be generalizable, although incidence was likely that of the general population.

CONCLUSIONS

A retrospective analysis assessed the use of silver-impregnated surgical dressings compared to gauze surgical dressing in hopes of preventing mediastinitis. The analysis showed no benefit with the use of silver-impregnated surgical dressings. Based on these results, treatment of the sternal incision with gauze may be preferred to reduce cost. Further investigation of optimal wound care during the postoperative period is needed in the effort to eliminate this costly and deadly complication.


Keywords: standard of care, mediastinitis, surgical wound infection, cardiac surgical procedures, postoperative period
Trends in Internet Safety Education by Healthcare Providers

Gary King, M.D., Thuy Bui, MPH, Julian Dedeaux, Ph.D., Carolyn R. Ahlers-Schmidt, Ph.D., Kari Harris, M.D.
University of Kansas School of Medicine-Wichita, Wichita, KS
Department of Pediatrics

ABSTRACT

Introduction. The purpose of this study was to explore healthcare provider training, comfort, and provision of internet safety counseling. Prior research has demonstrated increased parental concern regarding the pervasive access to the internet by children, including the potential impacts of risky internet behavior and adverse media exposure.

Methods. A self-reported survey was provided to a convenience sample of 31 healthcare providers during a mental health training seminar. Responses were analyzed using descriptive statistics.

Results. Internet safety counseling, especially regarding risky online behavior, was not a focal point of provider–patient interaction in the sample population. This finding was reinforced with more than half of the respondents indicating that they infrequently or never provide internet safety counseling (n = 17, 56%). While research has placed an emphasis on the importance of discussing the risks of exposure to violence, drugs, and sexually explicit media online, this study found that the topics most often discussed were setting time limits (77%), limiting access to media devices (67%), and supervising internet use (50%). This may be due in part to the fact that most respondents (n = 17, 57%) reported never receiving training on internet safety counseling.

Conclusions. Overall, significant deficits were identified in internet safety counseling training for professionals and provision of education for families. These finding were inconsistent with the American Academy of Pediatrics recommendations around media use counseling and a point of urgent concern given the increasing time spent on media devices, particularly during the COVID pandemic.


INTRODUCTION

Internet access is nearly ubiquitous to American youth with access becoming virtually unlimited through mobile devices. The COVID pandemic has encouraged social distancing, and as a result, children’s access to the internet is becoming increasingly pervasive. As of 2015, 92% of adolescents go online daily.1,2 Approximately 75% of adolescents own a smart phone with 25% reporting they are online “almost constantly”. In addition, 76% of adolescents maintain at least one social media profile. This prevalence is not only relevant in adolescent youth. Nearly all homes with small children (98%) own a mobile device, an increase from 75% in 2013 and 52% in 2011.3 Further, 50% of five-year-old children go online daily and nearly 75% of four-year-old children have their own mobile device.4,5 Although data were lacking on media use during the COVID pandemic, these prior statistics supported the American Academy of Child and Adolescent Psychiatry’s (AACAP) concern that quarantined youth have unprecedented access to potentially harmful media content and that risk needs to be mitigated.6

Parents were concerned about potential adverse impacts of the internet on their children, most notably the impact of exposure to violent and sexual content.7 Parental concerns were placed appropriately given research has shown poor outcomes of child exposure to risky behaviors. Specifically, children who consume media rich in alcohol advertisements were more likely to initiate use.8-10 The same influential effect has been shown for sexually explicit media, including pornography.11,12 These risks can be applied to other online safety concerns such as cyberbullying and increased risk of suicidal ideation.13 To mitigate these risks, trusted adults need to engage in conversation with youth emphasizing media safety.14,15 Taken together, parental mediation of media use has been shown to decrease risky behaviors.16,17 More than ever, parents should be intentional about helping youth develop positive media habits. This can be done by modeling healthy behaviors, setting limits, and co-viewing.18

In addition to parents, healthcare providers play an important role in delivering internet safety education to youth.19,20,21 Parents trust healthcare providers to provide appropriate recommendations for the health and well-being of their children. The American Academy of Pediatrics (AAP) has released a policy statement, “Media Use in School-Aged Children and Adolescents”, outlining best practices for parents and pediatric healthcare providers.19 This statement included information on the AAP’s Family Media Plan, which can be an asset to parents during quarantine as well as non-quarantine times. Healthcare providers have a unique opportunity to support parents in providing resources and anticipatory guidance on internet safety. Despite this policy statement, only one in five parents were aware of the AAP’s recommendation, indicating a gap in communication between parents and pediatric healthcare providers. Although pediatricians have been tasked with educating parents on this topic, to what extent this happens remained unclear.

Three study objectives were investigated:
1. To explore the extent and type of counseling provided by healthcare providers on internet safety.
2. To explore the type and extent of training that healthcare providers have received on internet safety counseling. Prior to use, the survey was reviewed by an expert panel for readability.
3. To determine if internet safety counseling differs between provider demographic groups.

METHODS

Prior to engaging in the study, Institutional Review Board approval was obtained through University of Kansas School of Medicine-Wichita Human Subjects Committee. An anonymous, self-reported, 14-item survey was developed to capture information related to healthcare provider demographics, training, and experience with internet safety counseling. Prior to use, the survey was reviewed by an expert panel for readability.

Healthcare providers attending a local mental health training seminar in late 2018 were asked to participate in this study. Participation was voluntary, informed consent was obtained, and no incentives were
provided. Participants included community and academic physicians, resident physicians, and physician extenders (i.e., nurse practitioners, physician assistants) who provide primary care to children. Non-practicing healthcare providers and providers who do not serve children were excluded from the study.

Data were entered into the encrypted and HIPAA compliant REDCap® online data capture application. Descriptive statistics were calculated from the database.

**RESULTS**

Of 31 potential participants, a total of 30 (n = 30, 97%) completed the survey. Of the 30 respondents, most were pediatricians (n = 24, 80%), female (n = 21, 70%), and had been in practice for an average of 10.5 years (SD = 9.8; Table 1). The majority of providers characterized their practice as urban (n = 20, 67%), and cared for children in all age ranges (≥ 80%). The mean provider’s age was 42.3 years (SD = 99). Most providers reported having children of their own, with only 17% (n = 5) reporting they had no children. No statistically significant correlations were found between provider demographics and provider delivery of internet safety counseling.

Most providers (n = 17, 57%) reported having never received training on internet safety counseling. Of those who had received training (n = 13; 43%), independent study and informal training were most common, followed by in-person lectures, and online courses (Table 2). Few reported the adequacy of their training as good and none as very good. Regardless of training, few respondents (n = 8; 27%) felt comfortable or very comfortable with their knowledge on internet safety. An equal amount (n = 8; 27%) of providers reported that they felt uncomfortable with their level of knowledge.

The majority (n = 17; 57%) of respondents reported providing internet safety counseling during well child and adolescent visits infrequently or never. When counseling was provided, only 3% (n = 1) waited to initiate counseling until the patients started high school. Topics discussed most often by providers included setting time limits (n = 23; 77%), limiting access to media devices (n = 20; 67%), and supervising internet use (n = 15; 50%; Figure 1). Topics involving avoidance of risky internet behavior were discussed routinely by 37% (n = 11) of respondents and risks of adverse internet exposure were discussed only by 27% (n = 8).

Ninety percent of respondents (n = 27) indicated time constraint as a barrier to providing internet safety counseling, followed by 47% (n = 14) having limited knowledge on the topic, 40% (n = 12) forgetting to provide counseling, and 30% (n = 9) having a lack of resources.

**DISCUSSION**

The results of this study demonstrated provider training, comfort, and delivery of internet safety counseling were less than optimal with over half of providers never or infrequently providing counseling. Only 20% of providers reported counseling most of the time. Parents have reported internet safety as a top concern, specifically regarding exposure to sexual and violent content, or risky internet behaviors. While providers in this study reported discussing risky internet behaviors, the rates of these discussions were at lower frequency than other topics, such as setting time limits. This result illustrated a gap in care, as media topics that parents were most concerned about were being discussed infrequently by their child’s healthcare provider.

The results of this study demonstrated provider training, comfort, and delivery of internet safety counseling were less than optimal with over half of providers never or infrequently providing counseling. Only 20% of providers reported counseling most of the time. Parents have reported internet safety as a top concern, specifically regarding exposure to sexual and violent content, or risky internet behaviors. While providers in this study reported discussing risky internet behaviors, the rates of these discussions were at lower frequency than other topics, such as setting time limits. This result illustrated a gap in care, as media topics that parents were most concerned about were being discussed infrequently by their child’s healthcare provider.

The optimal time for introduction of internet safety to children is not known. Nevertheless, many key stakeholders, including parents, adolescents, teachers, and healthcare providers agreed that internet safety counseling should be started at a young age, between six to eight years. However, given the increasing prevalence of very young children accessing the internet regularly, it would be prudent for internet safety education to be introduced with the onset of internet use. This study found only 13% of providers initiated conversations about internet safety with the parents of very young children, and 33% start during elementary school.

The AAP has recognized that pediatricians have an important role in providing guidance to patients and families regarding internet safety in their policy statement “Media Use in School-Aged Children and Adolescents”. In this statement, the AAP emphasized the development and use of a personalized Family Media Use Plan that considers the child’s age, health, temperament, developmental stage, and individual needs. The use of this tool has been encouraged during the COVID pandemic. This study found that the primary barriers to providing internet safety counseling center around time constraints and lack of provider knowledge on the topic. Increasing awareness of the important role providers have in mitigating risks associated with unsafe internet
use may reduce these barriers. Providers should be offered resources and education on adverse media exposure, including ways to initiate discussions with families. Some authors suggested expanding the HEADS (Home; Education/Employment; Activities; Drugs/Depression/Diet; Sex/Suicide/Safety) psychosocial history-taking pneumonic as a useful tool to include elements of media use, thereby assisting providers to engage patients and families on discussions of internet safety.21,22

Table 2. Physician training and practice on internet safety counseling.

<table>
<thead>
<tr>
<th>Training format</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent study</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Informal setting</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>In-person lecture</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Online training</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>None</td>
<td>17</td>
<td>57</td>
</tr>
</tbody>
</table>

Adequacy of training

<table>
<thead>
<tr>
<th>Adequacy of training</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Good</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Adequate</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Very poor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Did not receive training</td>
<td>13</td>
<td>43</td>
</tr>
<tr>
<td>Missing</td>
<td>4</td>
<td>13</td>
</tr>
</tbody>
</table>

Comfort with knowledge

<table>
<thead>
<tr>
<th>Comfort with knowledge</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very comfortable</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Comfortable</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Neutral</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>Uncomfortable</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>Very uncomfortable</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Frequency of practice

<table>
<thead>
<tr>
<th>Frequency of practice</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Most of the time</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Sometimes</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Infrequently</td>
<td>13</td>
<td>43</td>
</tr>
<tr>
<td>Never</td>
<td>4</td>
<td>13</td>
</tr>
</tbody>
</table>

Age of initiation of internet safety counseling

<table>
<thead>
<tr>
<th>Age of initiation</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Middle school</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>Elementary school</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Pre-school</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Infant/toddler</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Do not provide</td>
<td>6</td>
<td>20</td>
</tr>
</tbody>
</table>

The AAP’s policy statement has provided much of the educational background needed for providers to offer internet safety counseling, although some providers would benefit from more structured education modalities.18 In short, the AAP recommended that families include the following components in their Family Media Use Plan in addition to traditional media recommendations: 1) how media is accessed, 2) where it is accessed, 3) when it is accessed, 4) how long the child is spending on media, 5) who they are interacting with both on- and off-line, 6) what is appropriate to share online, 7) what the child is accessing, 8) risks and avoidance of inappropriate content, 9) consequences of accessing inappropriate content, 10) how to respond to online attacks, and 11) parental role modeling of healthy internet use.

Limitations. This study had several limitations. First, the small sample size may limit the generalizability of these results to the larger pediatric healthcare community, however, sampled providers came from various regions of the state representing diversity in healthcare practices. Second, the study survey did not delineate providers’ levels of training (i.e., attending physician, resident physician, or physician extender) which may have affected training experience. In addition, age and level of training also may impact providers’ personal level of comfort with the internet and technology in general which may in turn impact their comfort providing internet safety education to patients. Third, the survey was conducted during a voluntary mental health training event which may introduce a sample bias of respondents interested in mental health, including internet safety. Finally, the COVID pandemic emerged during compilation of this manuscript. Although data were collected prior to the pandemic, it was perhaps more valuable given the increased access youth have during this time and supported that internet safety counseling should be a priority. Despite these limitations, provider training, comfort, and delivery of internet safety counseling were insufficient to meet current recommendations.

Future Research. This study examined the trends in internet safety counseling by a small cohort of healthcare providers, practicing in the midwestern part of the United States. The results of the study found that provider training, comfort, and provision of internet safety counseling below optimum. To determine if these trends were reflective of the greater population of healthcare providers caring for children, future studies designed to target a larger, multi-regional study population may qualify the seriousness of this problem better. With a larger sample, future studies may consider exploring the influence of provider demographic characteristics on training and practice of internet safety counseling.
CONCLUSIONS

Healthcare providers have a unique opportunity to support parents and children in providing resources and anticipatory guidance on internet safety. Nonetheless, significant deficits were identified in provider training, comfort, and provision of internet safety counseling for families. Further studies need to be performed to evaluate the significance of these findings on a wider scale. Providers need to be cognizant of their role in mitigating risk associated with unsafe media exposure by offering internet safety counseling to patients and their families.

ACKNOWLEDGEMENTS

We would like to thank the University of Kansas School of Medicine-Wichita Department of Pediatrics and The REACH Institute for allowing us to survey the attendees of their mental health seminar. We also acknowledge Dr. Julian Dedeaux for his assistance in bringing this manuscript to completion.

REFERENCES

A Disclosure About Death Disclosure: Variability in Circulatory Death Determination

Christopher P. Robinson, D.O., M.S.,1 Suzanne L. Hunt, M.S.,2 Gary S. Gronseth, M.D.,2,3 Sara Hocker, M.D.,4 Eelco F.M. Wijdicks, M.D., Ph.D.,4 Alejandro A. Rabinstein, M.D.,4 Sherri A. Braksick, M.D.1,4
1University of Florida, Gainesville, FL
2Department of Neurology
University of Kansas Medical Center, Kansas City, KS
3Department of Biostatistics and Data Science
4Department of Neurology
Mayo Clinic, Rochester MN
Department of Neurology

ABSTRACT

Introduction. Circulatory-respiratory death declaration is a common duty of physicians, but little is known about the amount of education and physician practice patterns in completing this examination.

Methods. An online survey of physicians was conducted evaluating the rate of formal training and specific examination techniques used in the pronouncement of circulatory-respiratory death. Data, including the level of practice, training received in a formal death declaration, and examination components, were collected.

Results. Respondents were attending physicians (52.4%), residents (30.2%), fellows (10.7%), and interns (6.7%). Most respondents indicated they had received no formal training in death pronouncement; however, most reported self-perceived competence. When comparing examination components used by the study’s cohort, 95 different examination combinations were used for death pronouncement.

Conclusions. Formal training in death pronouncement was uncommon and clinical practice varied. Implementation of formal training and standardization of the examination are necessary to improve physician competence and reliability in death declarations.


INTRODUCTION

Clinicians working in hospitals unfortunately are faced with the declaration of death following circulatory-respiratory arrest. Determination of death following circulatory-respiratory arrest has been practiced for centuries, while formal criteria for the determination of death only recently has been developed. The Uniform Determination of Death Act (UDDA), written in 1981, simply defines death as “total failure of the circulatory-respiratory system or irreversible loss of all brain functions.” Currently, only one guideline for the declaration of circulatory-respiratory death exists, and it defines minimal acceptable standards for declaration: cardiopulmonary auscultation, central pulse assessment, pupillary reaction, and responsiveness to stimulation (Table 1). Recently, additional evidence-based declaration standards have been proposed with the introduction of donation after circulatory death (DCD).

Table 1. Recommended minimal acceptable standards for circulatory-respiratory death assessment.

<table>
<thead>
<tr>
<th>Minimal acceptable clinical standards</th>
<th>Additional testing for consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Absence of breath sounds</td>
<td>1. Loss of pulsatile arterial blood pressure through arterial line monitoring</td>
</tr>
<tr>
<td>2. Absence of heart sounds</td>
<td>2. Absence of anterograde aortic flow on echocardiography</td>
</tr>
<tr>
<td>3. Absence of spontaneous respirations and visible chest wall movement</td>
<td>3. Isoelectric electroencephalogram</td>
</tr>
<tr>
<td>4. Absence of palpable pulse</td>
<td>4. Absence of pulse by Doppler</td>
</tr>
<tr>
<td>5. Loss of pulsatile arterial blood pressure through non-invasive measures</td>
<td></td>
</tr>
<tr>
<td>6. Coma with fixed and dilated pupils</td>
<td></td>
</tr>
</tbody>
</table>

Autoresuscitation, defined as the spontaneous return of cardiovascular function following death, is an important consideration in death pronouncement. Autoresuscitation can occur both following cardiopulmonary resuscitation (CPR) and in the absence of any resuscitation efforts, but has not been reported to occur beyond 10 minutes after cardiopulmonary arrest. The potential for this phenomenon would suggest that an observation period following apparent circulatory-respiratory arrest prior to a formal declaration of death is reasonable.

Death declarations in academic medical centers are often the responsibility of physicians-in-training, and the degree of formal training these physicians receive is unknown. Additionally, given the paucity of recommendations in a death pronouncement, the exact examination performed to determine death also is unclear. This lack of training and discomfort in completing the examination is illustrated in a recent editorial by a family medicine intern who describes his first encounter in a death pronouncement.

We conducted a survey of physicians to determine the rates of formal training in death declaration and which specific examination techniques are used by physicians to declare a patient deceased. With this information, we aimed to develop an algorithm, based on existing literature and the definition of circulatory-respiratory death, to aid examiners in pronouncing a patient deceased.

METHODS

An electronic survey was developed using REDCap®, an online assessment tool and data repository. Data were collected and stored on the University of Kansas Medical Center site, available through grant support from the Clinical and Translational Science Awards program. The institutional review boards at each institution approved this study.

Participants. Physicians from three academic, tertiary care hospitals (two affiliated with the University of Kansas, one private) were invited via email to participate. Informed consent was waived as accessing the electronic survey was considered implied consent.

Procedure. Potential participants were identified by sending an introductory email with the common survey link to all individual department or division chairs and administrative assistants for distribution through their department email listserv to all attending physicians, fellows, residents, and interns. Participants were asked if and when they received training in a death pronouncement, their perceived competence in death pronouncement, and which examination components they assessed as part of the examination. Specific information requested through this survey is listed in Table 2.

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: https://creativecommons.org/licenses/by-nc-nd/4.0/)
Table 2. Survey tool.

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your current level of practice?</td>
<td>• Intern • Resident • Fellow • Staff physician</td>
</tr>
<tr>
<td>What is your medical specialty?</td>
<td>• [fill in]</td>
</tr>
<tr>
<td>What medical facility are you affiliated with?</td>
<td>• Institution A • Institution B • Institution C</td>
</tr>
<tr>
<td>Have you ever received formal training in completing a death examination? (Not brain death)</td>
<td>• Yes • No</td>
</tr>
<tr>
<td>When did you receive this training?</td>
<td>• Medical school • Internship • Residency • Fellowship • As staff</td>
</tr>
<tr>
<td>Do you feel competent in the pronunciation of death (excluding brain death)?</td>
<td>• Yes • No</td>
</tr>
<tr>
<td>What components do you assess when completing a death examination? (choose all that apply) (Not brain death)</td>
<td>• Responsiveness to voice • Spontaneous respirations • Heart sounds • Peripheral pulse • Central pulse (i.e., carotid) • Pupillary light response • Corneal response • Oculocephalic response (Doll's Eyes) • Oculovestibular response (cold calorics) • Gag • Cough • Motor response to pain • Peripheral reflexes (i.e., patellar, biceps) • Other _________</td>
</tr>
<tr>
<td>Do you announce a time of death while in the patient's room?</td>
<td>• Yes • No</td>
</tr>
<tr>
<td>Have you ever pronounced a patient deceased who had not yet passed away?</td>
<td>• Yes • No</td>
</tr>
</tbody>
</table>

Statistical Analysis. A primary interest of the pilot survey was to summarize the clinical practice of determining death. The components assessed by physicians when determining death became the focus of the analysis. Five respondents did not select any exam components and completed less than 25% of the survey, and were not included in the analysis.

Neurolgic responsiveness was defined as assessing any one of the following clinical examination components: responsiveness to voice, pupillary light response, corneal response, oculocephalic response, oculovestibular response, cough, gag, motor response to pain, or peripheral reflexes. Chi-square tests were used to compare trained and untrained respondents using particular components when determining death. A significance level of 0.05 was used and no corrections for multiple testing were made. The analysis was completed with SAS software, version 9.4 of the SAS System for Windows.

RESULTS

Overall distribution of the survey included 42 separate division or departmental chairs across the three study institutions, with physicians from 23 different departments/divisions responding, for an overall response rate of 54.8%. The specific number of survey recipients is unknown as individual distribution of the survey was not possible. Five respondents did not respond to any of the physical examination questions and were excluded from the final analysis.

Of the 225 respondents, most were attending physicians (n = 118, 52.4%), followed by residents (n = 68, 30.2%), fellows (n = 23, 10.7%), and interns (n = 15, 6.7%; Figure 1). The departments of neurology and anesthesiology were represented most highly in this study.
Most physicians (62.7%) indicated they had received no formal training in performing a death pronouncement. For those who had formal education, training most often occurred during residency (45.2%) and internship (33.3%). Most respondents (78.7%) reported self-perceived competence in the determination of death. When separated by level of training, only 67% of interns (1 of 15 respondents) reported formal training in death declaration with 26% reporting self-competency (4 of 15 respondents). Conversely, 33% of residents and fellows and 36% of attending physicians reported formal training, while 82% and 77% self-reported competency, respectively.

The frequencies of examination techniques used by the study’s cohort in the determination of death are listed in Table 3. Most respondents reported assessing breath sounds (97%), listening for heart sounds (90%), and checking central pulses (79%); while the majority of those surveyed reported some assessment of neurological responsiveness, with pupillary response being evaluated most often. Neurologists or neurosurgeons evaluated at least one component of the neurologic examination 85.6% of the time, while non-neurology specialties reported assessing at least one component of the neurologic examination 87.5% of the time. Somewhat surprisingly, there was no statistical difference in the frequency of a single physical examination component between those who were trained in death pronouncement and those who were not (Table 3), as indicated by the overlapping confidence intervals among the two groups. However, 95 different examination combinations were used to declare a patient deceased by the survey cohort.

Large variation was seen across respondents in the reported use of a neurological examination in their assessment. Examination techniques included assessment of pupillary responses, corneal responses, gag reflex, oculocephalic reflex, cough reflex, and peripheral neurological reflexes. Forty-eight percent of all respondents reported the assessment of central responses to painful stimuli and formal assessment of coma.

When comparing the examination performed based on level of training, 100% of interns reported checking for breath sounds, while only 66.7% assessed heart sounds, and 26.7% checked peripheral pulses. Comparatively, greater than 90% of all other physician groups reported using all three of these examination components.

A substantial majority of respondents (75.2%) announced a time of death while in the patient’s room. Two individuals (0.9%) reported incorrectly pronouncing a patient as deceased, but the circumstances of these pronouncements were otherwise unknown. Of interest, 11% of all physicians reported using means other than a clinical examination in death determination, such as ultrasound to confirm cardiac standstill (3.1%), evaluation using cardiac telemetry (3.1%), and absence of vital signs for greater than 15 minutes (0.4%).

**DISCUSSION**

Performing a complete and accurate examination for death determination is a necessary skill that should be learned early in medical training. Yet, the survey results suggested that formal training often was lacking. Physicians self-reported a variable degree of competence, with interns reporting less competence than more experienced physicians.

In the traditional hierarchy of academic medical education, death declaration has primarily been the responsibility of physicians-in-training at academic medical centers in the U.S. However, only one of the interns in this study reported receiving formal training in death declaration, and a substantial minority felt competent. Additionally, only one-third of all responding physicians reported formal training in death declaration throughout their medical career. Despite such a large gap in training, over two-thirds of respondents reported self-perceived competency when pronouncing death. Over time, competence appears to increase, which is likely a consequence of accumulated experience.

When performing a pronunciation, physicians reported performing many different examination combinations. This result emphasized the lack of standardization in clinical practice, and this inconsistency may indicate an insufficient understanding of the definition of circulatory-respiratory death, further complicating the development of a formal training program for new physicians.

Most of the respondents reported completing an assessment of breath sounds, heart sounds, and central pulses, while about half of those surveyed reported an assessment of the nervous system (i.e., pupillary response, corneal response). Interns were less likely to perform cardiac auscultation as compared to residents, fellows, or attending physicians.

Published acceptable minimum standards for circulatory death recommended assessment of responsiveness to pain and pupillary light reaction in addition to cardio-pulmonary auscultation and palpation of central pulses. Only two-thirds of the cohort reported compliance with the neurological standard in this guideline. In contrast, the
UDDA defined death as either total failure of the circulatory-respiratory system or irreversible loss of all brain functions. One could argue that the assessment of pain after identifying the absence of cardiac and pulmonary function does not make physiologic sense. Additionally, it is fully possible for a patient to have unreactive pupils (due to an upper brainstem, cranial nerve III lesions, or post-surgical pupillary abnormalities) but not be deceased. These latter points may make the neurologic assessment in the setting of cardiopulmonary failure unnecessary to determine death.

Of note, it is important to emphasize that the definition of clinical death may not be documented formally or defined in the same manner in countries outside of the U.S., and these findings cannot be extrapolated to suggest international practice is similar, as no hospitals outside of the U.S. were surveyed.

In the U.S., death may be declared within a protocol for DCD in patients who are not brain dead but have a brain injury that they cannot survive. Discussion related to declaration in DCD was out of the scope of this paper; however, it is important to note that guidelines related to this process include a defined waiting period prior to the death pronouncement. Such a waiting period was developed to account for the possibility of autoresuscitation, which is a rare but important phenomenon that should be considered during formal death declaration. In patients who have undergone CPR, autoresuscitation times have ranged from 30 seconds to 10 minutes. In patients who did not receive CPR or underwent withdrawal of life sustaining therapies, times have ranged from seconds to three minutes. These data suggested that a defined waiting period prior to death declaration in all patients is reasonable. In this study, two of the respondents indicated that they incorrectly had pronounced a patient deceased. The details behind such situations were not disclosed; however, it is plausible that autoresuscitation or simply an incomplete assessment of circulatory-respiratory function may have played a role.

Of interest, three-quarters of the respondents in this survey announced time of death while in the patient’s room. Though time of death is legally necessary for documentation, no formal recommendation regarding an audible pronouncement exists. Calling out the time of death while in a patient’s room may lead to unease amongst staff and undue psychological stress on the patient’s family. We do not believe that stating the time of death aloud is necessary to complete a formal death pronouncement. On the same token, physicians cannot leave any uncertainty when performing a death pronouncement, and audibly indicating that the patient has died is necessary to prevent confusion by family members that are present for the clinical examination.

Study results indicated wide variability among physicians from multiple specialties in the degree of formal training on death determination and the examination performed. To help fill this gap, we propose an algorithm for circulatory-respiratory death declaration, based on the definition provided in the UDDA, existing evidence, and expert opinion, which is detailed in Figure 2. The authors are hopeful that providing a standardized method for death pronouncement, a clear mechanism for training can be developed, improving physician confidence and competence in this examination.

**Figure 2. Proposed algorithm for circulatory-respiratory death declaration.**

This survey-based study had limitations. The study design was dependent on individual department chairs, division heads, and administrators to distribute the email to the physician members of their department. Consequently, the responses are not from a random sample. As physicians-in-training and practicing physicians in the U.S. may have received some or all of their training outside of the U.S., information regarding differences in training based on location may be lacking, as this was not collected as a part of this survey. A low response rate impaired the ability to evaluate the current clinical practice completely across the study sites. There was the possibility that respondents misread components of the survey and inaccurately answered the questions as a result. Results were limited in the data analysis because not all providers answered every question included in the survey.

**CONCLUSIONS**

Formal training in death declaration often was missing and clinical practice varied among physicians in academic medical centers. Implementation of formal training in medical school or during internship is necessary to fill this important gap, eliminate discrepancies in practice, and guarantee the reliability of the death declaration.
REFERENCES


Keywords: determination of death, practice guidelines as topic, medical education, cardiopulmonary arrest, questionnaires and surveys
Emergency Action Planning in School-Based Athletics: A Systematic Review

Riley Hedberg, B.S.1, William Messamore, M.D., Ph.D., Tanner Poppe, B.S.1, Armin Tarakemeh, B.A.1, Rick Burgholder, M.S., ATC2, Trent Carter, M.S., ATC3, Bryan Vopat, M.D.1, Jean-Philippe Darche, M.D.1

1University of Kansas Medical Center, Kansas City, KS
Department of Orthopedic Surgery, Orthopedic Sports Medicine
2Kansas City Chiefs, Kansas City, MO
3University of Kansas Health System, Lawrence, KS

Received March 25, 2021; Accepted for publication July 30, 2021; Published online Nov. 5, 2021 https://doi.org/10.17161/kjm.vol14.15299

ABSTRACT

Introduction. A significant number of preventable catastrophic injuries occur in secondary school athletics. Compliance to Emergency Action Plan (EAP) recommendations is not well documented. The purpose of this systematic review was to identify compliance to EAP recommendations, access to an athletic trainer (AT) and automated external defibrillator (AED), and current legislative mandates in school-based athletics.

Methods. Electronic databases were searched to identify articles that met criteria for inclusion. Studies in English that focused on adoption, implementation, or compliance with EAPs or other national guidelines pertaining to athlete health were eligible for inclusion. Quality and validity were examined in each article and data were grouped based on outcome measures.

Results. Of 12,906 studies, 21 met the criteria for inclusion and full text review. Nine studies demonstrated EAP adoption rates ranging from 55% - 100%. Five studies found that EAPs were rehearsed and reviewed annually in 18.2% - 91.6% of schools that have an EAP. At total of 99% of schools were compliant with all 12 National Athletic Trainers Association (NATA) EAP guidelines. A total of 2.5% - 27.5% of schools followed NATA exertional heat illness guidelines and 50% - 81% of schools had access to an athletic trainer. In addition, 61% - 94.4% of schools had an AED available at their athletic venues. Four of 51 state high school athletic association member schools were required to meet best practice standards for EAP implementation, 7 of 51 for AED access, 8 of 51 for heat acclimation, and 3 of 51 for concussion management.

Conclusions. There was a wide range of EAP adoption and a low rate of compliance to EAP guidelines in U.S. schools. Barriers to EAP adoption and compliance were not well documented and additional research should aim to identify impeding and facilitating factors.

Kans J Med 2021;14:282-286

INTRODUCTION

In 2019, nearly 8 million adolescents participated in school-related sporting activities according to the 2018 - 19 High School Athletics Participation Survey conducted by the National Federation of State High School Associations. From 2011 to 2014, the Centers for Disease Control and Prevention reported nearly 5.6 million injuries related to sport or recreation among persons aged 5 - 24. Although the majority of injuries were not life threatening, there were a significant amount of catastrophic and fatal injuries. During the 2017 - 2018 academic year, 99 catastrophic injuries, defined as fatalities, permanent disability injuries, serious injuries (fractured neck or serious head injury) even though the athlete has a full recovery, temporary or transient paralysis, heat stroke due to exercise, or sudden cardiac arrest or sudden cardiac or severe cardiac disruption, occurred in high school and college athletes. Of these, 85 events occurred during or due to sport-related activities, and 66 of 85 sport-related catastrophic injuries were at the high school level.

Implementing emergency action plans (EAPs) likely mitigates athletes’ risk of sudden death or catastrophic injury. Professional organizations have published guidelines on emergency preparedness and state high school athletic associations (SHSAA) have issued policies of their own, based on those professional guidelines. Specifically, the National Athletic Trainers’ Association (NATA) has published 13 consensus statements endorsed by over 26 organizations on various aspects of emergency health and safety, and sports medicine best practices in collaboration with various inter-association task forces. Most notably, NATA has published a position statement on emergency planning in athletics detailing the 12 best practice guidelines athletic organizations should follow (Table 1).

The American Heart Association (AHA), Sideline Preparedness Collaboration (AAFP, AAOS, ACSM, AMSSM, AOSSM, AOASM), and National Collegiate Athletic Association (NCAA) have published similar documents that align closely with NATA consensus statements.† It is agreed widely that sports related injuries and medical emergencies are best prevented by implementing and rehearsing a venue specific EAP. The goal of this review was to analyze the adoption and compliance of EAP recommendations, access to an athletic trainer (AT) and automated external defibrillator (AED), and current legislative mandates in school-based athletics. In addition, we aimed to identify ways to improve compliance to evidence-based guidelines, like those that have been created by the Sideline Preparedness Collaboration, NCAA, AHA, and NATA.

METHODS

A systematic review of the literature was conducted on March 12, 2020, using PubMed, Embase, MEDLINE, Cochrane, CINAHL, and Google Scholar with the following string: Emergency preparedness OR Emergency action plan OR School-based athletics OR Sport injury and illness OR Exertional heat illness in sports. After removal of duplicates, articles were screened by abstract and title using our predetermined inclusion and exclusion criteria. Studies were included if the article was written in the English language and focused on adoption and/or compliance with EAPs or other national guidelines pertaining to athlete health. Studies were excluded if they were not written in the English language, focused solely on epidemiology in school-based athletics, or did not evaluate adoption or compliance with an EAP or national guideline. The full text of the articles was obtained and evaluated if eligibility could not be assessed from the first screening. Of note, one study included in our results was only available as an abstract.
Table 1. National Athletic Trainers’ Association position statement: Best practice recommendations.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Each institution or organization that sponsors athletic activities must have a written emergency plan. The emergency plan should be comprehensive and practical, yet flexible enough to adapt to any emergency situation.</td>
</tr>
<tr>
<td>2</td>
<td>Emergency plans must be written documents and should be distributed to certified athletic trainers, team and attending physicians, athletic training students, institutional and organizational safety personnel, institutional and organizational administrators, and coaches. The emergency plan should be developed in consultation with local emergency medical services personnel.</td>
</tr>
<tr>
<td>3</td>
<td>An emergency plan for athletics identifies the personnel involved in carrying out the emergency plan and outlines the qualifications of those executing the plan. Sports medicine professionals, officials, and coaches should be trained in automatic external defibrillation, cardiopulmonary resuscitation, first aid, and prevention of disease transmission.</td>
</tr>
<tr>
<td>4</td>
<td>The emergency plan should specify the equipment needed to carry out the tasks required in the event of an emergency. In addition, the emergency plan should outline the location of the emergency equipment. Further, the equipment available should be appropriate to the level of training of the personnel involved.</td>
</tr>
<tr>
<td>5</td>
<td>Establishment of a clear mechanism for communication to appropriate emergency care service providers and identification of the mode of transportation for the injured participant are critical elements of an emergency plan.</td>
</tr>
<tr>
<td>6</td>
<td>The emergency plan should be specific to the activity venue. That is, each activity site should have a defined emergency plan that is derived from the overall institutional or organizational policies on emergency planning.</td>
</tr>
<tr>
<td>7</td>
<td>Emergency plans should incorporate the emergency care facilities to which the injured individual will be taken. Emergency receiving facilities should be notified in advance of scheduled events and contests. Personnel from the emergency receiving facilities should be included in the development of the emergency plan for the institution or organization.</td>
</tr>
<tr>
<td>8</td>
<td>The emergency plan specifies the necessary documentation supporting the implementation and evaluation of the emergency plan. This documentation should identify responsibility for documenting actions taken during the emergency, evaluation of the emergency response, and institutional personnel training.</td>
</tr>
<tr>
<td>9</td>
<td>The emergency plan should be reviewed and rehearsed annually, although more frequent review and rehearsal may be necessary. The results of these reviews and rehearsals should be documented and should indicate whether the emergency plan was modified, with further documentation reflecting how the plan was changed.</td>
</tr>
<tr>
<td>10</td>
<td>All personnel involved with the organization and sponsorship of athletic activities share a professional responsibility to provide for the emergency care of an injured person, including the development and implementation of an emergency plan.</td>
</tr>
<tr>
<td>11</td>
<td>All personnel involved with the organization and sponsorship of athletic activities share a legal duty to develop, implement, and evaluate an emergency plan for all sponsored athletic activities.</td>
</tr>
<tr>
<td>12</td>
<td>The emergency plan should be reviewed by the administration and legal counsel of the sponsoring organization or institution.</td>
</tr>
</tbody>
</table>

An electronic form for data extraction was created to analyze the results of the selected articles. Data relating to EAP adoption, compliance with EAP guidelines, access to an AT, access to an AED, or compliance with state mandated guidelines were extracted. Data were grouped into broad categories to account for the wide variety of survey questions in each article. Data were only grouped together if the articles were measuring the same outcome. One limitation of this comparison was the fact that study populations varied between coaches, athletic trainers, and other school staff. We recognized the notable differences between these stakeholders and the fact that this could affect the reliability of comparisons.

RESULTS

A total of 12,906 articles were identified in the initial database search. After duplicates were removed, abstracts were screened for relevance to EAPs based on title and brief summary of abstract. This left 26 articles that were screened using inclusion/exclusion criteria. Five articles were excluded after full text review; these studies focused on epidemiological data. A total of 21 articles remained for full text review, see Figure 1.

Nine studies aimed to identify if schools had adopted a formal EAP and demonstrated EAP adoption rates ranging from 55% - 100% (Figure 2).

Figure 1. Flow diagram for study selection.

Figure 2. Percentage of schools with a written EAP.
One study identified 38% of high schools always having an EAP, while 36% have never had an EAP in place.\textsuperscript{19} Five studies found that EAPs were rehearsed and reviewed at least annually in 18.2% - 91.6% of schools that have an EAP.\textsuperscript{11,13,15,17,18} Scannan et al.\textsuperscript{16} identified that only 99% of schools were compliant with all 12 NATA guidelines, while Meredith et al.\textsuperscript{12} found that only 4% of schools were compliant with all three guidelines set forth by the AHA. Two studies identified that 2.5% - 27.5% of schools complied with all Exertional Heat Illness (EHI) guidelines set forth by the NATA.\textsuperscript{20,21}

Two studies identified that only 50% - 81% of schools had access to an AT.\textsuperscript{11,23} Olympia et al.\textsuperscript{19} found that 34% of schools have an AT at all athletic events, while Jones et al.\textsuperscript{10} found that only 4.6% of schools had an AT available for medical problems at practices. Nine studies found that 48% - 98% of schools had an AED on campus.\textsuperscript{10,12,16,19,23,24} Tennessee had the lowest rate at 48%, while West Virginia high schools had the highest rate of 98% among the states included in the studies.\textsuperscript{12,19} Four studies found that 61% - 94.4% of schools had an AED available at all athletic venues.\textsuperscript{13,14,19} In 2017, Johnson et al.\textsuperscript{21} found that only 56% of Oregon high schools had an AED available for early defibrillation (within four minutes) at all athletic venues. Meredith et al.\textsuperscript{12} found that of the 21 sudden cardiac arrest events that occurred in the previous five years in Tennessee high schools, an AED was not available in 10 (48%) and in four cases (19%) the AED was present, but not opened.

A benchmark study was performed in 2018 to identify the extent to which SHSAA and other state regulations mandate their respective member schools to create health and safety guidelines that align with current best practices.\textsuperscript{25} This study showed that only 4 of 51 SHSAA member schools were required to meet best practice standards for EAP adoption, 7 of 51 for AED access, 8 of 51 for heat acclimatization, and 3 of 51 for concussion management.

**DISCUSSION**

The results of this systematic review supported the hypothesis that there is low EAP adoption (55% - 100%) and compliance (99% when using NATA guidelines) with EAP guidelines in schools. This review also identified poor access to ATs (50% - 81%) and AEDs (48% - 98%). Schools with access to ATs were associated with higher rates of EAP adoption and compliance, as well as better access to AEDs and early defibrillation.\textsuperscript{11,22} Schools with AEDs were more likely to follow EAP guidelines than those without.\textsuperscript{18,24} The EAP adoption rate of schools with at least one AED was 86.5% compared to 47.4% of schools with no AED.\textsuperscript{24} This association could indicate that barriers to AED access may be similar to EAP adoption and compliance barriers.

The three most common barriers to AED access were lack of funding, medical-legal reasons (i.e., fear of liability), and lack of certified medical personnel or access to certified medical personnel.\textsuperscript{12,17,19,23,24} AED access is important, but it is also important to have an EAP in place and to have staff trained in first aid and CPR. The barriers to EAP adoption have not been studied, but could include lack of funding, certified medical personnel, appropriate facilities, and continuing education.\textsuperscript{19}

Further studies are needed to identify factors that facilitate and impede EAP adoption and compliance, including discussion with ATs, coaches, and other stakeholders. Finally, only 8% of states mandated EAP adoption, 14% mandated AED access, 16% mandated heat acclimation guidelines, and 6% mandated concussion management guidelines.\textsuperscript{28} Illinois, Kentucky, Missouri, and North Carolina required all 10 EAP recommendations between SHSAA bylaws and state legislation. The remaining 47 of 51 SHSAAAs do not make the EAP recommended guidelines mandatory for participating schools, and there have been a limited number of studies evaluating compliance with the emergency-preparedness best practices.\textsuperscript{4,19,26} Although states rarely have EAP mandates, Kerr and colleagues\textsuperscript{20,21} identified that states with mandated guidelines had better adoption of EHI guidelines than those without. Kerr et al.\textsuperscript{27} found that SHSAA mandated heat acclimation guidelines were associated with a 55% reduction in EHI incidence.

Sports related injuries and medical emergencies are best prevented by implementing and rehearsing a venue specific EAP.\textsuperscript{4,9} The NATA, AHA, and Sideline Preparedness Collaboration have set forth guidelines and recommendations that athletic organizations should follow to align with sports medicine best practices.

The NATA in conjunction with the Sideline Preparedness Collaboration and the Inter-Association Task Forces advocate for the implementation of EAPs at any institution that sponsors athletic activities.\textsuperscript{4,5} These recommendations included having an EAP placed in writing, and that they be distributed to all appropriate personnel, ensured they are incorporated with local emergency medical services, and rehearsed at least annually. The NATA detailed their recommendations for effective EAP implementation in a 12 point explanation and provided evidence-based reasoning to its position statement. This position statement emphasized the importance of implementing EAPs in preventing catastrophic injury and death, and showed that implementation requires three steps: committing an EAP to writing, educating those involved in the plan, and rehearsing the plan.

Most notable of the 13 consensus statements published by NATA are the best practice recommendations for the prevention of sudden cardiac arrest in secondary school athletics programs, and the document on emergency health and safety.\textsuperscript{6,7} The former provided detailed information on EAPs, AT services, conditioning sessions, brain and neck injuries, exertional heat stroke, sudden cardiac arrest, and exertional sickness. It emphasized that most deaths in secondary school athletics are avoidable by providing appropriate prevention, recognition, and treatment strategies. This guide also recognized that supervisors of secondary school athletics programs would benefit from AT services to meet the increasing requirements of health policies and mandates.\textsuperscript{6} The latter provided the strength of recommendation and level of evidence to each of the policies and guidelines they recommended. This document served as a guide for national governing bodies for youth sports.\textsuperscript{7} These consensus statements and an updated list of endorsing organizations can be found at https://www.nata.org/news-publications/pressroom/statements consensus.

The Sideline Preparedness Collaboration advocated understanding and practicing specific prevention measures for sports related injury/illness and provided guidelines to help team physicians implement
these prevention strategies. In agreement with the NATA and the Sideline Preparedness Collaborations’ stance on EAP implementation, the NCAA released its Inter-Association Recommendations in July 2019. These recommendations emphasized that at a minimum, EAPs should be developed for head and neck injury, cardiac arrest, heat illness and heat stroke, exertional rhabdomyolysis, exertional col-lapse associated with sickle cell trait, any exertional or non-exertional collapse, asthma, diabetic emergency, and mental health emergency. The NCAA also emphasized that EAPs should be consistent with their concussion safety protocol checklist. Overall, most deaths in sports are deemed preventable and the Inter-Association Task Forces’ charge was to meet this expectation.

The AHA is a leader among these organizations in advocating for the importance of AED availability. Their stance is predicated on AED availability being crucial in the response to sudden cardiac arrest as neurological outcomes are compromised by every minute without appropriate treatment. Although the AHA recommended that state laws and regulations require schools to have a cardiac emergency response plan, including the availability of an AED, only seventeen out of fifty states (34%) had some legislation that require AED installation in schools. In addition, only one state required AED installation in all public grade schools, private schools, and colleges.

CONCLUSIONS

Emergency Action Planning is an important preventative measure for high schools to take to protect their athletes from sports related injuries and illness. The results of this study showed that there is a wide range of EAP adoption across U.S. high schools and a low rate of EAP compliance with NATA/AHA guidelines. In addition, there is poor access to athletic trainers and AEDs in high schools, which may hinder EAP implementation and compliance. One common barrier to AED access was due to costs; to address this, states may need to allocate more funding to high schools to allow them to be fully compliant with AHA recommendations. There also seems to be low percentage of states mandating best practice recommendations for the prevention of the leading causes of sudden death and concussion management. Advocating for the implementation of state mandates may improve high school EAP compliance which would improve prevention of sports related injury or illness in high school athletics as well as improvement in outcomes of sudden cardiac arrest in high schools. In conclusion, given the widely accepted recommendations by multiple respected organizations, EAP for sport related injury and illness should be a top priority for all athletic organizations to ensure the utmost safety of our athletes.

REFERENCES


Keywords: sports medicine, athletic injuries, youth sports, team sports
INTRODUCTION

Despite an abundance of literature supporting percutaneous mechanical thrombectomy of pulmonary embolism (PE), only a limited number of case reports in the literature attest to the utility of percutaneous mechanical thrombectomy for clot in transit.1,2 With a recent U.S. Food and Drug Administration (FDA) approval for the FlowTriever® system for percutaneous mechanical thrombectomy for clot in transit,3 we present a dramatic case with recent trimalleolar fracture, having undergone open reduction and internal fixation, post-operative course being complicated by extensive deep vein thrombosis with resultant pulmonary embolism and clot in transit which was extracted successfully using the percutaneous mechanical thrombectomy FlowTriever® system.

CASE REPORT

A 59-year-old male with past medical history of atrial fibrillation on rivaroxaban, hypertension, morbid obesity, and heart failure with preserved ejection fraction presented with shortness of breath after being discharged from a same day surgical facility for a malleolar fracture repair. He had a fall and suffered a trimalleolar ankle fracture. After holding his rivaroxaban for three days prior to surgery, he underwent internal fixation of the left trimalleolar ankle fracture and was discharged the same day.

Upon trying to exit his car at a fast-food restaurant, the patient had severe shortness of breath and was brought to the emergency room. In the emergency room, he was tachycardic with a heart rate of 137 beats per minute, blood pressure of 95/61 mmHg, and respiratory rate of 18 per minute with an oxygen saturation 96% on 4 liters by nasal cannula. His exam was significant for clear lungs bilaterally, but with increased effort for breathing. Heart examination was irregular without any significant murmurs. He had + edema bilaterally. The differential diagnosis included pulmonary embolism, fat embolism, acute coronary syndrome, and aortic dissection.

Electrocardiogram revealed atrial fibrillation with rapid ventricular rate and low voltage (Figure 1). His blood work was significant for a hemoglobin 13.9 g/dL, white blood cell count of 8.2 x 10^9/L, platelet count of 137 x 10^9/L, and creatinine of 1.19 mg/dL. Troponin I returned at 0.04 ng/mL along with an elevated whole blood lactate 5.1 mmol/L. Due to concern for pulmonary embolism, he underwent computed tomography angiogram of the chest which demonstrated a large thrombus burden in the right and left pulmonary arteries with extension into the segmental branches of the left upper, left lower, right lower, and right middle lobes (Figure 2, Video 1) along with an impressive clot in transit in the right atrium (Figure 3). The clot in transit was passing in/out of the tricuspid valve and not attached to any intracardiac structure. The pulmonary embolism response (PERT) team was activated. Given the recent surgery and extensive clot in transit, systemic thrombolysis was avoided despite borderline hemodynamics. He was brought to the catheterization lab where he underwent echocardiography-guided (Figure 4, Video 2) extirpation of the clot in transit (Video 3) and from bilateral pulmonary arteries (Figure 5). [Videos are only available on the website: journals.ku.edu/kjm].

A post procedure echocardiogram (Figure 6, Video 4) demonstrated resolution of the clot in transit in the right atrium, along with dramatic improvement in hemodynamics with heart rate of 79 beats per minute, respiratory rate of 15 per minute, saturating 98% without requiring supplemental oxygen, and blood pressure of 122/99 mmHg. He underwent bilateral lower extremity duplex which showed acute occlusive deep vein thrombosis in the right popliteal and posterior tibial veins. He was started on warfarin with heparin bridging following the procedure. He was discharged on day five, and a plan for a vascular medicine follow-up for hypercoagulable workup as an outpatient.

Figure 1. Electrocardiogram demonstrates atrial fibrillation with rapid ventricular rate with S1, T3 inversion.

Figure 2. Computed tomography angiogram of chest (pulmonary embolism protocol) demonstrates large bilateral pulmonary artery embolisms (RPA right pulmonary artery; LPA left pulmonary artery).
This case demonstrated safe application of percutaneous mechanical thrombectomy in a patient with a clot in transit in the right atrium. While percutaneous mechanical thrombectomy has revolutionized the treatment of pulmonary embolism, relatively little data exist on the safety and efficacy of the utility of percutaneous therapies for clot in transit (CIT). Despite obtaining FDA approval, this application of the FlowTriever™ system remains under-described and is vitally important to be recognized.

CIT presents a challenging decision for physicians. While systemic tissue plasminogen activator (TPA) is an option, intracranial hemorrhage and distal embolization of the clot are significant limitations. Percutaneous options avoid cardiopulmonary bypass and the high bleeding risks associated with surgical thrombectomy and systemic TPA. The FLARE (FlowTriever Pulmonary Embolectomy Clinical Study) demonstrated the effectiveness and safety of the percutaneous therapy in pulmonary embolism. This, in combination with utilization of ultrasound guided (radiation free) aspiration of CIT, allows percutaneous mechanical thrombectomy therapies an attractive niche for CIT. This is important especially in the postoperative patient population, where thrombolysis and/or even simple therapeutic anticoagulation compounds the risks.

Similar to our patient, intermediate to higher risk PE patients present diagnostic and therapeutic dilemmas for physicians. While the extremes of acutely unstable patients warrant systemic thrombolytic therapy and low risk patients can be managed safely solely with anticoagulation, these intermediate to higher risk patients require thoughtful consideration and ideally, utilization of a multidisciplinary pulmonary embolism response team. Recent data increasingly support the safety and efficacy of large bore aspiration for acute thromboembolism. Wible et al. found up to a 100% technical success with the device and over 70% of patients required less oxygen following the procedure. They highlighted the low rate of adverse events (3.8%, mainly driven by respiratory deterioration) with zero device related complications, furthering the evidence for the utility of the device for acute thromboembolism.

CONCLUSIONS
Due to the limited literature regarding percutaneous extirpation of clot in transit, this dramatic case of hemodynamic and clinical improvement was presented. Several learning points are notable. Clot in transit creates a challenging therapeutic decision for physicians. Percutaneous mechanical thrombectomy has the potential to revolutionize the treatment of thromboembolism in transit and should continue to gain momentum given the safety and efficacy of the device.

REFERENCES


Keywords: percutaneous aspiration thrombectomy, pulmonary embolism, deep vein thrombosis
Brushing Up on Brush Borders: Intestinal Spirochetosis Diagnosis and Management

1Tulane University School of Medicine, New Orleans, LA
2Department of Pathology
3Department of Internal Medicine, Division of Infectious Diseases

INTRODUCTION
Intestinal spirochetosis was first described in 1967.1 Diagnosis is based on colon biopsy histology where spirochetal microorganisms are found attached to the apical cell membrane of colorectal epithelium as a pseudo-brush border. Higher risk groups include those living in poorly developed nations, persons living with human immunodeficiency virus (HIV), and men who have sex with men.2 Symptoms most commonly associated with adult cases of intestinal spirochetosis include abdominal pain with watery diarrhea.3 Adolescent cases of intestinal spirochetosis may present with nausea and failure to thrive, along with diarrhea.4 Many case patients are asymptomatic.

This case highlighted a patient diagnosed with intestinal spirochetosis after years of nonspecific abdominal symptoms. The diagnosis of this rare condition requires ruling out common etiologies and a detailed inspection of colon biopsy histology.

CASE REPORT
A 46-year-old man with HIV infection and exocrine pancreatic insufficiency was referred for colonoscopy with symptoms of intermittent diffuse abdominal cramping, nausea, and diarrhea of unexplained origin for several years. He had no improvement with lipase-protease-amylase capsules for pancreatic enzyme replacement (taken as two capsules three times daily with meals and one capsule with snacks). His work-up included negative Clostridium difficile PCR, Giardia and Cryptosporidium fecal antigens, stool culture, stool acid fast stain (no cyclospora, cryptosporidium or isospora seen), and syphilis antibody. The patient had a normal complete blood count with differential, thyroid stimulating hormone level and fecal fat percentage on two random collections, tissue transglutaminase antibody level, vitamin B12 level, and vitamin D (25-OH) total. At the time of his planned procedure, the patient denied fever, chills, night sweats, unintentional weight loss, vomiting, hematochezia, and melena. Otherwise, his recent review of systems was unremarkable.

The patient did not use tobacco, alcohol, or recreational drugs. He lived in a house with his son and denied sexual partners for several years, though in the remote past had male and female partners. He had no recent travel history though had been to Iraq and the desert southwest United States in the past. He was not working. He had no animal exposures aside from dogs. He did not consume raw meat or uncooked shellfish. He had not been swimming in the recent past.

On physical examination, the patient was afebrile and in no distress. Cardiac, pulmonary, and abdominal examinations demonstrated no abnormal findings. His most recent absolute CD4+ T-cell count was 140 cells/μL with an HIV viral load of 37,700 copies/mL. Serum white blood cell count was normal. Computed tomography scan of the abdomen and pelvis with contrast demonstrated homogeneous enhancement of the pancreas without mass, ductal dilation, parenchymal calcification, or peripancreatic inflammatory changes. He had normal caliber small bowel and colon, and a normal appendix with no free fluid or mesenteric lymphadenopathy. There was a tiny nonobstructive right renal calculus.

Colonoscopy revealed a normal appearance of the colon. Biopsy of colonic mucosa was performed, demonstrating no active inflammation or architectural distortion. On histologic examination, typical organisms were found adherent to the surface epithelium as a pseudo-brush border (Figure 1). A Warthin-Starry stain highlighted the organisms (Figure 2).

This patient with HIV infection, a low CD4+ cell count, a lengthy history of abdominal cramping, nausea, and diarrhea without definitive alternative diagnosis, and normal findings on colonoscopy was found via colonic biopsy to have spirochetal organisms adherent to the surface of the colonic mucosa. These findings were consistent with a diagnosis of intestinal spirochetosis. The patient was prescribed a seven day course of metronidazole. One month following the therapy, he had subjective improvement in cramping abdominal pain as well as improvement in both quantity and consistency of his loose stools.
DISCUSSION

Spirochetes are classified into Spirochaetaceae, Leptospiraceae, and Brachyspiraceae based on morphologic and phylogenetic differences. Brachyspiraceae species Brachyspira pilosicoli and Brachyspira aalborgi are the most commonly identified organisms in human intestinal spirochetosis. These fastidious anaerobes grow between 6 and 14 days at around 38.5°C on artificial culture media and brain heart infusion agar with 10% bovine blood and spectinomycin plus polymyxin B, respectively. Their main host species include pigs and chickens, where they can cause diarrhea, failure to thrive, and delayed egg production. The bacteria are shed in feces leading to the proposed mechanism of infection being transmission by the fecal-oral route or exposure to contaminated water with higher colonization rates in developing countries. When observed with in vitro antimicrobial susceptibility of Brachyspira pilosicoli, the pathogen has been found to be susceptible to metronidazole, ceftriaxone, meropenem, tetracycline, moxifloxacin, and chloramphenicol. Most published case series recommend metronidazole as an initial treatment.

Some debate exists regarding whether intestinal spirochetosis is a disease process or merely intestinal colonization. One reason for this uncertainty is the high incidence of coinfection with other enteric bacteria. In some case series, risks such as men who have sex with men, HIV virus infection, and co-infection with Neisseria gonorrhoeae or Chlamydia trachomatis were suggested. In one series looking at 20 cases, 70% had CD4 lymphocyte cells >200/μL. In a large series investigating colorectal biopsies in Japan, there was a slightly higher incidence of intestinal spirochetosis in patient with HIV. Visualization of mucosa with colonoscopy contributed little to diagnosis, as the findings rarely correlated with disease severity, but can be used to rule out other pathologies.

Intestinal spirochetosis has been identified from proximal colon to rectum and within the veriform appendix. Diagnosis is made with biopsy. Histology findings along the intercryptal epithelial layer show diffuse blue fringe on hematoxylin-eosin stain. Spirochetes subsequently can be visualized on Warthin-Starry or Dieterle silver impregnation stains. The proposed pathogenic mechanism for diarrheal associated with this disease is micrillus destruction caused by spirochetal attachment. Furthermore, when a significant population of enterocytes become attached it may lead to a physical restriction of electrolyte and water resorption adding to diarrhea.

In our patient, it was difficult to confirm if the spirochetes were pathogenic. In the months subsequent to the diagnosis, he had recurrent diarrhea that improved without intervention and an additional episode that improved with a repeat short course of metronidazole.

CONCLUSIONS

Diagnosis of intestinal spirochetosis should be considered for a patient with unexplained chronic, watery diarrhea and abdominal pain, particularly in a patient with HIV infection. Work-up should include a thorough review of history, Clostridium difficile PCR, Cryptosporidium and Giardia fecal antigen testing, and colonoscopy to rule out alternative diagnoses. Diagnosis of intestinal spirochetosis can be confirmed with biopsies of colonic mucosa viewed on Warthin-Starry stain which will reveal spirochetal organisms adherent to mucosa surface. Patients with intestinal spirochetosis can be treated with a course of metronidazole, although symptoms may resolve spontaneously.

Acknowledgements

Full informed consent was obtained from the patient for the publication of his information and imaging.

We thank Dr. John Bonino in the Division of Gastroenterology, Department of Internal Medicine at the University of Kansas Medical Center for his aid in the clinical care of this patient. We also would like to extend thanks to Dr. Stephanie Wood in the Department of Pathology at the University of Kansas Medical Center for her assistance in the preparation and interpretation of the biopsy specimen.

REFERENCES


Keywords: infectious disease, gastroenterology, microbiology, brush border, spirochete infection
Have a manuscript ready to publish?
Visit our website for instructions on submitting a manuscript.

journals.ku.edu/kjm

The University of Kansas Medical Center prohibits discrimination on the basis of race, color, ethnicity, religion, sex, national origin, age, ancestry, disability, status as a veteran, sexual orientation, marital status, parental status, gender identity, gender expression, and genetic information in the University’s programs and activities.

The following office has been designated to handle inquiries regarding the non-discrimination policies: The University of Kansas Medical Center Department of Equal Employment Opportunity, 1054 Wescoe, 3901 Rainbow Blvd., Kansas City, KS, 66160, 913-588-5088.