World J Surg (2013) 37:953–955
DOI 10.1007/s00268-013-1905-0

World Journal of Surgery

Utilization of a Non-preserved Cadaver to Address Deficiencies in Technical Skills During the Third Year of Medical School: A Cadaver Model for Teaching Technical Skills

Stephen J. Kaplan · Joseph T. Carroll · Saman Nematollahi · Andy Chuu · William Adamas-Rappaport · Evan Ong

Published online: 25 January 2013

Abstract

Background Emergency technical procedures performed by medical students have decreased in the last decade. An Emergency Surgical Skills Laboratory (ESSL) using a non-preserved cadaver was developed in response to address this deficiency.

Methods A total of 232 students rotating through a 6-week surgery clerkship participated in the ESSL from 1 July 2008 to 1 July 2011. Two four-hour sessions using case-based trauma scenarios in the ESSL served as a model for procedural instruction. Skills taught included basic suturing, intubation, cricothyrotomy, chest tube placement, thoracentesis, venous access, central line, and radial arterial line placement.

Results Students noted that technical proficiency in suturing was obtained during the ESSL sessions in comparison to the emergency department or operating room ($p < 0.001$) during the 6-week clerkship. During the 6-week rotation only 12 % of students participated in chest tube insertion, 5 % central venous line placement, and 14 % femoral vein blood draw. Finally, 90 % of respondents reported increased understanding and comfort in regard to trauma resuscitation following the ESSL.

Conclusions Technical procedural proficiency has become increasingly difficult to obtain in medical school due to multifactorial limitations. The ESSL provides an opportunity for developing technical skills needed for emergency situations not otherwise provided during the surgical clerkship.

S. J. Kaplan · W. Adamas-Rappaport (✉) · E. Ong
Department of Surgery, The University of Arizona, 1501N. Campbell Avenue, P.O. Box 245058, Tucson, AZ 85724-5058, USA
e-mail: Cdjpk1@gmail.com

J. T. Carroll · S. Nematollahi · A. Chuu
University of Arizona College of Medicine, 1501N. Campbell Avenue, P.O. Box 245058, Tucson, AZ 85724-5058, USA

Introduction

The number of technical procedures performed by medical students has decreased over the last 2 decades both at our institution and on a national level [1, 2]. In response to diminished opportunities to develop technical skill proficiency necessary for beginning residency, we instituted an emergency surgical skills laboratory (ESSL) utilizing a non-preserved cadaver during the third-year surgery clerkship [2].

Methods

Two four-hour sessions in the ESSL served as the model for instruction. Two experienced senior surgeons were selected to provide instruction. The study population included a total of 232 third-year medical students rotating through their 6-week surgery clerkship from 1 July 2008 to 1 July 2011. The following procedures were taught: endotracheal intubation, cricothyrotomy, chest tube insertion, thoracentesis, central venous line placement, femoral vein cannulation, and radial arterial line placement (Fig. 1). For each technical skill, indications and contraindications were emphasized as well as anatomic landmarks. Procedures were performed under the supervision of the two senior surgeons. This was accomplished in the first session of the ESSL using case-based scenarios. The second session focused on technical suturing skills. Suturing skills included the following: simple interrupted, running subcuticular, and vertical mattress closures. At the end of the 6-week rotation, students completed a questionnaire consisting of 13 items (5-point Likert scale and Yes/No responses). Data were analyzed with descriptive statistics. Additionally, repeated-measures analysis of

variance was performed using Likert scale items with $\alpha = 0.05$ and Bonferroni post-hoc test to measure statistical significance.

Results

From the total study population of 232 students, 35 surveys were excluded from the study due to incomplete responses, leaving 197 complete surveys. Students reported obtaining suturing proficiency in the ESSL (mean = 4.7, standard deviation [SD] = 0.8) compared to the operating room (mean = 3.3, SD = 1.4) or the emergency department (mean = 2.9, SD = 1.5). Differences among locations were statistically significant ($p < 0.001$). In regard to emergency procedures performed during the surgery clerkship outside the ESSL, only 12 % (24) took part in a chest tube insertion, 14 % (28) a femoral vein blood draw, and 5 % (10) a central venous line insertion. No student participated in thoracentesis or cricothyroidotomy. Ninety-four percent (185) felt the ESSL provided additional opportunities to perform procedures. Ninety percent (177) of students reported an improved understanding of trauma resuscitation through the ESSL.

Discussion

Multiple factors have contributed to the declining number of technical procedures performed by medical students prior to beginning their intern year [1–5]. Economics has been cited as an important factor in this decline during residency as both operation time and costs increase when residents assist in surgery [6, 7]. Allowing students to suture or perform technical skills would result in an even greater length of procedure. In addition, fear of litigation has contributed to this decrease in procedural experience for both medical students and interns [8]. Expertise and comfort with a given technical skill comes with experience and practice. Nakayama and Steiber demonstrated that first-year surgical residents felt uncomfortable performing procedures not performed previously as medical students [9].

One potential method to address this problem of acquiring procedural skills prior to residency is through simulation [10]. Utility of simulation-based surgical training was most dramatically illustrated with the advent of laparoscopic procedures. Previous data have shown that a surgeon performing a laparoscopic cholecystectomy had a 1.7 % chance of injuring the bile duct in their first case in comparison to a 0.17 % chance of injury in the fiftieth case. Other authors have also noted that increased experience decreases complication rates and procedural time as well as increasing comfort level with the named procedure [10–12]. The importance of acquiring experience prior to clinical situations was recognized by the American College of Surgeons Residency Review Committee, who mandated implementation of a skills laboratory into surgical residency curricula [13].

Similar simulations are also used for technical skills such as those described in our ESSL [8, 14]. However, there are several drawbacks to simulation laboratory-based training for emergency procedures. The inability to fully replicate human tissue and anatomy is a major obstacle [15], as well as the initial program costs associated with starting a simulation laboratory. Although some programs have utilized the recently deceased to overcome cost and fidelity issues, this method raises ethical considerations as a recent study demonstrated that 76 % of programs "almost never" obtained family consent prior to using recently deceased patients [16].

An alternative is the utilization of a non-preserved cadaver model. At our institution, patients have donated their bodies for medical education through our Willed Body Program. Cost assessed to our department is $600.00 per 6-week rotation (one body).One cadaver allows for a maximum of 14 students to complete the ESSL. These cadavers are able to provide an accurate representation of

Fig. 1 Medical students in the emergency surgical skills laboratory performing various procedures on a non-preserved cadaver. **a** Subclavian central line placement. **b.** Direct laryngoscopy and endotracheal intubation. **c** Chest tube insertion

living tissue. The ability to transfer skills learned in a cadaver lab or other simulation modality to real life situations has been well documented [11, 12, 16, 17]. Berman et al. [15] showed that the use of a cadaver model to teach arthrocentesis was superior when compared to simulations or lectures alone.

The changing face of healthcare has presented unique challenges in medical training. Novel approaches must be developed to provide proficient education and training for future physicians. The ESSL is an effective way to ensure that all students rotating on the surgery clerkship obtain important technical skills previously taught in the operating room, emergency department, and wards. Our study demonstrated that many procedural skills were taught solely in the ESSL as opposed to other locations where, in the past, technical skills were taught. In addition, students reported increased procedural opportunity as a result of the ESSL, though this is difficult to validate. The non-preserved cadaver lab is a viable option to provide additional training opportunities. We have instituted this lab in a more advanced form for incoming interns in our surgery residency program.

There are a number of limitations to this study. First, data was collected via post-rotation student self-assessment, exposing the study to methodological biases. In addition, proficiency of the procedures taught were not assessed pre- and post-ESSL in order to document expertise and retention. Further investigation is warranted to address this issue. While students felt the ESSL allowed them additional procedural opportunity, there are no firm data to support this. Finally, we have a very active Willed Body Program allowing a constant supply of cadavers. In other countries as well as locations within the United States this may not be a viable form of simulation because of a lack of a cadaver supply.

In summary, the decline of traditional procedural teaching opportunities has increased the demand for new, innovative models to teach technical skills. We have demonstrated that use of the ESSL can provide a safe environment for familiarization of trauma resuscitation and provide a venue for obtaining critical technical skills that may not otherwise be provided through surgical rotations.

References

1. Dent JA (2001) Current trends and future implications in the developing role of clinical skills centres. Med Teach 23:483–489
2. DiMaggio PJ, Waer AL, Desmarais TJ et al (2010) The use of a lightly preserved cadaver and full thickness pig skin to teach technical skills on the surgery clerkship—a response to the economic pressures facing academic medicine today. Am J Surg 200:162–166
3. Graber MA, Pierre J, Charlton M (2003) Patient opinions and attitudes toward medical student procedures in the emergency department. Acad Emerg Med 10:1329–1333
4. Margrane D, Gannon J, Miller CT (1994) Obstetric patients who select and those who refuse medical students' participation in their care. Acad Med 69:1004–1006
5. Scott DJ (2006) Patient safety, competency, and the future of surgical simulation. Simul Healthcare 1:164–170
6. Bridges M, Diamond DL (1999) The financial impact of teaching surgical residents in the operating room. Am J Surg 177:28–32
7. Babineau TJ, Becker J, Gibbons G et al (2004) The "cost" of operative training for surgical residents. Arch Surg 139:366–369
8. Windsor JA (2009) Role of simulation in surgical education and training. ANZ J Surg 79:127–132
9. Nakayama DK, Steiber A (1990) Surgery interns' experience with surgical procedures as medical students. Am J Surg 159:341–343
10. Moore MJ, Bennet CL (1995) The learning curve for laparoscopic cholecystectomy. Am J Surg 170:55–59
11. Seymour NE, Gallagher AG, Roman SA et al (2002) Virtual reality training improves operating room performance. Ann Surg 236:458–464
12. Grantcharov TP, Kristiansen VB, Bendix J et al (2004) Randomized clinical trial of virtual reality simulation for laparoscopic skills training. Br J Surg 91:146–150
13. Scott DJ, Dunnington GL (2008) The new ACS/APDS skills curriculum: moving the learning curve out of the operating room. J Gastrointest Surg 12:213–221
14. Holland JP, Waugh L, Horgan A et al (2011) Cadaveric hands-on training for surgical specialties: is this back to the future for surgical skills development? J Surg Educ 68:110–116
15. Berman JR, Ben-Artzi A, Fisher MC et al (2012) A comparison of arthrocentesis teaching tools: cadavers, synthetic joint models, and the relative utility of different educational modalities in improving trainees' comfort with procedures. J Clin Rheumatol 18:175–179
16. Fourre MW (2002) The performance of procedures on the recently deceased. Acad Emerg Med 9:595–598
17. Martin M, Scalabrini B, Rioux A et al (2003) Training fourth-year medical students in critical invasive skills improves subsequent patient safety. Am Surg 69:437–440