Students teaching students: A novel solution for teaching procedures via instruction on the corpse

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❯ Abstract

Introduction: Increased faculty and resident responsibilities have led to the decreased time available for teaching clinical skills to medical students. Numerous advances in education and simulation have attempted to obviate this problem; however, documented success is lacking. Our objective was to describe a novel fresh cadaver-based, student-driven procedural skills lab and to compare the educational effectiveness of student instructors to the senior instructor (SI).

Methods: This was a prospective study performed at an academic medical center. A pilot program, "Students Teaching Students," was introduced where four trained first-year medical students (TMS) instructed 41 other untrained first-year medical students in technical procedures. This study compared the teaching evaluations of the SI with the TMS teaching equivalent procedures. Paired t-test was used to determine statistically significant changes in procedural confidence between pre- and post-training. Utilizing a post-training questionnaire, average post-training confidence improvement values and objective post-training test scores of the participants were compared between TMS and SI, using a 2 sample t-test. Statistical significance was considered as a p<0.05. All statistical analyses were conducted in Stata 11 (StataCorp LP, College Station, TX, USA).

Results: Twenty-nine out of 39 (74%) students completed the questionnaire. Both groups demonstrated a statistically significant improvement in subjective confidence level in performing each procedure when pre- and post-training scores were compared, while there was no statistically significant difference found in cognitive knowledge between the groups (p=0.73). There was no statistically significant difference in the mean confidence improvement between the SI and TMS groups for chest tube insertion (2.06 versus 1.92 respectively, p=0.587), femoral line placement (2.00 versus 1.94 respectively, p=0.734) or student test score (88% versus 85% respectively).

Conclusion: Our results demonstrate that first-year medical students well-trained in technical skills, such as our TMS, may be a valuable additional teaching resource. The Students Teaching Students procedure lab employed in this study was effective at immediately increasing first-year medical students' confidence and technical skill. First-year medical students well-trained in technical skills, such as our TMS, may be a valuable additional teaching resource.

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Introduction

A basic foundation of technical skill competency is pivotal in medical student training prior to entering residency. Unfortunately, opportunities to perform or practice medical procedures have declined over the last two decades (1-3). It is postulated that some of the contributing factors include time constraints on academic faculty, increased financial pressures, and overarching concerns with allowing novice practitioners opportunities to "practice" on clinical patients (1). This national trend has led to growing concern that medical students may not be exposed to procedures that they will be expected to competently perform upon entering residency (2, 4,5).

Innovations in the field of simulation and procedure models have increased the medical students' exposure to clinical procedures. Despite these advances, the integration of these models requires dedicated time and significant faculty involvement (1, 3, 6-9). Our objective was to describe a novel cadaver-based, student-driven procedural skills lab and to compare the educational effectiveness of student instructors to the senior instructor (SI).

Methods

This was a prospective study performed at an academic medical center. The study participants were 41 first-year medical students. Participation in the study was voluntary. Our sample was from a population of medical students with a mean age of 26, of whom 51% were male. This investigation was reviewed by the Institutional Review Board and determined to be a quality improvement project that does not require IRB oversight. Data were collected from February 2015 to May 2015.

Trained medical students (Authors) received approximately 15 hours of training from the SI (Author), a professor of surgery with over 35 years of surgical experience. This training included both didactic and hands-on procedural training utilizing a non-preserved cadaver. Each procedure was graded using a validated checklist. All of the participants in the STS group completed the given procedure without instruction before they were deemed ready to teach their first year colleagues. In addition, during the study this instruction between the STS group and the senior instructor was carried out regularly to insure expertise on the part of the former group (Table 1).

The authors instituted a two-hour hands-on technical procedures cadaver lab, called "Students Teaching Students," which was directed by four trained first-year medical students (TMS) and a SI. During each session, the TMS and SI groups used non-preserved cadavers to teach five distinct procedures: endotracheal intubation, cricothyroidotomy, chest tube insertion, thoracentesis, and ultrasound-guided femoral line placement. Student participants were divided into three groups of three students, with novice student participants rotating through each

Table 1: Skills station descriptions

Students teaching students procedures	
Skills station	**Learning objectives**
Breathing - Chest Tube insertion & Cricothyroidotomy (30 min)	*Key concepts of performing chest tube insertion:* 1. Find the level of the fourth rib, as indicated by the nipple line and anterior axillary line. In females/obese individuals the fifth rib, as indicated by the breast crease, is used for approximation. 2. Once the selected rib has been marked, make a 3-4 cm incision with a No.10 scalpel, making sure to avoid the inferior border of the rib as the neurovascular bundle is found along that location. 3. Once the incision has been made, insert a large Kelly clamp to bluntly dissect the track over the rib. (Make sure the tip of the Kelly Clamp is held with a fist to avoid complete penetration and possible internal organ damage). Once resistance has been encountered (intercostal muscles and parietal pleura) continue to apply pressure to advance the clamp into the thoracic cavity. 4. Once inside the thoracic cavity, dilate the incision with the clamp and a finger. This will allow to confirm correct location within the chest cavity. 5. Obtain another Kelly clamp and clamp a chest tube (No. 24-36 Fr size for adults, No. 16-24 Fr for children) at the tip to flatten the tube and ease the penetration into the thoracic cavity. 6. Once the tube is inserted into the thoracic cavity, release the clamp and guide the tube towards the posterior and apical end of the lung. If resistance is encountered do not force the tube. Retract and reperform the maneuver. 7. Once the tube is secured in place, attach to the Pleur-evac to begin drainage.
Circulation – Ultrasound guided intravenous (femoral) access: (30 min)	*Key concepts of performing intravenous access with ultrasound (US) guidance:* 1. Ultrasound should be used to identify the femoral vein and femoral artery in the inguinal region. 2. Compression should be used to help distinguish artery (non-compressible) from vein (compressible). 3. While keeping the vein in view, rotate the transducer 90 degrees so that the vein is seen in long axis. 4. Though not strictly necessary, it is beneficial to insert the needle in plane with the transducer so that the entire length of the needle can be visualized during the procedure. 5. Remember to keep the US beams parallel to needle to improve in-plane imaging of the entire needle.

station. Two stations were taught by TMS and one by the SI (Figure 1).

The cadaver lab was performed five times. Prior to each session, it was randomly determined which procedural station would be taught by SI and which one by TMS for the whole session. Each station maintained an instructor to student ratio of 1:2. Student participants were taught relevant pathophysiology and technical proficiency. Successful performance of the stations' skill was required before rotating to the next station.

Assessment consisted of a post-training questionnaire, made by the authors; it was administered seven days after participation in the session.

The questionnaire included 12 objective questions used to assess the student's knowledge in performing the procedures independently, as well as 13 questions regarding individual confidence in performing the procedures via a 4-point Likert-scale (1=strongly disagree; 4=strongly agree). All students without prior experience were given an initial score of 1 (strongly disagree) regarding confidence in performing the procedures taught. Participants with prior experience were excluded from assessment.

After discussions with experts in the field of Emergency Medicine and General Surgery, the decision was made to focus post-educational assessment utilizing only 2 of the 3 procedures: chest tube insertion (CTI) and ultrasound-guided femoral line placement (FLP). These experts felt that CTI and FLP were most comparable regarding the level of difficulty and total number of steps in performing the procedure.

Measurements of the 4-point Likert-scale were used to compare the mean post training confidence improvement (PCI), which was defined as the difference between the students' pretraining confidence value and posttraining confidence value, via a paired t-test. Additionally, average PCI values and objective post-training test scores were compared between students taught by TMS and students taught by SI using a 2-sample t test to determine any statistically significant changes. All statistical analysis was conducted in Stata 11 (StataCorp LP, College Station, TX, USA). Data are presented as means and standard deviations (SD) and percentages with 95% confidence intervals (CI). A paired t-test was used for comparison of the paired samples. The statistical level of significance was set at $p < 0.05$.

Results

A total of 41 students participated in the sessions, while 39 were given the post-training questionnaire (two students were excluded from the study due to previous experience). Seventy-four percent of the students (29/39) completed the post-training questionnaire. The objective test score average for all students was 86.3% (95% CI, 78%-94%). For students taught by TMS, cognitive test score average was 85% (95% CI, 66%-100 versus 88% for those taught by the SI (95% CI, 72%-100%) (p=0.73) (Table 2). The average student confidence improvement following instruction was 1.96 for FLP (p<0.001) and 2.0 for CTI (p<0.001) (Table 2). When comparing students taught by TMS vs. SI, we found no statistically significant differences in student procedural confidence (p=0.734) (Table 2).

Discussion

The importance of acquiring experience prior to clinical situations was recognized by Kaplan et al. (1) and the American College of
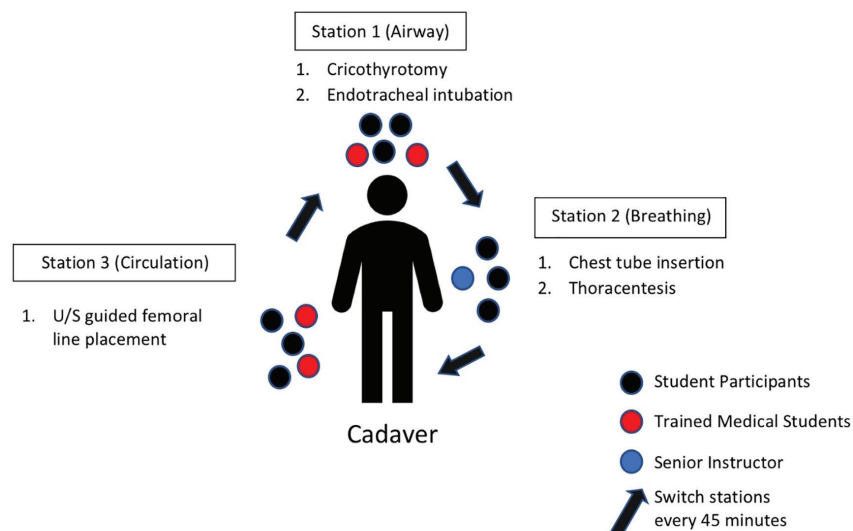

Figure 1: Areal view of skills lab

Table 2: Difference in confidence and cognitive knowledge between TMS and SI-taught groups for each procedure

Variable	Pre test	Post test	Change or difference	Statistical index	p
Objective Test Score Average (TMS)	N/A	85%	N/A	(95% CI, 66%-100%)	
Objective Test Score Average (SI)	N/A	88%	N/A	(95% CI, 72%-100%)	
Objective Test Score Difference (TMS vs SI)			3%		0.73
CTI PCI Mean (TMS) n=13	1	2.92	1.92	SD=0.494	<0.001
CTI PCI Mean (SI) n=16	1	3.06	2.06	SD=0.854	<0.001
CTI PCI Difference (TMS vs SI) n=29	N/A	N/A	0.14	N/A	0.59
FLP PCI Mean (TMS) n=16	1	2.94	1.94	SD=0.574	<0.001
FLP PCI Mean (SI) n=13	1	3	2.00	SD=0.408	<0.001
FLP PCI Difference (TMS vs SI) n=29	N/A	N/A	0.06	N/A	0.73

N/A indicate differences in confidence

Surgeons Residency Review Committee (10-11). Surgical education has dramatically changed in response to numerous constraints placed on residency programs, but a substantial gap still exists between expectations and performance (12). This gap is in part due to the declining trend in teaching technical skills during medical school and has resulted in the necessity to look for other avenues of skill training such as mannequin simulations and software-based training (2, 4). Technological advances have allowed for curriculums to create new, viable mechanisms of teaching modalities. Yet, limitations exist within these avenues, such as the equipment cost and the necessity to have full-time faculty present who is familiar with the software-based training. Furthermore, the realistic tissue handling, hepatic feedback and preserved tissue planes provided by non-preserved cadavers were unparalleled when compared to the inferior degree of realism provided by mannequins (1, 2, 6-8, 13-19).

We implemented numerous fresh cadaver educational labs at our institution in the past. However, these training sessions did not address the constant strain on faculty time, nor did they evaluate the use of a peer-to-peer teaching method (1, 3, 6-8, 16-19). The STS approach of near-peer instructors sought to increase the teacher to student ratio, thus mitigating the issue of diminished faculty teaching time. There is some evidence supporting the utilization of peer to peer teaching, but its utility in teaching procedures is unproven (12, 20). To the best of our knowledge, our study is unique in that it successfully integrated medical students as educators for a clinical procedure lab. While some residency programs have created procedure labs, or "boot camps," where incoming interns can learn and practice resident-level skills and procedures, there is no current practice in undergraduate medical education (21).

Our results demonstrated no statistically significant difference between TMS and SI instruction regarding the student participants'

subjective confidence level in performing the procedure nor objective procedural cognitive knowledge. Our data suggest that properly trained first-year medical students, such as our TMS, can be a viable teaching resource in addition to clinical faculty. If this model proves successful in other studies, then the potential exists to improve the teacher to student ratio, allowing for increased hands-on instruction. In our study, our teacher to student ratio was 1:2, which is lower than other studies that have used small groups to teach procedures (8). Smaller student to teacher ratios increase practice opportunities, increasing the likelihood that a student will achieve competency in a given procedural skill. Repetition of procedures is pivotal to mastering skills in long term as confirmed by other studies (21).

Within our institution, the Willed Body Program is a crucial component in training students with non-preserved cadavers. However, the concept elicited by this paper can also be implemented as a viable option to increase the teacher to student ratios with other teaching modalities such as inexpensive phantom models. Further investigation is recomended to study the efficacy of TMS in teaching hands-on technical skills through methods other than non-preserved cadavers, such as mannequin simulations or software-based training.

Limitations

Our study had several limitations, including small sample size. Although we tested the confidence of each student in performing each skill set, further studies should evaluate and compare the performance of the technical skill acquisition between student instructor groups and senior instructor groups. Moreover, our investigation was vulnerable to self-selection bias, as students who volunteered had probably increased personal interest in technical skill acquisition. Future investigations are recommended to incorporate additional procedures to assess if other procedures could

be taught in this manner. Future research should also evaluate long-term benefits of procedural competency prior to residency.

Conclusion

The Students Teaching Students procedure lab employed in this study was effective in immediately increasing first-year medical students' confidence and technical skill. First-year medical students well-trained in technical skills, such as our TMS, might be a valuable additional teaching resource.

Acknowledgement

Conflict of Interest: None declared.

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