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ORIGINAL ARTICLE

Implementation of the ACS/ASE simulation-based basic airway skills module in medical school curriculum: experience from Saudi Arabia

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ABSTRACT

Background: Simulation-based basic airway management training may enhance the learner's competence and offer practitioners the opportunity to practice infrequently applied skills in cases with difficult airway management. Here, we aimed to examine the effectiveness of implementing the American College of Surgeons/Association for Surgical Education (ACS/ASE) simulation-based Basic Airway Management module in the current medical school curriculum in PNU.

Methods: This is a quasi-experimental study in which 44 students were enrolled in the training course; the instructors comprised six practicing physicians and technicians from the anesthesia and emergency departments. The students were divided among six groups for a 20-minutes hands-on training. Cognitive assessment and performance rating scale were conducted after the introduction of the module. An independent *t*-test was applied to analyze the pre- and post-test training scores for the cognitive assessment and performance rating scale. Statistical significance was set at $p < 0.05$.

Results: There was a significant improvement in the post-training cognitive assessment scores, especially for basic maneuvers to establish the airway in a restrained and unrestrained driver, and in a patient with neck hematoma. A significant difference was also observed in pre- and post-training procedural steps, product characteristics, and global rating score.

Conclusions: The ACS/ASE surgical skills curriculum for basic airway skills training is a feasible and effective approach for teaching basic airway management skills to medical students in PNU and other local universities.

Keywords: Basic airway, medical student, simulation-based curriculum.

Introduction

Simulation-based basic airway management training has been gaining considerable attention as it can enhance the learner's competency [1]. Development and maintenance of airway management skills through simulation-based experiences may offer practitioners the opportunity to practice and maintain infrequently applied skills in cases with difficult airway management [2].

Accreditation standards in medical education demand that theory-based active learning strategies should expand to include new teaching methods. There is also an increased emphasis on utilizing new approaches in the medical curriculum to develop competencies desirable of modern physician [3].

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Medical students are required to attend a 2-week anesthesia course during their 4th year at PNU University. Throughout this period, they are expected to learn a variety of fundamental skills, with a special emphasis on basic airway management [4]. Basic airway management involves maneuvers to open the airway (head tilt/chin lift and jaw thrust), the use of airway adjuncts such as oropharyngeal and nasopharyngeal airways, and the utilization of a self-inflating resuscitator [5].

There are numerous medical education methods available for basic airway management training. Among these, simulation-based training (SBT) has been gaining considerable attention as it can enhance the learner's competence [6,7]. Numerous studies have demonstrated the efficacy of SBT in all aspects within different curriculums, including basic airway management. A previous study implemented surgical knot-tying and suturing sessions using the American College of Surgeons/Association for Surgical Education (ACS/ASE) medical student module [8]. They tested the proficiency and comfort level of the students before and after implementing the module and showed successful student improvement with 99% of students becoming proficient in basic surgical skills [4].

One meta-analysis has checked the effectiveness of SBT and showed that airway management using SBT can effectively increase learner satisfaction, knowledge, and technical skills, compared with traditional learning strategies [9]. Additionally, development and maintenance of airway management skills through simulation-based experiences may offer practitioners the opportunity to practice and maintain infrequently applied skills in cases with difficult airway management [10]. In developing countries, however, the cost, lack of experience, and limited resources may be barriers to the implementation of SBT.

At present, the medical education curriculum comprises a variety of different disciplines, specialties, and pedagogical approaches, which may produce different qualities of educational outcomes [11]. The approaches of curriculum standardization and contextual diversity tend to operate as separate philosophies, with little attention paid to the interplay between them [12]. This applies particularly to the basic airway management skills component of the medical education curriculum. Curriculum standardization has many rewards such as enhancing patient safety, fostering continuous quality improvement, and enabling the spread of the best practices [13].

A previous experimental study evaluated the feasibility and validity of implementing the ACS/ASE simulation-based surgical skills curriculum into a university curriculum [13]. The results showed that there was an improvement in the medical students' clinical skills, indicating that this ACS/ASE curriculum is a feasible and effective approach for teaching medical students in simulation-based laboratories [13].

Our primary objective was to examine the feasibility and effectiveness of implementing the ACS/ASE simulation-based Basic Airway Management module in the current medical school curriculum at PNU. Our secondary objective was to assess the impact of previous experience on the students' performance during the evaluation of the performance rating scale and the cognitive assessment test.

Materials and Methods

A quasi-experimental study was designed, in which the recruitment of students was voluntary; they were asked to read the study consent form, sign it if they wished to be enrolled, and register their unique student identification number. The instructors comprised six experts, who were practicing physicians and technicians from the anesthesia and emergency departments. The principal investigator of the study provided a training module to all instructors in person, along with papers and online access to the ACS/ASE basic airway management module. The module with the assessment tools can be found at the American college of surgeon's website at this link: https://www.facs.org/education/program/simulation-based.

An announcement for a training course on basic airway management skills, as a part of an educational intervention study, was made for the 1st-, 2nd-, and 3rd-year medical students who had not received prior formal training on airway management. A total of 72 students registered through an online link. Of these, 44 students attended the training course. Upon online registration, students were asked to watch the two videos of the module before the day of training.

An initial orientation session was provided to all students to further explain the contents of the module and group distributions. A cognitive assessment test was performed immediately after the orientation, using the cognitive assessment tool from the ACS/ASE Basic Airway Management module. An anesthesia attendant presented a 20-minutes didactic session to the whole group, followed by the two videos from the module.

Students were equally distributed among six groups for the hands-on skills assessment and training; each group was assigned a fully trained instructor from the anesthesia and emergency department. A trained observer was assigned to rotate between the groups and independently rate the students using the same tool used by the instructor. The students completed post-assessment surveys of the training module's comfort level, i.e., regarding student satisfaction and the skills learned after module completion. The students also indicated their self-perception of proficiency, which was compared with their instructor's opinion. Assessment of cognitive skill acquisition was performed using the tools in the ACS/ASE Basic Airway Management module.

The three components of the performance rating scale in this module (procedural steps; technique, errors, and product characteristics; and global rating score) were converted into electronic forms. The technical performance of the students was assessed through the cognitive skill assessment tool during the evaluation and treatment of a mannequin in a simulated clinical condition. The fluidity of skill execution and clinical assessment was evaluated using the global rating score. The overall proficiency corresponded with the cognitive

skill assessment and was used to classify students as either competent, or as those who required assistance or remediation to independently perform the skills in a clinical or simulated scenario.

The pre-test evaluation was performed through an electronic survey using the skills assessment tool from the standardized module. A small hands-on session of approximately 20 minutes was conducted for each group.

Data analyses were performed using Statistical Package for the Social Sciences version 25 (IBM, Armonk, NY). The internal validity of the tool used was determined using the bivariate Pearson correlation. The basic statistical overview of the medical student assessments was presented as frequencies and percentages. An independent *t*-test was applied to analyze the pre- and post-test training scores for the cognitive assessment and performance rating scale. The statistical significance value was set at $p < 0.05$.

Results

A total of 44 students from PNU completed the cognitive and performance rating scale assessment. Out of 44 enrolled students, 36 (81.8%) were 2nd-year medical students, six (13.6%) were 1st-year, and two (4.6%) were 3rd-year. Thirty-seven (84%) students watched the airway videos at least twice (45.6%). A majority of the students required additional instructions for review as they had not received previous training for advanced airway management (68.2%). Of the 44 students, only 12 had received prior training of basic life support (27.2%) and airway management (4.6%) as detailed in (Table 1).

A significant difference was observed between the pre- and post-training cognitive assessment scores for the initial basic maneuvers to establish the airway of an unrestrained driver [mean = 0.09, standard deviation (SD) = 0.293 and mean = 0.48, SD = 0.505, respectively; $p < 0.000$]; to establish the airway of a patient with neck hematoma (mean = 0.33, SD = 0.476 and mean = 0.12, SD = 0.328, respectively; $p < 0.010$); and to maintain the airway of a restrained passenger (mean = 0.35, SD = 0.482 and mean = 0.86, SD = 0.351, respectively; $p < 0.000$). There were no significant differences between the pre- and post-training scores for the basic maneuvers to establish the airway in a patient with suspected cervical injury, and in a patient with inadequate ventilation (Table 2). Regarding the performance rating scale, there was a significant difference between the pre- and post-training procedural steps ($p < 0.000$); technique, errors, and product characteristics ($p < 0.000$); and global rating score ($p < 0.000$). Mean scores for procedural steps; technique, errors, and product characteristics; and the global rating score were 5.24, 2.96, and 2.55, respectively, before training, and 8.61, 4.45, and 4.10,

Table 1. *Participant profile.*

		Frequency	%
Enrolment year	First-year medical student	6	13.6
	Second-year medical student	36	81.8
	Third-year medical student	2	4.6
Did you watch the airway videos?	Yes	37	84.0
	No	7	16.0
How many times?	Zero	2	4.6
	One	20	45.6
	Two	20	45.6
	Three	1	2.1
	Five	1	2.1
Opinion on basic airway management skills (Instructor's Grade)	I feel proficient in the clinical setting under direct supervision	4	9.1
	I feel proficient in the simulated setting with assistance	10	22.7
	I need further instructions for review	30	68.2
Do you have any previous training in basic/advanced airway management?	Yes	14	31.8
	No	30	68.2
Please specify any prior airway training	Airway courses	2	4.6
	Basic life support courses	12	27.2
	Not applicable, no prior training	30	68.2

Table 2. *Pre- and post-training cognitive assessment scoring using an independent sample t-test.*

Questions	*N*	Pre-training	Post-training	*p*-value
Initial basic maneuvers to establish the airway of an unrestrained driver	44	0.09 (0.293)	0.48 (0.505)	0.000
Establishing the patient's airway in the setting of a suspected cervical spine injury	44	0.26 (0.442)	0.30 (0.463)	0.647
Establishing a patent's airway for neck hematoma	44	0.33 (0.476)	0.12 (0.328)	0.010
Inadequate ventilation	44	0.56 (0.502)	0.60 (0.495)	0.651
Basic maneuvers to maintain the airway of a restrained passeçnger	44	0.35 (0.482)	0.86 (0.351)	0.000

respectively, after training (Figure 1). There was no statistical significance between the instructor's grade and the student's self-perception of proficiency (Figure 2).

Discussion

In this study, we were able to implement the ACS/ASE Basic Airway Management module in medical school curriculum by expert practicing physicians and technicians from anesthesia and emergency departments. Our team of experts were instructed to follow the module for standardization.

The observed significant improvement of student's cognitive assessment scores after the module was mainly in the initial basic maneuvers for unrestrained drivers and restrained passengers. Similar improvement in scores was observed in a similar study implementing the same module but the instructors were surgical residents [13]. Interestingly, the scores for the initial management of patients with neck hematoma was observed to be lower after the module. This could be due the fact that it was the most difficult scenario and students probably answered randomly. Emphasis of this part of basic airway management should be added to the didactics as the focus on basic airway management in trauma patients was mainly on maintaining inline neck immobilization by jaw thrust maneuver.

Similar to the previous results of the above-mentioned study, significant improvement was noted in the performance of the skills and global rating scores [13]. Since it was a hands-on practice rather than discussion based, our participants were more insightful about their proficiency level as there was no statistical significance between the instructor's grade and the student's self-perception of proficiency. In general, SBT has shown to be effective at providing students with airway management experience [13].

Additional advantages of SBT were shown in previous studies and have found that it is more enjoyable to medical students in comparison to didactics [14,15]. Furthermore, students who participated in a knowledge test achieved higher scores than those who participated in a discussion [14,15].

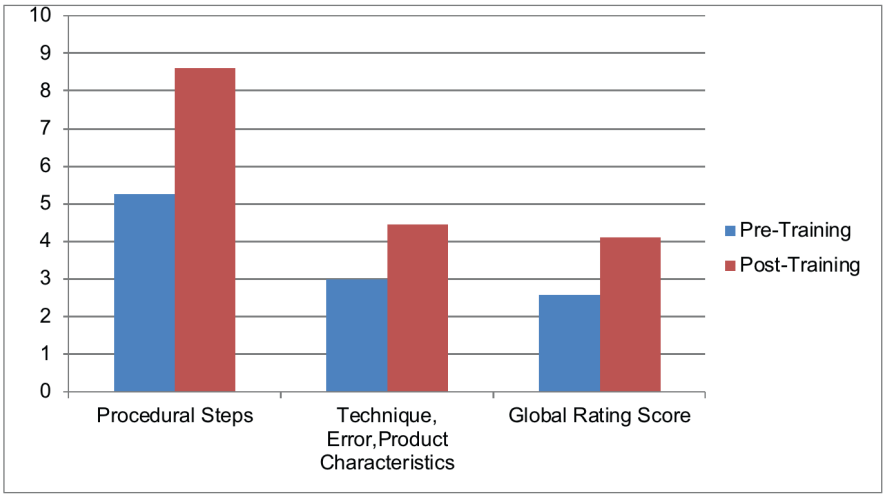

Figure 1. *Pre- and post-training performance rating scores.*

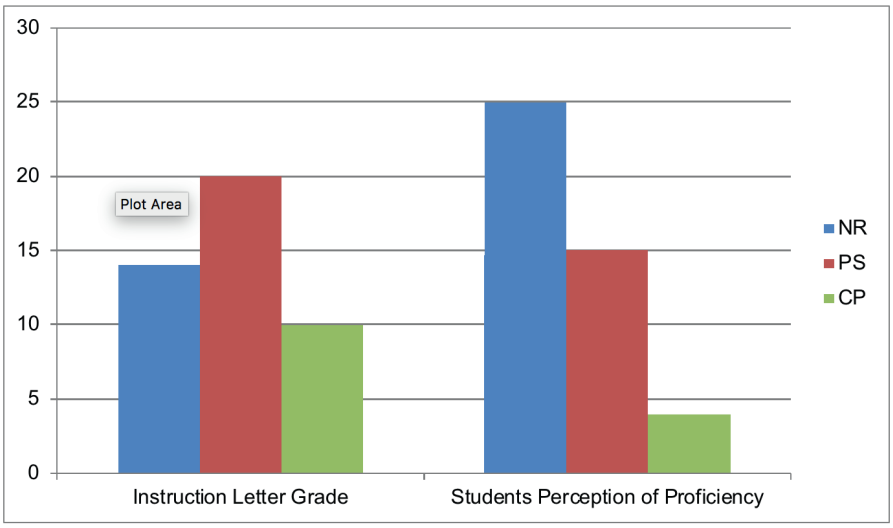

Figure 2. *Comparison of instructor's grade versus student's perception of proficiency, NR = needs review; PS = proficient in a simulated scenario; CP = proficient in a clinical scenario.*

Based on our findings, we highly recommend incorporating SBT in airway management in undergraduate health care student's curriculum in a standardized form. A previous study conducted a national survey with medical students and clerkship directors to determine the topics that should be incorporated in a simulation-based curriculum for medical students, including a specified time period of when these topics should be offered. Both groups were in overall agreement regarding the content; however, 4th-year medical students expressed that some topics in medical school should be taught earlier than when the clerkship directors felt it was essential [16]. In other studies, student skills were assessed in a simulated environment, and the students rated the experience as highly significant [17,18].

This study has several limitations, which may have important implications regarding the potential widespread integration of the ACS/ASE Basic Airway Management module into the medical school curriculum. First, the study only included female participants as it was conducted at a women-only university. Second, the assessment tools used in the study were taken from the original module without further validation for our students. Third, the study did not include a control group. Randomization of student cohorts to a conventional skills session may be incorporated into future studies for the improved assessment of utilization effectiveness. Finally, a long-term follow-up of skills-retention was lacking; future studies should include a long follow-up period for investigating the progressive implementation of this module in medical student curriculums.

Conclusion

A framework to implement the ACS/ASE Basic Airway Management module in the medical education curriculum was assessed. The ACS/ASE curriculum is pilot-tested, portable, and free. This module proved to be feasible for implementation and effective in regard to airway management training in our small group of PNU students. Therefore, the adaptation of this module for basic airway management skills training during the first 3 years of medical education is highly recommended.

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List of Abbreviations

ACS	American College of Surgeons
ASE	Association for Surgical Education
SBT	Simulation based training

Conflict of interest

The authors declare no competing interest.

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None.

Consent to participate

All student participants provided informed consent.

Ethical approval

The study was approved by the institutional review board in PNU (PNU IRB log number: 19-0255).

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