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Aim: The study aims to evaluate the learning outcomes of various types of intubation for paramedic and anesthesia students before and after studying two courses of airway management in the department of clinical technology.

Methods: A model for measuring, comparing, and analyzing the fields of knowledge about skills and experiences obtained by the students is prepared. Students are enrolled from the emergency medical service and the anesthesia department of clinical sciences at the Faculty of Applied Medical Sciences at Umm Al-Qura University in Makkah Al-Mukarramah.

Results: Psychomotor skills were the most important domain among students in EMS department, followed by airway compromise knowledge, intention or attitude, and effective communication.

Keywords: *EMS paramedics, endotracheal, glidescope, intubation, technology.*

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Intubation Types among Paramedic and Anesthesia

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Results: Psychomotor skills were the most important domain among students in EMS department, followed by airway compromise knowledge, intention or attitude, and effective communication. Compromise knowledge was the most important domain among students in the Anesthesia department, followed by psychomotor skills, effective communication, and intention or attitude.

Conclusion: Medical student ETI proficiency was related to cumulative clinical procedural experience in this study. A viable strategy might be presented by clinical experience to foster medical student procedural skills.

Keywords: EMS paramedics, endotracheal, glidescope, intubation, technology.

I. Introduction

Emergency airway management is an essential and crucial element of resuscitation of critically ill patients [1]. The success rates of prehospital endotracheal intubation vary from 69% to 98.4%. There are several categories into which factors contribute to this differentiability in success [2]. These categories include paramedic experience, system factors, and patient factors. A constant challenge has been experienced by paramedics to obtain appropriate exposure to opportunities for performing this critical process as well as balancing this cognitive skills and demanding guidelines [3-5]. The invasive procedure is considered for airway management that allows futuristic appropriate and sufficient administration of medical gases to susceptible patients who are incompetent for carrying out appropriate ventilation throughout different medical or surgical processes [4]. Intubation is one part of airway management, which is considered a lifesaving procedure in several cases [5, 6].

Endotracheal intubation (ETI) has a 30% failure rate in pre-hospital settings by non-physicians in extreme conditions [7]. There are some limitations to use ETI in prehospital settings, even though EETI is a lifesaving and important procedure to secure the airway. Therefore, appropriate guidelines of ETI indicate that it should be performed by skillful, current, and expert personnel such as paramedics or practitioners [8]. In contrast, such personnel lack due to financial crisis in most of the emergency settings, specifically in rural and suburban areas [9]. Also, ETI has been done by gag reflexes, laryngeal spasm, and paralyzing the patient for preventing the head movement. Drug usage is prohibited for Emergency Medical Technician Intermediate, controversial for paramedics, and emergency medical technician basic [10]. Continual and multiple intubation efforts are related majorly with respiratory issues as the intubation failure rate is comparatively high. Also, intubation is a technically difficult procedure and time-consuming procedure, which makes it unrealistic in some conditions, which include trauma patients suffering from bleeding [11].

There is a lack of evidence regarding the requirement of ETI training experts for achieving adequately high success rates with advanced airway management [12]. A median number of total ETIs per student of seven is described from the complete survey of paramedic training programs with suggestions that approximately 25 ETIs are required for achieving an overall ETI success rate of 90% [13]. Several intermediate airway management techniques include placement of oral or nasal airway devices and bag-mask ventilation used by Emergency Medical Technicians [14]. The placement of oropharyngeal airways such as King LT tube, Laryngeal Mask Airway, and Combitube is involved for the most advanced airway management techniques. These airways are reserved for the advanced level of prehospital providers such as physicians or paramedics [4]. Also, airway rescue device placement, cricothyroidotomy, capnography, and endotracheal intubation remain the responsibility of either physicians or paramedics with advanced airway training [9]. Recently, progressions in the refinement of

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oropharyngeal and video-assisted laryngoscopy (VAL) have shown the potential to add or change to the conventional approach of prehospital airway management [11].

It is crucial to continue the process of evaluation and refinement oflearning outcomes for the students taught airway courses during the successive years to adopt new strategic plans for better student learning outcomes. The role of intubation is practiced in most respectful universities for many medical students especially the paramedic and anesthesia students through controlled anesthesia simulation labs provided by highly computerized manikins that can sense even a small fraction of error in intubation procedures. In this regard, the study aims to evaluate the learning outcomes of various types of intubation for paramedic and anesthesia students before and after studying two courses of airway management in the department ofclinical technology. The study is significant in the context of Saudi Arabia, where there lacks evidence regarding the association between the level of both education of students and their training about intubation with the clinical patient outcomes of care.

II. Material and Methods

The study had used National Registry Checklist for evaluating the student performance before and after the teaching of two Airway Management Courses where students had practical sessions and lectures with laboratory simulations and video demonstrations for all types of intubation over a minimum of two semesters (30 weeks). An evaluation form is developed for measuring the four domains of learning, which include (1) intention and attitude toward helping students; (2) psychomotor skills obtained for managing airways compromise; (3) effective communication with self, patients, and all the health team members; and (4) knowledge about anatomy, diagnosis, physiology, and management of airways compromise. The study has collected data from the paramedic and anesthesia technology students' pre and post airways management courses (n = 128). The study has measured knowledge, attitude, skills, and effective communication for all students before and after the two courses in the class.

An unblended observer records the following outcomes (1) overall intubation success rate; (2) number of intubation attempts; (3) modified Cormack-Lehane score; (4) intubation time; (5) frequency of esophageal intubation; (6) mucosal trauma; (7) lip or dental injury; and (8) desaturation (SpO2 <95%).

a) Procedures

Intubation using Glide Scope video laryngoscopes can be simplified when applying the following points:

1. Successful oral endotracheal tube (ETT) placement always requires some form of a stylet, such as the Glide Rite Rigid Stylet (Verathon)—a reusable rigid stylet—or the Satin-Slip (Mallinckrodt) disposable intubating stylet. Otherwise, the ETT is floppy and very hard to direct through the vocal cords. A stylet is not used for nasal intubation.
2. The primary limitation in using the Glide Scope is not in getting a good view of the glottis, but rather in manipulating the ETT through the vocal cords. This is because the ETT tip often tends to hit against the anterior tracheal wall. When this happens, it is often helpful to retract the stylet by 3 to 5 cm, as this often advances the ETT into a more favorable position. Sometimes, even when the stylet is removed completely, the ETT still abuts against the anterior tracheal wall; in these cases, the ETT should be twisted by 180 degrees.

When initially placing the Glide Scope video laryngoscope blade or the ETT, learners should first look into the patient's mouth and not at the monitor to prevent injury to any oropharyngeal structures.

b) Statistical Analysis

The baseline characteristics are presented using descriptive statistics. Categorical data are expressed as counts, whereas continuous variables are given as mean ± standard deviations. The general linear model analysis of variances (ANOVA) is used to compare the means of different domains. All calculations were performed using the IBM SPSS software for Windows, version 20.

III. Results

Table 1 presents a descriptive analysis for department and evaluation. The findings have shown that a total of 65 students belong to the anesthesia department (50.8%), whereas 63 students belong to the EMS department (49.2%). Also, a total of 67 students were evaluated for post-course, and 61 students were evaluated for pre-course knowledge.

Table 1: Descriptive Analysis for Department and Evaluation

Department	Frequency	Percent
EMS	63	49.2
Anesthesia	65	50.8
Total	128	100.0
Evaluation	**Frequency**	**Percent**
Pre	61	47.7
Post	67	52.3
Total	128	100.0

The statistical difference for domains in the EMS department is presented in Table 2 using the ANOVA test. The findings have shown a significant mean difference for all domain's knowledge among students in the EMS department. Psychomotor skills were the most important domain among students in the EMS department, followed by airway compromise knowledge, intention or attitude, and effective communication.

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Table 2: ANOVA Test for Different Domains in EMS Department

Domain Name	Evaluation Pre or Post	Number of cases	Mean	P- value
Intention /attitude	Pre	31	.0758	.000
	Post	32	.3491	
Communication Knowledge	Pre	31	.1285	.000
	Post	32	.3029	
P Skills	Pre	31	.1566	.000
	Post	32	.3544	
Effective Communication	Pre	31	.0387	.000
	Post	32	.3333	

The statistical difference for domains in the Anesthesia department is presented in Table 2 using the ANOVA test. The findings have shown a significant mean difference for all domain's knowledge among students in the Anesthesia department. Compromise knowledge were the most important domain among students in the Anesthesia department, followed by psychomotor skills effective communication, and intention or attitude.

Table 3: ANOVA Test for Different Domains in Anesthesia Department

Domain Name	Evaluation Pre or Post	Number of cases	Mean	P- value
Intention /attitude	Pre	30	.0181	.000
	Post	35	.5014	
Compromise Knowledge	Pre	30	.0941	.000
	Post	35	.3170	
Psychomotor Skills	Pre	30	.0688	.000
	Post	35	.3804	
Effective Communication	Pre	30	.0647	.000
	Post	35	.4493	

IV. Discussion

The study has evaluated the learning outcomes of various types of intubation for paramedic and anesthesia students before and after studying two courses of airway management in the department of clinical technology. Psychomotor skills were the most important domain among students in EMS department, followed by airway compromise knowledge, intention or attitude, and effective communication. On the contrary, compromise knowledge was the most important domain among students in the Anesthesia department, followed by psychomotor skills effective communication, and intention or attitude. The deliberate practice model of Ericsson offers a theoretical framework to understand the ETI skill utilization in this study. Repetition alone might not lead to an expert or superior skill levels, whereas experience might enhance performance in an activity. It has been argued that students practicing deliberate practice must be involved in intense goal-directed learning for achieving higher levels of proficiency [15, 16]. The student must pursue learning activities for correcting limitations and enhancing performance and must be merged with immediate correction, remediation, repetition, and feedback. Students must perform tasks outside their existing areas of authentic performance to involve in deliberate practice.

This study has illustrated that students must perform tasks outside their current areas to depict the utilization of fundamental ETI skills by novice medical students regardless of previous specialized airway management skills. Additional specialized goal-directed learning must be achieved by an expert-level ETI beyond the scope of the fundamental anesthesia curriculum [17]. In this study, the complementary using of human-simulator training might have contributed to use ETI skills. It has been argued that ETI proficiency must be obtained by paramedic students using human simulator or training based regardless of the live operating room. Simulated ETI training is included by previous studies before clinical experience [17, 18]. Intensive teaching without any distractions of current clinical care is facilitated by simulator/mannequin-based training theoretically to allow for isolated or concentration elements of a skill or process. However, the design of this study did not allow assessment of the interactive or independent influence of simulation upon clinical ETI performance.

This study cannot assess the safety of student ETI efforts in the operating room, but it is assumed that the courses were relevant, considering the culture and guidelines of the institution. For instance, the institution has a strict policy to attend anesthesiologist during ETI and anesthesia induction. The majority of student ETIs occurred on patients rated Mallampati class I or II, which indicated that easier cases were intubated preferentially by students. Also, only one medical student laryngoscopy attempt was involved in mostly patient experiences, which signaled the potential limitation of

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student ETI efforts. It has been believed that early medical student exposure to ETI training is authentic until the experience is adequately supervised. Without adequate supervisory culture or resources, institutions might not be able to achieve the same balance between patient safety and education.

a) Limitations

The study was unable to adjust or quantify for prior airway experience. Self-reporting bias might have resulted in over-reporting of student ETI success while supervising anesthesiology staff confirmed all logbook entries. Students in this study might have differently performed easier intubations. In addition, there was a wide variation in the number of ETI chances provided to each student. Other airway management procedures were not evaluated, such as laryngeal mask airway insertion, or bag-valve-mask ventilation. There was no information regarding the attributes of instructors or students. The study has not controlled for patient selection, education, or ETI techniques used and other aspects of clinical care. Similarly, the study has not controlled for differences in instructional technique or instructor, and changes in clinical skill over time.

Performance might have differed with longer or additional clerkship experience. This study has only evaluated psychomotor skills and knowledge-related abilities, which do not allow to evaluate decision-making skills. Intubation performance by medical students should be depicted under supervised and controlled operating room conditions, and cannot be examined outside of this clinical practice setting. Skill utilization might have been influenced by other factors. For instance, the learning process might be influenced by the quality and nature of instructor-trainee interaction. Students might be motivated to pursue critical care-oriented fields for learning ETI, achieving higher rates of early ETI success, and performing a larger number of ETIs.

V. Conclusion

The learning curve for prehospital ETI success rates explains an increase in the odds of successful ETI with each cumulative training exposure to ETI in a paramedic training program with significant clinical opportunities and resources. High numbers of previously performed ETIs might be required for first-pass placement of the ETT that may surpass the number available in training programs. Medical student ETI proficiency was related to cumulative clinical procedural experience in this study. A viable strategy might be presented by clinical experience to foster medical student procedural skills.

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