

Research Article

Endotracheal Intubation and Airway Management Skills of Iranian Freshman Emergency Medical Students in 2014

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ABSTRACT

Background: Evaluating emergency medical students' skill of endotracheal intubation (ETI) as the best and challenging procedure to airway control for seriously ill and injured patients, is important for validating the utility and effectiveness of educational experience they previously received.

Methods: A descriptive- analytical study was conducted on 146 Iranian freshman students who newly admitted for emergency medical Bachelor's degree in Alborz medical science university in 2014. Students' knowledge and skill of endotracheal intubation were measured on a model through a visual checklist contains 17 stages in which each stage had a maximum. Data was analysed by the SPSS software through one-sample t- test statistical test.

Results: Evaluating students' knowledge and skill of ETI revealed that however, majority of students had skill' score more than 30 out of 40 (optimal score), but the mean score of all students showed a negative significant distance between actual gained skill of students and optimal skill according to ETI standard techniques. Moreover, the least distance was seen about stages which was related to initial evaluation, scene evaluation and appropriate position of head and neck that don't need much skill. Adversely, some stages which were really crucial to survive critically ill patient such as Intubation correctly, Check tube placement and preparing intubation equipment had the most gap to optimal level.

Conclusions: Regarding the results, either they haven't learned ETI courses previously very well or have forgotten whatever they learned. Therefore, training programs both theoretically and practically should be strongly encouraged and given high priority.

Keywords: Endotracheal intubation, Airway management, Students' skill and knowledge, Emergency medical services, Iran.

INTRODUCTION

Primary prevention continues to be one of the most important ways to reduce the burden of injuries and damages while evidence showed that many of the deaths and long-term

disabilities are preventable by strengthening trauma and emergency care.^[1,2] Survival rates have been increased when patients in shock receive aggressive and integrated management

of both pulmonary and cardiovascular systems.^[3-6] According to statistics, out-of-hospital cardiac arrest is a leading cause of death in the world.^[7] But survival is less than 10%, with little improvement seen over the last 30 years.^[8] However, low survival in out-of-hospital arrests may depend on different factors, outcomes may be improved if early and effective cardiopulmonary resuscitation (CPR) and defibrillation are provided.^[7,9] Airway management is one of the fundamental out-of-hospital resuscitation of critically ill and injured patients^[10] which needs to be done rapidly and effectively because respiratory support can be considered the primary concern of personnel managing a critically ill patient^[3]

Endotracheal intubation is known as the best and challenging procedure to airway control for patients in shock or with unprotected airways^[11] which applying by emergency medical services (EMS) personnel in the prehospital setting decreases the rate of death and helps to improve the outcome of critically ill patients, especially those with cardiac or respiratory arrest, multiple injuries, or severe head trauma.^[12]

Mastery of ETI is particularly important for paramedics, who must perform the intervention on critically ill patients under challenging conditions.^[13,14] Failure to airway management is associated with negative outcomes in some patients.^[15,16] The ability to accomplish ETI in the out-of-hospital setting can be affected by multiple factors involving the patient, the environment, and the skill and experience of the operator.^[11] Mock et al (2009) also, believe that resources needed for treatment of obstructed airways categorized into Human (skills, training, staffing) and physical (equipment, supplies) resources.

Personnel skills and training to improve their skills as human resources are critical for airway management. Poor resuscitation performance may be the consequence of inadequate opportunities to practice and refine resuscitation skills.^[2] However, it should be noted that Successful airway management is dependent on a comprehensive understanding of pathophysiological processes and high competence in advanced corrective

interventions, and is not equivalent to good technical skills in ETI alone^[17], but adequacy of their skills is really essential. Some studies highlight adverse events and errors associated with paramedic ETI, including poor outcomes, unrecognized tube misplacement, oxygen desaturation, and bradycardia, among others^[18-20] which maybe is related to lack of continuous and updated training. Wang (2001) stated that conventionally-trained out-of-hospital rescuers such as paramedics often fail to accomplish endotracheal intubation (ETI) in patients requiring invasive airway management.^[21] In addition, prehospital emergency medical personnel are not always trained or authorized to perform this potentially lifesaving manoeuvre.^[22]

Assessing medical student ETI skill acquisition is important for validating the utility and effectiveness of educational experience they previously received.^[23] Therefore, considering importance of emergency medical services (EMS) personnel skills toward ETI, an attempt was therefore made to test the theoretical and practical ability of Iranian freshman emergency medical students based on the standard guidelines of ETI to figure out how big the gap between their current and optimal skills is.

METHODS

Research method and samples

A descriptive- analytical study was conducted. The subjects included 146 Iranian freshman students who newly admitted for emergency medical Bachelor's degree in Alborz medical science university in 2014. The 146 students were calculated using Cochran's formula and selected randomly.

The inclusion and exclusion criteria were as follow: Inclusion criteria included all students who had passed the course of airway management and ETI in the previous educational section and were voluntarily satisfied to participate in this study.

Exclusion criteria included was the lack of willing to participate and continue in this study. All study procedures were explained to the students, and they were participated after obtaining their informed consent.

Materials and study process

Data were collected through a questionnaire of demographic information (age, marital status, being employment, work experience, work setting, the previous university, the average score, the status of interest, knowledge and attitudes toward their field of study) and a standard checklist include a set of guidelines for the performance of airway management were formulated by American Heart Association (AHA).^[24]

While students had attended Alborz medical university to register in new curriculum, the questionnaires were distributed randomly after describing study procedures and how they have to ask question. The response rate was 100%.

Students' attitudes towards their field of study were measured by a scale of 13 items covering Strengths and weaknesses of emergency medical curriculum and asked them to answer based on Likert range of 1 = strongly disagree to 5 = strongly agree. To measure students' knowledge and skill about endotracheal intubation procedure, a standard checklist contains 17 steps of endotracheal intubation was used in which each step had special score that was the maximum value. For knowledge and skill test, 2 manikins (models) were used and students were asked supposing that there is a patient with GCS<9, No breathing with HR=120 and locating ETI stages in correct order firstly and then doing practically gradually on the manikins. Finally, the actual score of students for each stages and total were calculated and compared to optimal (maximum) score. Students with previous knowledge on the priority of each stage practically performed more accurate and quicker; thus, gained optimal scores.

RESULTS

The majority of the participants aged 30 to 35 years and were married. About 97 percent of them were employment and only 3 percent were unemployment. Most of them (62.3 percent) had more than 5 years' work experiences and worked (93 percent) in 115 emergency bases and the rest worked in hospitals (5.5 percent) and private

emergencies. Average score of them ranged 15 to 17 mostly (Table 1).

Moreover, the results showed that the majority of students (92.5 percent) had high and very high familiarity with their field of study and the rest had moderate (6.2 percent), low (0.7 percent) and without (0.7 percent) familiarity. Moreover, according to students' interest about their field of study results, the majority (94.5 percent) had high and very high interest about their field of study and only 0.7 percent of them had no interest about their field of study (Table 2).

Students' Attitude toward their emergency medical curriculum

According to research findings, the majority of students (95.8 percent) were agree and strongly agree toward their emergency medical curriculum. In other word, most of them had positive attitudes toward their field of study and no one had negative attitude. The mean and standard deviation of attitude value was 4.12 ± 0.406 which showed that participants' attitudes were into positive range (Table 3).

Endotracheal intubation and airway management' skills of emergency medical students

Evaluating theoretical and practical skills of students about endotracheal intubation and airway management procedure showed that the mean score of total skills they gained was about 30 which was significantly lower than optimal score of 40 and a gap of 10 score were seen. Moreover, emergency medical students were categorized into three groups based on their skill score as fallow: the first group with low skill that their score was under 20 and contained about 18 percent of students. The second group with moderate skill that their score were between 20.1 and 30 which contained about 20 percent of them and the third group with high skill which gained scores more than 30.1 and contained about 62 percent of students (Table 4). However, the majority of students had acceptable skill but according to comparing mean score of total studied population' skill with maximum (optimal), students' skill were

significantly far from optimal and there was not complete familiarity with endotracheal intubation and airway management. In addition, there is a significant gap of 10.40 between actual gained skill and optimal skill (Table 5).

The results of evaluating students' knowledge and skills about individual stages of endotracheal intubation and airway management also showed that there were significant gap between actual skill score of all stages with optimal score. This means that there was not any stage which done correctly by all students. However, some stages had more gaps and some had fewer gaps which realized the level of students' skills about them. The fewer stages far from optimal, the more correctly performed stages (high skill). According to ranking of endotracheal intubation which was done based on mean differences, "initial evaluation", "scene evaluation" and "Appropriate position of head and neck" with mean differences of -0.137, -0.151 and -0.158 were ranked first to their respectively. In other word, against other stages, these three stages was done more correctly by students and a little distance was seen between actual gained skill and optimal needed skill. Reversely, stages of "Intubation correctly (Insert blade in right side of mouth, Do not use teeth as fulcrum, Insert endotracheal tube while maintaining visualization of vocal cords, withdraw laryngoscope from mouth correctly, Inflate endotracheal cuff properly)", "Check tube placement (Visual observation of the tube passing through the vocal cords, Auscultate stomach and lung fields for adequate breath sounds)" and "Preparing intubation equipment (Equipment checked to ensure working properly, Select appropriate size of endotracheal tube, Laryngoscope blade inserted properly, Hold laryngoscope correctly in hand)" with mean differences of -1.411, -1.116 and -1.048 were ranked in the last respectively which means that students had the lowest knowledge and skill about these stages and have not done correctly and quickly.

DISCUSSION

The skill of ETI is the main airway control for most critically ill and injured patients in the

operating room, in the early phases of an intensive care unit (ICU) hospitalization, or in the out-of-hospital setting.^[25,26] Moreover, prehospital ETI was correlated with positive outcomes particularly in the most challenging circumstances^[26,27] like cardiopulmonary arrest cases and in the most severely injured trauma patients. Therefore, being update of care providers especially emergency medical students' knowledge about ETI and theirs skills status is crucial to increasing rate of survival.^[28] In this regard, to know how update knowledge and skills of emergency medical students who newly admitted to Alborz medical university of Iran and have passed the ETI courses before, were, a theoretical and practical test through two manikins by ETL procedure were done in this study. Another aim was that, is hiatus after passing ETL courses in classroom affect negatively on the students' knowledge and skill? The results of demographic characteristics of students showed that all students except three percent of them were working particularly in 115 emergency bases for more than 5 years. However some of them were working in hospitals and private emergencies. These means that they were involving in emergency care services and weren't much far from life-saving activities. In addition, they were really interested in your field of study and had positive attitudes towards emergency medical services and curriculum. Therefore, it was assumed that students' knowledge and skills of ETI and airway management is updated without significant distance to optimal one.

Evaluating students' knowledge and skill of ETI revealed that however, majority of students had skill' score more than 30 out of 40 (optimal score) and were categorized as students with high skill, but the mean score of all students showed a negative significant distance between actual gained skill of students and optimal skill according to ETI standard techniques. In other word, can be said that there were fluctuations among students in case of their knowledge and skill about ETI as some of them were highly skillful and some were skillless. Therefore, according to results, hiatus after passing ETI courses in classroom affected negatively on the

students' knowledge and skill. Pepe (2015) also stated that ETI skills may deteriorate a little with a hiatus from practice. It may refer to both lack of frequent experience and real scenes of injured patients along by a group to practice team working. Tarasi et al. (2011) believe that while experience may improve performance in ETL, repetition alone may not lead to superior or expert skill levels.^[23] Moreover, Even if initial training techniques are expert and well-taught, both in the classroom and on-scene, frequency of performance is a critical factor.^[26]

While in all stages of ETI, also the students' knowledge and skill was significantly far from maximum level, but in some stages, this gap was lower than others. The least distance was seen about stages which was related to initial evaluation, scene evaluation and appropriate position of head and neck that don't need much skill. Adversely, some stages which were really crucial to survive critically ill patient such as Intubation correctly, Check tube placement and preparing intubation equipment had the most gap to optimal level. As a result, students had more knowledge about stages which were simple to perform and just need an evaluation but in stages with more details which need precise operations, they had the least information and skill. Thus, either students haven't learned ETI courses previously very well or have forgotten whatever they learned. In total, what is really important is that low skills of emergency medical student led to low quality of CPR particularly ETI and when the quality of CPR is poor, survival rates are decreased.^[7,29-30]

Therefore, attention to training programs and methods both theoretically and practically by experts are really essential because the efficacy of resuscitation can be maximized when EMS practitioners develop and maintain competency in the skills and knowledge of resuscitation by more training (4 dyson). In addition, resuscitation skills is about to deteriorate rapidly after training.^[31-34] Thus, the use of the endotracheal tube in the prehospital setting should be strongly encouraged and the training of EMS personnel in this skill should be given high priority.

In Mexico, Arreola-Risa et al. reported on training programmes designed to strengthen the performance of an existing, basic EMS. In this locale, few prehospital providers had formal certification as emergency medical technicians. An effort by local government provided better training for existing staff and tightened requirements for newly hired staff so that all full-time staff were eventually certified. As a result, mortality for all trauma patients treated by the EMS decreased from 6.3% to 2.5%.^[2,35] The effective training programs in order to improve students' knowledge and skill and maintain update must fallow some points such as: first, Training and experience are more important than the type of practitioner for intubation success.^[17] Therefore, Attainment of expert-level ETI likely requires additional specialized goal-directed learning beyond the scope of basic anaesthesia curriculum. Moreover, learning activities pursued by the student must correct weaknesses and improve performance, and must be coupled with immediate feedback, correction, remediation and repetition.^[23] Second, the methods used to train paramedics in airway management should re-examine.^[14] Third, the training programs must repeat frequently with update information. As O'Flaherty (1992), stated, medical students can obtain better results at correct tube placement with repeated attempts under optimum conditions. With increasing quality of training programs, the emergency medical personnel' skill improve and subsequently the rate of survival increase.^[36]

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Table 1. Frequency distribution of the majority classes of studied variables

variables	The majority class	Frequency	percent
Age range	30-35	73	50
Marital status	Married	106	72.6
Employment status	Employment	142	97.3
Work experience	> 5 years	91	62.3
Work setting	115 emergency base	136	93.2
The average score	15-17	95	65.1

Table 2. Frequency distribution of studied students based on familiarity and interest about their field of study

variables	None		low		moderate		high		Very high	
	Frq.	Pct.	Frq.	Pct.	Frq.	Pct.	Frq.	Pct.	Frq.	Pct.
Familiarity with their field of study	1	0.7	1	0.7	9	6.2	63	43.2	72	49.3
Interest about their field of study	1	0.7	0	0.0	7	4.8	41	28.1	97	66.4

Frq. = frequency Pct. = Percent

Table 3. Frequency distribution of Participants' attitude towards their emergency medical curriculum

Attitude toward emergency medical curriculum	frequency	percent	Mean ± SD	Min.	Max.
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Strongly disagree	0	0.0	4.12 ± 0.406	2.92	4.85
Disagree	0	0.0			
No opinion	6	4.1			
Agree	103	70.5			
Strongly Agree	37	25.3			
Total	146	100.0			

Scale range: Strongly disagree = 1, Disagree = 2, No opinion = 3, Agree = 4, Strongly Agree = 5

Table 4. Frequency distribution of students based on their endotracheal intubation and airway management' skills

<i>skills level and score</i>	<i>Frq.</i>	<i>Pct.</i>	<i>Cum. Frq.</i>	<i>Mean ± SD</i>	<i>Min.</i>	<i>Max.</i>
*X ≤ 20 (low skill level)	26	17.8	17.8	29.6 ± 9.45	4	40
20.1 ≤ X ≤ 30 (moderate skill level)	29	19.9	37.7			
X ≥ 30.1 (high skill level)	91	62.3	100.0			
Total	146	100.0				

*X= Skill score gained by students; Frq. = frequency; Pct. = Percent

Table 5. Compare mean of students' actual endotracheal intubation skill with optimal score

<i>actual endotracheal intubation' skills</i>	<i>Mean score gained</i>	<i>Optimal score</i>	<i>t value</i>	<i>Sig.</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>	
						<i>Lower</i>	<i>Upper</i>
	29.60	40	-13.3**	0.000	-10.40	-11.95	-8.86

** Significant at 99% level

Table 6. Compare mean of students' actual endotracheal intubation skill with optimal score stage by stage

<i>endotracheal intubation' procedure</i>	<i>Mean score gained</i>	<i>Optimal score</i>	<i>t value</i>	<i>Sig.</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>		<i>Rank</i>
						<i>Lower</i>	<i>Upper</i>	
Scene evaluation	0.85	1	-5.07**	0.000	-0.15	-0.21	-0.09	2
Safety and BSI	1.39	2	-9.52**	0.000	-0.61	-0.74	-0.48	10
Accident Scene Management and stress control	1.23	2	-13.70**	0.000	-0.77	-0.89	-0.66	12
Initial evaluation	0.86	1	-4.32**	0.000	-0.14	-0.20	-0.07	1
AVU evaluation	1.62	2	-7.30**	0.000	-0.38	-0.49	-0.28	5
open airway technique for trauma patient (JT)	1.39	2	-9.52**	0.000	-0.61	-0.74	-0.48	9
open airway technique for non-trauma patient (H.C)	1.58	2	-7.40**	0.000	-0.42	-0.53	-0.31	6
Suction Oropharynx (closed on entry, exit rotations & maximum of 15 seconds.)	2.19	3	-10.17**	0.000	-0.82	-0.97	-0.66	13
proper position while Ambu bag Ventilation (above patient's head) and shooting two Ambu bag	2.10	3	-11.25**	0.000	-0.90	-1.06	-0.75	14
Preparing intubation equipment (Equipment checked to ensure working properly, Select appropriate size of endotracheal tube, Laryngoscope blade	2.95	4	-11.10**	0.000	-1.05	-1.24	-0.86	15

inserted properly, Hold laryngoscope correctly in hand)								
Appropriate position of head and neck	0.84	1	-5.21**	0.000	-0.16	-0.22	-0.10	3
Intubation correctly (Insert blade in right side of mouth, Do not use teeth as fulcrum, Insert endotracheal tube while maintaining visualization of vocal cords, withdraw laryngoscope from mouth correctly, Inflate endotracheal cuff properly)	3.59	5	-11.24**	0.000	-1.41	-1.66	-1.16	17
Done procedure properly (pulling forward and up)	1.34	2	-11.35**	0.000	-0.66	-0.78	-0.55	11
Attention to proper intubation time (10-20, 20-30 seconds)	1.47	2	-7.98**	0.000	-0.53	-0.66	-0.40	8
Check tube placement (Visual observation of the tube passing through the vocal cords, Auscultate stomach and lung fields for adequate breath sounds)	2.88	4	-10.29**	0.000	-1.12	-1.33	-0.90	16
Lack of air sounds in lung (Deflate cuff, pulling tube out one to two centimetre and refilling)	1.57	2	-6.78**	0.000	-0.43	-0.56	-0.31	7
How to properly fix the endotracheal tube	1.64	2	-6.07**	0.000	-0.36	-0.48	-0.25	4

** Significant at 99% level