DOES MANAGEMENT OF CARDIAC ARREST SCENARIOS DIFFER BETWEEN RESIDENTS OF DIFFERENT DISCIPLINES? A COMPARISON WITH SIMULATION

Mehmet Emin Aksoy*, Dilek Kitapcioglu**,
Gulay Eren*** and Cengiz Yumru**

Abstract

Background: Training multidisciplinary teams using simulation allows for communication, development and maintenance of teamwork. In this study we compared the behavior of residents from emergency and anesthesiology departments on treatment of cardiac arrest.

Methods: 42 anesthesiology and 29 emergency residents are included in the study. Two scenarios were designed for diagnosis and treatment of asystole and ventricular fibrillation. First scenario was a case with ventricular fibrillation (VF) and the second was an asystole case. ACLS protocols were used for assessment. Age, years of training, and years in practice were compared for each group.

Results: Anesthesiology residents attempted to secure the airway immediately after checking the carotid pulse and began the cardiac compressions. After intubation, the vast majority (88%) of participants monitorized the patient. Only 11.9% of the residents started compressions and were reminded to monitorize the patient.

Emergency residents immediately started CPR with compressions and ventilation by mask. 79.3% of them decided to intubate after a few compressions but 20.7% of them didn't attempt it. 50% of the residents monitorized the simulator whereas the other half was reminded to. There was no significant difference between the groups in terms of ventricular fibrillation and asystole management, but the age of the doctors was a decisive factor affecting the success in the VF simulation.

Conclusions: This study demonstrates the use of simulation to identify the deficiencies in basic knowledge and the skills of emergency and anesthesiology residents. It highlights the need to emphasize criteria that should be used in resuscitation.

Keywords: anesthesiology, simulation, ACLS protocol, medical education.

* Biomedical Engineering, Turkish Ministry of Health, Istanbul Health Directorate.

** Taksim Training and Research Hospital.

*** Bakirkoy Dr Sadi Konuk Training and Research Hospital, Departments of Anesthesiology and Intensive Care, Turkish Ministry of Health, Istanbul Health Directorate, Simmerk Advanced Medical Simulation Center, Istanbul, TURKEY.

Corresponding Author: Gulay Eren, Büyükdere cad. Binbircicek sok. No:2 K:4 34330 Levent/İstanbul, TURKEY. E-mail: glyeren@mynet.com. Phone: +90 212 2683545, Cell: +90 505 4782578, Fax: +90 212 2842255.

Introduction

Simulation in medicine was first introduced in the 1960s, although increased attention to medical simulation did not emerge until the 1980s when advances in technology allowed for increased feasibility in producing high-fidelity simulators[1].

There are many reasons why simulation is used in medical education. First and foremost, use of simulation provides no risk to patients; errors may be elicited and corrected without consequence. Simulation also allows the creation of a wide variety of scenarios including less frequent but critical events. Simulation provides flexible, job-specific training and hierarchical learning that can be tailored to a participant's skill level and/or learning style. Simulation can also be used at any time, in an on-demand manner. Thus, training does not have to be delayed due to "real patient" variables. Simulators have predictable behavior and are available at any time to fit curriculum needs. In addition, simulators can be programmed to simulate selected findings, conditions, situations and complications. Simulators also allow standardized experience for all trainees and be used repeatedly with fidelity and reproducibility[2].

Evaluations of clinical performances during actual events are often made retrospectively. But these cases vary in terms of complexity and type of event, which makes it difficult to compare the behavior of clinicians in different crisis situations. Realistic patient simulators offer a tool for the reproducible presentation of complex critical events. Mannequins for cardiopulmonary resuscitation have been used to evaluate performance of the technical actions of basic and advanced cardiac life support (ACLS) protocols. Realistic simulators have also been used to assess the decision-making skills of anesthesiologists during simulated crisis situations.

Training multidisciplinary teams by using simulation allows the instructors to evaluate the performances for communication skills, decision making capabilities. In fact, team training has become increasingly important[3].

We run a simulation center founded by Istanbul Health Directorate of Turkey since 2007. In this advanced medical simulation center, residents from different medical departments like anesthesiology, emergency medicine, general surgery, gastroenterology, radiology and urology are trained with different medical simulators according to a schedule. For anesthesiology, METI HSP6 high-fidelity simulation system is used to simulate physiological functions and disease states for educational purposes with intentional scenarios.

During the past 15 years there have been dramatic changes in the field of emergency medicine. The development of a structured training program, fellowship examination and intercollegiate faculty, have produced a breed of emergency physicians who now have to manage critical conditions within their own departments. However experience at major incidents has shown that anesthetists still have a valuable role in the emergency room (ER). Triage, resuscitation, relief of severe pain and occasionally anesthesia at the site of the incident will be requested from the anesthesists[4].

So it is not surprising to see these two departments working in the ER side by side. In our country they often work together as a team especially for the management of patient with cardiac arrest. The aim of this study was to compare the residents of the two departments on the cardiac arrest cases, which are often encountered incidents at the ER, and to evaluate their clinical performances.

Materials & Methods

42 anesthesiology residents and 29 emergency medicine residents from two different state hospitals of Istanbul were included in this study. Written informed consent was obtained from all subjects for video recording and subsequent analyses of their performances.

Our main anesthesiology simulation room includes a patient stretcher, directional lighting fixtures, equipment and drug carts, an anesthesia unit, utility fixtures (such as O2, forced air and suction), a defibrillator/monitor and vital signs monitor. The simulation procedure and the video output of the vital signs monitor are recorded with a digital video recorder. All of these instruments were used to enhance the realism of the simulation. The instructors were usually in a control room separated by a one way glass window from the simulation room. METI-

HSP6 (Medical Education Technologies Incorporated, Sarasota, FL, USA) is a full-size, computer controlled mannequin (patient) with a variety of physiological functions (e.g. heart and breath sounds, pulses, end-tidal carbon dioxide). Events can be programmed in advance and the simulator reacts in a physiologically and pharmacologically appropriate manner to management actions. Monitors respond immediately to interventions and demonstrate both negative and positive consequences.

The patient mannequin was on the stretcher, and the roles of the emergency staff and the accompanying person of patient was scripted and acted by the instructor. Instructors playing the role of the accompanying persons provided the appropriate panic behavior during the simulation. Two clinically realistic scenarios were developed to simulate asystole and ventricular fibrillation. Subjects were divided into two groups: Group 1 consisted of resident anesthesiologists with varying clinical experience, and Group 2 of residents of emergency medicine.

Just prior to the simulation session, residents were instructed to manage the patient as they would do in the emergency room and verbalize all their observations, possible problems, and treatments administered. Instructors also scored the participants by using recorded video data.

Demographic data, including age, training (duration of residency, and medical experience), and location of practice, were collected from all participants. All participants received a 30-min familiarization of the mannequin and the environment, physiologic monitor, and simulation facility. They were given the same scenarios consisting of:

1) Ventricular fibrillation (VF): a 27 years old case presented by a witness to ER with a collapse out of hospital,

2) Asystole: a 65 years old case found unconscious nearby the hospital and brought to ER within 5 minutes.

The instructors were certified in simulation instructing program. All performances by participants were video-recorded by digital means for subsequent review and assessment.

Depending on 2010 ACLS protocols, management of the cardiac arrest was scored with "score 3" when everything in the protocol was fulfilled. In case of minor deviations, including small changes from the protocols for counter shock energies, drug dosages, or the order of drugs, the score was considered as "score 2". Failure to diagnose the rhythm, failure to counter shock or to administer epinephrine were accepted as major deviations from the protocol leaded to "score 1".

After completion of the simulation scenarios, participants were asked to evaluate the realism of their experience on a 10-point visual analog scale (VAS), whereas a rating of 0 indicated an unrealistic experience and a rating of 10 indicated a completely realistic experience. A discussion of the experience was undertaken with each subject at the end of the simulation.

Statistical Analysis

For statistical analyses NCSS (Number Cruncher Statistical System) 2007& PASS 2008 Statistical Software (Utah, USA) programs were used. Power analysis done before the study showed that: taken as Δ:8,5 SD:10, for power of 0.80 and α:0.05; the subject number of groups was to be 22. Age, years of training, and years in practice were compared for each group using one-way analysis of variance (one way ANOVA). Mean realism VAS scores for all groups were compared using a one-way ANOVA followed by pair wise comparisons, with $p < 0.05$ considered as significant. Years in practice of the subjects were compared with the simulation score using a Pearson correlation coefficient. The simulation realism score was compared with ACLS protocols scores using the Pearson correlation coefficient. $P < 0.05$ considered as significant.

Results

42 anesthesiology residents and 29 emergency department residents were evaluated. Ages of the subjects varied between 25-42 years with a mean of 30.35±3.59 years. The subjects consisted of 52.1% female and 47.9% male subjects. There was no significant difference between groups with respect to gender and time of residency, whereas residents

of emergency medicine were younger than those of anesthesiology (Table 1). All of the residents found the simulation similarly realistic, the realism scores given by groups were similar (Table 1).

Table 1
Evaluation of groups of residents regarding age, residency time; and comparison according to realism scores recorded.

	Anesthesiology	**Emergency Medicine**	**p**
+ **Age (years) Mean±SD**	31,19±3,98	29,13±2,53	*0,010**
++ **Residency (years) Mean±SD**	2,50±1,01	2,08±1,07	*0,095*
+ **Realism Score (VAS) Mean±SD**	8,35±1,22	8,00±1,16	*0,223*

+: Student t test ++: Mann Whitney U test * $p<0{,}05$.

All anesthesiology residents attempted to secure the airway immediately after checking the carotid pulse and gave orders to initiate the cardiac compressions, and all subjects except two managed to intubate the mannequin at their first attempt. After intubation, 37 of 42 subjects monitorized the patient and took over the compressions. The other five residents who started chest compressions first, were reminded to monitorize the patient by the staff.

Emergency department residents immediately started cardiopulmonary resuscitation (CPR) with compressions and ventilation by mask. 23 of 29 subjects from the emergency medicine department decided to intubate after a few compressions but six of them didn't attempt it at all. 15 of the 29 subjects monitorized the mannequin whereas 14 subjects were reminded about it.

The approach of the subjects to VF and asystole scenarios (according to 2010 ACLS protocol) was similar. Approximately half of subjects in both groups had the "score 2" indicating minor deviations from standard protocol (Table 2). When we evaluate the relationship of scores with age and length of residency time of subjects, the subjects with higher ages were found significantly more successful in VF scores. With the longer duration of residency asystole scores were observed to be significantly better (Table 3).

Table 2
Comparison of residents of anesthesiology and emergency medicine in terms of VF and asystole scores. According to the 2010 ACLS protocols, VF and asystole scores were evaluated as 1: major deviations from the protocol, 2: minor deviations from the protocol, and 3: everything in the protocol was fullfilled.

		Anesthesiology	**Emergency Medicine**	**p**
		n (%)	**n (%)**	
VF Score	1	10 (23,8 %)	10 (34,5 %)	***0,577***
	2	22 (52,4 %)	14 (48,3 %)	
	3	10 (23,8 %)	5 (17,2 %)	
Asystole Score	1	-	-	**-**
	2	20 (47,6 %)	13 (44,8 %)	***0,817***
	3	22 (52,4 %)	16 (55,2 %)	

Chi-square test

Table 3
Evaluation of VF and asystole scores according to age and length of residency time. According to the 2010 ACLS protocols, VF and asystole scores were evaluated as 1: major deviations from the protocol, 2: minor deviations from the protocol, and 3: everything in the protocol was fullfilled.

	VF score			**p**	**Asystole score**			**p**
	1	**2**	**3**		**1**	**2**	**3**	
Age (years) (mean±SD)	30,85±2,6	31,00±3,9	28,13±3,2	0,024•*	-	31,09±2,9	29,71±4,0	0,107•
A Residency (years) (mean±SD)	2,00±0,84	2,79±0,93	2,35±1,20	0,107‡	-	2,40±0,83	2,59±1,17	0,517++
EM	2,30±0,91	2,10±1,11	1,60±1,34	0,252‡	-	2,53±1,03	1,71±0,99	0,022++*

A: Anesthesiology, EM: Emergency medicine.
•: Oneway Anova test; ‡: Kruskall Wallis test; ++: Mann Whitney U test.
* *$p<0{,}05$.*

Discussion

The attitude of subjects against VF and asystole scenarios regarding cardiac management (according to 2010 ACLS protocol) was similar. Approximately half of subjects in both groups received the score of “2” indicating minor deviations from standard protocol. Even among the teams that successfully performed ACLS protocols, the incidence of errors, particularly incorrect defibrillator energy setting and drug administration, was frequent. Based on instructors’ observations and feedback from the participants during debriefing, this could be due to several areas of break down in the cognitive process for recognition and treatment. In both group there were teams that did not recognize VF and as a result the appropriate treatment was not pursued. A number of studies of cardiac rhythm interpretation by resident physicians have shown that house staff are error-prone in interpreting dysrhythmias[5-9]. For house staff in emergency and anesthesiology, recognition and treatment of VF should be an emphasis due to its frequent occurrence in emergency patients. However, in the clinical setting this rhythm occurrence may be sporadic, so the need for simulation as an educational adjunct is very important.

The attitude of subjects in airway management during resuscitation differed in both groups. In our study all anesthesiology residents attempted to secure the airway immediately after checking the carotid pulse and tried to intubate the patient, although it is not a priority in 2010 ACLS protocol. After intubation, the vast majority of them ordered monitorization of the patient and took over the compressions but emergency group immediately started CPR with compressions and ventilation by mask without attempting intubation. Residency training in emergency medicine does not emphasize monitoring to the same degree as residency training in anesthesiology. Also the issue of unfamiliarity with defibrillation among emergency and anesthesiology trainees needs to be addressed in corresponding departments.

A study of pediatric house officers by White et al determined that many lacked familiarity with resuscitation equipment, leading to loss of valuable time while attempting to decipher the functionality of the equipment[10]. This discomfort with technical aspects of defibrillation is not unique to emergency trainees. The results of a study by Settgast et al mirror our findings[11]. Their study demonstrated that internal medicine residents had difficulty with simple skills such as turning on a defibrillator, entering appropriate charge and positioning the paddles or pads correctly, even among those who had completed a course in ACLS. After additional teaching and practice in each of these mechanical and technical skills, using simulated experiences comfort levels of task performance[11]. These findings show the need for practice of skills using modalities such as simulation. In our study all of the residents had completed the ACLS course in accordance with standard residency program; despite this they had discomfort and unfamiliarity with the use of the defibrillator. We feel that this makes an important statement about the efficacy of the current standards of training resuscitation during residency. Simulation is a very good opportunity for residents because of providing intermittent refreshments, and refamiliarization of concepts. Prior studies have suggested that simulation is a promising method for enhancing team work training[12]. Simulation has become a teaching modality that can be used as part of an iterative process that allows for diagnosis of knowledge and skill deficiencies and reassesses improvement of individuals and teams[13]. As such this type of training can be cornerstone in achieving a degree of competence before performing skills on actual patients[13].

The limitation in simulation is the difficulty in representing altered mental status using a simulator. Simulation is not reality. Although we tried to simulate an emergency room by equipment and environment, participants insisted that, their approach would be different if this was a real patient. This issue of realism in simulation is discussed frequently in the literature[14-16]. In this study we used METI HPS6 simulator, standardized historical information and objective monitoring data (ECG, pulse oximetry, etc). In an attempt to enhance the realism instructors role-played as patient companions and tried to overcome this limitation. However we recognized that realism and difficulty in representation of physical findings may hinder patient assessment. Also we realized that participants had difficulty in working in other places instead of their hospital. This is another issue to be evaluated. Although we did not make an attempt to measure the teamwork of our participants, it is possible that poor communication and working in a different place may have contributed to mistakes. This is an important point which should be considered in future studies.

Conclusion: The purpose of the study was to identify the approach of emergency and anesthesiology residents to VF and asystole. It was difficult to compare them in real clinical cases so we tried to evaluate the differences by using the simulation scenarios. This study demonstrates the use of simulation to identify the deficiencies in basic knowledge and the skills of emergency and anesthesiology residents. It highlights the need to emphasize criteria that should be used in resuscitation. Theoretically participants know what to do but practically they have deficiencies using defibrillator and to begin treatment without delay. So, simulation is a great opportunity to enhance their practical behaviors. In future studies we hope to show the impact of simulation on the skills and performance of physicians in a much more detailed manner.

References

1. Bradley P: The history of simulation in medical education and possible future directions. *Med. Educ*; 2006, 40:254-262.
2. Issenberg SB, Mcgaghie WC, Hart IR, Mayer JW, Felner JM, Petrusa ER, Waugh RA, Brown DD, Safford RR, Gessner IH, Gordon DL, Ewy GA: Simulation technology for health care professional skills training and assessment. *JAMA*; 1999, 282 (9):861-866.
3. Musson DM, Helmreich RL: Team training and resource management in healthcare: current issues and future directions. *Harvard Health Policy Review*; 2004, 5(1):25-35.
4. The Association of Anesthetists of Great Britain and Ireland: The role of the anesthetist in the emergency service. London. 1991, 1-21.
5. Trzeciak S, Erickson T, Bunney B, Sloan EP: Variation in patient management based on ECG interpretation by emergency medicine and internal medicine residents. *Am J Emerg Med*; 2002, 20:188-195.
6. Giuffre RM, Nutting A, Cohen J, Crawford S, Johnson DW: Electrocardiogram interpretation and management in a pediatric emergency department. *Pediatr Emerg Care;* 2005, 21:143-148.
7. O'rourke DJ, Palac RT, Schindler JT, Keim SG: Clinical utility of adenosine in difficult to diagnose tachyarrhythmias. *Clin Cardiol;* 1999, 22:633-636.
8. Conti JB, Belardinelli L, Curtis AB: Usefulness of adenosine in diagnosis of tachyarrhythmias. *Am J Cardiol*; 1995, 75:952-955.
9. Berger JS, Eisen L, Nozad V, D'angelo J, Calderon Y, Brown DL, Schweitzer P: Competency in electrocardiogram interpretation among internal medicine and emergency medicine residents. *Am J Med*; 2005, 118:873-880.
10. White JR, Shugerman R, Brownlee C, Quan L: Performance of advanced resuscitation skills by pediatric house staff. *Arch Pediatr Adolesc Med;* 2005, 152:1232-1235.
11. Settgast A, Nguyen JT, Devries A, Krebs E, Duane P: An innovative approach to teaching resuscitation skills. *Med Teach*; 2006, 23:90-93.
12. Shapiro MJ, Morey JC, Small SD, Langford V, Kaylor CJ, Jagminas L, Suner S: Simulation based teamwork training for emergency department staff: does it improve clinical team performance when added to an existing didactic teamwork curriculum? *Qual Saf Healthc;* 2004, 13:417-421.
13. Shilkofski NA, Nelson KL, Hunt EA: Recognition and treatment of unstable supraventricular tachycardia by pediatric residents in a simulation scenario. *Empirical Investigations*; 2008, 3(1).
14. Gaba DM, Deanda A: A comprehensive anesthesia simulation environment: re-creating the operating room for research and training. *Anesthesiology*; 1988, 69:387-394.
15. Ker JS, Hesketh EA, Anderson F, Johnston DA: Can a ward simulation exercise achieve the realism that reflects the complexity of everyday practice junior doctors encounter? *Med Teach;* 2006, 28:330-334.
16. Nishisaki A, Keren R, Nadkarni V: Does simulation improve patient safety? Self-efficacy, competence, operational performance and patient safety. *Anesthesiol Clin;* 2007, 25:225-236.