

Improving advanced cardiovascular life support skills in medical students: simulation-based education approach

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Abstract

Objective: In this trial, we intend to assess the effect of simulation-based education approach on advanced cardiovascular life support skills among medical students.

Methods: Through convenient sampling method, 40 interns of Mashhad University of Medical Sciences in their emergency medicine rotation (from September to December 2012) participated in this study. Advanced Cardiovascular Life Support (ACLS) workshops with pretest and post-test exams were performed. Workshops and checklists for pretest and post-test exams were designed according to the latest American Heart Association (AHA) guidelines.

Results: The total score of the students increased significantly after workshops (24.6 out of 100 to 78.6 out of 100). This demonstrates 53.9% improvement in the skills after the simulation-based education ($P < 0.001$). Also the mean score of each station had a significant improvement ($P < 0.001$).

Conclusion: Pretests showed that interns had poor performance in practical clinical matters while their scientific knowledge, such as ECG interpretation was acceptable. The overall results of the study highlights that Simulation based-education approach is highly effective in Improving ACLS skills among medical students.

Keywords: Advanced cardiovascular life support (ACLS), Cardiopulmonary resuscitation (CPR), Intern, Human patient simulation (HPS), Simulation-based education

Introduction

Cardiopulmonary Resuscitation (CPR) which is part of Advanced Cardiovascular Life Support (ACLS) is a procedure to preserve brain function until the establishment of spontaneous blood circulation and breathing in a cardiac arrested patient. These urgent interventions include airway management, respiration support, treatment of Bradyarrhythmia and Tachyarrhythmia (1). In fact rescuing the patient in complex cardiovascular, respiratory as well as other metabolic, toxicological and other emergencies simply takes a pair of hands and basic skills (2). Obviously, educational levels of involved personnel in the operation affect the quality and outcome of cardiopulmonary resuscitation (3). Simulation technology is one of the suggested educational methods which can boost the learning process and provide a safe and controlled environment for practice. In this method, learners practice on a human simulator so eliminating any chances of jeopardizing real patients. This method provides more opportunities for

observation and needed corrections, shedding students' fear of operation and building up their self-confidence preparing them for real life situations (4). In this trial we intend to assess the effect of simulation-based education approach on ACLS skills among medical students.

Methods

During a four-month period, 40 interns of Mashhad University of Medical Sciences in their emergency medicine rotation (from September to December 2012) participated in this study. These interns varied by gender as well as elapsed time from the start of their internship period. Participants were unaware of the purpose of the exam and classes and a blinded study was adopted. ACLS workshops with pretest and post-test exams were performed. Workshops were designed for 10 hours over two days based on the training objectives of ACLS, according to the latest American Heart Association (AHA) guidelines (5). In addition, slide lectures and tutorials were given after the



end of each item and participants practiced on mega code mannequins as well. The training manikin was like a real patient encounter and attendants could accurately monitor the students' activity to identify and resolve their problems. The pretest encompassed 10 Objective Structured Clinical Examination (OSCE) stations that students had to pass the exam before the workshops. Then they took part in the workshops and after 2 weeks they participated again in the OSCE stations. The checklists for each station were designed according to the AHA guidelines. Scores of each station were expressed as percentage (100 means that one did all steps correctly). Finally, after completing the workshop along with the post test, a questionnaire of satisfaction, self-esteem and the need for more training was completed by the interns. The questionnaire was based on a Likert scale.

SPSS 11.5 software (SPSS Inc., Chicago, Illinois, USA) was used for all statistical analyses. Standard descriptive statistics were applied to describe the pattern of the data. Gender, pre-internship score (out of 200) as an indicator of baseline knowledge, duration from the start of internship and passing cardiology and internal courses were correlated to pre-education performance. Analysis was performed using paired T-test and Spearman correlation test. All tests were 2-tailed, and probability values equal to 0.05 were considered significant.

Results

40 interns of Mashhad University of Medical Sciences in their emergency medicine rotation (from September to

December 2012) participated in this study. 58% of participants were women and 42% men. Duration from the start of internship was more than 9 months among 50% of participants. The mean of pre-internship score (out of 200) as an indicator of baseline knowledge was 136.8 ± 10.48 with the range of 120 to 170. In pretest exam, the maximum score was attributed to ECG station (68 ± 15.7) and the minimum score was for the approach to stable wide complex Tachycardia station (9.54 ± 16).

Table 1 depicts the total scores of OSCE stations. The total score of the students had a significant increase after the workshops (24.6 out of 100 to 78.6 out of 100) which showed 53.9% improvement in the skills after the simulation-based education ($P < 0.001$) (Table 2). On the other hand, the score of each station after the intervention increased significantly ($P < 0.001$). The highest effect of simulation-based education was in Asystole station ($t = -27.975$), and the lowest improvement was in ECG station ($t = -7.062$). Table 3 shows the Correlation of pre- and post-education function with possible related items. Female gender, higher pre-internship score, and longer internship period poorly correlated with both before and after training function, but neither was statistically significant ($P > 0.05$). Performance after the intervention was minimally improved among those who had passed only internal or cardiology course, but it was not statistically significant ($P > 0.05$), however, better performance significantly correlated to passing both internal and cardiology courses ($P = 0.009$). In addition, pre-education function was strongly correlated to post-education performance

Table 1. Total scores of OSCE stations

	Minimum	Maximum	Mean	Std. Deviation
Pre-education function	9	48	24.67	9.415
Post-education function	57	96	78.60	10.175

Table 2. Pre- and post-education function in OSCE stations

	Pre-education function (mean \pm SD)	Post-education function (mean \pm SD)	Paired difference (mean \pm SD)	t	P-value
Initial approach	28.9 \pm 18.178	81 \pm 15.317	-52.100 \pm 16.246	-20.282	<0.001
ECG	68 \pm 15.722	79.6 \pm 9.038	-11.600 \pm 10.389	-7.062	<0.001
Bradycardia	19.22 \pm 9.164	75.3 \pm 17.806	-56.075 \pm 16.379	-21.653	<0.001
Asystole	19.55 \pm 13.407	80.05 \pm 12.73	-60.500 \pm 13.678	-27.975	<0.001
VF/VT ¹	28.38 \pm 20.851	80.92 \pm 14.177	-52.550 \pm 16.193	-20.525	<0.001
Unstable tachycardia	14.65 \pm 13.026	76.28 \pm 13.517	-61.625 \pm 17.387	-22.417	<0.001
Stable_NCT ²	14.25 \pm 13.759	70.15 \pm 18.516	-55.900 \pm 16.100	-21.959	<0.001
Stable_WCT ³	8.82 \pm 15.584	70.7 \pm 13.727	-61.875 \pm 17.581	-22.259	<0.001
Electroshock	17.35 \pm 17.237	82.7 \pm 9.208	-65.350 \pm 12.899	-32.042	<0.001
CPR	27.95 \pm 16.142	89.78 \pm 9.062	-61.825 \pm 14.370	-27.210	<0.001

¹Ventricular tachycardia/Ventricular fibrillation

²Stable narrow complex tachycardia

³Stable wide complex tachycardia

with the correlation coefficient of 0.662 (Table 4). Self-report on satisfaction, self-esteem and demand for more training after participation in workshops by participants on a five-point Likert scale is shown in Table 5.

Discussion

Cardiopulmonary failure is the most possible dangerous condition for human and the most critical situation for a doctor to deal with. The doctor must be enough trained to make the best decisions and react in the shortest possible time to save the patient's life. These skills can only be achieved through a good educational method. Different results show that hospitals with experienced and educated teams have a higher rate of success in CPR and patient

discharge (6). In this trial, the effect of simulation-based education approach on ACLS skills among medical students was assessed. This study showed that before the intervention, interns had poor performance in practical clinical matters, while their scientific knowledge such as ECG interpretation was acceptable. Studies carried out in Chicago University indicate that the quality of resuscitation differs when handled by experienced personnel who even have not read any published guidelines. Furthermore; most internal residents have very little or no experience at all dealing with different situations aroused during ACLS in the first residency year (3). Although 75% of interns passed internal and cardiology internship courses, their academic knowledge and practice in management of car-

Table 3. Spearman's correlation of pre- and post-education function with possible related items

		Pre-education function	Post-education function
Gender	Correlation Coefficient	0.290	0.308
	P-value	0.070	0.054
Pre-internship score	Correlation Coefficient	0.241	0.127
	P-value	0.134	0.435
Duration from the start of internship	Correlation Coefficient	0.092	0.086
	P-value	0.574	0.600
Merely cardiology rotation	Correlation Coefficient	0.154	-0.206
	P-value	0.342	0.203
Merely internal rotation	Correlation Coefficient	0.004	-0.159
	P-value	0.982	0.326
Both cardiology and internal rotation	Correlation Coefficient	0.363*	0.409**
	P-value	0.021	0.009

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table 4. Pre- and post-education function according to passing internal and cardiology rotation

	Pre-education function (mean ± SD)	Post-education function (mean ± SD)
Neither	16.4 ± 4.648	74.4 ± 10.058
Cardiology	26.43 ± 5.996	73.43 ± 11.574
Internal	24.25 ± 8.382	75.5 ± 4.041
Both	28.47 ± 10.151	83.37 ± 8.946
Total	24.67 ± 9.415	78.6 ± 10.175

Table 5. Satisfaction, self-esteem and demand for more training after participation in workshops (scores out of 5)

	Mean	SD
Simulation-based education strengthens my clinical skills	4.2	1.1
I received very useful feedback from Simulation-based education	4.6	0.9
Simulation-based training enhances my confidence	4.6	1.2
Simulation-based training is more valuable than bedside teaching	2.8	1.3
Simulation-based training should be an essential part of educational curriculum	4.3	1.2

diopulmonary arrest patients and other ACLS conditions were poor. This could be due to the lack of efficient education and active participation in the reanimation process and clinical training during internal and cardiology rotations. The overall results of the study and statistical analysis of the data showed that the simulation-based education approach is highly effective in improving ACLS skills among medical students. In a study carried out in Imam Khomeini Hospital by Tehran University of Medical Sciences, the success rate of operations when executed by experienced staff showed an increase from 18.4% to 30% (7). Better performance, after our trial, significantly correlated to passing both internal and cardiology course in this study. It shows that baseline knowledge and experience can boost educational process. Other studies indicated that using educated and experienced personnel in resuscitation operations dramatically increase recovery (8-17). This study had some limitations. ACLS workshops were held in the morning while some interns spent their night shift after hours of emergency care. Therefore, practitioners in these classes were present and felt tired and sleepy and yield reduction was having an effect. This study showed that education of ACLS by simulation and mega code manikin is accompanied by a great increase in student learning. So it is suggested that this kind of education should carry a special consideration in the learning curriculum of medical students.

Total sample size was relatively small and as this is the first study which used simulation-based education approach on medical students, a need for further studies is crucial. Interns should be actively involved in clinical teaching. Lack of clinical skills centers in our setting is a problem and if there are any, they should be equipped with the state of the art technologies for better education.

This study showed that education of ACLS by simulation and mega code manikin was accompanied by a great increase in students learning. In addition; interns were very interested, welcomed and satisfied in the process. Therefore; applying this method in all parts of medical education can be proposed. This kind of education should carry a special consideration in the learning skills and curriculums of medical students and even different groups.

Ethical issues

This study was approved by the ethic committee of Mashhad University of Medical Sciences.

Authors' contributions

Authors contributed to the publication of this article as follows: Conception and design (HR, ME, EP, and EB); Analysis and interpretation (VV); Data collection (NJ, HR, ME, EP, and EB); Writing the article (VV); Critical revision of the article (VV, HR); Final approval of the article (VV, HR); Statistical analysis (VV); Obtained funding

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