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Research Article

Emergency Medical Technicians' Long Term Retention Following Cardiopulmonary Resuscitation Training: A Follow Up Study

G. Ulufer Sivrikaya[1*], Sibel Kizilkar[2], Canan Oner[2], Ferhat Saribek[2], M Fatih Gulsen[2], Emre Sukayar[2]

[1] Rahmi M. Koç Academy of Interventional Medicine, Education and Simulation (RMK AIMES), Istanbul, Turkey

[2] The Health Directorate of Antalya, Region Training, Practice and Simulation Center, Antalya,Turkey

[*]**Corresponding author:** G. Ulufer Sivrikaya, Rahmi M. Koç Academy of Interventional Medicine, Education and Simulation (RMK AIMES), Istanbul, Turkey

Abstract

Background: Effective management of emergency critical situations in pre-hospital setting by healthcare providers working in 112 Ambulance Service as first responders has a vital importance, since it is directly associated with mortality and morbidity rates' of these patients. The aim of this study was to evaluate Emergency Medical Technicians (EMTs)'s knowledge and cardiopulmonary resuscitation skills retention one year following of ACLS course and the factors can have an effect on retention. **Methods:** The course included lecture, skill training, team-based practice with 6 simulated arrest scenarios. First Evaluation (FE) was performed during course. After one year (retention evaluation) all participants performed the same scenarios (Second evaluation-SE). Resuscitation skills were assessed with a checklist. Participants knowledge was evaluated with Multiple Choice Questionnaire before (MCQ1), at the end of the course (MCQ2) and during retention evaluation (MCQ3). **Results:** 42 EMTs participated in this study. SE score was significantly higher in 32% EMTs, was similar or higher (not significant)in 25% EMTs than FE score. Correct answer percentage was 49.3% MCQ1, 82.8% MCQ2 and 69.4% MCQ3. Seventy three percent of the participants with higher SE score were experienced 2-5 years (versus experienced< 2 years) and 68% of them having an average number of 150 arrest patients in a year (versus<150 arrest patient/year). **Conclusion:** The results of this study showed that; knowledge and cardiopulmonary resuscitation skills improved after ACLS course including simulated scenarios. Nonetheless in a long term period (1 year) a significant decline in retention was observed in both knowledge and skills. Being more experienced than 2 years and having more than 150 arrest patients in a year seem to have a positive effect on this long-term retention.

Introduction

Out-of-hospital cardiopulmonary arrest is a major public health problem with high mortality rate [1,2]. The survival rate of the out-of-hospital cardiopulmonary arrest varies between 5 and 38%, and this difference is related to effective management of emergency critical situations in pre-hospital setting [3]. Healthcare providers working in Ambulance Services as first responders play a vital role, since this management directly effects mortality and morbidity rates' of these patients. The healthcare personnel working in 112 Ambulance Service of The Ministry of Health in Turkey have to complete a training module including 5 different courses: Basic Life Support, Advanced Cardiac Life Support, Pediatric Advanced Life Support, Advanced Trauma Life Support and Basic and Advanced Ambulance Driving Techniques.

The aim of the study was to evaluate of Emergency Medical Technicians (EMT)s' knowledge and cardiopulmonary resuscitation skills retention one year following of ACLS course

and the factors can have an effect on retention.

Methods

The study was designed as a randomized controlled trial. The course included lecture, skill training, team-based practice with 6 simulated arrest scenarios in a mannequin Simulator (SimMan, Laerdal) and debrief. The participants were Emergency Medical Technician (EMT)s who were selected through a purposive sampling method. First Evaluation (FE) was performed during course. While a team was performing scenario, it is available for the other teams to observe and also participate in the post simulation debriefing. After one year (retention evaluation)all participants performed the same scenarios (Second evaluation-SE). Resuscitation skills were assessed with a checklist made according to the European Resuscitation Council (ERC) Guidelines 2015 [4] (Table 1). Each skill graded with one (1) point when performed and the total score was 15 (100%) when all completed. The main parameters were; high quality CPR, differentiate shockable and non shockable rhythm, applying the correct energy dose and correct medication and dose administration.Participants knowledge was evaluated with multiple choice questionnaire (MCQ) before ACLS course (MCQ1), at the end of the course (MCQ2) and during retention evaluation (MCQ3). A survey was conducted consisted of practising years as an EMT, frequency of their arrest patients for a year, willingness to participate remedial trainings with simulation and participant' thought about the usefulness of simulation.

The study was approved by the Ethics Committee of Antalya Health Directorate. All participants were informed about the objectives and the methods of the study, their rights and the researchers'duties.The permission to record the simulation sessions was obtained from the participants. The participants signed the informed consent form.

No	Items	
	Examination	
1	Open airway	Yes/No
2	Check breathing	Yes/No
3	Check pulse	Yes/No
4	Verbally stating cardiac arrest	Yes/No
	Performance of chest compressions	
5	Correct compression depth	Yes/No
6	Correct compression rate	Yes/No
7	Correct placement of hands	Yes/No
	Performance of ventilations	
8	Insert an oro-pharyngeal airway	Yes/No
9	Place the bag-valve-mask	Yes/No
10	Applied compression: ventilation ratio 30:2	Yes/No
	Defibrillation	
11	Correct preperation	Yes/No
12	Correct placement of the paddles	Yes/No
13	Defibrillation with the right dose of energy	Yes/No
	Administration of drugs	
14	Right timing	Yes/No
15	Right amount	Yes/No

Table 1: ACLS skills evaluation.

Results

42 EMTs working as a crew member in 112 Ambulance Service participated in this study. The age range was 21-42 years with a mean age of $25,07 \pm 6,14$ years (mean ± SD). The minimum work experience was 2 years and the maximum was 16 years. Their mean work experience was $8,62 \pm 5,79$ years (mean ± SD). According to gender, 19 (45,2%) participants were male and 23 (54,8%) were female. SE score was higher (significantly) in 32% EMTs, was similar or higher (not significant) in 25% EMTs was lower 43% than FE score showing resuscitation skill of the participants.

Study parameters	Percentage		
	At the end of the course	One year after the course	P value
Mean rate of correct compression depth	89,4 %	68,3 %	**<0,05**
Mean rate of correct compression rate	86,6 %	64,6 %	**<0,05**
Mean rate of correct placement of hands	94,3 %	91,4 %	>0,05
Application of compression/ventilation ratio as 30:2	94.3 %	82.1 %	>0,05
Differentiate shockable and non shockable rhythm	85,3%	61,4 %	**<0,05**
Defibrillation with the right dose of energy	87,7%	74,1%	>0,05
Correct medication and dose administration	88,6%	69,3%	**<0,05**

Table 2: Skills evaluation following ACLS course and one year after.

Sixty nine percent of the participants with higher SE score were experienced 2-5 years (versus experienced< 2 years) and 68% of them having an average number of 150 arrest patients in a year (versus<150 arrest patients/year).

Correct answer percentage was 49.3% MCQ1, 82.8% MCQ2 and 69.4% MCQ3. Confidence of participants was 38.52% vs 70.92% before scenarios and after scenarios following debriefing respectively.

All participants believed of the usefullness of simulation for enhancing their knowledge and skills. Participants with less years of clinical experience were more likely to be willing to participate a remedial training at least 6 months frequency.

	Parameter	Percentage
Practising years as an EMT	2 - 5 years	69 %
	< 2 years	31 %
Average number of arrest patients for a year	> 150	68 %
	< 150	32 %
Usefullness of simulation for enhancing their knowledge and skills		100 %
Willingness to participate remedial trainings with simulation		100 %

Table 3: Survey evaluation.

Discussion

Simulation can be used as an assessment tool to evaluate retention of knowledge and resuscitation skills following an ACLS course. In this study in a long term period (1 year) a significant decline in retention of EMTs' knowledge (assessed by MCQs) and cardiopulmonary resuscitation skills (assessed with simulation scenarios) observed.

Ministry Health of Turkey has a mandatory training module with 5 courses for 112 Ambulance Crew Members before they assigned their duties working as pre-hospital healthcare personnel in ambulances. As a pilot training program, simulation scenarios added the standard ACLS courses and the retention of knowledge and skills after one year was evaluated with the same simulation scenarios.

Simulation in healthcare is not used only for education but also for assessment. And there is an increasing trend to use simulation as an assessment tool [5]. The other two purposes are research, and health system integration in facilitating patient safety. Multiple choice tests and oral exams have been traditional methods to assess knowledge and ability for generations. Simulations are effective means of evaluating students' competencies, such as their professionalism, as well as their content knowledge [6].

The International Liaison Committee on Resuscitation (ILCOR) and European Resuscitation Council (ERC) Guidelines provide recommendations for high quality CPR and underline the importance of implementation, education and training [7]. To perform high-quality CPR, timely recognition of arrest and initiation of chest compressions along with the correct depth and rate of compressions as well as allowing adequate chest recoil is essential [8] However, the relevant learning objectives may not necessarily be identical across different learner groups. For pre-hospital level healthcare providers,optimizing compression fraction, compression depth and rate, and simultaneously in corporating rhythm identification, manual defibrillation, and medication administration are standard expectations [9].

In our study as ACLS skills; (a) chest compressions in correct depth [10,11] and (b) rate [12,13] in (c) correct hand position [14], (d) differentation of shockable and nonshockable rhythm, (e) defibrillation with right dose of energy and (f) correct medication and dose administration were evaluated mainly following ACLS training and one year after training along with knowledge evaluation with MCQ tests.

All subjects performed the ACLS skills (a-f, defined above) with a higher percentage then 85% following the course. But at 1 year after ACLS training, all participants showed decreased CPR skills.The best ACLS skills which were kept well were correct placement of hands, application of compression/ventilation ratio as 30:2 and defibrillation with the right dose of energy. Most decreased skill was differentiation of shockable and non shockable rhythm. In a study by Cho, et al. the accuracy of the CPR skills as compression rate, compression depth and compression position right after training were similar with our numbers and 3 months after training, overall accuracy of CPR skills decreased [15]. A previous study reported that accuracy of CPR skills were likely to deepen at four months after BLS training [16]. ACLS participants demonstrated an overwhelming failure rate of 77% and the majority was not competent in ACLS skills after 3 months in Kimberly, et al. study [17].

Technical CPR skills were mastered immediately following training in our study which is a well established situation. Previous reviews showed that skills deteriorate rapidly in the interval between 6 weeks and 6 months after training [18] and in some studies the skills typically returned to baseline after approximately

1 year [19,20]. Studies of healthcare and lay rescuers showed that resuscitation skills degrade quickly and knowledge is retained longer than skills [21-24]. In our study both knowledge and ACLS skill retention was declined and it was consistent with previous literature [25,26]. In a review article Yang et al retrieved 336 articles and 11 papers were included. Most studies used multiple-choice questionnaires to evaluate knowledge retention and cardiac arrest simulation or other skills tests to evaluate skills retention. They concluded that; the available evidence suggests that ALS knowledge and skills decay by 6 months to 1 year after training and that skills decay faster than knowledge [27].

In Umuhoza et al study, years of practice did not affect final performance on cardiopulmonary resuscitation of nurses working in paediatric department [28]. It has previously been observed that while work experience may increase the confidence level of individual nurses,there is no correlation between years of work experience and competencies in the performance of CPR [29]. Unlike these studies in our study work experience was a factor in higher score for resuscitation skills in 1 year retention. Another factor with higher retention was the arrest number of EMTs managed in field.

In Kimberly, et al. study, the nurses who had ACLS training were moderately confident in their abilities to perform as an ACLS team member and had the greatest confidence in their abilities to perform as an ACLS team leader after 6 months of their training [17]. Previous studies have showed that confidence increases significantly after CPR training [30,31], decrease to 70% after all [30]. Low confidence and competence might affect decision to perform CPR in emergency,which indicates the need for short and periodic training [32]. Further,frequent training is needed as retention of CPR skills declines dependant on time since training, although the exact temporal curve of skill deterioration is unknown [33].

In our study all participants believed of the usefullness of simulation for enhancing their knowledge and skills. Participants with less years of clinical experience were more likely to be willing to participate a remedial training at least 6 months frequency. In Dehghan-Nayeri N, et al. study, they concluded that the implementation of appropriate educational policy can be a facilitator to cardiopulmonary resuscitation through facilitating the personnel's abilityand updating their information [34].

Our study has several limitations. First, there was only one study group who had the course with simulation scenarios. The reason was our aim to use simulation as an assesment method. To see if simulation scenarios implementation to an ACLS course had an effect on retention of ACLS knowledge and skills in long term there should be another study group who had the ACLS course without simulation scenarios. Second, skills were evaluated using simulated scenarios which may not reflect the performance during the actual patient encounter.

There is a lack of large well-designed studies examining the retention of adult ALS knowledge and skills in healthcare providers. Additional studies needed to help provide evidence-based recommendations for assessment of current knowledge and skills.

Conclusion

The results of this study showed that; knowledge and skills improved after ACLS course including simulated scenarios. Nonetheless in a long term period (1 year) a significant decline in retention was observed in both knowledge and skills. Being more experienced than 2 years and having more than 150 arrest patients in a year seem to have a positive effect on this long-term retention.

Acknowledgements

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