Research Article (Araştırma Makalesi)

The Importance of Simulation in Medical Education and Improving the Emergency Team Performance on Cardiopulmonary Resuscitation by Using Simulation-Based Education

Tıp Eğitiminde Simülasyonun Önemi ve Simülasyon Eğitimi ile Acil Tıp Ekibinin Kardiyopulmoner Resüsitasyon Uygulamasında Takım Performansının Artırılması

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Özet

Amaç: Bu çalışmada tıp eğitiminde simülasyonun önemini, simülasyonla eğitimin kardiyo-pulmoner resüsitasyonda takım performansını artırıp artırmadığını ve tıp eğitiminin kalitesini artırmak için yapılması gerekenleri araştırdık.

Gereç ve Yöntemler: Çalışma, Gaziantep Üniversitesi Tıp Fakültesi Acil Tıp Anabilim Dalı tarafından yürütüldü. Tıp fakültesi 3. Sınıf öğrencilerinden 120 kişi 4 gruba ayrılarak Temel Yaşam Desteği eğitimi verildi. Eğitim yöntemleri olarak; geleneksel yolla eğitim, basit manken üzerinde simülasyon yöntemi ile eğitim, yüksek teknoloji içeren manken üzerinde simülasyon yöntemi ile eğitim ve kendi kendine eğitim yöntemleri uygulandı. Takım performansı değerlendirmesi için kontrol listeleri kullanıldı.

Bulgular: Tüm grupların cinsiyet ve yaş ortalamalarına göre dağılımları arasında anlamlı fark yoktu (sırasıyla; p=0,311, p=0,217). Tüm grupların teorik bilgi düzeylerinin eğitimler sonrası arttığı test edildi (p<0,001). Bu artışta gruplar arasında anlamlı bir farklılık yoktu (p=0,067). Ancak teorik bilgi düzeylerindeki bu artış takım performansı düzeylerindeki artışla uyumlu değildi. Takım performansı ve beceri yeterliliğinde simülasyonla eğitilen 2 grup diğer gruplara göre anlamlı ölçüde daha başarılı bulundu (p<0,001). Simülasyonla eğitilen bu iki grubun arasında performans değerlendirmelerinde anlamlı bir fark yoktu (p=1,000). Geleneksel yöntem ile eğitilen grupla kendi kendine eğitim alan grup arasında takım performansı açısından anlamlı bir fark yoktu (p=1,000) ancak beceri değerlendirmesinde kendi kendine eğitim alan grup daha başarılı oldu (p=0,018). Uygulanan anket sonuçlarına göre öğrencilerin kendine olan güveni genel olarak artmıştı (p<0,001). Performans değerlendirmeleri için kullanılan kontrol listeleri kendi aralarında mükemmel düzeyde korelasyon göstermekteydi (p<0,001).

Sonuç: Simülasyonla eğitim tekniği resüsitasyon gibi karmaşık olayların yönetilmesinde takım performansını, beceri düzeyini ve öğrencilerin kendilerine olan güvenlerini artırmaktadır. Bu nedenle tıp eğitimine entegre edilmesi gerekmektedir.

Anahtar Kelimeler: Simülasyon, resüsitasyon, takım performansı, tıp eğitimi

Abstract

Objective: This study investigated the importance of simulation in medical education, whether simulation training enhances team performance in cardiopulmonary resuscitation, and what measures are necessary to improve the quality of medical education.

Materials and Methods: The study was conducted by the Department of Emergency Medicine, Faculty of Medicine, Gaziantep University. 120 third-year medical students were divided into 4 groups and given Basic Life Support training. The training methods employed were traditional training, training using a simple mannequin simulation method, training with a high-tech mannequin simulation method, and self-training. Checklists were used for team performance assessment.

Results: There was no significant difference between the distributions of all groups according to gender and age averages (p=0.311, p=0.217, respectively). It was tested that the theoretical knowledge levels of all groups increased after the training (p<0.001, for all). There was no significant difference between the groups in this increase (p=0.067). However, this increase in theoretical knowledge levels was not compatible with the increase in team performance levels. The two groups trained with simulation were found to be significantly more successful than the other groups in team performance and skill competence (p<0.001). There was no significant difference in performance assessments between these two groups trained with simulation (p=1.000). There was no significant difference in team performance between the group trained with the traditional method and the self-trained group (p=1.000), but the self-trained group was more successful in skill assessment (p=0.018). According to the applied survey results, the students' self-confidence generally increased (p<0.001). The checklists used for performance assessments showed excellent correlation among themselves (p<0.001).

Conclusion: Simulation training technique increases team performance, skill level, and students' self-confidence in managing complex events such as resuscitation. Therefore, it should be integrated into medical education.

Keywords: Simulation, resuscitation, team performance, medical education

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INTRODUCTION

Simulation is the fully interactive imitation of important real-world things with guided experiences to revive or develop real experiences (1). It is the provision of the targeted situation by realistically imagining and animating events, behaviors, some cognitive activities, technical skills, and tasks that exist or are likely to happen. With the advancement of technology and its widespread use in medicine, simulation education has begun to increase the quality of education, which has led to an increase in simulation applications and tools (2).

In recent years, with the increasing sensitivity to patient safety and patient rights, there has been an increase in the search for increasing the experience and skills of students or practitioners in medical education. For this reason, simulation education is becoming increasingly widespread. To increase knowledge and skills in the field of medical education and to train well-equipped physicians, simulation-based medical education should be included in the curriculum. Trainers should learn the principles and techniques of simulation education well, have sufficient knowledge about simulators, develop scenarios appropriate to educational objectives, and be proficient in adult learning theories.

Patients' unwillingness to be subjects or objects of education, and students' fear and hesitation of performing the first application on the patient, cause contradictions in medical education. This contradiction will be eliminated with the widespread use of simulation in medical education. Since cardiac arrest is an important health problem, resuscitation training attracts great attention. To deliver resuscitation training to all citizens, it is necessary to educate school teachers and nurses and train future educators. Video-based short courses and the use of mannequins are useful in the spread of resuscitation techniques. The use of Automatic External Defibrillators (AEDs) should be liberalized, and training on Basic Life Support (BLS) and AED use should be simplified, allowing non-healthcare personnel to practice. Undergraduate-level training in medical schools and nursing schools should be improved. Healthcare workers should be trained according to their needs, and non-technical skills such as leadership and teamwork should be emphasized. Training should be evaluated and implemented with the performance evaluation technique. Simulation will continue to be an important method in the field of resuscitation training today and in the future (3). In light of this information, this study was conducted to emphasize the importance of simulation in medical education and to reveal the training methods that should be applied and the training materials that should be selected to increase team performance in the management of complex emergencies such as resuscitation, through simulation training.

MATERIALS AND METHODS

The Department of Emergency Medicine, Faculty of Medicine, Gaziantep University, conducted the study in 2013. Before starting the study, the person who would perform the training on simulation education was sent to trainer courses abroad and in Turkey. After the trainer training on the subject, information about the infrastructure was collected by visiting simulation centers in Turkey and abroad. A simulation room was established within the Department of Emergency Medicine, and a training room was prepared. A camera was placed in the simulation room for video recording.

A Truman Multi simulation mannequin (a mannequin designed for CPR application and AED use, with simple technology, capable of showing the location, depth and effectiveness of ventilation, and with AED electrodes) and a Smart Stat model 405 simulation mannequin (a mannequin with high technology, a monitor, and remote control of vital signs and speech) were provided for use in the training. The simulation room was made suitable for resuscitation. Scenarios regarding BLS and CPR application were prepared, and their controls were performed.

The study included Term 3 students with the permission of the Gaziantep University Faculty of Medicine Dean's Office. All participants were informed at the beginning, and their permissions for video recording were obtained. Participants participated in the study voluntarily.

Emergency medicine department faculty members and training assistants took part in the study. Visual and written training materials on the subject were prepared by the AHA (American Heart Association) 2010 guide (4).

Some checklists were used to evaluate the students' practices and team performance during the simulation in the study. The observer who would fill out these checklists was trained and assigned to the subject.

In the study, Team Emergency Assessment Measure (TEAM): Emergency Medical Team Performance Measurement Scale (5), Anesthetists' Non-Technical Skills: Anesthetists' Non-Technical Skills Scale (ANTS) (6), Team Performance Observation Tool (TPOT) (7) and Adult Basic Life Support skills training assessment scales prepared by the AHA guide were used for team performance assessment (Skill) (8,9). After the observer filled in the checklists, the video and audio camera recordings were repeatedly watched by experts to test their accuracy.

120 volunteers from the 3rd year medical school students were divided into 4 main groups. The groups were randomly assigned.

1. Traditional education group (TE): The group that received training only with visual and written resources,
2. Simulation education group on a simple mannequin- Simple Model Education (SME): The group that received training with scenario-guided practice on a simple mannequin in addition to training with visual and written resources,
3. Simulation education group on a complex mannequin- Simple Model Education (CME): The group that received training with scenario-guided practice on a complex mannequin in addition to training with visual and written resources,
4. Self-education group (SE): The group that received training on its own with peer groups after receiving training with visual and written resources once.

The same pre-test was applied to all groups at the beginning. This pre-test included 20 questions prepared by the multiple-choice test technique to measure the knowledge level of the student on adult basic life support. At the end of the same test, a survey (pre-survey) was applied to the students. After this stage, the students were trained in groups at predetermined times. When the training and practices were completed, a post-test and a final survey (post-survey) were applied to all groups. Ethics committee approval was obtained from the Gaziantep University Medical Faculty Medical Ethics Committee for this study (Ethics committee decision no: 19.06.2012/277 Date: 19.06.2012). The Declaration of Helsinki was complied with.

Statistical Analysis

At the end of the study, SPSS 21.0 (Statistical Package for Social Sciences) and PAST programs were used in the analysis of the data obtained. The Kolmogorov-Smirnov test, ~~Shapiro-Wilk test~~ and coefficients of variation of univariate data were examined for suitability for normal distribution; parametric methods were used in the analysis of variables with normal distribution. One-Way ANOVA (Robust Test: Brown-Forsythe) was used for comparing multiple groups, and Tukey and Games-Howell tests were used for Post Hoc analyses. A Paired-Samples T-test was used to compare two dependent groups. In comparing dependent two categorical data, the McNemar test was used with the Monte Carlo Simulation technique. In comparing categorical data, the Pearson Chi-Square test was tested with the Monte Carlo Simulation technique. Pearson correlation coefficient was used to assess the relationship between quantitative data with adjusting age and gender. Quantitative data are expressed in the tables as mean ± std. (standard deviation). Categorical data are expressed as n (number) and percentages (%). Data were examined at 95% confidence level and p value less than 0.05 was accepted as significant.

RESULTS

A total of 120 3rd year medical faculty students, 57 (47.5%) male, and 63 (52.5%) female, were included in the study. These students were between the ages of 22 and 20, and their average age was determined as 21.03±0.74. These 120 students were divided into 4 homogeneous subgroups of 30 (25%) each, to receive training with the traditional method, training on a simple mannequin, training on a complex mannequin, and training on their own **(Table 1)**.

The distribution of the groups according to their gender and age averages was evaluated **(Table 1)**. When the distribution of the gender and age averages of the students included in the study was evaluated according to the groups, it was determined that there was no statistically significant difference (p=0.3110, p=0.217, respectively).

Table 1. Evaluation of the distribution of groups according to gender and age averages

	Groups				**Total**	**P value**
	Traditional Education	Simple Model Education	Complex Model Education	Self-Education		
Male n (%)	11 (19.3%)	13 (22.8%)	18 (31.6%)	15 (26.3%)	57 (100%)	**0.311***
Female n (%)	19 (30.2%)	17 (27%)	12 (19%)	15 (23.8%)	63 (100%)	
Age (years)/Mean±Std.	20.8±0.8	21.0±0.8	21.1±0.6	21.2±0.7	21.03±0.74	**0.217****

*Pearson Chi-Square Test - **Oneway ANOVA Test, Std: Standart deviation

The pre-test and post-test results of the students included in the study were evaluated according to the groups **(Table 2)**.

It was tested that the theoretical knowledge levels of all groups increased after the training (p<0.001, for all). There was no significant difference between the groups in this increase (p>0.067). However, this increase in theoretical knowledge levels was not consistent with the increase in team performance levels. The TEAM, ANTS, TPOT, and skill checklists used in the simple and complex mannequin applications of the students included in the study were evaluated according to the groups **(Table 3)**.

Table 2. Evaluation of Pre-Test and Post-Test results of students included in the study according to groups

	Groups				**P value
	Traditional Education	Simple Model Education	Complex Model Education	Self-Education	
	Mean±Std.	Mean±Std.	Mean±Std.	Mean±Std.	
Pre Test	39.50±15.80	36.20±17.16	42.90±14.23	35.43±16.57	**0.255**
Post Test	90.73±8.54	87.47±8.27	85.57±8.97	86.60±10.62	**0.153**
Change.Test	-51.23±13.70	-51.27±15.45	-42.67±15.39	-51.17±15.30	**0.067**
***P value**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	

* Paired T Test, ** Oneway ANOVA Test, Std: Standart deviation

*P value: For Pre-Test Post-Test within Group **P Value: For Pre-Test Post-Test between Groups

Table 3. Evaluation of the TEAM, ANTS, TPOT, and skill checklists used in the applications on simple and complex mannequins of the students included in the study according to the groups.

	Groups				*P value
	Traditional Education	Simple Model Education	Complex Model Education	Self-Education	
	Mean±Std	Mean±Std	Mean±Std	Mean±Std	
Simple TEAM	2.30±1.34	6.10±1.20	6.10±0.99	2.30±1.83	**<0.001**
	P(TE-SME)<0.001 P(TE-CME)<0.001 P(TE-SE)=1 P(SME-CME)=1 P(SME-SE)<0.001 P(CME-SE)<0.001				
Simple ANTS	12.40±9.45	35.70±5.48	40.90±6.72	22.40±9.22	**<0.001**
	P(TE-SME)<0.001 P(TE-CME)<0.001 P(TE-SE)=0.036 P(SME-CME)=0.464 P(SME-SE)=0.003 P(CME-SE)<0.001				
Simple TPOT	31.40±5.68	58.00±12.90	68.50±14.36	38.20±14.51	**<0.001**
	P(TE-SME)<0.001 P(TE-CME)<0.001 P(TE-SE)=0.615 P(SME-CME)=0.249 P(SME-SE)=0.005 P(CME-SE)<0.001				
Simple mannequins	3.30±2.58	6.00±1.63	7.40±0.70	4.80±2.66	**0.001**
	P(TE-SME)=0.059 P(TE-CME)=0.003 P(TE-SE)=0.587 P(SME-CME)=0.111 P(SME-SE)=0.626 P(CME-SE)=0.055				
Complex TEAM	3.50±1.43	7.20±1.03	7.20±0.79	5.10±1.85	**<0.001**
	P(TE-SME)<0.001 P(TE-CME)<0.001 P(TE-SE)=0.053 P(SME-CME)=1 P(SME-SE)=0.007 P(CME-SE)=0.007				
Complex ANTS	20.00±4.78	41.80±8.57	44.60±7.47	32.60±10.45	**<0.001**
	P(TE-SME)<0.001 P(TE-CME)<0.001 P(TE-SE)=0.020 P(SME-CME)=0.863 P(SME-SE)=0.176 P(CME-SE)=0.041				
Complex TPOT	34.70±4.88	66.50±14.14	77.20±13.98	52.40±18.99	**<0.001**
	P(TE-SME)<0.001 P(TE-CME)<0.001 P(TE-SE)=0.068 P(SME-CME)=0.352 P(SME-SE)=0.272 P(CME-SE)=0.019				
Complex mannequins	4.20±1.99	6.90±1.66	8.10±0.57	6.70±2.41	**0.001**
	P(TE-SME)=0.009 P(TE-CME)<0.001 P(TE-SE)=0.018 P(SME-CME)=0.449 P(SME-SE)=0.994 P(CME-SE)=0.315				

*Oneway ANOVA Test (Robust Test: Brown-Forsythe), Post Hoc Test: Tukey HSD & Games Howell, std: Standart deviation
TE: Traditional Education, SME: Simple Model Education, CME: Complex Model Education, SE: Self-Education
TEAM: Team Emergency Assessment Measure, ANTS: Anesthetists' Non-Technical Skills Scale, TPOT: Team Performance Observation Tool

The 2 groups trained with simulation were found to be significantly more successful than the other groups in team performance and skill proficiency (p<0.001). There was no significant difference in performance evaluations between these two groups trained with simulation (p=1.000). There was no significant difference between the group trained with the traditional method and the self-trained group in terms of team performance (p=1.000), but the self-trained group was more successful in skill evaluation (p=0.018). The evaluation of the pre-survey and post-survey results of the students included in the study according to the groups is given in **Table 4**. According to the applied survey results, the students' self-confidence generally increased (p<0.001) **(Table 4)**.

The correlations between the TEAM, ANTS, and TPOT control lists used in the applications on the simple and complex mannequins were evaluated. It was determined that there was a positive and perfect correlation (r=0.909) between ANTS (p<0.001), a positive and perfect correlation (r=0.841) between TPOT (p<0.001), and a positive and perfect correlation (r=0.898) between ANTS and TPOT (p<0.001). With the complex TEAM; It was found that there was a perfectly positive (r=0.877) significant correlation (p<0.001) between ANTS, a perfectly positive (r=0.804) significant correlation (p<0.001) with TPOT, and a perfectly positive (r=0.894) significant correlation (p<0.001) between ANTS and TPOT.

DISCUSSION

This study was planned to compare the current education-training method with the simulation education-training method and the self-learning method. As a result of this study, post-test scores were found to be higher in all groups after the training. This result shows that theoretical knowledge increased in all groups after the training.

This general increase in theoretical knowledge in this study was not compatible with team performance and skill adequacy. In the study conducted by Rodgers *et al.* (10) it was also emphasized that the written assessment cannot be an indicator of the participant's skill in a simulated cardiac arrest case and that the skill assessment and written assessment should be used together. The results obtained from our study also support the results of this study (10).

In this study, it was found that the groups trained with the simulation method (SME and CME) were more successful in performance assessments and skill application adequacy. This result shows us that training with the simulation method increases skill and team performance in the BLS application. In the study conducted by Siassakos *et al.* (11) it was reported that the group that performed the best teamwork showed the best performance. In the study conducted by Kory *et al.* (12), the group trained with simulation was found to be significantly more successful than those trained traditionally in airway management skills. In the study conducted by Hunziker *et al.* (13), it was emphasized that team structure affects performance.

In this study, when the two groups trained with simulation were compared within themselves (SME and CME), no significant difference was found between them in terms of team performance and skill adequacy. This result shows that there is no difference between the simulation training with a standard (simple) mannequin and the simulation training with a high-tech (complex) mannequin in terms of team performance and skill adequacy. In the study conducted by Hoadley (14), high and low-fidelity simulations were applied to 2 groups of Advanced Cardiac Life Support course participants, and no statistically significant difference was found between the performances and skills of both groups. In addition, an improvement in application and learning was detected in both groups.

Table 4. Evaluation of pre-survey and post-survey results of the students included in the study according to groups

How do you feel? Traditional Education n (%)		Groups: Simple Model Education n (%)	Complex Model Education n (%)	Self-Education n (%)		**P value
Pre-Survey	Poor	29 (25.4%)	28 (24.6%)	27 (23.7%)	30 (26.3%)	0.508
	Good	1 (16.7%)	2 (33.3%)	3 (50%)	0 (0%)	
	Total	30 (25%)	30 (25%)	30 (25%)	30 (25%)	
Post-Survey	Poor	22 (66.7%)	2 (6.1%)	1 (3%)	8 (24.2%)	<0.001
	Good	8 (9.2%)	28 (32.2%)	29 (33.3%)	22 (25.3%)	
	Total	30 (25%)	30 (25%)	30 (25%)	30 (25%)	
*P value		0.039	<0.001	<0.001	0.001	

Pearson Chi-Square Test (Monte Carlo Simulation) & McNemar Test (Monte Carlo Simulation)

*P Value: For Intra-Group Pre-Survey -Post-Survey

**P Value: For Pre-Survey and Post-Survey between Groups

In a study conducted by Norman *et al.* (15) 24 studies based on performance evaluations were examined, comparing learning with high and low-fidelity mannequins, and it was determined that training with both types of mannequins provided an increase in learning and performance. In a study conducted by Owen *et al.* (16) full-body mannequins, part task manager, and computerized screen-based simulation training were compared, and no significant superiority was found between them. Similar to our study, it was also shown that these two types of mannequins were not superior to each other. In this study, when the TE group and the SE group were evaluated in terms of team performance on the simple and complex mannequin, no significant difference was found. According to the skill assessment on the simple and complex mannequin, no significant difference was found between the TE group and the SE group in terms of skill on the simple mannequin (simple skill). However, a significant difference was found in skill on the complex mannequin. These results showed that the group that received training on their own was similar to the group that traditionally received training in team performance and was partially more successful in acquiring skills than those trained traditionally. In the study conducted by Moule *et al.* (17) the knowledge and performance levels of the traditional education group and the e-learning (self-paced) group in BLS training were compared. It was reported that the knowledge level of both groups increased after the training, and there was no significant difference between the skill and performance levels.

In this study, as a result of the survey conducted before the training (pre-survey), all groups stated that they felt bad about their BLS knowledge and management. No significant difference was found between the groups. As a result of the survey conducted after the training (post-survey), the number of those who felt good in general increased, and a significant difference was found between the groups. After the training, the SME, CME, and SE groups felt good and stated that their self-confidence increased. In the study conducted by Hoadley (13), simulation training was given on advanced cardiac life support, and in the evaluation made afterward, it was reported that the participants' self-confidence increased.

In this study, it was determined that the TEAM, ANTS, and TPOT checklists used to evaluate team performance showed a perfect positive correlation among themselves.

The limitation of our study is its single-center design.

In conclusion, the simulation training technique increases team performance, skill level, and students' self-confidence in the management of complex events such as resuscitation. Therefore, it should be integrated into medical education.

Ethical Approval: Ethics committee approval was obtained for this study from the Gaziantep University Faculty of Medicine Medical Ethics Committee (Ethics committee decision no: 19.06.2012/277 Date: 19.06.2012). The Declaration of Helsinki was complied with. An informed consent form was taken from the participants.

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