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Research article

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An alternative educational method: Computer-based simulation program for advanced cardiac life support education

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Ethics Committee Approval
Ethics committee approval for this study was obtained from the Ethics Committee of Gazi University (Date and number of documents: 09/02/2017 - E.20669).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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Abstract

Background/Aim: Technology is gaining importance in medical education, along with distance learning and technology-enhanced learning systems. In certain conditions, such as the Covid-19 outbreak, adapting technology to our medical education is essential. Computer-based simulation is one of those technologies that can be used in medical education. We aimed to measure the contribution of computer-based simulation to students' knowledge of cardiac rhythms in the advanced cardiac life support (ACLS) curriculum, compared to the classic educational method.
Methods: Interns (6^{th}-grade medical students) were included in this observational study and divided into a study group and a control group. Both groups received a 2.5-hour-long ACLS rhythms lecture. Afterward, case studies were completed with a computer-based simulation program in the study group and with the classical didactic method in the control group. The participants took a multiple-choice test to measure the level of knowledge before (pre-test) and 4 weeks after (post-test) the training. "ACLS Simulator 2016" licensed program was used.
Results: A total number of 80 medical students were included in the study. There were 35 (43.75%) males and 45 (56.25%) females, with a mean age of 23.7 (1.1) years. The mean number of correct answers in the pre-training test was 12.6 (3.2), and similar between the two groups (P=0.131), but significantly increased to 15.7 (3.3) (P<0.001) after the training. In the post-training test, the study and the control groups answered 16.0 (3.6) and 15.5 (3.1) questions correctly, respectively (P=0.477).
Conclusion: Adapting a computer-based simulation program improves students' level of knowledge. Case scenario training with a computer-based simulation is as effective as the classical method.

Keywords: Simulation, Computer-based, Undergraduate, Medical education, Advanced cardiac life support

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Introduction

Simulation is used for replacing real experiences and training in many fields, including medical education. With the development of technology, simulation methods also improved and became a growing trend. Distance learning, screen-based educational programs, and interactive learning environments gained increased importance. The use of simulation methods for medical education was investigated and integrated into the curriculum during the last few years, prominently for critical skills such as cardiopulmonary resuscitation. Simulator-mediated training is also recommended in the most recent cardiopulmonary resuscitation guidelines [1, 2].

The foremost concern of the interns in our country regards approaching an emergency patient and they feel insufficient both in theoretical and practical aspects [3]. Cardiopulmonary resuscitation is one of those subjects. Simulation-supported education is effective in teaching various algorithms and skills, and recent AHA and ERC guidelines emphasize the importance of using simulation techniques in cardiopulmonary resuscitation education. Many studies evaluate the effectiveness of simulation education alone; however, a few studies compare the different education methods with each other. With this study, we aim to assess the contribution of the simulation-supported education model on intern doctors' knowledge of ACLS rhythms and correct resuscitative approaches comparatively with today's classical education model.

Materials and methods

Eighty last-grade students who were working as interns in Gazi University Faculty of Medicine, Department of Emergency Medicine between February 15, 2017-April 30, 2017, were included in the study. Written consent was obtained from all participants. The students were divided into two equal groups, the control group, and the study group. Within the scope of ACLS training were arrest rhythms, tachycardia, and bradycardia. Two and a half hours of theoretical training was given to both groups before proceeding to case studies. Then, the same sample cases were shown, discussed, and solved with both groups; with a computer-based simulation program in the study group and with the classical didactic method in the control group. The participants were asked 25 multiple choice questions with a single correct answer to measure the level of knowledge, both before and 4 weeks after the training.

The questions were classified into 3 categories for thorough analysis:

Category 1 questions (simulation-direct): Questions consisting of the information in the scenarios shown with the simulation program

Category 2 questions (lesson): Topics included in the standard ACLS rhythms training, explained in the didactic phase of the lesson, but not included in the scenarios of the simulation program.

Category 3 questions (simulation- indirect): Rhythms are expected to be learned indirectly within the simulation program (arrest rhythms, bradycardic and tachycardic rhythms).

"ACLS Simulator 2016" licensed program, prepared by Anesoft Company, containing 12 scenarios per the ACLS guide of AHA (2015), was used on a single computer. Students solved the cases together interactively. The first 6 cases within the simulation program were about arrest rhythms and the last 6 cases regarded tachycardic rhythms.

Each case started with explaining the patient's clinical condition. The next screen simulated the patient's vital signs and heart rhythm. The students could see the patient's physical examination findings, administer a drug with chosen dose, make the decision on airway management (supportive oxygen supply, mask oxygenation, mask-valve mask ventilation, and endotracheal intubation), initiate and end cardiopulmonary resuscitation (CPR), and use the biphasic defibrillator to perform defibrillation and cardioversion with the desired joules.

Throughout the simulation, the students were expected to decide on the management and treatments in real-time, so there was a stopwatch in the upper left corner of the screen. Detailed information about the content and features of the program were explained to the students before starting the case studies. After a case was initiated, every step was decided by the students. By the end of the scenario, a special tab on the program screen revised the correct maneuvers and mistakes and revealed how the patient was managed. Later, the correct management of the simulated patient was discussed according to the ACLS guide.

Ethics committee approval for this study was obtained from the Ethics Committee of Gazi University (Date and number of documents: 09/02/2017 - E.20669).

Statistical analysis

Statistical analysis of the data was performed with SPSS (Statistical Package for Social Science, Chicago, II, USA) 19.0 program. Wilcoxon Signed Ranks Test was used to compare groups among themselves, and Mann-Whitney U test was used for inter-group analyses. Descriptive statistics included frequency, percentage mean, standard deviation, minimum and maximum values. The significance level was P<0.05 for all tests.

Results

Eighty medical students, 35 (43.75%) males and 45 (56.25%) females, with a mean age of 23.7 (1.1) years, were included in this study. There were 25 questions in the pre-training test, and the overall mean number of correct answers was 12.6 (3.2). While the study group answered a mean of 12.0 (3.3) out of 25 questions correctly, those in the control group answered 13.2 (3.2), which were similar (P=0.131).

The mean number of correct answers of the study and control groups in category 1, 2, and 3 questions in the pre-training test were 4.2 (1.6) and 4.7 (1.6) (P=0.141), 2.2 (1.0), and 2.8 (1.0) (P=0.009), 5.6 (1.6), and 5.6 (2.0) (P=0.930), respectively (Table 1).

Table 1: Comparison of the study and control groups before the training

	Study group	Control group	*P*-value
All questions	12.0 (3.3) (3-17)	13.2 (3.2) (4-20)	0.131
Category 1	4.2 (1.6) (0-7)	4.7 (1.6) (1-7)	0.141
Category 2	2.2 (1.0) (0-4)	2.8 (1.0) (0-5)	0.009
Category 3	5.6 (1.6) (3-9)	5.6 (2.0) (2-12)	0.930

The mean number of correct answers to the questions in the post-training test in both the study and control groups was significantly higher compared to the pre-training test in all categories ($P<0.001$ for all).

In the post-training test, the study group answered 16.0 (3.6) questions correctly, while the control group answered 15.5 (3.1) ($P=0.477$). The mean number of correct answers of the study and control groups in category 1, 2, and 3 questions in the pre-training test were 4.9 (1.6) and 5.2 (1.5) ($P=0.484$), 3.5 (1.2), and 3.7 (0.8) ($P=0.534$), 7.6 (2.3), and 6.6 (1.7) ($P=0.103$), respectively (Table 2).

Table 2: Comparison of the study and control groups after the training

	Study group	Control group	*P*-value
All questions	16.0 (3.6) (7-23)	15.5 (3.1) (8-22)	0.477
Category 1	4.9 (1.6) (1-7)	5.2 (1.5) (2-7)	0.484
Category 2	3,5 (1.2) (0-5)	3.7 (0.8) (2-5)	0.534
Category 3	7.6 (2.3) (4-13)	6.6 (1.7) (2-10)	0.103

Discussion

According to our findings, adapting a computer-based simulation program improves students' level of knowledge. Our sample size of 80 participants is larger than many other studies in the literature [4-8]. Integrating simulation programs into the curriculum contributes to the student's level of knowledge and is as effective as training with the classical method. This result is similar to those of the previous studies. Among 64 students, Tan et al. [6] aimed to teach the management of anaphylaxis under the curriculum of "crisis management", and a significant difference was found under the category of "learning specific treatments" in the simulation group, trained with a computer-based simulation program. It was equally effective in classical resuscitation, diagnosis, and total score categories. In that study, students took the lectures in the second week of their internship, at the end of which post-training evaluation was performed. Similarly, a multicenter study conducted on 50 participants by Davis et al. [8] showed that training with a computer-based simulator is as effective as classical training. In this study, the post-training evaluation test was performed immediately after the training. However, the duration between pre- and post-tests was 4 weeks in our study, which reflects a longer-term effect of the education. Our study differs from other studies in the literature in this aspect.

In Biese et al.'s [9] study with 26 participants, there was no performance increase after simulation training. In contrast to this finding, our study showed that simulation education increases students' knowledge.

In the study group, after the lecture on ACLS rhythms, simulated cases were studied with the program "ACLS Simulator 2016". In this program, the objective is to learn to manage ACLS rhythms through 12 simulated cases. Arrest and tachycardia rhythms were discussed, each with 6 different case scenarios. There are no case examples of the bradycardic rhythms described in the ACLS manual, although they were covered in the lecture. This is a limitation of the program and our study. This is valid for the standard version of the program, however, in the institute-licensed version, it is possible to write your case scenarios and extend the content.

For this study, the simulation program was installed on a single computer and reflected on a big screen, and the cases were solved interactively. Simulated cases were discussed by the student group, the decision to be made at each step was commonly taken by all students. This way, a knowledge-sharing platform was created. Students expressed their opinions about the correct management steps and put forward their arguments to support them against other opinions. In this knowledge-sharing environment, the students also discussed how to analyze the clinical status and approach the simulated case. They observed each other's perspectives and approaches. Knowing how to manage a real patient is one of the biggest challenges for the students and interactive small-group training with simulated patients contributes to this skill.

An open-access simulation program that also enables multi-users may enable students to practice whenever they want. This could allow a higher number of students to take advantage of this training at any time, without the need for a separate classroom, instructor, and training period. This will help them reinforce their knowledge and practice. The findings of our study, which we conducted on a single computer license, are positive and promising despite all our limitations. Our study showed that a lecture reinforced with computer-based simulation is beneficial. More comprehensive studies on this subject may lead to the inclusion of these simulations in the standard education program.

Many studies in the literature showed that training with high-fidelity simulators is effective and they are the closest created environment to a real clinical situation. However, building up a simulation laboratory is tough. High-fidelity mannequins, extensive spaces, trained educators and personnel, and technical team are essential; a multi-disciplinary approach is needed. The number of students who can be trained simultaneously is exceptionally low compared to other simulation methods, creating a significant limitation, especially at the pre-graduate level. Due to the other requirements mentioned, it may not be possible to open a simulation center within the faculty or the hospital.

Screen-based simulation programs are cost-effective when used for training for appropriate skills, allowing students to practice on their own and repeat at any time. The feedback included in the programs gives the chance to see their mistakes. Thus, they can be directed to study more on that subject. All these aspects make the simulation programs suitable for more effective training.

Limitations

The major limitations of our study include the small number of participants and providing training on a specific subject only. Thus, our findings cannot be generalized to the whole medical education process. Also, our simulation training was performed in groups. Future research with a higher number of participants in which the computer-based simulation is made available for individual access, enabling repetitive training, may provide more accurate data.

Conclusion

We found no significant differences between the study and control groups after the training, which reveals that case scenario training with a computer-based simulation program is as effective as the classical didactic method. ACLS training with computer-based simulation can be an effective alternative in distance learning programs and in circumstances where face-to-face education cannot be performed.

References

1. Bhanji F, Finn JC, Lockey A, Monsieurs K, Frengley R, Iwami T, et al. Part 8: Education, Implementation, and Teams: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. (1524-4539 (Electronic)).
2. Greif R, Lockey AS, Conaghan P, Lippert A, De Vries W, Monsieurs KG. European Resuscitation Council Guidelines for Resuscitation 2015: Section 10. Education and implementation of resuscitation. (1873-1570 (Electronic)).
3. Yalçınoğlu N, Kayı İ, Işık Ş, Aydın T, Zengin Ş, Karabey S. İstanbul Üniversitesi Tıp Fakültesi Son Sınıf Öğrencilerinin Tıp Eğitimi İle İlgili Görüşleri. İstanbul Tıp Fakültesi Dergisi. 2013;75(3):41-5.
4. Günay O. Erciyes Üniversitesi Tıp Fakültesi Son Sınıf Öğrencilerinin Tıp Eğitimi Hakkındaki Düşünceleri. Tıp Eğitimi Dünyası. 2002(7):49-55.
5. Bonnetain E, Boucheix JM, Hamet M, Freysz M. Benefits of computer screen-based simulation in learning cardiac arrest procedures. Med Educ. 2010;44(7):716-22.
6. Tan GM, Ti LK, Tan K, Lee T. A comparison of screen-based simulation and conventional lectures for undergraduate teaching of crisis management. Anaesth Intensive Care. 2008;36(4):565-9.
7. Schwid HA, Rooke GA, Michalowski P, Ross BK. Screen-based anesthesia simulation with debriefing improves performance in a mannequin-based anesthesia simulator. Teach Learn Med. 2001;13(2):92-6.
8. Davis J, Crabb S, Rogers E, Zamora J, Khan K. Computer-based teaching is as good as face-to-face lecture-based teaching of evidence based medicine: a randomized controlled trial. Med Teach. 2008;30(3):302-7.
9. Biese KJ, Moro-Sutherland D, Furberg RD, Downing B, Glickman L, Murphy A, et al. Using screen-based simulation to improve performance during pediatric resuscitation. Acad Emerg Med. 2009;16 Suppl 2:S71-5.

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