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ORIGINAL RESEARCH

Studies of comparison between traditional based BLS and ACLS training vs. Simulation based BLS and ACLS training among final year medical students, NCR Institute of Medical Sciences, Meerut (U.P.) India

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ABSTRACT:
Aim: Effective studies of comparison between traditional based BLS and ACLS training vs. Simulation based BLS and ACLS training among final year medical students NCR Institute of Medical Sciences, Meerut.
Material and methods: The NCR Institute of Medical Sciences in Meerut played host to our prospective, randomised, parallel-group trial. Eligible participants were fourth-year medical students doing an emergency medicine (EM) clerkship for credit. Eighty fourth-year medical students were randomly assigned to either a year of medical simulation (SIM) or a year of traditional instruction (STD). The AHA recommendations for high-quality CPR were taught to the SIM group through PowerPoint presentation and training on a high-fidelity simulator over the course of an hour. The STD group received the same education, but their CPR training was conducted on a low-fidelity Resusci Anne® manikin. All of the students handled a simulated cardiac arrest with the main result meeting the criteria for high-quality CPR as outlined by the AHA guidelines (specifies metrics for compression rate, depth, recoil, and compression fraction). Involvement of EMS was a secondary result.
Results: Of 80 eligible participants, For our primary outcome, the mean compression depth was 4.62cm (95% CI [4.28–4.91]) for the SIM group and 3.92cm (95% CI [3.61–4.41]) for the standard (STD) group, p=0.03. The compression fraction was 0.732 (95% CI [0.701–0.762]) for the SIM group and 0.682 (95% CI [0.667–0.699]) for the STD group, p=0.01. The mean compression rate was 125.22 per minute (95% CI [119.25–130.25]) for the simulation (SIM) group and 117.25 per minute (95% CI [111.25–123.58]) for the STD group, p=0.07. The mean percentage of chest compressions that were accompanied by full chest recoil was 0.961 (95% CI [0.932–0.982]) for the SIM group and 0.957 (95% CI [0.884–0.991]) for the STD group, p=0.71. For our secondary outcome, the time to activation of EMS was 25.22 seconds (95% CI [16.25–42.85]) for the SIM group and 81.25 seconds (95% CI [46.58–121.33]) for the STD group, p=0.006.
Conclusion: We found that high-fidelity simulation training resulted in CPR performance that was more closely aligned to AHA CPR guidelines when compared to standard training in our prospective, randomised, and parallel-group study comparing the relative effectiveness of high-fidelity simulation training versus standard training.
Keywords: Traditional, BLS, ACLS, Simulation

INTRODUCTION

As a result of the evolution of higher education, an increased focus has been put on active learning rather than passive learning. Techniques that may be used in the classroom and are geared at boosting

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student engagement can be found in plenty in the published literature across all areas of education, including training programmes for healthcare professionals. [1,2] Training experts in fields as diverse as aviation, the armed forces, law enforcement, and other emergency responders often make use of simulation technology. This practise has been prevalent for many decades. [3] The use of simulation in the education of medical professionals has been on the rise, and it has garnered recognition on a global scale for the purpose of teaching advanced life support for cardiac arrest (ACLS). [4] Out-of-hospital cardiac arrest (OHCA) has a significant negative effect, since it is responsible for the loss of over 300,000 lives each year. [1] Despite the fact that survival rates may be rather variable, they are nevertheless usually low (less than 10%) over the majority of the nation. [3] The survival rates of many communities, on the other hand, have seen dramatic improvements. High-quality cardiopulmonary resuscitation has been the primary emphasis in areas that have had the greatest number of lives saved due to OHCA (CPR). Growing data shows that minor adjustments to CPR technique, with a focus on establishing the correct compression rate, depth, and chest wall recoil, as well as reducing interruptions and preventing overventilation, may significantly increase survival rates. [4–6]

Although our comprehension of the principles behind cardiopulmonary resuscitation (CPR) is growing, there is still a significant gap between what we know and how it is actually carried out on patients in both in- and outside-of-hospital settings. In spite of the fact that cardiopulmonary resuscitation is a vital part of the chain of survival, the quality of CPR that is provided in both contexts is variable. [7–8] The American Heart Association (AHA) CPR Guidelines highlight the need of developing a culture of monitoring and assuring high-quality CPR in order to bridge the knowledge-practice gap and save more lives. This is one of the primary recommendations made by the AHA. [9–10]

The use of human patient simulation offers the chance to close the knowledge-practice gap in the context of the teaching, training, and application of high-quality CPR. The term "simulation" refers to the use of any technology or procedure that recreates a contextual setting in such a way as to enable a learner to experience success and failure, make errors, get feedback, and build confidence in an environment that is learner-oriented and free of patient risk. [11] The Institute of Medicine, the Educational Technology Section of the Academic Emergency Medicine Consensus Conference, and the general public have all called for expanded simulation training as a means of reducing the number of errors that occur in the medical field. [12–16] Both basic life support (BLS) and advanced cardiac life support (ACLS) have been acknowledged as the standard standards for determining a person's level of ability to handle patients who are experiencing cardiac arrest. There are very few randomised studies that compare the effectiveness of simulation versus standard teaching and training in terms of retention of ACLS knowledge and the ability to manage critically ill patients. Written evaluation is not a good predictor for skills performance in an ACLS course, and there are very few studies that compare the effectiveness of simulation versus standard teaching and training. [17–20] In this research, we evaluate the efficacy of standard low-fidelity manikin training with high-fidelity simulation for the purpose of teaching medical students how to do chest compressions according to the AHA BLS CPR recommendations for rate, depth, recoil, and compression fraction.

MATERIAL AND METHODS

The NCR Institute of Medical Sciences in Meerut played host to our prospective, randomised, parallel-group trial. Eligible participants were fourth-year medical students doing an emergency medicine (EM) clerkship for credit. There is a simulation component to the EM clerkship. Students were given the opportunity to voluntarily participate in the research once a month during clerkship induction. No restrictions were placed on participants' use of the simulator, and the study's findings had no bearing on how clerks were graded.

Using a computer-generated random number generator with block sizes of four, participants were assigned to either a control or intervention group. Each student was given a similar introduction to the human patient simulator (Laerdal SimMan® 3G full-scale patient simulator) after being randomly assigned to use it. This included going over the simulator's capabilities and the physiologic monitoring equipment that came with it. During the simulated patient situation, students were required to verbally communicate their ideas, directives, and actions. The pupils had no idea what kind of simulation scenario they'd be responsible for. Everyone involved was familiar with the simulator from prior use.

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The American Heart Association's Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care were presented in a lecture format using PowerPoint to both groups (ECC). [21] The International Consensus on CPR and ECC Science with Treatment Recommendations was developed by the International Liaison Committee on Resuscitation (ILCOR), and it served as the foundation for the development of the CPR and ECC Guidelines. [22,23]
Immediately after the completion of the theoretical instruction came the portion dealing with practical abilities. During this session, the medical students were instructed on how to conduct high-quality CPR in accordance with the precise criteria that were outlined and emphasised in the ILCOR recommendations. [23] Chest compression rate, depth, recoil, and compression fraction are the elements that make up high-quality cardiopulmonary resuscitation (CPR). Students performed CPR with a particular emphasis on each of these four aspects of the technique. Education and training were delivered in exactly the same manner to both the intervention and control groups during this particular session; the only difference was in the manikins that were used (high-fidelity vs. low-fidelity). During the course of student CPR, the high-fidelity manikin offered feedback in real time on the chest compression rate, depth, and recoil. The low-fidelity manikin does not provide real-time feedback in the same manner.
After performing cardiopulmonary resuscitation (CPR), participants in the control group were given feedback on how they did. The only difference between the students in the intervention group and the students in the control group who took part in the practical skills component of the course was the kind of manikin that they were randomly assigned to use during their training. The CPR training for the intervention group was done on the high-fidelity human patient simulator, whereas the training for the control group was done on the regular low-fidelity CPR procedural tasks.

METHODOLOGY

Chest compression rate, depth, recoil, and compression percentage were the performance parameters examined for high-quality CPR in our research, all of which were described in detail by the AHA Guidelines for CPR and ECC. Data on chest compression rate, depth, and rebound may be recorded in real time with the help of the high-fidelity simulation software. Accuracy is shown to the closest full compression for rate, to the nearest millimetre for depth, and to the nearest percent for recoil (100% release recoil meaning all compressions given during a cycle were followed by acceptable chest recoil).
Before beginning the actual investigation, we established performance measures. The number of compressions applied to the chest in one minute was considered the compression rate. Chest compression depth was measured in cm from the sternum's neutral position. Chest recoil was defined as the time between chest compressions during which the sternum is allowed to recover to its neutral position one hundred percent of the way. The percentage of time chest compressions were performed while the patient lacked a perfusing rhythm is known as the compression fraction. Time without a perfusing rhythm was tracked from the beginning of ventricular fibrillation to the conclusion of the tenth cycle of cardiopulmonary resuscitation. Patients who choose to do CPR using just their hands did so until they reached 300 compressions, at which point the procedure was considered complete. This enabled the same performance metrics to be collected after 300 compressions as with the 10-cycle CPR group. Time to EMS activation was measured from the commencement of ventricular fibrillation until the subject made a request to call for help. The American Heart Association's (AHA) adult cardiac arrest strategy begins with calling for help.
The simulation scenario utilised was based on the AHA ACLS SimMan® Scenarios collection and included an elderly man experiencing a cardiac arrest. A full-time simulation expert, a researcher to ensure the study protocol was followed correctly, and a confederate in the scenario were all utilised as human resources in the assessment scenarios.
Standardized data abstraction sheets were used for data entry. Instructional workshops were held to teach data abstractors on how to enter data into collecting sheets and the definitions of the performance measures being used. To reduce the possibility of human mistake in data abstraction, we used a system of duplicate data input. Problems were handled by going back to the source data in the recordings and seeing whether we had correctly abstracted it. We created a master data spreadsheet and entered all information there.

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The AHA CPR and ECC Guidelines were developed with input from experts throughout the world and are grounded on the ILCOR International Consensus on CPR and ECC Science with Treatment Recommendations.

22,23 High grade CPR was defined as 100 compressions or less per minute, 5 cm or less of depth, complete chest recoil (100%) and a compression fraction of 100%. According to the recommendations, advanced cardiac life support (ACLS) treatments expand upon the basics of basic life support (BLS), which include calling 911 and doing chest compressions. 21 This was the impetus for our secondary outcome, which we called "time to activation of EMS," and which was defined as the duration between the onset of cardiac arrest (ventricular fibrillation) and the student's desire to call for help. The results were collected during a simulation of a cardiac arrest using a scenario derived from the American Heart Association's ACLS SimMan® Scenario Collection, which was known for its high level of realism.

ANALYSIS

The data found on the master data collecting sheet were exported to Stata format for further analysis. The Kruskal-Wallis rank sum test was used to give the means of continuous variables with 95% CIs. If the value of the two-tailed alpha was less than 0.05, then the results were statistically significant. In order to determine the optimal size of our sample, we assumed a difference in compression depth of 5 mm between the two groups (the effect size). In order to detect a difference between groups with a power of 0.8, we required 34 people in each group, assuming a two-tailed alpha () of 0.05 and a beta () of 0.2.

RESULTS

Of 80 eligible participants, For our primary outcome, the mean compression depth was 4.62cm (95% CI [4.28–4.91]) for the SIM group and 3.92cm (95% CI [3.61–4.41]) for the standard (STD) group, p=0.03. The compression fraction was 0.732 (95% CI [0.701–0.762]) for the SIM group and 0.682 (95% CI [0.667–0.699]) for the STD group, p=0.01. The mean compression rate was 125.22 per minute (95% CI [119.25–130.25]) for the simulation (SIM) group and 117.25 per minute (95% CI [111.25–123.58]) for the STD group, p=0.07. The mean percentage of chest compressions that were accompanied by full chest recoil was 0.961 (95% CI [0.932–0.982]) for the SIM group and 0.957 (95% CI [0.884–0.991]) for the STD group, p=0.71 (Table .1)

For our secondary outcome, the time to activation of EMS was 25.22 seconds (95% CI [16.25–42.85]) for the SIM group and 81.25 seconds (95% CI [46.58–121.33]) for the STD group, p=0.006.

Table 1. **Main outcome variables according to teaching method.**

Parameter	**Teaching method**	**Mean**	**95% CI**	**P value**
Compression rate/min	STD	117.25	111.25–123.58	0.07
	SIM	125.22	119.25–130.25	
Depth (cm)	STD	3.92	3.61–4.41	0.03
	SIM	4.62	4.28–4.91	
Recoil proportion	STD	0.957	0.884–0.991	0.71
	SIM	0.961	0.932–0.982	
Compression fraction	STD	0.682	0.667–0.699	0.01
	SIM	0.732	0.701–0.762	
Time to EMS activation (seconds)	STD	81.25	46.58–121.33	0.006
	SIM	25.22	16.25–42.85	

SIM, simulation training group; *STD*, standard training group; *CI*, confidence interval; *cm*, centimeter; *EMS*, emergency medical services; *min*, minute.

Compression rate/min = number of chest compressions delivered per minute; recoil proportion = proportion of compressions accompanied by 100% chest recoil; compression fraction = proportion of time compressions performed while patient in a non-perfusing rhythm.

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DISCUSSION

We found that high-fidelity simulation training resulted in CPR performance that was more closely aligned to the AHA CPR guidelines in our prospective, randomised, and parallel-group study comparing the relative effectiveness of high-fidelity simulation training versus standard training. The study was designed to evaluate the relative effectiveness of high-fidelity simulation training versus standard training. To the best of our knowledge, this is the first paper to establish that using high-fidelity simulation to teach high-quality CPR results in increased performance on the part of medical students. To be more specific, we found an improved performance in terms of chest compression depth and compression percentage, both of which are measures that the AHA has specifically identified as being essential components of high-quality CPR. Additionally, we saw that the simulation-trained group activated the EMS system more quickly than the other group. Recent studies that have showed better results with OHCA and have reinforced the need of a higher focus on proper compression rate, depth, recoil, and compression fraction support the advice and emphasis on these metrics that are placed by the AHA. [24–31] On the other hand, our new method of training did not have any measurable influence on the compression rate or recoil.

The simulation industry may particularly benefit from highlighting a few key aspects of the primary suggestions included in the guidelines. The first piece of guidance is a suggestion that "manikins with realistic characteristics such as the potential to reproduce chest expansion and breath sounds, create a pulse and blood pressure, and talk may be effective for integrating the information, skills, and behaviours necessary in ALS training." [32] The second point is that "written exams should not be utilised only to judge the competency of a participant in an advanced life support course," and instead, there should also be an evaluation of the person's performance. Third, "CPR prompt and feedback devices may be effective for training rescuers and may be useful as part of an overall approach to enhance the quality of CPR for real cardiac arrest," according to research published in the journal Resuscitation. [32]

There is a growing body of literature that supports the use of simulation in resuscitation research and training, and our results that simulation produces student performance that is more closely adherent to AHA standards are consistent with this literature. A simulation-based ACLS course was shown to dramatically increase participants' knowledge, psychomotor abilities, and overall performance during resuscitation, according to research that combined high-fidelity simulation with traditional ACLS training. [33] According to the findings of a study that was prospective, randomised, and carried out at 10 different institutions using a standardised simulated cardiopulmonary arrest scenario, the application of innovative and applicable technology has the potential to improve compliance with the AHA guidelines for CPR, which are associated with better outcomes. [34] In addition, there has been study conducted using simulations which shows that real-time resuscitation instruction dramatically promotes adherence to the AHA standards. [35] Knowledge, skills, learning, and retention of CPR techniques, as well as advanced resuscitation techniques, have all been demonstrated to benefit from the use of high-fidelity simulation in the nursing and pharmacy fields. [36,37] Recent findings from a meta-analysis and systematic review that evaluated the use of simulation technology in resuscitation training came to the conclusion that training in resuscitation that is based on simulation is extremely beneficial. [38]

Our research is a contribution to the simulation literature, which advances scientific knowledge in the field of simulation education, provides guidance for future areas of research, and also offers insight for those stakeholders who play an important role in the development of policies, protocols, or procedures in the practise of simulation-based education. Our research contributes to the existing corpus of literature on simulation in a variety of different ways. The vast majority of interventional research that have been conducted in the field of simulation-based training have used non-experimental study designs (also known as non-randomized study designs) in order to assess the efficacy of simulation. Our research used a prospective, randomised controlled trial study design, which, in comparison to non-randomized study designs, presents a lower risk of bias. When compared to other types of research designs, randomization provides the highest level of certainty when it comes to attributing variations in result to the intervention being tested. Previous studies either did not assess all of the performance metrics or showed no significant difference in the outcomes. However, our research is also unusual in that we employed performance measures of high-quality CPR expressly specified by the AHA recommendations as the main outcome. [34,35]

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There is also a body of research that has shown that resuscitation simulation training has no positive outcomes. No significant difference in adherence to the AHA recommendations was identified in a prospective trial that evaluated whether simulation-based ACLS training improved performance in handling simulated and true cardiac arrest. [39] Another research that compared the performance of participants who received ACLS training on high-fidelity manikins to those who received instruction on low-fidelity manikins found that there was no significant difference in the groups' written test results. [40] Some of the published research on simulation in resuscitation care contains flaws, such as selection bias, heterogeneity of outcome measures, a study design that lacks rigorous methodologies, and small samples that lead to underpowered studies that are unable to detect a genuine difference between groups.

The secondary result that we noticed was that the group that had been taught via simulation activated the EMS system an average of 57 seconds faster than the control group. In the event of a cardiac arrest in an adult, the first step in the algorithm is to activate emergency response. Research has demonstrated that providing early cardiopulmonary resuscitation (CPR) and quick defibrillation to sufferers with observed ventricular fibrillation arrest may greatly enhance the likelihood of surviving until hospital discharge. [41–46] The potential for improving patient outcomes may be increased by putting into practise education and training programmes that are geared to monitor and improve these measures.

Because students get to actually experience what the correct compression rate, depth, recoil, and compression fraction feel like, we believe that feedback in high-fidelity simulation is a key driver behind performance enhancement. This is because students get to actually experience what it is like to have the correct compression rate. The learner is able to make quick modifications to their performance because to the real-time feedback, which also helps them acquire confidence that their activities are leading to the intended outcome (s). We think that the feedback that is offered via high-fidelity simulation is the reason why the SIM group was able to execute CPR at a higher level than the other groups. We think that a student's behaviours will more accurately represent what they have learned and practised if the learner is able to be immersed in a training environment to a greater degree.

During their training, members of the SIM group got input from the simulator that indicated the pace and depth of chest compressions. We saw what looked to be exhaustion setting in more quickly in those students who were working at appropriate rates and depths, and we also noticed that they were quicker to ask for assistance when they needed it (EMS activation). This observation is quantified by comparing the two groups' times to EMS activation and finding that there is a difference between them. We believe that participant fatigue during the CPR performance assessment and the fidelity of immersion during the practical skills training are two variables that contributed to this difference. During the CPR performance assessment, participants were asked to perform chest compressions on a mannequin. It has been shown via research that having knowledge of CPR is required but not sufficient to actually conduct the technique in a manner that is highly compliant with the recommendations established by the AHA. [47] Training that is based on simulation makes it possible to quantitatively assess performance during chest compressions and also gives a tool to monitor improvement.

CONCLUSION

We found that high-fidelity simulation training resulted in CPR performance that was more closely aligned to AHA CPR guidelines when compared to standard training in our prospective, randomised, and parallel-group study comparing the relative effectiveness of high-fidelity simulation training versus standard training. The study was carried out by comparing high-fidelity simulation training to standard training. Participants who had received simulation training had faster delays to EMS activation, which is the first stage in the AHA's strategy for treating adult cardiac arrest.

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