ORIGINAL ARTICLE

An Analysis of the Efficacy of Different Teaching Modalities in Imparting Adult Cardiopulmonary Resuscitation Skills among First-year Medical Students: A Pilot Study

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Abstract

Introduction: Our current medical curriculum devotes a large percentage of time to knowledge acquisition by means of didactic lectures. Psychomotor skill acquisition takes a back seat. Certain lifesaving skills like basic life support skill training have not even made an appearance in the current curriculum. Equal time distribution to cognitive and psychomotor skills should be allotted for MBBS trainees, which is a very practical subject. Simulation can prove to be a valuable tool in imparting skill training. The present study aims to evaluate the efficacy of different teaching modalities in imparting lifesaving skills among first-year MBBS students.

Materials and methods: This cross-sectional study was conducted among 33 first-year students who consented to participate. Approval was obtained from the institutional ethics committee. The students were divided into three groups, each undergoing either didactic lecture or animation-based videos or simulation studies. Pretest, posttest, and skills tests were administered to them. One-way analysis of variance (ANOVA) and paired *t* test were the statistical tests employed using SPSS version 21.

Results: The pretest and posttest scores were comparable in the three groups while the improvement in the posttest scores in all the three groups was significant. The skills test was significantly better in the group undergoing simulation training compared to the other groups.

Conclusion: Didactic, animation, and simulation are all good methods in imparting cognitive knowledge, but simulation is the method of choice in imparting psychomotor skills.

Clinical significance: An overhauling of the medical curriculum to include more skills training to the budding doctors using simulation-based techniques is recommended.

Keywords: Basic life support, Cardiopulmonary resuscitation, Didactic, Manikins, Medical students, Simulation.

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Introduction

Cardiopulmonary resuscitation (CPR) is an attempt to restore spontaneous circulation by performing chest compressions with or without ventilation.[1] Cardiopulmonary resuscitation may be performed by a person having a medical or allied medical sciences background or by bystanders. Suffice to say, CPR is a lifesaving skill, the training of which should be imparted to all individuals belonging to medical or nonmedical fields.[2] Despite knowing the importance of CPR, it has failed to make an appearance in the Indian medical curriculum and continues to remain as a skill to be acquired optionally. Often, some aspects of CPR are covered in the form of didactic lectures in a classroom setting for first-year medical students. There exists an inherent difficulty in imparting knowledge on complex topics that are difficult to grasp for students who have had no exposure to direct patient care as a part of their training.[3]

Medical errors are a combination of human and system errors and can occur at any step during patient management.[4] Good knowledge and adequate clinical skills can prevent treatment-related mishaps. While didactic lectures provide a satisfactory knowledge base to the students, acquisition of technical skills continues to remain a challenge. This challenge is inadequately addressed by incorporating videos of the skill to be acquired. Do these methods actually help in bridging the gap between having the knowledge about those skills and actually practicing them?

Research in Western countries has shown that simulation-based training maybe superior in teaching technical skills across multiple medical specialties, and hence, the incorporation of the same as a day-to-day teaching tool may be recommended.[5–9]

Simulation is a technique to replace or amplify real-life experience with guided experience, often immersive in nature, that evokes or replicates the aspects of the real world in a fully interactive fashion.[10] If the fidelity of the simulator is sufficient, immersion, reflection, and feedback aid the learning process and, in addition, provide the benefit of protection to the learner from the risks associated in clinical situation.[11] This study does not

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question the importance of didactic lectures in the knowledge acquisition process in the life of a medical student. It merely questions the appropriateness of using a didactic or a video-based tool in imparting a skill to a medical student. The aim of this study was to compare the efficacy of different teaching modalities in imparting lifesaving skills to the first-year MBBS students. A paucity of evidence in this regard in our country prompted this study.

Materials and Methods

This was a cross-sectional study done among first-year medical students in a medical college in south India after obtaining an approval from the Institutional Review Board and Institutional Ethics Committee (IEC Study Ref. No. 18/19/IEC/JMMC&RI). The protocol was registered under ctri.nic.in (CTRI/@019/03/018279).

Participants

First-year medical students in a single medical college in south India were included if they voluntarily consented to be part of the study. Out of the total 100, 33 first-year medical students consented to participate in this study. After ensuring that the students had no physical disability impeding them from effectively performing high-quality CPR or prior knowledge of CPR, they were divided into three batches consisting of 10, 11, and 12 students each according to their roll numbers. An initial briefing regarding the project was given to all the students who were asked to gather on one Sunday morning in the institution. A pretest consisting of 10 questions based on accepted 2015 guidelines of the American Heart Association was administered to the students.[12] The duration of the pretest was 10 minutes. Following this, the three batches were assigned to their respective rooms in the following order. Batch A underwent didactic training, batch B was shown animation videos, and batch C was given hands-on training using manikins by American Heart Association (AHA)-certified basic life support (BLS) instructors. The same content of information was imparted to all the students using different modalities of teaching in these sessions over a period of 1 hour.

Following the intervention, a posttest was administered to the students consisting of the same questions as in the pretest but in different order. The intervention was concluded by taking a skills test of all the three groups in their respective rooms using manikins and a CPR checklist.[12] At no point of time was the intermingling of students allowed to happen. In order to ensure equal distribution of knowledge in the end, all students were given training in the modalities that they missed out in the first session.

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 21. Paired *t* test, one-way ANOVA, and Tukey's *post hoc* tests were used in the present study.

Results

A total of 33 out of 100 first-year medical students who were approached consented to participate in this study. They were divided into three batches consisting of 10 students in the didactic group, 11 in the animation video group, and 12 students in the simulation group (Table 1).

Mean pretest marks were 3.0 ± 1.56, 2.4 ± 1.36, and 2.0 ± 1.12 in didactic, video, and simulation groups, respectively, while 8.6 ± 0.84, 7.6 ± 0.80, and 7.9 ± 1.72 were the posttest scores, respectively, in each group (Table 1). Among participants in all three groups, the mean differences in pre- and post-examination score were statistically significant ($p < 0.001$) and the improvements in exam score (mean difference) following the didactic, video, and simulation were 5.6 ± 1.71, 5.1 ± 1.72, and 5.9 ± 1.56 marks, respectively, in each category (Table 1). The median distribution of scores in the three groups is shown in Figure 1.

The one-way ANOVA test was used to compare the posttest scores in each of the group, i.e., didactic, video, and simulation, and no statistical significance was seen. The minimum and maximum scores obtained by the group in each category are also mentioned (Table 2).

Table 1: Mean distribution of pre and posttest scores

Methods (n = 33)	*Mean + SD*	*Mean difference*	*t value**	*p value*
Didactic (*n* = 10)				
Pretest marks	3.0 ± 1.56	−5.6 ± 1.71	−10.34	0.000**
Posttest marks	8.6 ± 0.84			
Video (*n* = 11)				
Pretest marks	2.4 ± 1.36	−5.1 + 1.72	−9.98	0.000**
Posttest marks	7.6 ± 0.80			
Simulation (*n* = 12)				
Pretest marks	2 ± 1.12	−5.9 ± 1.56	−13.10	0.000**
Posttest marks	7.9 ± 1.72			

*Paired *t* test
**$p < 0.001$

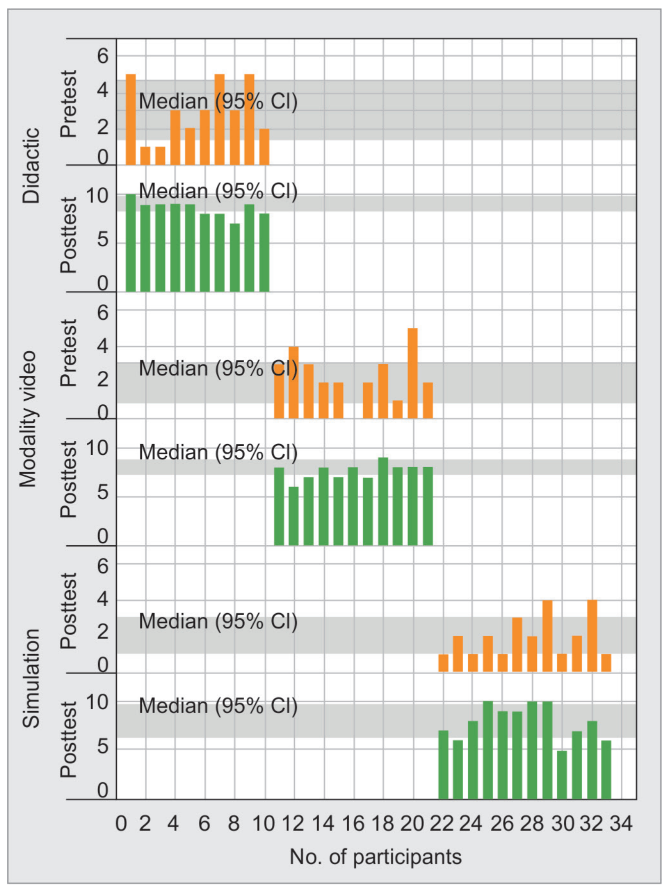

Fig. 1: Median distribution of scores for pre and posttest amongst the three teaching modalities

Table 2: Pre- and posttest mark distribution among three groups

	Mean + SD	*Min. score*	*Max. score*
Pretest score (*n* = 33)			
Didactic (*n* = 10)	3.0 ± 1.56	1	5
Video (*n* = 11)	2.4 ± 1.36	0	5
Simulation (*n* = 12)	2.0 ± 1.1	1	4
Posttest score (*n* = 33)			
Didactic (*n* = 10)	8.6 ± 0.84	7	10
Video (*n* = 11)	7.6 ± 0.80	6	9
Simulation (*n* = 12)	7.9 ± 1.72	5	10

Table 3A: Skill test mark distribution among three groups

Skill test score (n = 33)	*Mean + SD*	*Min. score*	*Max. score*
Didactic (*n* = 10)	4.3 + 1.15	3	6
Video (*n* = 11)	4.0 + 1.48	1	6
Simulation (*n* = 12)	9.3 + 0.98	8	10

Table 3B: Comparison of mean skill test scores among three groups

	Sum of squares	*df*	*Mean square*	*F**	*p value*
Between groups	206.203	2	103.102	69.093	0.000**
Within groups	44.767	30	1.492		
Total	250.97	32			

*One-way ANOVA
***p* < 0.001

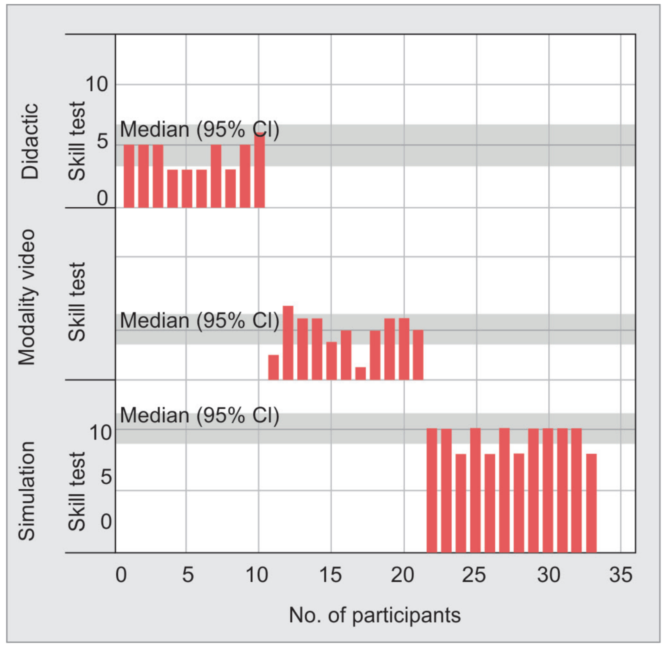

Fig. 2: Median distribution of the scores for skill test amongst the three teaching modalities

The mean scores, for the skill test conducted in each of the three groups, were found to be 4.3 ± 1.15, 4.0 ± 1.48, and 9.3 ± 0.98, respectively (Table 3A). The minimum skill score and the maximum are also indicated for each batch of students. The difference was highly significant ($p < 0.001$) using the one-way ANOVA test (Table 3B). Simulation scores were better than didactic and video modes while didactic was better than video with a statistical significance of $p < 0.001$ using the Tukey's *post hoc* test. Figure 2 gives more clarity on the median distribution of the scores in each category of students.

Discussion

Kolb's learning cycle includes learning in cognitive, affective, and psychomotor domains.[13] Our current medical curriculum devotes a large percentage of its time in helping students acquire cognitive knowledge. The psychomotor domain development takes least priority. The present study aims to demonstrate the active and increased inclusion of skill development as a part of an improvement in the psychomotor domain.

Table 1 show the pretest and posttest scores conducted in 33 first-year medical students. Ten students belonging to the didactic group scored a mean of 3.0 marks in the pretest out of 10. Eleven students belonging to the video group scored 2.4 in the pretest, which then improved to 7.6 in the posttest. The last group, which consisted of 12 students in the simulation category, scored an average of 2 marks in the pretest, which improved to 7.9 in the posttest. The improvement in the posttest scores was highly significant. The median distribution of the marks obtained by the three different groups in both pretest and posttest shows that there was not a single student who did not perform better after the mode of instruction, irrespective of the method of instruction used. The results of the study prove that the cognitive domain of the students improved significantly irrespective of the method of teaching. From the study, it is however unclear whether the improvement in posttest scores could lead to improvements in comprehension, projection abilities, and ultimately managing an emergency medical condition.[14] In studies done by various researchers comparing various research modalities, the results obtained were highly variable.[15–17] The lack of consensus leads to confusion with regards to the choice of teaching modality to be made. However, our pilot study clearly indicates no clear superiority in any of the teaching modalities as far as the cognitive skills are concerned.

On comparing the posttest scores in each of the three groups, their mean value does not significantly differ (didactic—8.6; video—7.6; and simulation—7.9) as seen in Table 2. This goes to reiterate the fact that one teaching modality cannot be considered superior to the other while imparting knowledge in the cognitive domain. In a study conducted by Wang et al., no noticeable difference was seen in the MCQ scores in the two groups using didactic and simulation modalities.[18]

Tables 3A and B provide us with a clue regarding the performance of students in each category in the psychomotor domain. The skill test scores were significantly higher (mean = 9.3) in the simulation group. The didactic group scored a mean of 4.3 and the video group scored a mean of 4 in the skill tests. Intergroup comparisons showed simulation to be a significantly better tool in imparting skill and knowledge compared to the other two groups. Didactic as a method of instruction proved better than video-/animation-based learning, although the difference was not significant. Figure 2 describes the median of marks obtained in the skills test in each of the three groups. It is visually apparent and statistically proven that simulation-based teaching had the maximum effect in students.

Simulation provides a safe environment for students without affecting patient safety to learn, provided the manikins are of high fidelity.[19] Exposure to hands-on teaching using manikins promotes the theory of experiential learning and allows the participants an enhanced decision-making ability in the emergency scenario.[20] Repetitive practice through simulations followed by reflective observation with adequate debriefing that forms the hallmark of simulation-based education has proven to be a superior method in knowledge acquisition and retention, evident in this study too.[21]

Limitations

The study had certain limitations, the most important among them being the smaller sample size. Around 67% of the population did not participate in the study. The retention of information following the imparting of knowledge was not tested in this.

Conclusion

There are many facets to a students' learning process. A predominant inclusion of only one type of teaching modality may be inadequate in creating efficient doctors. Blending of different teaching methods might be required in imparting different skills and knowledge. Our study proves the superiority of simulation-based learning over didactic and videos in imparting both knowledge and psychomotor skills and hence the recommendation of the same in the medical curriculum is not unwarranted. In addition, training the students in lifesaving skills should be mandatory at the very beginning of medical course.

Clinical Significance

The study points out an important lacuna in our present medical curriculum, i.e., the lack of CPR training and simulation-based techniques for undergraduate students. Hence, an overhauling of the medical curriculum to include more skills training to the budding doctors using simulation-based technique is recommended.

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