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Original article

Efficacy of simulation-based learning compared to lecture-based learning among final-year medical students

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Abstract

Introduction: The need for simulation-based education during paediatric clinical rotations has increased in the last decade because of patient safety concerns and other complexities. There are very few studies during the undergraduate postings comparing lecture-based and simulation-based teaching. This study aims to compare the efficacy of simulation-based teaching with lecture-based teaching among final-year undergraduate medical students posted in paediatrics and also assess the students' perception about these methods of teaching.

Methods: A simulation module was developed for the status epilepticus scenario by the simulation educators of the Paediatric Faculty of Father Muller Medical College, Mangalore, Karnataka, India. A convenient sample of final-year undergraduate medical students was divided into two groups. One group was subjected to lecture-based teaching, and the other group to simulation scenario-based teaching. The pre- and post-test scores of both groups were evaluated for learning outcomes, and a self-assessment questionnaire captured the post-intervention confidence level of the participants. Quantitative data were analysed using paired t-test of the mean scores and analysis of variance.

Results: Twenty-six students were included in each group. Post-test scores of both groups showed significant improvement over pre-test scores

($p < 0.001$). However, the post-test scores of the didactic lecture group were significantly higher compared to the simulation group. Students felt more confident to manage status epilepticus with simulation teaching, though both methods got similar overall ratings.

Conclusion: The study specifically compared two teaching-learning methodologies to achieve the desired learning outcomes for a case of status epilepticus in a paediatric patient, and the authors conclude that both methods achieved the desired learning outcomes and simulation teaching can be adjunct to lecture classes.

Keywords

Lecture, medical students, paediatrics, status epilepticus, simulation.

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Introduction

Simulation is defined as a learning method through role-playing or through the use of devices in an imitated environment, and learners demonstrate competencies, critical thinking, decision making.

The need for simulation in student education has increased in the last decade because of the less patient care exposure and other complexities [1], more so in clinical paediatrics. Simulation allows exposure to different clinical scenarios in a structured fashion without increasing patient risk.

There are many studies evaluating the efficacy of simulation, but the majority involve nursing schools. There are very few studies involving medical students comparing lecture-based and scenario-based teaching. Hence, this study was undertaken with the objective of comparing the efficacy of simulation-based teaching with didactic lecture teaching among undergraduates posted in paediatrics. In addition, students' perceptions about these methods of teaching were assessed.

Methods

Context

There is a lack of data comparing the efficacy of lecture-based teaching and simulation-based teaching in the paediatric undergraduate curriculum.

Intervention

Develop and implement a simulation-based module for managing a paediatric patient with status epilepticus and compare this methodology with a regular lecture-based session using a PowerPoint® presentation.

Study design and sample

An interventional study design was used. The sample included 52 final-year undergraduate medical students posted in the Paediatric Department of Father Muller Medical College, Mangalore, Karnataka, India. They were randomly divided into two groups of 26, each using the manual lottery method. One group was subjected to lecture-based teaching, and the other group to simulation scenario-based teaching.

Study setting and ethical considerations

The study was conducted in the Paediatric Department classroom for the lecture group and at the simulation and skill centre for the simulation group. The sample participants included final-year undergraduate medical students posted in the Paediatric Department. The invitation to participate included information and consent details clearly stating that participation was voluntary and confidential. The study protocol received approval from the institution Ethics and Research Committee.

Development and implementation of the intervention

All 52 students were given pre-reading reference materials from standard textbooks and then given the pre-test MCQ-based questionnaire. The principal investigator took the lecture class of one-

hour duration using a PowerPoint® presentation for the lecture group. Two trained simulation educators from the Paediatric Department, which included the principal investigator and one simulation educator from the simulation centre, developed the simulation scenario and delivered the module over one hour to the simulation group of students. The scenario of status epilepticus was given, and students were asked to manage the case using CAE Baby Emergency Care Simulator. This was followed by a debriefing session of their performance. All 52 students received a post-test MCQ-based questionnaire following the respective sessions. The students also completed a self-assessment questionnaire to gauge their confidence level for managing a status epilepticus patient.

Data collection

The tools used for data collection were validated pre- and post-test MCQ-based questionnaire and a self-assessment questionnaire. The MCQ-based questionnaire was aimed at assessing the knowledge domain of the student with respect to managing a status epilepticus paediatric patient. The test content was validated by a panel of four experts from the Paediatric Department not involved in the study. The self-assessment questionnaire was validated by conducting a pilot study using a group of students not enrolled in the study.

Data analysis

Statistical Package for the Social Sciences® version 21.0 was used to analyse the data. The data were analysed using the paired t-test to compare mean scores and one-way analysis of variance test values. The results were statistically significant ($p < 0.001$).

Results

Group 1 consisted of 26 students who received lecture-based teachings, and group 2 consisted of other 26 students who received simulation scenario-based teaching on the same topic (**Fig. 1**). There was no significant difference between pre-test scores in both groups. Post-test scores of both groups showed improvement over pre-test scores (**Tab. 1**). However, post-test scores of group 1, which received didactic lectures, were significantly higher compared to the simulation group (**Tab. 2**).

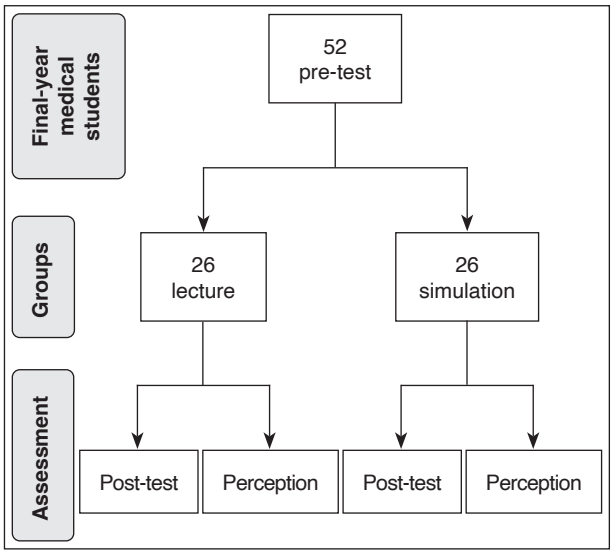

Figure 1. Randomisation of groups.

Table 1. Significant improvement in post-test scores compared to pre-test scores in both groups.

Group	Scores	Mean	SD	Mean difference	Paired t-test
Lecture	Pre-test scores	5.8	0.4	3.3	t (25) = 8.9 **p < 0.001**
	Post-test scores	9.1	0.2		
Simulation	Pre-test scores	6.6	0.3	0.8	t (25) = 4.85 **p < 0.001**
	Post-test scores	7.4	0.2		

Table 2. Comparison between pre- and post-test scores of the two groups.

Scores	Group	Mean	SD	Mean difference	Test
Pre-test scores	Lecture	5.8	0.4	0.8	p = 0.07 Not significant
	Simulation	6.6	0.3		
Post-test scores	Lecture	9.1	0.2	1.7	**p < 0.001** Highly significant
	Simulation	7.4	0.2		

Students' perception about the method of teaching was assessed by a questionnaire (**Tab. 3**). Material covered was perceived to be better in lecture-based teaching. Students perceived increased confidence to manage status epilepticus following simulation-based teaching. Students felt more involved in simulation-based teaching though both methods met the expectations and received similar overall ratings on the Likert scale.

Table 3. Perception of students about method of teaching.

Parameters	Group	Mean	SD	Mean difference	Test
Material covered	**Lecture**	3.9	0.1	0.2	p = 0.30 NS
	Simulation	3.7	0.2		
Confidence	**Lecture**	3.4	0.1	0.3	p = 0.19 NS
	Simulation	3.7	0.2		
Met expectations	**Lecture**	4.2	0.1	0.2	p = 0.59 NS
	Simulation	4.0	0.2		
Overall rating on the Likert scale	**Lecture**	4.1	0.2	0.1	p = 0.86 NS
	Simulation	4.0	0.2		

NS: not significant.

Discussion

There is ample literature on designing simulation research and training [2, 3] and evaluating the efficacy of simulation, but the majority involve nursing schools. In a study by Saied [4], the impact of simulation on paediatric nursing students concludes that simulation is an effective teaching and learning modality. In a study by Tofil et al. [5], using high-fidelity simulators among third-year medical students during paediatric clerkship, it was concluded that simulation enhances learning. This study used MCQ-based knowledge assessment pre- and post-simulation and a Likert-based skill and attitudes assessment, similar to this present study. In another study [6], students perceived simulation as more enjoyable, which can be compared to the results of the present study where students perceived more engagement during simulation.

The results of this study reveal that both lecture-based and simulation-based teaching methods improve learning outcomes. The significantly higher scores captured by the MCQ-based questionnaire post-lectures compared to post-simulation could be due to the didactic nature of the transfer of knowledge during lectures, unlike simulation, where the content is not taught, but prior knowledge is applied and reflected upon. Students in the simulation group perceived more confidence to manage a paediatric patient with status epilepticus due to the hands-on approach provided by this methodology, wherein not just the theoretical knowledge on how to manage a case but the critical thinking and decision making skills can be practiced.

Simulated training was superior to a didactic lecture in a study [7] conducted on fourth-year medical students to assess and manage simulated myocardial infarction and anaphylaxis. However, in our study, we limited our assessment to the acquisition of knowledge only.

Another study [8] demonstrated that high-fidelity simulation resulted in equivalent immediate knowledge gain and superior long-term knowledge retention compared to lectures. In a Saudi Arabian study involving medical students, most students agreed that simulation-based learning improved their knowledge, skills and attitude [9]. Future development in simulation depends on overcoming issues related to technology, cost and faculty development, as mentioned by So et al. [10].

Limitations

The sample size was small and represented only a single topic, status epilepticus. Crossover studies with a larger sample size with multiple scenarios may give a better insight. Moreover, this study was done in one institution only. There were unmeasured confounding factors within the groups considering the voluntary enrolment and individual characteristics of each student.

Conclusions

The study specifically compared two teaching-learning methodologies to achieve the desired learning outcomes for a case of status epilepticus in a paediatric patient, and we conclude that both methods achieved the desired learning outcomes and suggest that simulation-based teaching can be a good adjunct to lecture classes rather than replacement.

Declaration of interest

The Authors declare that there is no conflict of interest.

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