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Original Article

Education Section

Usefulness of Simulation Based Learning in First Year Medical Students: A Quasi-experimental Study

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ABSTRACT

Introduction: Auscultation of chest is an important part of clinical patient assessment and the skills required to interpret it are traditionally learned by listening the heart and lung sounds of many different patients. It may be difficult for the students to compare actual heart and lung sounds with similar findings. Therefore, use of simulated heart and lung sounds in teaching and training of medical students may be helpful in such scenario as it allows the repetitive and individualised oriented training in support of learning in real scenarios.

Aim: To evaluate the usefulness of simulation in understanding various respiratory and cardiovascular sounds, to assess the learning gain of students by pretest and post-test and to evaluate the perception of students towards simulation based learning.

Materials and Methods: The present quasi-experimental study was carried out on 100 first year MBBS students at Clinical Skills Laboratory and Department of Physiology, at Mahatma Gandhi Institute of Medical Sciences, Wardha, Maharashtra, India, from April 2018 to September 2018. Pretest was taken before intervention from all participants. Students were randomly divided into two groups. Group I had undergone clinical examination of Cardiovascular System (CVS) and Respiratory System (RS), where as, group II had undergone clinical examination of CVS and RS as well simulation based learning. Objective Structured Clinical Examination (OSCE), post-test and feedback was obtained from all participants. Data was analysed using Microsoft excel and Statistical Package for Social Sciences (SPSS) version 20.0 software.

Results: Both groups had 50 subjects each, with age group of 18-20 years and mean age 18.3±1.9 years . There were 21 male and 29 female subjects in both groups. Mean scores of OSCE in group I and II were 7 and 8.18 respectively. Mean score of pretest in group I and II were 5.04 and 5.02 respectively, whereas mean score of post-test in group I and II were 6.66 and 7.54 respectively. Comparison of OSCE and post-test scores in two groups was found to be statistically significant (p-value <0.0001).

Conclusion: Understanding of cardiovascular and respiratory sounds was better in group II where simulation based learning was used compared to other group. Hence, it was concluded that simulation based learning is useful additional tool to learn clinical examination of cardiovascular and respiratory physiology. It helps first MBBS students to enhance their clinical knowledge, skills and attitude.

Keywords: Heart sounds, Learning gain, Lung sounds, Physiology

INTRODUCTION

Clinical examination skills are very important and are identified as being fundamental to the practice of medicine. A decline in the clinical skills of medical students and junior doctors is well documented [1]. Auscultation of chest is an important part of clinical patient assessment. The skills required to interpret the auscultatory findings are traditionally learned by listening the heart and lung sounds of many different patients. It may be difficult for the students to compare actual heart and lung sounds with similar findings, since they may not be accessible at the same time, also rare auscultatory findings are not available for demonstration [2].

This may lead to under or over diagnosis ultimately leading to financial implications for the patients. Therefore, use of simulated heart and lung sounds in teaching and training of medical students may be helpful in such scenario as it allows the repetitive and individualised oriented training in support of learning in real scenarios. Simulation Based Learning (SBL) offers gain of clinical skills by practice on an artificial representation of a real world process to accomplish educational goals through empirical learning [3]. Improved clinician performance in simulated emergencies should translate into improved performance in real patient care situations [4].

A cross-sectional study conducted on 185 medical students to see the effect of simulation based learning found out that students were happy with the teaching methods, mannequins used and learning atmosphere. It was observed that in spite of some challenges, maximum students were happy with the simulation based learning and accepted that their knowledge retention, communication and skills improved with SBL [5]. Although few studies have been conducted in the past to see the usefulness of SBL, most of these studies [3-5] were carried out on students in later years of MBBS curriculum whereas in present study we tried to introduce the SBL at first year itself as it is crucial to introduce the SBL at the beginning of medical course. Hence, to assess the potential usefulness of heart and lung sound simulator in understanding the physiology, this topic was chosen.

Aim of the present study was to evaluate the usefulness of simulation in understanding different respiratory and cardiovascular sounds, to assess the learning gain of students by pretest and post-test and to study the perception of students towards simulation based learning.

MATERIALS AND METHODS

The present quasi-experimental study was carried out on 100 first year MBBS students at Clinical Skills Laboratory and Department of Physiology, at Mahatma Gandhi Institute of Medical Sciences, Wardha, Maharashtra, India, from April 2018 to September 2018. Institutional Ethics Committee approval was obtained (IEC/131/2017). Written informed consent was obtained from all the subjects.

Inclusion criteria: All the first year medical students, of both the gender and who gave written informed consent were included in the study.

Exclusion criteria: Students not willing to participate and those who did not provide the written informed consent were excluded from the study.

As this was an educational study, all 100 first year MBBS student were recruited the Random sampling method was used to select the participants. Authors used 100 chits (50 each for group I and II) and asked the students to pick up the chit and accordingly recruited the student in particular group.

Each group was taught as given below:

Group I: Clinical examination of Respiratory System (RS) and Cardiovascular System (CVS) (Traditional way of clinical examination of RS and CVS under inspection, palpation, percussion and auscultation).

Group II: Clinical examination of respiratory and cardiovascular system (traditional way of clinical examination of RS and CVS under inspection, palpation, percussion and auscultation) and simulation based learning of RS and CVS.

Study Procedure

Two sessions of simulation based learning were organised, first session was conducted immediately after completion of traditional practical session and second session was conducted during revision practicals at the end of clinical examination section. Each session was of 2 hours duration. Senior faculty members of the department supervised the sessions.

The simulator used in the study was a portable handy instrument manufactured by Pinnacle Technology Group Inc. Two plug-in modules were there along with the instrument- one simulates 16 types of different lung sounds. Other simulates 16 different types of heart sounds and additional sounds (murmurs) .This instrument was available in the Institute's Skill Laboratory.

Pretest was conducted for all the participants before the start of study. Pretest was an Multiple Choice Question (MCQ) based test with 10 questions, each question carry 1 mark. MCQ questions were selected from departmental prevalidated MCQ bank; additionally these questions were discussed with senior faculty members of the department before administering it to the students. Maximum and minimum possible scores were 10 and 0 respectively, score of more than five was considered as high scores whereas score of five or less considered as low scores. As pretest was conducted before the start of study, the scores obtained by the students indicate their previous knowledge. Then students were divided into two groups: Group I and II.

Objective Structured Clinical Examination (OSCE) session was conducted for all participants. Authors made 10 stations; in each station one particular activity (to listen the heart/respiratory sound and interpret the sound) was given to students carrying 1 mark each. Faculty was present in each station to check whether students have performed correctly or not and accordingly mark was allotted. If performed correctly one mark was given and no mark was given if not performed correctly. Maximum and minimum possible scores are 10 and 0 respectively, score of more than five considered as high scores whereas score of five or less considered as low scores. The OSCE session was conducted to assess the skills and performance of students, whereas post-test was conducted to check their knowledge. The OSCE was conducted after the training sessions on both group participants to evaluate usefulness of simulation based learning. Post-test was conducted eight weeks after pretest.

After data collection was complete, authors did crossover of students in two groups so that each student will be taught theory, clinical examination as well as simulation based teaching (ANNEXURE I and II).

Authors conducted the OSCE on all 100 students and compared the mean score of two different groups. Authors conducted pretest and post-test to compare the learning gain of students of two groups. Authors measured Absolute learning gain (post-test-pretest), Relative learning gain (post-test-pretest/pretest) and Normalised gain (the change in the class average score divided by the maximum possible gain) [6,7].

Questionnaire

A self developed questionnaire was devised by the researchers to check the students perception towards simulation based learning, after reviewing the literature [6,7]. Questionnaire containing 10 questions were given to all 100 (both group I and II) students at the end of the study to check perception of students regarding simulation based learning. This questionnaire was validated by an experienced reviewer and the reliability (Cronbachs alpha >0.7) was determined for all the question items. Responses were measured on a 5 point Likert scale, ranging from strongly disagree (1) to strongly agree (5) and interpretation was in percentage of students satisfaction (ANNEXURE III: Feedback form).

STATISTICAL ANALYSIS

Data was analysed using Microsoft excel and Statistical Package for Social Sciences (SPSS) version 20.0. Independent t-test was used to compare the data and $p<0.05$ is considered statistically significant.

RESULTS

In the present study 100 first year MBBS students with mean age 18.3±1.9 years were divided into two groups of 50 students each. Both Group I and II contain 50 students each. They were matched for gender distribution. Both the groups consisted of 21 male (42%) and 29 female (58%) students. Comparison of two groups was found to be statistically non significant [Table/Fig-1].

	Group I		Group II		
Gender	n	%	n	%	p-value
Male	21	42	21	42	1.00
Female	29	58	29	58	
Total	50	100	50	100	

[Table/Fig-1]: Demographic data of subjects in Group I and Group II.
Independent t-test used, p<0.05 is taken as statistically significant

Mean score of pretest in group I was 5.04 and in group II was 5.02. Comparison of pretest score in two groups was found to be statistically non significant [Table/Fig-2].

Pretest	Mean	SD	p-value
Group I	5.04	1.38	0.945
Group II	5.02	1.49	

[Table/Fig-2]: Comparison of Pretest score of Group I and II.
Independent t-test used, p<0.05 is taken as statistically significant

Mean score of post-test in group I was 6.66 and in group II was 7.54. Comparison of post-test score in two groups was found to be statistically significant [Table/Fig-3].

Post-test	Mean	SD	p-value
Group I	6.66	0.93	<0.0001
Group II	7.54	0.86	

[Table/Fig-3]: Comparison of post-test score of Group I and II.
Independent t-test used, p<0.05 is taken as statistically significant

Mean score of pretest and post-test in group I were 5.04 and 6.66 respectively whereas mean score of pretest and post-test in group II were 5.02 and 7.54 respectively. Comparison of pretest and post-test scores in both the groups were found to be statistically significant [Table/Fig-4].

Absolute learning gain, relative learning gain and class average normalised gain in group I were 1.62, 0.43 and 0.31 respectively. Whereas, absolute learning gains, relative learning gain and class

average normalised gain in group II were 2.52, 0.65 and 0.48 respectively [Table/Fig-5].

Mean score of OSCE in group I was 7 and in group II was 8.18. Comparison of OSCE score in two groups was found to be statistically significant [Table/Fig-6]. Feedback (in questionnaire form) from students for simulation based learning on Likert scale is presented in [Table/Fig-7].

Groups	Pretest score	Post-test score	p-value
Group I	5.04±1.38	6.66±0.93	<0.0001
Group II	5.02±1.49	7.54±0.86	<0.0001

[Table/Fig-4]: Comparison of Mean pretest and post-test score within Group I and II. paired t-test used, p<0.05 is taken as statistically significant

Groups	Absolute learning gain	Relative learning gain	Class average normalised gain
Group I	1.62±0.945	0.43±0.52	0.31±0.14
Group II	2.52±1.343	0.65±0.60	0.48±0.20

[Table/Fig-5]: Comparison of Absolute Learning Gain, Relative Learning Gain and Class Average Normalised Gain in Group I and II.

OSCE score	Mean	SD	p-value
Group I	7.00	0.90	p<0.0001 (S)
Group II	8.18	0.84	

[Table/Fig-6]: Comparison of Objective Structured Clinical Examination (OSCE) score of Group I and II.
Independent t-test used, p<0.05 is taken as statistically significant

S. No.	Evaluation point	SA	A	U	D	SD
1	I am familiar with simulation based learning	55	44	1	0	0
2	Simulation based learning made topic more interesting	63	36	0	0	1
3	Simulation based learning helped me to retain knowledge	70	29	0	1	0
4	Simulation based learning helped me to improve my clinical skills	69	29	2	0	0
5	Simulators are useful addition to learning with real patients/ subjects	69	31	0	0	0
6	Simulation based learning is useful learning method	64	36	0	0	0
7	I felt comfortable with simulators	50	43	7	0	0
8	I would prefer more training with simulators	72	27	0	1	0
9	Simulation based learning should be used more frequently	65	32	2	1	0
10	I found it difficult to treat simulator as real patient/subject	0	09	11	28	52

[Table/Fig-7]: Feedback (in Questionnaire form) from students for simulation based learning on Likert Scale.
(After intervention and post-test data collection authors have given SBL to group I students also to avoid any bias. Then the feedback was collected from all 100 students); SA: Strongly agree; A: Agree; U: Uncertain; D: Disagree; SD: Strongly disagree

DISCUSSION

In the present study, authors conducted pretest and post-test on both the groups to assess the learning gain. Pretest score for group I and II was 5.04 and 5.02 respectively. The pretest score are statistically non significant (p-value=0.945) suggesting that two groups are comparable. Post-test score for group I and II was 6.66 and 7.54 respectively. The post-test score of two groups are statistically significant (p-value <0.001). This result shows significant improvement of post-test scores in group II compared to group I after intervention. It indicates that SBL resulted in enhancement of knowledge about clinical examination of cardiovascular and respiratory system examination. Results of present study were comparable to that of Liaw SY et al., conducted the study on 31 nursing students and reported, there was significant improvement on post-test scores from pretest scores for self-confidence and knowledge after simulation based learning [8]. The present study findings are in accordance with Bray SB et al., they used pretest and post-test to assess the impact of simulation based learning on pharmacy student. They mentioned significant improvement in knowledge and retention in those students [9].

Steadman RH et al., observed better transfer of knowledge in simulation educated students compared with traditional teaching [10]. Other studies have demonstrated more student satisfaction for material taught with simulation compared with traditional modalities such as Power-point presentation, self study session and group discussion [11-13]. Studies have reported that student gain more knowledge and confidence during simulation sessions for clinical examination and also improves communication and team work in emergency situations [14,15].

Authors also compared the score of OSCE in two groups. Group I with traditional clinical teaching has mean score of 7. Whereas group II with traditional clinical teaching along with simulation based learning has mean score 8.18. Authors found statistical significant difference (p-value <0.001) between two group scores, suggesting that traditional clinical teaching along with simulation based learning is more effective. Ryall T et al., their systemic review mentioned that 27% studies use OSCE as the method of evaluation for simulation based learning [16]. The present study results are comparable to that of Zarifsanaiey N et al., conducted OSCE on 40 students to assess the effectiveness of traditional method over simulation based learning. They found significant higher performance in OSCE score of simulation based learning group [17].

It is necessary for medical graduates to have sufficient exposure to real patients so that they can acquire the necessary skills. On the other hand, there should be accountability to ensure patient's safety, comfort and well-being. These two competing needs can sometimes pose a dilemma in medical education [18]. At first MBBS level, students learn to auscultate chest for heart and respiratory sounds. As both these organs lie close to each other, seldom there is confusion in what to hear during auscultation. Thus simulation-based learning can be the answer to developing student's knowledge, skills, and attitudes, while protecting patients from unnecessary discomfort and risks. Simulation-based learning can be a platform for learning to alleviate ethical concerns and resolve practical dilemmas [19].

In the present study, we studied the student's perception about simulation based learning. A questionnaire was used in the form of feedback form to assess student's perception. Most of the students strongly agreed that simulation based learning is a useful addition to traditional learning with real patients and they would prefer more training with simulators. Students strongly agreed that simulation based learning made topic more interesting, it helped them to retain knowledge and improved their clinical skills of auscultation. Most of the students agreed that simulation based learning helped them to be more confident in clinical examination and it will also improve their performance in clinical examination of Physiology.

The present study results are in agreement with that of Joseph N et al., who conducted a study to explore the perception of 247 medical students towards simulation based learning. They reported that SBL was perceived as favourable by a large number of participants indicating a bright prospect for its implementation in the medical curriculum [20].

Limitation(s)

The simulation instrument used provides the heart and lung sounds only. Although it is useful in better understanding of heart and lung sounds, the SBL sessions organised are less. There should be more SBL sessions for better understanding and acquiring the requisite skills.

CONCLUSION(S)

Simulation based learning was introduced to students to assess their understanding of RS and CVS, it was found that the performance (post-test, OSCE, learning gain) of group II students was better compared to group I students. Student's had perceived SBL approach positively, implying that the simulation based learning is useful additional tool to learn clinical examination of cardiovascular and respiratory physiology. It helps first MBBS students to enhance their clinical knowledge, skills and attitude. Thus, its use should be increased and simulation based learning should be incorporated in the existing undergraduate curriculum of Physiology. The SBL should be used in all subjects and its usefulness shall be assessed in future studies.

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ANNEXURE I: PRETEST

Tick on correct option

1. Second heart sound is best heard in
   a) Mitral area b) Aortic area c) Tricuspid area d) All of the above
2. First Heart Sound is produced because of
   a) Closure of AV valves b) Opening of AV valves c) Due to atrial systole d) Closure of semilunar valves
3. Which heart sound coincide with Carotid pulsations
   a) First b) Second c) Third d) Fourth
4. Which heart sound is high pitched?
   a) First b) Second c) Both d) None
5. Murmurs are
   a) Additional musical sounds b) Regular musical sounds c) Additional harsh sounds d) Regular harsh sounds
6. During Auscultation, bronchial sounds are normal heard over
   a) Trachea b) Chest wall c) Bronchus d) None of the above

7. Crepitations are
   a) Normally heard over posterior aspect of chest b) Audible in Consolidation of lung c) Musical sound d) None of the above
8. Type of respiration in males
   a) Thoracic b) Abdominal c) Abdomino-thoracic d) Thoraco-abdominal
9. Rhonchi are
   a) Musical sounds b) Soft sounds c) Loud banging sounds d) High pitched sounds
10. Pause is present in
    a) Bronchial sound b) Vesicular sound c) None d) Both a and b

ANNEXURE II: POST-TEST

Tick on correct option

1. Second heart sound is best heard in
   a) Mitral area b) Aortic area c) Tricuspid area d) All of the above
2. First heart sound is produced because of
   a) Closure of AV valves b) Opening of AV valves c) Due to atrial systole d) Closure of semi lunar valves
3. Which heart sound coincide with Carotid pulsations
   a) First b) Second c) Third d) Fourth
4. Which heart sound is high pitched?
   a) First b) Second c) Both d) None
5. Murmurs are
   a) Additional musical sounds b) Regular musical sounds c) Additional harsh sounds d) Regular harsh sounds
6. During Auscultation, bronchial sounds are normal heard over
   a) Trachea b) Chest wall c) Bronchus d) None of the above
7. Crepitations are
   a) Normally heard over posterior aspect of chest b) Audible in consolidation of lung c) Musical sound d) None of the above
8. Type of respiration in males
   a) Thoracic b) Abdominal c) Abdomino-thoracic d) Thoraco-abdominal
9. Rhonchi are
   a) Musical sounds b) Soft sounds c) Loud banging sounds d) High pitched sounds
10. Pause is present in
    a) Bronchial sound b) Vesicular sound c) None d) Both a and b

ANNEXURE III: FEEDBACK FORM

"Study of usefulness of simulation based learning in first year medical students."
Questionnaire for Student Perception of Simulation based learning

S. No.	Evaluation point	SA	A	U	D	SD
1	I am familiar with Simulation based learning					
2	Simulation based learning made topic more interesting					
3	Simulation based learning helped me to retain knowledge					
4	Simulation based learning helped me to improve my clinical skills					
5	Simulators are useful addition to learning with real patients/subjects					
6	Simulation based learning is useful learning method					
7	I felt comfortable with simulators					
8	I would prefer more training with simulators					
9	Simulation based learning should be used more frequently					
10	I found it difficult to treat simulator as real patient/subject					