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EVALUATION OF THE EFFECTIVENESS OF SIMULATION TRAINING IN TEACHING HEART AND LUNG AUSCULTATION

Parpibaeva Dinara Ayupovna,
Ergashov Nodirbek Shermukhamat ugli,
Salaeva Muborak Saidabdullaevna,
Salimova Nargiza Djurabaevna,
Buvamukhamedova Nasiba Takhirovna

A B S T R A C T

The use of simulation technology for training and assessment in medical education has been increasing over the past decade. However, the training effectiveness of most simulators needs to be fully evaluated. The purpose of this prospective study was to evaluate whether brief individual training in a patient simulator could improve cardiac and pulmonary auscultation skills in undergraduate students.

Materials and Methods:
Third-year medical students who had undergone simulator training (n = 62) were compared with fourth-year medical students (n = 53) who had not previously experienced simulator training. Students participated in the study on a voluntary basis. Students' ability were evaluated according to four randomly presented heart sounds (mitral stenosis, mitral regurgitation, aortic stenosis, and aortic regurgitation) and four lung sounds (crackles, wheeze, rales, pleural friction murmurs).

Results:
Practice and training in simulators significantly improved cardiac auscultation skills, for example, 83.2% of 4th year students correctly identified mitral regurgitation by auscultation, while 94% of 3rd year students 7% correctly identified this defect (p = 0.02). In general, 3rd-year students responded more accurately than 4th-year students in identifying all cardiac auscultatory signs. Pulmonary auscultation did not reveal a significant difference between the groups.

Conclusions: This study shows that one-hour individual training of medical students with a patient simulator significantly improved their cardiac auscultation skills. Our data suggest that simulation can be useful for learning auscultation skills, especially when it is combined with a graphic sound display.

K E Y W O R D S

Simulation, medical education, cardiac auscultation, pulmonary auscultation.

INTRODUCTION

Pulmonary heart auscultation is the most important integral part of any examinations. This method is the most widely used method especially in the work of a general practitioner and plays an important role in identifying early signs of diseases of various severity. There are many obstacles to the formation of these skills in traditional methods. Technology and high-fidelity patient simulators are valuable new tools for teaching, skill acquisition and assessment in medicine. Unlike training students directly on the patients themselves, simulators provide the convenience of being available at any time. In some studies conducted around the world, training using simulators has been able to significantly improve the performance of skills. This prospective study also aimed to evaluate the effectiveness of short-term training using simulators. For this purpose, we evaluated the ability of the 3rd and 4th year students of the Faculty of Medicine of the Tashkent Medical Academy to perform these skills by training and testing them in a simulator.

Research materials and methods.

This study is a prospective study conducted at the Department of Clinical Modeling, Faculty of Medicine, Tashkent Medical Academy (TTA) between 2019 and 2022. This study was designed to evaluate the effectiveness of patient simulator training in heart and lung auscultation. For this purpose, we compared two groups of third- and fourth-year medical students studying at TTA.

Students participated in the study voluntarily and informed consent was obtained to participate in this study. The control group (NG group; 53 students) included fourth-year medical students who had never used simulators before this study. These students passed the internal medicine propaedeutics exam in the 2019/2020 academic year and were tested in the clinical modeling department in the first semester of the 2020/2021 academic year. The main group (AG group; 62 students) included fourth-year medical students who underwent individual training with a pulmonary-cardiac auscultation simulator for 2 hours a day once a week for 5 weeks before taking the internal medicine propaedeutics exam. These students passed the exam in the propaedeutics of internal medicine in the academic year 2020/2021 and were tested in the department of clinical modeling in the first semester of the academic year 2021/2022. Before being included in the study, students were tested in the form of a test, and according to the results of the test, they were randomly selected in a mixed form.

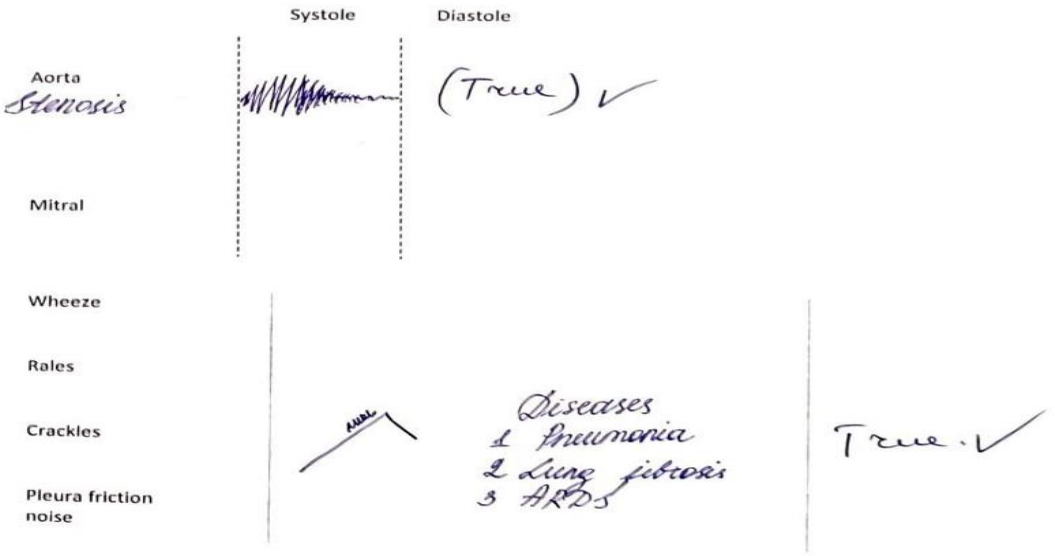
Training and examination.

2 groups of students from the 3rd year of the medical faculty took part in the exercises held in the simulator . Lectures and practicals were conducted by the same teacher to avoid differences due to different methods of different students. Pulmonary heart auscultation is included in the curriculum as a separate subject in the propaedeutics of internal medicine. Students first attended a 3-hour lecture. After that, the students trained in simulator-trainers for 5 weeks, 1 day a week for 2 hours. During this time, they practiced listening to aortic stenosis, aortic regurgitation, mitral stenosis, mitral regurgitation, pathological extra tones, dry and wet crackles, crepitations, and pleural friction sounds. Core group students developed their skills on a Kyoto-Kagaku patient simulator ("K Plus" cardiopulmonary simulator, Model #11257–159, Kyoto Kagaku Co. Ltd., Kyoto, Japan). During this simulator training, AG students were required to complete a simulation-based examination paper where they identified three consecutive heart sounds/murmurs and four consecutive lung sounds and expressed graphically. Students were given 5 minutes to listen to each heart sound and 5 minutes to

represent it graphically. Then, 5 minutes were given separately to listen to each lung sound and match it to the appropriate diagnosis . All the sounds were repeated randomly.

Student evaluation paper

№	Auscultation of the heart	True / False	№	Lungs Auscultation	True / False
☑	Aortic Stenosis	True ✓	☐	Wheeze	
☐	Aortic insufficiency		☐	Rales	
☐	Mitral stenosis		☑	Crackles	True ✓
☐	Mitral insufficiency		☐	Pleura friction noise	



Statistics

Results were analyzed using R software (version 3.3.2; 2016). A value of $p < 0.05$ is considered statistically significant. Groups (NG and AG) were compared using the Chi-square test of freedom to assess whether there were any differences in the distribution of correct and incorrect responses between groups. The McNemar test was used in the study to compare the results of AG students in the third and fourth years.

Results

Training with the simulator significantly improved the students' cardiac auscultation skills During the students' detection of heart sounds and murmurs, aortic stenosis was correctly identified by 69.6% of NG students and 88.5% of AG students ($p = 0.45$) (Table 1). Nevertheless, the percentage of students who correctly graphed the murmur of aortic stenosis was 68.4% in the NG group and 75.6% in the AG group ($p = 0.01$ vs. the NG group) (1 -table). Second, mitral regurgitation was correctly identified by

83.2 % of NG students and 94.7 % of AG students (p = 0.03) (Table 1). A difference between the groups was noted in terms of graphical representation of mitral regurgitation noise, with only 65.3% of NG students and 80.4% of AG students being able to complete this task (p = 0.02) (Table 1).
Training with the simulator did not significantly improve the students' lung auscultation skills. When the students listened to the chest, they were asked to identify the following four lung sounds: dry crackles, wet crackles, crepitations, and pleural friction sounds (Table 1). Wheezes were correctly identified by 95.6% of NG students and 96.1% of AG students (p = 0.96). Rales were correctly recognized by 88.3% of AG students and 90.1% of AG students (p = 0.92). Regarding crackles, AG students were able to correctly identify this noise in 98% of cases, but this was not statistically significantly different from the NG group (NG 97% p = 0.98). Pleural friction sounds were correctly identified by 82.5% of NG students and 84% of AG students (p = 0.02).

Summary

In conclusion, this study shows that individual training of medical students with simulators significantly improved their cardiac auscultation skills over time. In addition, this study shows that patient simulation can be useful for learning auscultation skills, especially when it is combined with a graphic sound display.

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