Digital Stethoscope as an Innovative Tool on the Teaching of Auscultatory Skills

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Abstract

Physical cardiovascular examination, particularly cardiac auscultation, is one of the most difficult clinical skills for students during their medical training. Studies suggest that the use of technologies such as digital stethoscope increase the accuracy of clinical examination, however, its impact on the teaching of cardiac auscultation for undergraduate students of medicine is not known.

The objective is to demonstrate the usefulness of the digital stethoscope compared to traditional methods as a tool in the teaching of auscultatory skills.

nterventional, longitudinal, controlled, unicenter and randomized study. Thirty-eight medicine students were enrolled for a cardiovascular semiology course lasting eight weeks. The course program included lectures and bedside practice in Cardiology wards. In the practical lessons, the students were randomized into two groups: 1) (n = 21) digital stethoscope (Littmann® Model 3200, 3M); and 2) (n = 17) conventional stethoscopes. A pre-training evaluation was conducted through a test using the software Heart Sounds®, which was repeated after the course. The average scores were compared by paired T test and unpaired T test.

It is observed that, at the end of the course, there was a significantly greater improvement in the group that used the digital stethoscope (51.9%) compared to the group using the conventional stethoscope (29.5%).

Short-term interventions for cardiac semiology teaching are able to contribute significantly to improving proficiency in the identification of heart sounds. The use of digital stethoscope proved to be a positive factor in teaching these skills.

Introduction

Physical cardiovascular examination is among the most difficult skills acquired by students during their academic training. Doctors and students are unanimous in considering the teaching of auscultatory skills as fundamental in medical training, qualifying as insufficient the teaching methods proposed both in undergraduate and graduate programs. This fact leads them to claim for a longer time to be devoted to auscultatory skills[1].

Keywords

Heart Auscultation/methods; Stethoscopes; Cardiology/education.

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Manuscript received June 06, 2012, revised manuscript November 01,2012, accepted November 27, 2012.

DOI: 10.5935/abc.20130033

It is known that teaching based solely on theoretical classes does not seem to improve recognition of heart murmurs[2]. Moreover, interventions that include the repetition of heart sounds in multimedia tools can improve the proficiency of auscultatory skills[3,4]. March et al.[5] using recordings of heart sounds, managed to increase their students' proficiency from 26% to 45% after training5. Barrett et al.[6] demonstrated that repeated cardiac auscultation substantially increases the accuracy of the auscultation made by students[6]. Vukanovic and Criley[7] integrated visual and auditory information and reached levels of 78% competency in cardiac auscultation[7].

Although the use of multimedia tools is corroborated in the literature as a good teaching strategy, little is known whether the use of modern digital stethoscopes can improve the process of teaching and learning auscultatory skills. Vörös et al8 organized a study comparing the digital and conventional stethoscope for cardiac auscultation in dogs. They found that the digital stethoscope is more sensitive and therefore more suitable for people with little experience[8]. These devices have advantages over conventional stethoscope, such as the external noise filtering, amplifying, recording and playing back sounds.

Therefore, given the need to seek improvements in the teaching of cardiovascular semiology, our purpose is to demonstrate the usefulness of the digital stethoscope compared to traditional methods as an innovative tool in the teaching of cardiac auscultation.

Methodology

We conducted an interventional longitudinal controlled unicenter randomized study, which was approved by the human research ethics committee from Hospital Universitário Antônio Pedro (HUAP), No. 0142.0.258.000-10. On demand and without any type of screening, 38 students from the fourth year of medical school were enrolled for a course on cardiovascular semiology lasting eight weeks (24 hours). We set up a program with lectures in order to homogenize the participants' theoretical knowledge and practical classes conducted in the HUAP's Cardiology wards. In the practical lessons, the students were randomized into two groups: 1) (n = 21) digital stethoscope (Littmann® Model 3200, 3M); and 2) (n = 17) conventional stethoscopes (Littmann® model Classic II, 3M). The lectures were conducted with two groups together.

For data collection, a pre-training (pre-test) assessment was made through a test using the heart sounds produced by the software Heart Sounds®, containing ten intermediate level discursive questions, where the students were asked to identify the following auscultation findings: B3, B4, B3 and B4, Gallop Rhythm, Normal Auscultation, Mitral Regurgitation, Mitral Stenosis, Aortic Regurgitation, Aortic Stenosis and Innocent

Systolic Murmur. The questions were the same for both groups and the same test was repeated after the course (post-test); only the order of the questions was changed.

To grade the test, one point was assigned for each correct answer. The maximum score of ten points was awarded for each test. During the course, six people gave up: two from group 1 and four from group 2. We compared the mean scores by Student's paired and unpaired t test. The significance criterion was level 5%.

Results

Table 1 shows the average of correct answers of the groups using the digital and conventional stethoscope in the pretest and in the posttest for a maximum total of 10 points. It is observed that there are significant differences in the pre-test between the groups using the digital stethoscope (4.14 ± 1.8) and the conventional stethoscope (4.06 ± 2.08) with a p-value of 0.74 in the unpaired t test.

By analyzing the average scores in the posttest, it is seen that both groups had a better performance: digital stethoscope (6.27 ± 2.6) and conventional stethoscope (5.27 ± 2.39). The group using the conventional stethoscope showed an improvement of 29.5%, with a p-value of 0.06 in the paired t test, while the group using the digital stethoscope showed an improvement of 51.2%, with a p- value of 0.02 in the paired t test. However, it is important to note that there was a significantly greater improvement in the group using the digital stethoscope after training (6.27) compared to the group using the conventional stethoscope (5.27) with a p-value of 0.028 in the unpaired t test (Chart 1).

Discussion

Several authors have reported that merely reading textbooks and lectures do not improve performance on acquiring auscultatory skills[6]. Currently, although the curricular theory of medicine courses associates theoretical to practical training, the learning process has been increasingly focused on theory and assessment of learning through written tests, leaving little space to practice on the bedside[2]. The reduced level of success in identifying heart sounds, as shown by some studies, indicates the need for changes in the teaching of cardiac auscultation[9].

Our study found equivalent performance between the groups in the pretest, demonstrating an effective randomization, and improved performance of both after

Table 1 - Average hits of groups 1 and 2, pretest and posttest

Stethoscope	Pretest	Posttest	p-value
Digital (group 1)	4.14 ± 1.8	6.27 ± 2.6	0.02
Conventional (group 2)	4.06 ± 2.08	5.27 ± 2.39	0.06

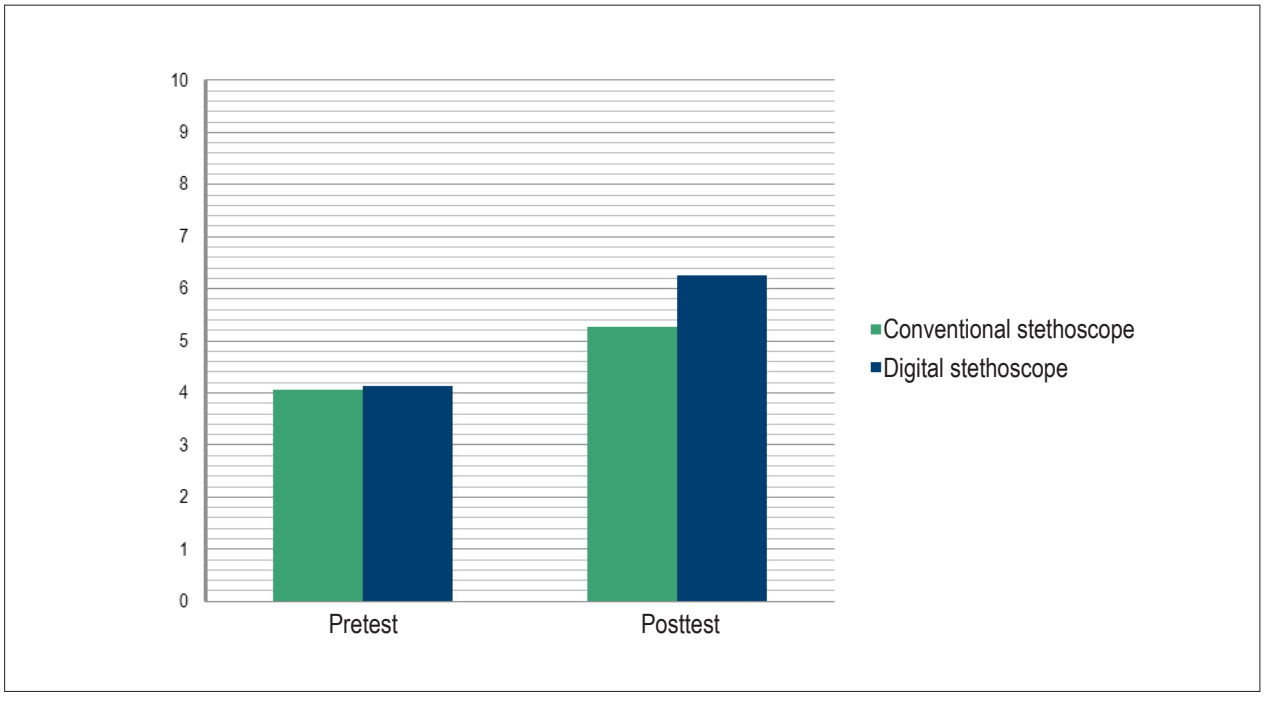

Chart 1 - *Comparison between the means of the groups in the pretest and posttest*

training. This shows that the theoretical-practical course was effective in increasing the students' auscultatory skills. We also observed a greater proficiency measured by the posttest in the group receiving lessons with the digital stethoscope, which suggests that such strategy is beneficial in the teaching of cardiovascular semiology.

In the course taught in our project, the lectures were immediately followed by practical sessions, a fact that provided greater solidification of knowledge, by stimulating the students' perception of the practical applicability of the issues discussed. Besides this, it proved to be the suitable space to clear doubts and repeat the concepts discussed in class. In addition to that, the students were enthusiastic about the use of an innovative learning technology, offering opportunities such as: recording, modifying the volume of sounds, leaving them free from external noise and repeating the sounds recorded as many times as necessary.

Some students have quit the course and this may be due to the period of college tests in which it was delivered. There was a clear association between the college tests and a higher rate of absences in the course. Another issue to be considered is the class hours: from 12 p.m. to 1 p.m. Some students reported difficulty in giving up their lunchtime. However, for the creators of the project, that was the best time, as it did not interfere with the curricular activities of the college.

The results obtained in our study showed that using the digital stethoscope was beneficial to the teaching of cardiac auscultation. We observed, at the end our work, that the theoretical classes used in our methodology in order to avoid bias were impactful, a fact that became clear with the favorable results of the group using the conventional stethoscope. The association between theory and practice was thus characterized as effective in the teaching and learning of cardiac auscultation. Further studies aiming to improve the use of similar techniques should be conducted to define the role of this methodology in the teaching of cardiovascular semiology.

Conclusions

Our findings suggest that short-term interventions for cardiac semiology teaching are able to contribute significantly to improving proficiency in the identification of heart sounds. The digital stethoscope as a tool for methodological innovation has proved to be a positive factor in teaching such skills.

Author contributions

Conception and design of the research, Acquisition of data, Analysis and interpretation of the data, Statistical analysis: Reis JC, Athayde CC, Machado HL, Lanzieri PG, Simões LS, Moura EC, Rodrigues GA, Mesquita CT; Obtaining funding: Reis JC, Athayde CC, Machado HL, Lanzieri PG, Simões LS, Rodrigues GA, Mesquita CT; Writing of the manuscript and Critical revision of the manuscript for intellectual content: Reis JC, Athayde CC, Machado HL, Lanzieri PG, Simões LS, Moura EC, Rodrigues GA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

This study was funded by PROPPI-UFF.

Study Association

This study is not associated with any post-graduation program.

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