Computer Based Learning of Cardiac Sounds and Murmurs

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It is most important that students learning cardiology are trained cardiac auscultation on the bedside on actual patients, but this is not always possible. Recording various sounds and murmurs and their reproduction on the computer in a graphic presentation serves as a good alternate. Our study demonstrates that this is an effective, ingenious and acceptable alternative.

Key Words: Cardiac sounds, murmers, computer recording

Acquiring knowledge through the use of computers has become the need of the day. It is a momentous tool, which can be used in a variety of ways in teaching undergraduates and postgraduate students. It is rapidly becoming a regular mode of teaching and evaluation in the education system in the west. The development of the presentation is time consuming and using the right software is pivotal to the success of the project. Computer based teaching programs are a useful and feasible alternative to lectures[1]. Computer-based learning materials have the potential to be valuable learning resources for medical education[2]. However, it has failed to realize its potential primarily because of unstructured approaches towards design and development[2]. Changes are occurring in the undergraduate medical curriculum in the UK[3]. This can be seen by the general moves towards computer-based teaching in higher education and the recommendations for the new medical undergraduate curriculum by the General Medical Council[3]. The aim of the study was to determine the impact of the computer technology on the students compared to conventional methods of teaching via lectures and theory.

Material and Methods

A Pentium 166Mhz MMX with 64 MB RAM, Gamma Galaxy video capture card, S3 VGA card, 8x CD-ROM, 16 bit sound card was used to prepare the teaching material. Cardiac sounds were recorded on tape with stethoscope with built in amplifier from various patients attending the Allama Iqbal Medical College out patient department, inpatients and cardiology ward. These sounds were transferred to the computer through microphone using Ulead Mediastudio Pro 2.5 Audio editor. All sounds were processed so that the noise is reduced and quality optimized. Basic sounds and murmurs were collected and auscultatory features of various cardiac pathologies reproduced by cut and paste technique. Phonocardiograms thus produced were displayed in wave or midi formats in real time. A question answer format of the presentations was prepared and given to the students. An interactive discussion was used to teach the cardiac sounds. Fifteen randomly selected students from third and forth year classes of Allama Iqbal Medical College, Lahore were shown the presentations and allowed to use the computer to learn the sounds. They were also allowed to use patients to practice their skills at the bedside. Another thirty students randomly selected were taught on conventional lines with theory lectures and bedside teaching, and served as controls. There were equal number of males and females in each group. Only those students were selected who had passed all previous examinations in first attempts. There were also proportionally equal number of students from third year and forth year in each group.

Group-1 was taught cardiac sounds the conventional way with theory and bedside teaching with actual cardiac patients. The group-2 students were also taught the same subject, but computer technology was used to simulate patients with interactive teaching methods and cardiac sounds reproduced in real time. They could also practice on the patients. After a period of 2 weeks both the groups were evaluated on patients. They are asked to draw the findings on auscultation and give the most probable diagnosis in each of the five cases presented in the evaluation time.

Results

Category	Result of auscultation
Group –1Theory based group	39% score
Group –2Computer based group	67% score

Both the groups were made to draw the findings on auscultation of the five patients kept for evaluation at the end of 2 weeks. Marks were kept for each correct identification and the final diagnosis. In group-1 with 30 students (15 boys and 15 girls) the score of the OSCE type of evaluation on five patients was 39%. In group-2 with 15 students (7 boys and 8 girls) on the other hand students scored 67%.

There was no statistical difference between the results in either group between male and female students. The lowest marks in group-1 were 21% compared to 43% in group-2. On the other hand the highest marks in group-1 was 73% while in group it was 91%.

Discussion

Learning cardiac sounds and murmurs is a night mare for many students because of under exposure to the medical cases in a general medical ward, high student to patient ratio, loss of interest of the students and failure to come in the evenings to seen and examine the patients. At times there is not enough clinical exposure to build the right confidence It is difficult in the beginning to learn and concentrate on individual sounds and intervals. Systole and diastole seem to be confusing. They are therefore shy in describing the findings. With this background in mind a computer program was built to train the undergraduates to recognize sounds and murmurs and to give them confidence in recognition and interpretation of the findings. It is relatively easy to interpret the findings if sounds are heard as well as seen at the same time. This can best be achieved through the aid of the computer. At the bedside it is indeed confusing when the 3rd or 4th year student hears added sounds or murmur for the first time. It takes years of practice to tune the ears to the low and high-pitched sounds and various cardiac lesions. Through the aid of computer when the student hears the normal sounds and the abnormal sounds along with the visual assistance it becomes relatively easy. One is able to see the quality of the sound, its loudness, pitch and timing. One is able to make out systole and diastole. The character of sounds and murmur is not only heard but is visible. This is to say an ejection systolic murmur can be heard and seen to be different from a pan systolic murmur. Similarly early, mid and late murmurs can be recognized. Clicks and opening snaps may be more easily recognized when heard and seen at the same time. Some times the added 3rd or 4th heart sound is not heard but may be seen in early or late diastole on the phonocardiogram.

In the process of learning it is important to gain the students attention. This can be enhanced by complex problem solving and patient simulation through the use of computer. Real life situations can be created, with a short narrated history and examination which is demonstrated in the form of video clip and auscultation.

In a study applied to fourth year medical students using hypertension as the topic for learning by Fasce E et al the experimental group had higher grades in the test than controls (71.4 and 64.6% respectively $p < 0.001$)[4] and a highly favorable opinion of the program. It was concluded that computer based teaching programs are a useful and feasible alternative to lectures[4]. Another multicenter educational study was highly rated by fourth-year medical students using programs in cardiology[5]. The economies and strengths associated with multimedia computer-assisted instruction program make it an attractive solution to a number of problem areas, and it will likely play an increasingly important role[5]. In the paper titled "Active computer systems for medical education: approach and implementation" the author discusses methodological bases and ways of building and using the new type of the educational computer-aided systems for physicians[6].

A game like interface when used with simulated clinical cases the student analyzes the data to make decisions. Understanding becomes easy and one is able to deduce logical conclusions. The students learn to relate the history, with the examination and auscultatory features and interrelate these with the laboratory data or investigations if presented. In our study we used similar methods of teaching with favorable results. Simulations of clinical scenarios for medical education can take a number of forms, including paper-based tutorials, interactive computer programs, and Standardized Patients. Where appropriate patients are not available, as is mostly the case at one particular moment, to create simulations on a computer is helpful and better than the low-fidelity simulation of paper-based tutorials. The C-ASE (computer-assisted simulated examination) project[7], developed to test this hypothesis, incorporated a simulated three-dimensional environment and digital video of patients and clinic staff.

The advantages of using computer-assisted synthesis and demonstration of cardiac sounds are:

1 Readily available all the time.
2 Replay in slow motion.
3 Display in real time.
4 Hearing and at the same time looking at the murmur (phomocardiographic representation in real time).
5 Modification possible (power to enhance the clinical sounds by editing software).
6 Synthesis of new murmurs and cardiac lesions possible.
7 An interactive game-like interface
8 A question answer format.
9 Learning through integration and problem solving interface rather than simple recall.
10 Learning at home possible (if student is computer literate and has one at home).
11 Self-learning possible (consultant may leave the students to work on their own).
12 Cost effective and saves time in the long term.
13 The program can always be altered to address new problems and other learning areas in the same subject.

Problems with this system of education are as follows:

1. An average speed computer must be present in the department.
2. A group of 10 to 15 students may be taught at one time.
3. A video projector must be present for larger audiences.
4. Initial preparation cumbersome and time consuming.

5. Collection of a large data base.
6. It is not an alternative to bedside patient evaluation.

It has been realized since many years, even by the Association of American Medical College's GPEP Report 10 years ago that medical schools should incorporate the training in the use of computer technology into their curricula. Now with the Internet and the information super highway, the need for such a changes has grown more compelling. Koschmann[8], strongly suggests that teaching medical students to be computer-literate will not only enable them to use information technology competently, but will help them to assess or test the adequacy of their knowledge, to find areas of deficiency and target to specific areas to meet the needs of the future[8]. It is not therefore surprising that education through the use of computers afforded a high degree of acceptability to the students in our study where the results were statistically significant in favour of this method of transfer of knowledge.

Conclusion

Computer based medical education is an effective method of teaching and serves to stimulate the student into interacting with the simulated patient in a game like fashion. This is especially true in cardiology, which is difficult to learn at the undergraduate level. The students hear the sounds and at the same time see the phonocardiographic representation in real time. This makes complex sounds easy to understand where the abnormality can be instantly identified through simultaneous auditory and visual aid. Once the student understands the basic foundations the process becomes easy. Computer technology has helped the process of understanding cardiac sounds and murmurs. This technology should be freely used in conjugation with traditional bedside teaching. The students should become familiar with this technology to gain the maximum benefit. The future of education lies in part in the proper use of this technology especially where patients are not readily available or where the ratio of the number of student to patient is unacceptably high.

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