Original Article

Use of Computer-based Clinical Examination for Assessment of Medical Students in Surgery

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Abstract

Background: The Video-projected Structured Clinical Examination (ViPSCE) replaced the oral (viva) examination as a student assessment tool in clinical surgery in our department since its invention in 2001 **(1, 2)**. It has been useful for assessing higher knowledge domain including problem-solving abilities.

Objectives: To improve the viewing of the Video-projected Structured Clinical Examination (ViPSCE), we developed a computerized version, and called it 'Computerized Clinical Examination' or (CCE). This was used to assess medical students' higher knowledge and problem solving skills in surgery. We present how we did it, test scores descriptive statistics, and the students' evaluation. To our knowledge the use of computers in this way has not been reported before.

Methods: A computer-based clinical examination (CCE) in surgery is administered to assess a class of 43 final year medical students at the end of their surgical clerkship.

Like the ViPSCE, the exam was delivered as a slide show, using 'PowerPoint' computer program. However, instead of projecting it onto a screen with a video-projector, each student had his/her own computer. The CCE consisted of 20 slides containing either still photos or short video clips of clinical situations in surgery. The students answered by hand writing on the exam papers. At the end, they filled evaluation forms.

The exam papers were corrected manually. The test scores descriptive statistics were calculated, and correlated with the students' scores in other exams in surgery. The evaluation forms were analyzed.

Results: Administration of the CCE was straightforward. The test scores were normally distributed. They correlated significantly with the scores obtained by the students in the other exams in surgery. Students' acceptability was high.

Conclusion: CCE is feasible. It inherits the validity and reliability of the ViPSCE with the added advantage of improving the viewing of the slides. It proved popular with the students.

Keywords: Computer-based clinical exam (CCE), ViPSCE, OSCE, E assessment.

The Video-projected Structured Clinical Examination (ViPSCE) replaced the oral (viva) examination as a student assessment tool in clinical surgery in our department since its invention in 2001[1, 2]. It has been useful for assessing higher knowledge domain including problem-solving abilities. It proved to be valid, reliable, and practicable. It saved money, and time for both staff and students.

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It is not surprising, therefore, how it rapidly became popular with teachers and students alike, not only in other departments in our university, but also with other medical faculties across the country.

There were some limitations with the ViPSCE, however. The exam consisted of slides of still photographs or short video clips of patients, instruments, investigations, or procedure. One of the concerns in administering the ViPSCE has been the visibility and slide clearness, since the slides were projected on a screen. This was

alleviated by several measures. We had to use a venue with special characteristics. It has to be large enough to accommodate the increasing numbers of students that could reach 120-150. The venue has to have a wide screen visible from a wide angle. Light within the exam venue has to be adjusted to have, at one end, a dim screen area to allow visibility of the slides, but enough light to allow the students to read and answer questions printed on paper. High resolution video projectors with strong illumination power have to be used. Students who have visual weaknesses were allowed to sit in the front row in the exam room.

We were fortunate to have an Information Technology (IT) centre built near the medical school. This centre was provided by 50 computers. The idea of transforming the ViPSCE into a computer-based exam was thus born.

The idea of using computers in assessment of medical students is not new, but its use as a tool in assessment in surgery in the way we did has not been reported in literature before.

Methods
The preparation of the exam
We assessed 43 medical students at the end of their surgical clerkship. The exam was in the form of a slide show. It consisted of 20 slides using PowerPoint (PPt) computer program (Microsoft 2007). The slides changed automatically after 3 minutes and the change was marked by an applause sound to draw the attention of the student to the appearance of the next slide.

 Some of the slides contained still photographs; others showed short video clips (of less than a minute duration). The material examined included photographs of patients, investigations such as x-rays with or without contrast and/or CT scans, surgical instruments, catheters, and various surgical and anaesthetic tubes. Video clips showed patients undergoing physical examinations of conditions such as hernias, and surgical procedures such as endoscopy, and spinal anaesthesia. It is worth mentioning that all the above items belonged to our local patients who were treated in our governmental teaching hospital after obtaining their consent. Pre-exam meetings were held to make sure that it covered evenly all the curriculum of surgery including emergency situation and cold cases. The questions also included the disciplines of general surgery, orthopaedics and trauma surgery, urology, and paediatric surgery. In addition, there were question in anaesthesia, as it is part of surgical curriculum. In this way we tried hard to ensure the content validity of the test.

The examination paper consisted of questions related to the slides. Care was taken so that the number of the question matched the number of the slide. These questions were constructed in an objective and structured way, mainly in the form of surgical problems. We avoided open-ended questions. They explored all the level of knowledge, from simple identification to problem solving. The students answered the questions by hand writing in the spaces allotted in the same exam paper.

Administration of the exam
The students were divided into two classes. Each student had his/her own computer (Figures 1, and 2).

Figure1. Administration of the CCE: Front View: (Students handwrite the answers in the questions sheet. Note the invigilator standing at the back)

There were 2-3 information technology tutors present in each class to help the students in case a technical problem appeared. In addition, at least one consultant surgeon was present in each class.

Figure2. Administration of the CCE: View from the back of the class. Compare computer picture and projection picture.

Before the beginning of the exam, the students were briefed about the exam. The use of computers was simplified, as the PPt program was prepared to start by one touch of the mouse. The two classes were made to start the exam and finish more or less at the same time to prevent communications. Of course mobiles and other communication media were prohibited, and the IT tutors helped in invigilation too (Figure1).

The exam time was 60 minutes (3 minutes per slide). The slides changed automatically. However, after the last slide (end of exam), the students were allowed three minutes for revision. The students were allowed a free use of the PPt program in their own computers to review the slides.

The students filled evaluation forms at the end of the exam.

The exam was corrected manually using a model answer sheet. The total test score was 100 (5 marks/slide). This was divided by 10 to give a score out of 10. Thus the contribution of the CCE as a tool was 10% of the total surgery score of 100. The other tools of assessment in surgery included: OSCE (total mark 40), multiple choice questions or MCQs (20), and short structured exam questions or SSEQ (30).

Analysis of CCE scores and evaluation forms
The scores in the CCE were described statistically and correlated with scores obtained by the students in the other tools of assessment in surgery, using SPSS statistical package.

The evaluation forms were analyzed manually.

Results
The scores: distribution and correlations
Figure3 shows the distribution of the CCE scores. The histogram describes a normal distribution with a mean of (4.97), standard deviation (1.17), with a range of 5 (2.5-7.5).

Using SPSS to compute 2 tailed Pearson correlation test; the scores of each student in the CEE significantly correlated at the 0.01 level with their scores in SSEQs (mean 19.97 +/-3.38) , MCQs (mean 11.67 +/- 2.2), and OSCE (mean 27.83 +/- 3.49)
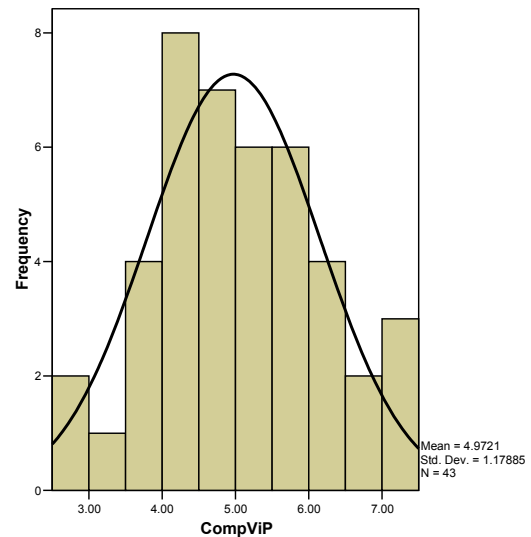

Figure3. Histogram showing the distribution of CCE scores of 43 students [Test score=10. Highest score=7.5. Lowest score=2.5]

Students' acceptability and evaluation
Twenty eight students filled evaluation forms (65 % response rate). Regarding computer literacy, it was interesting to note that 93% of the students in our sample had prior knowledge of the use of the computers, and 61% use the net regularly.

Most of the students (85, 86% respectively) thought the instructions of the exam and the slides were clear to very clear (Table1).

Table1. Evaluation of CCE [n=28 (65%)]
A. Computer Literacy

	Yes	No
Do you use computers?	26 (93%)	2 (7%)
Do you use the net	17 (61%)	11(39%)

B. CCE as an assessment method and its administration

Instructions:	Clear 24 (86%).	Not Clear 3 (11%)	
Slides:	Very clear/clear 24 (85%)	Not Clear 2 (7%)	missed data 2 (7%)
Seating:	Comfortable 22 (79%)	Not comfortable 4 (14%)	missed data 2 (7%)
Compared to the ViPSCE:			
CCE is	Better 18 (65%)	Worse 4 (14%)	No difference 6 (21%)

Would you recommend that departments other than surgery should use the CCE as an assessment

method?	Yes 18 (64%)	No 10 (36%)
Problems	Yes 6 (21%)	No 22 (79%)

Example of Problems: short time, difficult, unclear questions
Approval comments: good method, uses technology, brilliant, continue, move on.

The seating was comfortable (79%). The majority (65%), thought the computerization of the exam was better than the projection onto a screen, and that the CCE should be recommended for use in other departments as well (64%). Free comments showed that most of the students were happy with the exam particularly as it uses IT technology. Negative comments included short time and difficult questions.

Discussion
At Alazhari University Medical School, we use a variety of assessment tools in the summative examination in surgery at the end of surgical clerkship. Historically, this exam consisted of a 'theoretical' and a 'clinical' part each constituting 50% of the total marks. The oral (viva) exam formed a part of the traditional clinical exam. This has been replaced by the ViPSCE[1,2], and the traditional clinical exam by the OSCE. In this paper, we describe the development of the ViPSCE into a computerized clinical examination (CCE), and present our experience with it, the scores statistical analysis, and students' acceptability.
Computers have been used for assessment in medicine since the1960s to test knowledge and problem solving skills[3]. A survey of UK medical schools on the use of computers have shown that computer based assessment (CBA) has a potential for improving the assessment of doctors and other health professionals by developing more valid exams. It is generally popular with candidates, and efficient with delivery and

marking of tests[4]. CBA - also called computer based testing (CBT) and computer assisted assessment (CAA) - as an assessment tool has been used increasingly in many medical disciplines[5-7]. Its use, however, in the way we describe it has– to our knowledge- never been reported in literature before.
Like the ViPSCE, the CCE has a great potential to assess all levels of the knowledge domain from simple identification to critical analysis and problem solving. In this way it has been complementary to the OSCE, in which surgical skills including history and physical examination, as well as attitude, are assessed. The OSCE in some medical schools consists of both static and interactive stations. We have made use of the ViPSCE as a tool to accommodate the 'static stations', and thus leave our OSCE for pure interactive stations. As a result our practical clinical exam could be made to have 27 stations. This has the advantage of increasing the scope and depth of the exam.

The ease with which the exam was carried out proved its feasibility and time saving. The cost and technical expertise, however, should not be under estimated. This include the establishment of Information Technology Centre (or venue) supplied with enough computers and comfortable environment for holding exams.
There were no major problems or hiccups during the administration of the CCE. This is because the program was installed in the computers and rehearsed with the IT staff a day before.

One or two students started running the exam before the start signal was given and these were seen and asked to wait.

The scores of the CCE were normally distributed around a mean of 4.97. This is almost centered round the pass mark of 5. The range was 5. The highest mark was 7.5 and the lowest 2.5. This indicated a balanced exam that was neither very easy nor very difficult.

The scores of each student correlated significantly with their scores in other tools of surgical assessment denoting a strong reliability of the CCE. It is worth noting that the CCE does not assess surgical skills, nevertheless, its scores correlated strongly with those of the OSCE. Hence proving worth of the name we gave it: computerized *clinical* exam. The next step is to try to develop special software to enable this exam to be answered and corrected by the computer. Our survey showed a high computer literacy among our students, although the exam itself did not require much knowledge of computer use. The CCE proved popular with the candidates who seemed to like the idea of using computers as an exam tool. The majority of the students thought the slides were clear, the seating comfortable, and were generally approving of the CCE.

Conclusion

The CCE is a useful assessment method. It is feasible with the availability of enough numbers of computers. It complements the OSCE. The CCE inherits the strong characteristics of the ViPSCE as a valid, reliable and practicable and acceptable exam.

It has the added advantage of improving the viewing of the slides. It has a potential to computerized marking.

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