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A comparative study analysing the two methods of assessing cardiopulmonary resuscitation – multiple choices versus free response question test formats

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Summary

Background and objective. The purpose of the study was to compare two different methods of assessing the knowledge of cardiopulmonary resuscitation (CPR), multiple choices versus free response question test formats and to evaluate, which was better. *Methods*. The research was undertaken in 2004 and 2005 on a representative group of 150 fourth year medical students and 150 doctors one year after graduation (three years after their attendance to the same resuscitation classes). To assess the knowledge of basic resuscitation, two different formats (free response and multiple-choice) of tests were used, which had the same questions. The tests were constructed based on B. S. Bloom taxonomy, transformed by Polish professor B. Niemierko into ABC taxonomy and it assessed the knowledge of CPR at four different levels. For statistical analysis Wilcoxon matched-pairs signed-ranks test was used. *Results*. The results of these two tests were not the same and differed significantly at each level of knowledge. Both groups received better results solving multiple-choice questions when compared to the free response questions. *Conclusions*. The test with free response questions seemed to be a more reliable method for assessing cardiopulmonary resuscitation, when compared to the test with multiple-choice questions. We suggest that medical students should be assessed by the free response question test format. *Anestezjologia i Ratownictwo 2009; 3: 24-30.*

Keywords: cardiopulmonary resuscitation, free response questions, multiple-choice questions, taxonomy

Introduction

Till date we are not aware of the best method of assessing someone's knowledge. The different methods available can be classified into oral and written tests. The written tests are very popular all over the world, particularly the multiple-choice question format. There are also other different types of the question formats, which can be included in the test, for example free response open-ended questions. In free response format, the assessed person has to write his/her answers without any prompts as in multiple-choice question format, where the correct answer is listed among other wrong answers.

The aim of the study is to compare these two tests, and to decide which one is a better method to assess the knowledge of cardiopulmonary resuscitation.

The idea of this research is to make other authors aware and at the same time make them more interested about the different methods available for assessing medical students' knowledge in cardiopulmonary resuscitation. As we all know, in any emergency situation time is crucial and treatment has to be initiated as soon as possible, there is no time to review any book at that moment. The knowledge of management of any life saving situation should come from within and the

skills should be practised and perfected regularly. This is entirely different from other medical situations. So, if we want to assess the knowledge of cardiopulmonary resuscitation, the best way would be to use the test with free response questions. On the other hand, in multiple-choice question format, where the right answer is given among the others answers, we are not properly assessing one's knowledge.

Methods

The research was undertaken in 2004 and 2005 on a representative group of 300 people: 150 fourth year medical students from one University and a control group of 150 doctors one year after graduation (three years after their attendance to the same fourth year students' resuscitation classes). The Ethics Committee of a local University approved this research and all the participants consented to participate in the study. The curriculum of resuscitation in this University was at the basic level for first and third years and at advanced level for the fourth years. Two written tests constructed based on the guidelines of 2000 [1,2] were used to assess all the participants' knowledge. The questions in both tests were exactly the same and assessed the knowledge of basic resuscitation. The first test contained free response-open ended questions and the tested group had to write their answers. The second one contained multiple-choice questions and they had to choose only one right answer out of the four. The tests were constructed with the use of B.S. Bloom [3] taxonomy, transformed by Polish professor B.Niemierko into ABC taxonomy [4]. Using this taxonomy the questions in the written test were divided into four groups based on different levels of knowledge. The levels of knowledge starting from the easiest are: retention of knowledge (remembering i.e. passive knowledge), understanding of knowledge, use of knowledge in typical situations (e.g. in the simple algorithms) and the use of knowledge in problem situations (e.g. when the algorithm is more complicated).

Each test contained 30 questions. Ten questions assessed the retention of knowledge of resuscitation, by asking about the definitions of an adult, a child and an infant (borders in age), the method to assess consciousness, the recommendations to perform chest compressions in an adult, a child and an infant, the manoeuvres to open the airway, the number of breaths and chest compressions contained in the cycle for

adults, children and infants. The other ten questions assessed the understanding of knowledge of resuscitation by asking if the test group were able to explain some recommendations e.g. why the victim should be ventilated without so much pressure: what is the rule to call for help if the victim is unconscious in an adult versus a child, what are the recommendations to start chest compressions, whether a person if choking, needs chest compressions or not and why, what are the techniques to open the airway, what all factors can protect the brain in cardiac arrest. Five questions assessed the use of knowledge in typical situations, with the use of simple algorithm e.g. what to do if the adult and infant victim is choking, what is the beginning of the algorithm when adult was found lying on the floor, what to do if he is breathless. The last five questions assessed the use of knowledge in problem situations, e.g. what are the problems in managing a drowning victim, what to do if artificial ventilation in this victim is not effective, what to do if the victim in cardiac arrest is bleeding seriously, what is the plan of action in a car accident with two unconscious victims.

The correct answers to the same questions in both tests were given the same number of points. To get appropriate results from the tests, the groups were given free response question test (FRQ) first followed by the multiple-choice questions (MCQ). Groups solving free response questions have to know what to write without any prompts, but with multiple-choice questions there is a chance that they can remember the right answer by just looking at the choices. So by following the above order, FRQ followed by MCQ test gives the possibility to avoid false results, as they can remember the answer from MCQ test and write it in FRQ test.

When evaluating the results, the received number of points at each level of knowledge was divided by maximum number of points and converted into percentage. For statistical analysis Wilcoxon matched-pairs signed-ranks test was used and considered statistical significant if $p < 0.05$.

Results

When analysing the results, the group of medical students was named as No 1 and the control group with doctors one year after graduation (three years after the resuscitation classes) as No 2. In the diagrams multiple choice question tests was marked as MCQ and

free response question tests as FRQ. The results when compared were not the same and differed significantly based on the taxonomy, at each level of knowledge.

The results of the test for the retention of knowledge are presented for group 1 in diagram 1 and for group 2 in diagram 2.
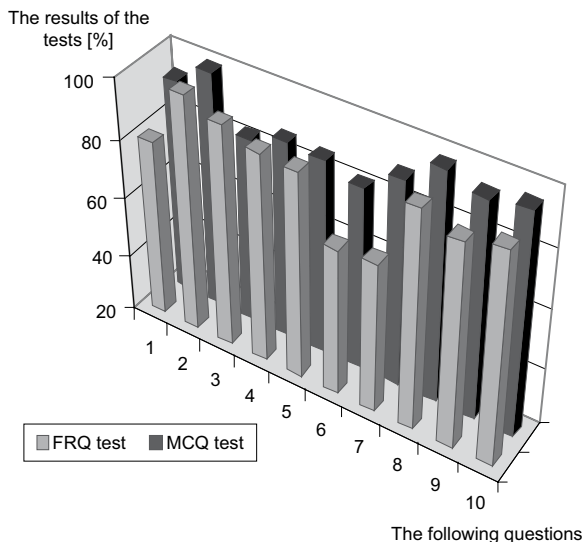

Diagram 1. The retention of knowledge of basic resuscitation of 150 four year medical faculty students – the comparison between MCQ and FRQ tests
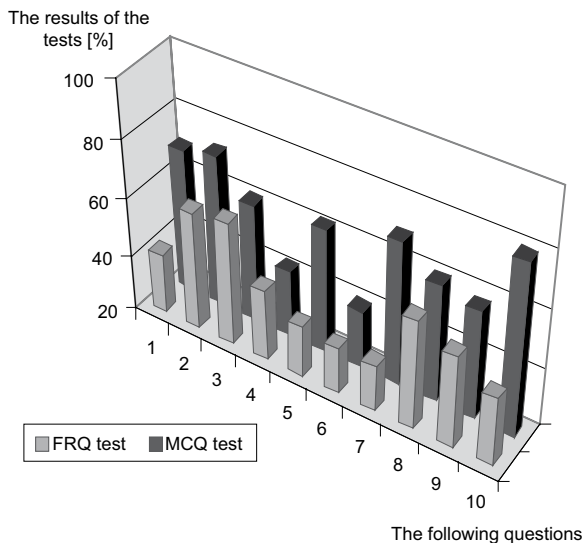

Diagram 2. The retention of knowledge of basic resuscitation of 150 doctors – the comparison between MCQ and FRQ tests
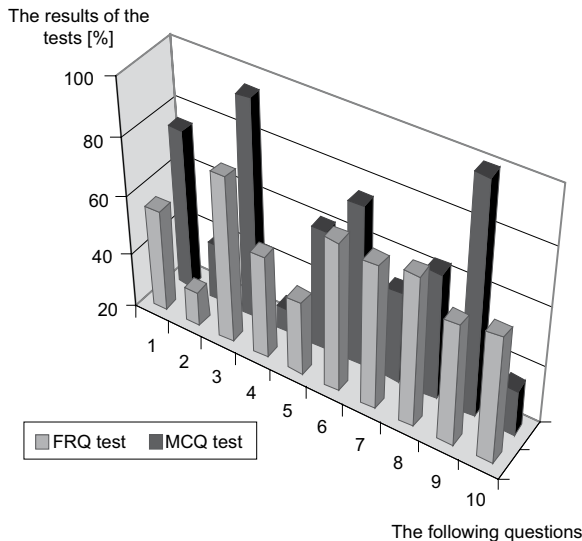

Diagram 3. The understanding of knowledge of basic resuscitation of 150 four year medical faculty students – the comparison between MCQ and FRQ tests
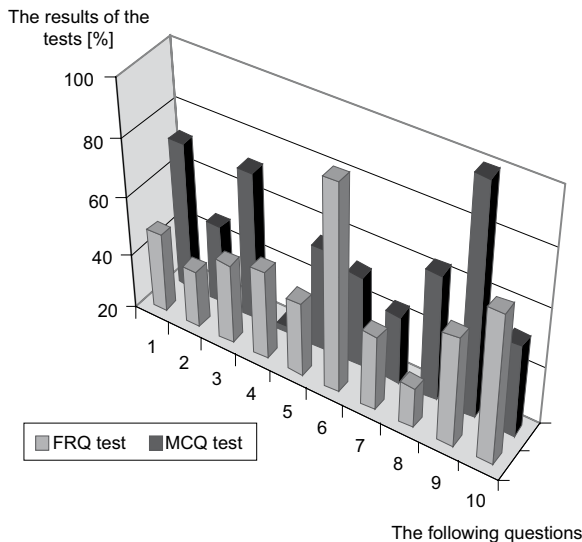

Diagram 4. The understanding of knowledge of basic resuscitation of 150 doctors – the comparison between MCQ and FRQ tests

The results of group 1 were better in 7 questions in multiple-choice test compared with free response test and in 8 questions in group 2. A statistical correlation (p=0.01-0.04) between the tests was found in four questions out of ten in group 1 and in six questions (p=0.003-0.04) in group 2. Surprisingly, group 1 received

a smaller number of points in three questions in MCQ than in free response question test. Group 2 received a smaller number of points in two questions in MCQ.

The results of the test for understanding of knowledge are presented for group 1 in diagram 3 and for group 2 in diagram 4.

The results of group 1 were better in 6 questions in multiple-choice tests compared with free response test and in 6 questions in group 2. A statistical correlation (p=0.0001 – p=0.01) between the tests was found in five questions out of ten in group 1 and in six questions (p=0.0001 – p=0.01) in group 2. Group 1 received a smaller number of points for four questions in MCQ than in free response question test. Group 2 received a smaller number of points also for four questions in MCQ.

The results of the test for the use of knowledge in typical situations are presented for group 1 in diagram 5 and for group 2 in diagram 6.

The results of group 1 were better in 3 questions in multiple-choice test compared with free response test and in 4 questions for group 2. A statistical correlation (p=0.0001 – p=0.01) between the tests was found in two questions out of five for group 1 and none for group 2. Group 1 received a smaller number of points for two questions in MCQ than in free response question test. Group 2 received a smaller number of points for one question in MCQ.

The results of the test for the use of knowledge in problem situations are presented for group 1 in diagram 7 and for group 2 in diagram 8.
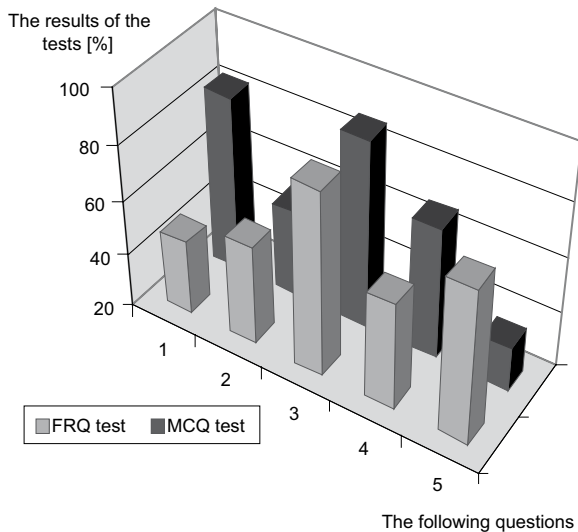

Diagram 5. The use of knowledge of basic resuscitation in typical situations by 150 four year medical faculty students – the comparison between MCQ and FRQ tests
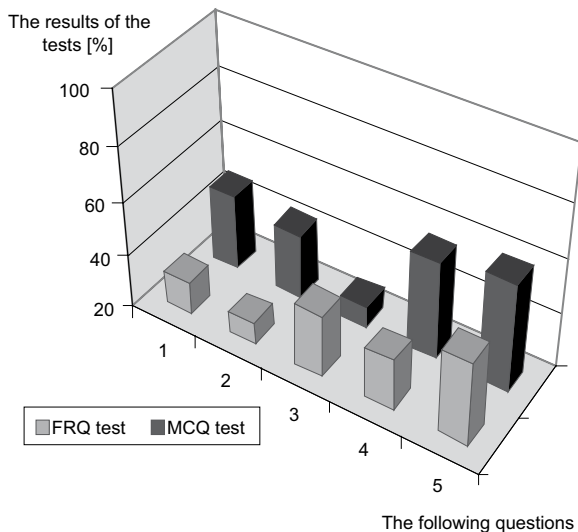

Diagram 6. The use of knowledge of basic resuscitation in typical situations by 150 doctors – the comparison between MCQ and FRQ tests
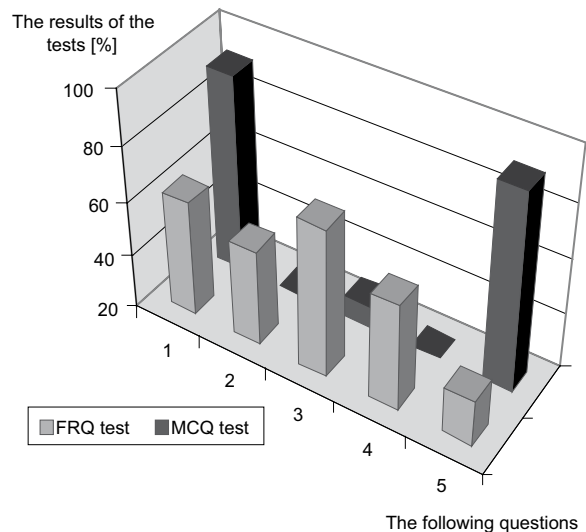

Diagram 7. The use of knowledge of basic resuscitation in problem situations by 150 four year medical faculty students – the comparison between MCQ and FRQ tests
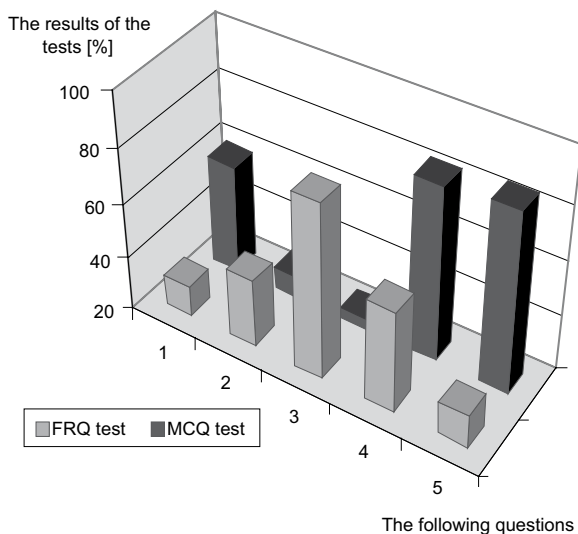
Diagram 8. The use of knowledge of basic resuscitation in problem situations by 150 doctors – the comparison between MCQ and FRQ tests

The results of group 1 were better in 2 questions in multiple-choice test compared with free response test and in 3 questions for group 2. A statistical correlation ($p = 0.0000 – p = 0.01$) between the tests was found in five out of five questions in group 1 and in three questions ($p = 0.0001 – p = 0.01$) in group 2. Group 1 received a smaller number of points in three questions in MCQ than in free response question test. Group 2 received a smaller number of points in two questions in MCQ.

Generally both groups received better results solving multiple-choice questions than free response questions. There were few exceptions from this, found in twelve questions out of thirty in group 1 and in nine questions in group 2. Group 1 (four year medical students) was better than group 2 (doctors one year after graduation) at each level of knowledge. It can be interpreted by the forgetting process in group 2, because these people were tested three years after their attendance of resuscitation classes. Similar results, showing the decrease of knowledge of a group estimated a few months after the attendance of the course or classes were observed by different researches even in healthcare providers [5-11].

Discussion

The best method in assessing someone's knowledge is by evaluating his/her real, current, possessed kno-

wledge. This method of assessment also analyses the different methods of teaching. Multiple choice question tests are very popular all over the world. They are used at the Universities of Medical Sciences to evaluate the knowledge of students in different fields of medicine. To prepare these tests the authors should rely on specific conditions of their construction. Few researches have been undertaken to find the best method in assessing medical students' knowledge particularly about their clinical skills. The proposed methods were multiple-choice question tests, essays and oral exams, but which is best among them is not known. A. S. Elstein [12] suggested that multiple-choice question tests could not assess the knowledge of managing difficult clinical situations. In his opinion essay questions and oral exams are better in assessing these kinds of questions. A. Keynan et al. [13] has recommended to assess clinical skills by a combination of multiple choice question test and oral examination.

Can we use multiple choice question tests to assess the knowledge of cardiopulmonary resuscitation or management of any urgent clinical situation? In any emergency situation, where time is crucial, the rescuer has to help the victim as quickly as possible. The rescuers will never get any time to refer to books or algorithms at that particular moment. So he must know what to do at that time and if he does not, he will not be able to help any victim! If we assess the knowledge of managing life saving situations by the use of free response tests (FRQ), asking the rescuers to write what he will do at that moment, we can evaluate his real, possessed knowledge, as they don't get any help from the test. By assessing the knowledge with MCQ format, can we make sure they know the right answer? No, because by solving the MCQ's the test people can pretend that they know the answer by mere guesswork from the given choices.

The results of the test groups were better when both groups solved the multiple choice questions. They could find the proper answer out of the four given in the test. Even if they forgot (group No 2), looking at the answers, they could remember the correct answer. When solving free response questions students had the opportunity to write their answers to the questions and hence those results when compared with multiple choice questions were worse. Similar research was undertaken by D. I. Newble et al. [14] where different groups of people wrote identical tests in two different formats, multiple choice questions and free response questions.

The results were significantly better when the group solved multiple choice questions. A. Srivastava et al. [15] concluded that multiple choice question tests can neither analyse conceptual understanding nor integration of concepts in medical students, but only factual information.

In a few cases the test group received better results in free response question test than in multiple choice questions. It can be interpreted that sometimes a person reading the answers given in the test can be influenced by something and can be misled. This did not happen in the free response question test. This is paradoxical, that a person knew what to do, received a very good result in free response question test, but just after it, found a wrong answer in multiple choice question tests. This similar situation, when a student incorrectly solved the clinical scenario in the multiple choice test was also described by A. S. Elstein [12].

If the effectiveness of teaching is poor it is time to improve the didactic process by changing the methods of teaching or methods of assessment. What is the best method to assess medical students or doctors knowledge in cardiopulmonary resuscitation? Should we still use multiple choice question tests, or should we assess their knowledge by free response question tests? The answer to this would be to use different methods, because combining different assessment types yields better results than the use of just one method [16].

Conclusions

Based on the results, free response question format seems to be a more reliable method of assessing cardiopulmonary resuscitation. The idea of this research was to make other authors aware and at the same time to create an interest in them about the various methods available for assessing medical students' knowledge in CPR. Till this date we can still question whether we assessed them in a proper way? We conclude that medical students should also be assessed by free response question tests in addition to MCQ.

It is difficult to accept this point of view which argues with the popular opinion at this time and affects the guidelines of some authorities. Multiple choice question tests are very popular all over the world. One of the arguments for using them is that they are an inexpensive way of testing. This economic aspect should not be the most important factor which influences the assessment of knowledge. If we keep using these improper methods of the assessment, doctors from these universities will not be properly qualified. As a consequence they will have to take future postgraduate courses to improve their knowledge. In this 21st century as science is advancing and new methods of teaching are evolving its time to reconsider our testing methods.

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