



EFFECT OF STRUCTURED ECG TRAINING PROGRAM ON KNOWLEDGE AND SKILLS OF ECG INTERPRETATION AMONG MEDICAL STUDENTS

Emergency Medicine

Dr. S Prakash Babu*	Assistant Professor, Dept. of Emergency Medicine, PES Institute of Medical Sciences And Research, Kuppam. *Corresponding Author
Dr. Irshad Ahmed	Assistant Professor, Dept. of Emergency Medicine, PES Institute of Medical Sciences And Research, Kuppam.
Dr. T. Krishna Chaitanya Kumar	Postgraduate Resident, Dept. of Emergency Medicine, PES Institute of Medical Sciences And Research, Kuppam.
Dr. Sai Pradeep	Professor, Dept. of Emergency Medicine, PES Institute of Medical Sciences And Research, Kuppam

ABSTRACT

Background And Objectives- The current study aims at evaluating the ECG knowledge among medical interns and to check improvement in their skills after a structured ECG training.

Methods And Materials- This was an interventional study. Participants were intimated in advance and a structured ECG training program was conducted. A pre-test and post-test were given before and after the training and scores were compared.

Results- Overall performance of the participants is poor in the pre-test (mean-8.46±2.623. 90). The poor performance is more pronounced in the interpretation of ECG than the answering the theoretical questions based on ECG (mean-1.99 vs 6.78). After the training program scores have improved in all aspects (mean-15.55). The results were statistically significant.

Conclusion- The study concludes that conventional teaching will not be useful for crucial skill training. Structured integrated training is required to teach crucial skills.

KEYWORDS

ECG: undergraduate: interpretation skills: structured training: integrated teaching

BACKGROUND AND OBJECTIVES

An electrocardiogram is used to diagnose life-threatening cardiac and electrolyte disturbances. Accurate interpretation of ECG is necessary for all medical graduates. But most of the medical graduates seem to lack the skill. This can be due to inadequate and ill-structured ECG training during the medical graduation curriculum. Assessing the knowledge and skills of final-year medical graduates will help in the identification of lacunas and design a structured training program on ECG interpretation skills. Testing the trainees after imparting the training can detect the effectiveness of the program. This helps in two ways. Firstly, knowledge and skills among medical students will improve and secondly it will help improve future training in ECG.

Multiple earlier studies showed that medical graduates lacked adequate knowledge and interpretation skills in ECG. With the ongoing non-communicable disease epidemic, it becomes important for primary care physicians to have adequate knowledge in identifying basic and life-threatening cardiac diseases. Every medical graduate should be able to identify myocardial infarction, various dysrhythmias, electrolyte abnormalities based on an ECG.

Objectives – The Objectives Of The Study Include

1. To assess the knowledge and ECG interpretation skills among medical interns
2. To assess the effect of a single structured hands-on training program on the improvement of knowledge and skills

Methods:

This was an interventional study on the knowledge and skills of ECG interpretation before and after a structured training program. All the participants were given a pretest, followed by a training program and a post-test. Pretest and post-test scores were compared and contrasted in terms of the total score, score from theoretical questions and score from the ECG tracing interpretations. A trial version of SPSS software was used for statistical analysis.

RESULTS

A total of 103 students undergoing their internship have participated in the training program and the study. The mean pretest score was 8.46±2.623. 9 students scored 5 or <5, 75 students scored 6 to 10, 18 students scored between 11 and 15, one student scored 18 marks in the pretest.

The mean post test score was 15.55 ±2.090. None of the students

scored ≤5 marks in the posttest. Only two students score 6 to 10 marks, 52 students score between 11 to 15, 49 students score between 15 and 20. The average score of the theoretical part of the pretest was 6.78 ± 1.372. 13 students scored ≤ 5 in pretest theory, 31 students scored 6 marks, 29 students scored 7 marks, 20 students 8 marks, 8 students scored 9 marks, 10 marks were scored by only 2 students. Whereas in the posttest theory no students scored less than 5, only one student scored 6 marks, 3 scored 7 marks, 12 scored 8 marks, 29 scored 9 marks and 58 scored 10 marks. In the interpretation part of the pretest 33 students scored 0 marks, 62 students scored between 1 to 5, 8 students scored 6 to 10. In the posttest interpretation only 2 students scored 0 marks, 35 students scored between 1 to 5, 66 students scored between 6 to 9, no student could score 10 marks. There was a huge statistical difference (p-value < 0.0001) between theoretical knowledge and practical skills of ECG interpretation of internship students. By using paired sample T-test there is a significant statistical difference between the scores of pretests and posttest, pretest theory and posttest theory, pretest interpretation to posttest interpretation with two-sided P values for all <0.001.

Analysis of variance was performed using gain scores which showed a statistically significant improvement in scores. The F-value for improvement in overall performance, theory performance, and interpretation performance were 9.628, 47.598, and 13.103 respectively. P-values for all the groups were <0.001.

Table1. Analysis Of Marks Scored By Students

	1-5	6-10	11-15	16-20
Total pretest score	9	75	18	1
Total posttest score	0	2	52	49
Pretest theory score	13	90		
Posttest theory score	0	103		
Pretest interpretation	95	8		
Posttest interpretation	37	66		

Table2. Descriptive Statistics Of Scores

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pre Score	103	3	18	8.46	2.623
Post Score	103	7	19	15.55	2.090
pretest theory	103	3	10	6.78	1.372
pretest interpretation	103	0	9	1.99	2.181
post test theory	103	6	10	9.36	.873

post test interpretation	103	0	9	6.21	1.969
Valid N (listwise)	103				

DISCUSSION

Participants in the study included interns who are in active clinical postings in the teaching hospital. They have been informed about the study and the training program. They were divided into smaller groups and a full-day training program was provided. All the groups have been trained by the same faculty members using the same set of audio-visual aids. They have been evaluated by pretest and posttest before and after completion of training. Pretest and post-test contained the same set of questions, albeit in a different order. Equal importance has been given to the theoretical and practical aspects of ECG interpretation. Participant scores in pretest and post-test have been compared.

103 interns participated and completed their pretest and posttest. Pretest showed a very poor mean score of 8.46 ± 2.623 out of 20 which is less than 50%. Further, there is huge variation between the scores of theoretical parts to the practical aspects of ECG interpretation with mean scores of 6.78 in the pretest theory vs. 1.99 in the pretest interpretation. In a survey conducted in Ethiopia¹, it was shown that ECG interpretation skills among graduating medical students were poor. Further, they stated that students who reported ECG self-learning scored better than those who did not. Similar findings have been reflected in the current study. The same study concluded that students who had emergency medicine rotations during clinical years and having been attended ECG classes or workshops had better knowledge. Also, mere attending the regular classes on ECG during the undergraduate curriculum did not have an impact. Another polish study² has reported that medical students had a good knowledge of ECG, but recognition of ECG abnormalities is very poor. The study also states that ECG knowledge is acquired through self-learning, but not by attending routine classes^{3,4}. The current study also reflects similarly low levels of ECG interpretation skills. A total of 95(92.2%) students scored less than 50%, while 33(32.03%) failed to correctly interpret even one ECG. A study from South Africa⁵ showed emergency medicine residents and emergency physicians are good at reading ECGs. Hence emergency medicine doctors can teach ECG better.

The ECG training in the current study consisted of basics like generation of the cardiac action potential, cardiac conduction system, ECG acquisition, basics of ECG interpretation, ECG abnormalities in different diseases, and finally actual interpretation of standardized ECGs. In the regular medical training, these aspects of the ECGs are thought in different classes and integration will be lacking leaving students confused and clueless. The basics of ECG are dealt with in the pre-clinical years. Some of the abnormalities are thought during clinical postings. But actual acquisition and systematic approach to an ECG based diagnosis are often lacking. Direct one-to-one interaction has been provided during the training for engagement and clarification of doubts.

A former study evaluating the best method to teach ECG has stated that no single method can be relied on to teach ECG⁵. They found that self-directed learning is associated with poorer interpretation competence and preferred summative assessment. Web-based ECG learning is a new model of learning ECG, but caution must be exercised in choosing sites carefully. Another study evaluating the effectiveness of a web-based ECG program stated web is a useful resource to ECG learning and internet-delivered education can be more effective than traditional teaching. The reason is improved visualization and interactivity. The current study model also aimed at greater interaction between the trainer and trainee through small-batch training. Further, it provided an opportunity to clear doubts on the spot.

Post-test scores of the study participants improved greatly. The overall mean score improved from 8.46 in the pretest to 15.55 in the post-test. Post-test theory means improved from pretest theory of 6.78 to 9.36. Scores in the interpretation part of the post-test also increased from a mere 1.99 in the pretest to 6.21. If one considers the arbitrary 50% mark as the qualifying marks which are so in all medical exams, there is a commendable improvement in scores.

Table3. Number Of Students Scoring <50% And >50% In Different Aspects

	Less than 50%	More than 50%
Pretest total score	84	19
Post-test score	2	101

Pretest theory	13	90
Post-test theory	0	103
Pretest interpretation	95	8
Post test interpretation	37	66

The improvement in mean scores is more pronounced in theoretical aspects of ECG compared to improvement in interpretation skills. This difference might be because although knowledge is gained, application of the knowledge comes only with practice. Hence students should keep practicing ECGs with the help of clinical coordinators or online sources⁴. Online practice sessions on ECG interpretation from reliable sources will be the future forward to keep oneself updated on ECG interpretation skills.

One study evaluating the web-based standardized ECG training program found that there are considerable score gains in students from a baseline mean of 52.7 to a post-test mean of 68.4. The current study differs from the above only in the way of delivery of content. Both the studies used standardized ECG training techniques and dedicated workshops. The score in different aspects of the current study is shown below. Several studies^{9,10,11} quoted graphics-sequence-learning method as effective method to teach ECGs. The current study identifies structured and integrated teaching also will work in the same way.

Table4. Score Gains From Pretest To Post-Test

	Mean	Standard deviation
Overall gain	7.097	2.978
Theory gain	2.5825	1.723
Interpretation gain	4.22	2.862

CONCLUSION-

Based on the findings of the current study and the available literature, the ECG knowledge and interpretation skills among the graduating medical students were poor. Conventional teaching does not focus on skills acquired by the students. The knowledge on any skill will be delivered in bits and pieces throughout the undergraduate curriculum. There is no real integration between knowledge gained and clinical application of the knowledge. The summative assessments focus on gaining theory knowledge. This study concludes that a standardized and integrated approach to ECG will help the students gain both theoretical and clinical knowledge. Not only for ECG but any specific important skills can be thought through integrated workshops. Students should be encouraged on self-learning and usage of web-based interactive learning to augment their skills.

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