

## Determination of the Level of Emergency Medicine Resident Physicians to Recognize the Electrocardiography Findings

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### Abstract

**Objective:** The aim of this study is to determine the accuracy and reliability of the interpretation of electrocardiography (ECG) findings by emergency medicine resident physicians (EMPs) and to provide training recommendations in line with emerging deficiencies.

**Material and Methods:** This research depended on the data from a questionnaire that we conducted among EMPs in Ankara. The survey included multiple-choice questions, selected through conceived cases presented in major textbooks or congresses. EMP ECG assessment levels were compared according to the duration of residency education and the presence of ECG education. The data were evaluated by using the Statistical Package for Social Sciences 17.0 (SPSS Inc., Chicago, IL, USA).

**Results:** A total of 112 volunteers participated. Mean age was 29.6±4.4; also, 47 were female and 65 were male. When all of the questions were taken into account, the mean number of total correct answers was higher for those who had received ECG training than who had not received it, those who underwent more training than those who underwent less training, and those whose duration of assistantship was longer than those whose duration was shorter.

**Conclusion:** The results of our study revealed that the evaluation of ECG is improved by increasing clinical knowledge and training. Depending on these results, we suggest that effective and practical ECG courses and training programs should be organized for EMPs. (*JAEM 2014; 13: 108-11*)

**Key words:** Electrocardiography, emergency medicine resident physicians, ECG training

### Introduction

Electrocardiogram (ECG) is a very helpful technique in the physical examination, used for detecting arrhythmias; acute myocardial infarction (MI); ischemic heart disease; electrolyte imbalances, such as hypokalemia and hyperkalemia; and non-cardiac pathologies, such as pulmonary embolism, hyperthyroidism, hypothermia, and many other pathologies (1). The diseases characterized by chest pain, which are commonly seen in the emergency department, come to the fore among them, due to their life-threatening aspects. Emergency physicians have to make the correct diagnosis of these diseases and begin the most appropriate treatment as soon as possible (2). All patients admitted to the emergency department with chest pain should be evaluated in terms of acute coronary syndrome (ACS). ECG must be performed initially, even in the absence of ACS symptoms in the physical examination or a patient's history of ACS (2, 3).

Standard 12-lead ECG is the oldest, most common, and still the best test for the diagnosis of acute myocardial ischemia in the emer-

gency department (2, 4-6). It is the only test used for differentiating STEMI and non-STEMI in the emergency department; therefore, it plays a very crucial role in preferring thrombolytic therapy or percutaneous coronary intervention. According to the rules of Advanced Cardiac Life Support (ACLS), ECG should be performed within the first 10 minutes of a patient's admission to the emergency department (2, 5, 6, 8).

In the emergency department, interpreting the ECG is extremely important, especially in the diagnosis, treatment, and discharge of patients presenting with chest pain. The aim of this study is to evaluate the levels of ECG interpretation skills of emergency medicine resident physicians (EMP) and to offer training suggestions.

### Material and Methods

#### Research Design and Data Collection

This study includes data from a questionnaire conducted through EMP training in 5 university hospitals and 5 training and



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research hospitals in Ankara. The approval of the Yıldırım Beyazıt University School of Medicine Non-Drug Clinical Research Ethics Committee was obtained. The aim of the study was to define the accuracy and reliability of EMP interpretations of basic ECG findings, emergency heart diseases, and ECG findings peculiar to some special cases.

The study was completed in about 2 months. The EMPs who were off-duty or who did not accept to fill out the questionnaire and who did not complete the questionnaire were not included in the study. The study included 112 EMPs. ECG training concept referred to at least 1 full-day training course after graduation in programs, such as congresses, symposia, and orientation programs of emergency medicine societies. Although these training courses were not completely standard, we accepted the courses given by emergency medicine specialists who have received ACLS trainer training courses co-organized by the Emergency Medicine Physicians Association of Turkey and Turkish Society of Cardiology for this study. The survey included multiple-choice questions about the cases presented and/or designed in the main textbooks or congresses. A validity and reliability study for this test is not available. The questionnaire consisted of 32 questions on ECG. The first three questions were written in text style, and the other 29 questions were asked on ECGs. Sixteen questions were about basic ECG knowledge, 10 questions were about evaluating life-threatening rhythms, and 6 questions were about ECGs peculiar to some clinical conditions or some specific diseases. The assigned work time and ECG training status of EMPs were assessed by 4 additional questions.

### Statistical Analysis

The data were evaluated by using Statistical Package for Social Sciences 17.0 (SPSS Inc., Chicago, IL, USA). Chi-square test was used for comparison of percentages. Mann-Whitney U-test was used for comparison of average measurements of the two groups. Kruskal-Wallis test was used for the comparison of average measurements of multiple groups, and  $p < 0.05$  was accepted as statistically significant. The median was used for comparisons of groups, because the data were not distributed normally, and is presented in brackets with 25%-75% quartiles.

### Results

The study included 112 (67%) of 167 EMPs training in Ankara. Given that a total of 1100 EMPs were training in Turkey in the same period, it was seen that the study included approximately 10% of the universe. Fifty-five EMPs (33%) who were off-duty for various reasons were not included in the study. All accessible EMPs volunteered to participate in the study; 36 EMPs (32.1%) were working in university hospitals, and 76 (67.9%) were working in training and research hospitals. The average age was  $29.6 \pm 4.4$ .

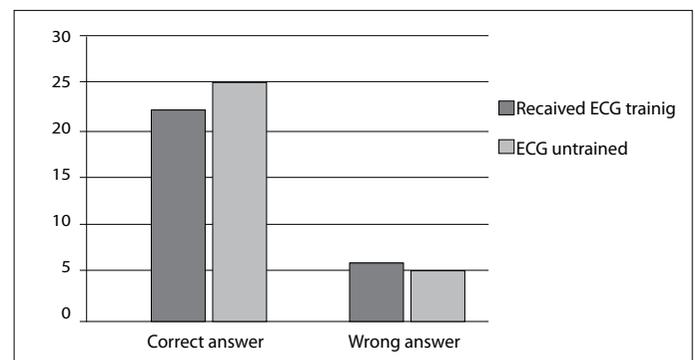
A total of 72 participants received ECG training. It was found that 26 EMPs (36.1%) had received one training, 21 EMPs (29.1%) had received two trainings, 25 (34.7%) had received more than two trainings, and 40 EMPs (35.7%) did not receive any ECG training. Regarding duration of residency, it was found that 35 EMPs (31.2%) were resident physicians for 0-6 months, 29 EMPs (25.9%) were resident physicians for 7-24 months, and 48 (42.9%) of them were resident physicians for more than 25 months.

The median for the number of all correct answers for all EMPs was 25 (22-29), and the median of wrong answers was 6 (4-10). The median for correct answers of EMPs who were residents in university hospitals was 25 (22-28), whereas it was 24 for EMPs who were resident physicians in training and research hospitals; this difference was not statistically significant ( $p > 0.05$ ).

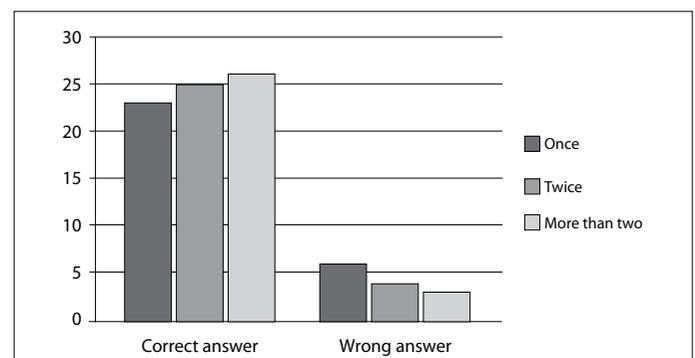
Considering all of the questions, it was found that the median of correct answers was higher in the group who received ECG training than in those who did not receive ECG training [26 (23-30)/24 (22-27);  $p = 0.003$ ], whereas the median of wrong answers was lower [6 (4-9)/7 (4-11);  $p = 0.024$ ]. The distributions of the medians of correct and wrong answers according to presence of ECG training are shown in Figure 1.

Considering all of the questions, it was found that the median of correct answers was higher in the group who received more ECG trainings than in those who received fewer ECG trainings (more than two times 27 (25-28), two times 26 (23-30), once 24 (21-26)  $p = 0.003$ ), whereas the median of wrong answers was lower (more than two times 4 (3-7), two times 5 (2-7), one time 7 (5-10);  $p = 0.002$ ). The distributions of the medians of correct and wrong answers according to number of trainings are shown in Figure 2.

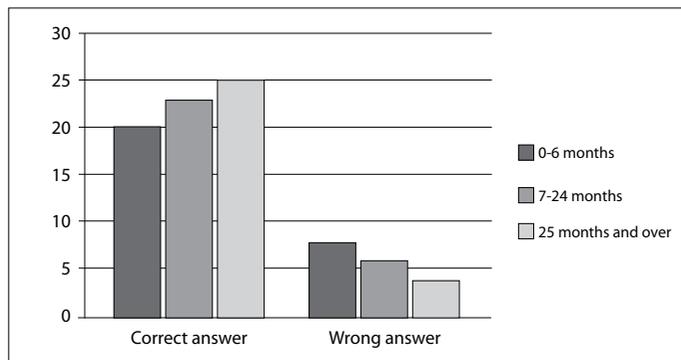
Considering all of the questions, the median of correct answers was higher in the groups whose duration of residency was longer than those whose duration of residency was shorter [ $\geq 25$  months 26 (25-28), 7-24 months 24 (21-26), 0-6 months 21 (17-26);  $p = 0.001$ ], whereas the median of wrong answers of those whose duration of residency was longer was lower [ $\geq 25$  months 5 (3-7), 7-24 months 7 (5-10), 0-6 months 9 (6-13);  $p = 0.001$ ]. The distributions of medians of correct and incorrect answers according to duration of residency are shown in Figure 3.



**Figure 1.** The distributions of the medians of correct and wrong answers according to presence of ECG training



**Figure 2.** The distributions of the medians of correct and wrong answers according to the number of trainings



**Figure 3.** The distributions of medians of correct and incorrect answers according to duration of residency

When questions were considered separately according to category, the median of correct answers for the first 16 questions about basic ECG findings was 12 (11-13) in EMP residents for 0-6 months, 14 (13-15) in EMP residents for 7-24 months, and 15 in EMP residents for more than 25 months. The difference in the 0-6-month group was statistically significant ( $p < 0.001$ ). There were no statistically significant differences between the other question categories.

In our study, the most incorrectly answered question was the ECG question about second-degree AV block type 1 findings; 73 EMPs (66.4%) answered this question incorrectly ( $n=112$ ). In our study, the most correctly answered question was the question about the calculation of speed in normal sinus rhythm ECG; 107 EMPs (96.4%) out of 112 correctly answered this question. In addition, we observed that the question about findings of acute inferior + right MI was answered incorrectly by 48 (43.2%) EMPs out of 112.

## Discussion

Our results revealed that the average of correct answers was higher and the average of incorrect answers was lower in those who received ECG training than in those who did not receive any ECG training, in those who received more ECG trainings, and in those whose duration of residency was longer.

To our knowledge, this kind of questionnaire study is rare in the literature. Rather, there are studies comparing the compatibility of electrocardiographic interpretations of cardiology specialists and emergency department physicians.

These studies indicated that the ratio of incorrect interpretations decreases with increasing duration of vocation and the number of ECG training courses. De Jager et al. (9) found that as the duration of residency got longer, the errors in ECG interpretation decreased in their survey with emergency physicians. Pudlo et al. (10), in a survey they applied on 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade students in Jagiellonian University, showed that the percentage of correct answers significantly increased in grade 6 students. In the same study, the percentage of correct answers by those who completed rotations in cardiology was found to be higher than in those who did not complete a cardiology rotation.

In another study investigating ECG assessment programs for emergency medicine residents, it was shown that ECG interpretation skills of EMPs become more accurate as their seniority in residency increased (11). The results of our study, which showed that as the number of ECG trainings and duration of residency increased, the percentage of correct answers increased, are similar to those studies.

In our study, the high rate of incorrect answers to the ECG question about acute inferior and right MI findings is similar to other studies in the literature (12).

Ho et al. (13) compared cardiology specialists with emergency department physicians in terms of ECG interpretation in the selection of eligible patients for thrombolytic therapy in their study, and they found that ED physicians evaluated 13 of 236 ECGs incorrectly. In the same study, they reported that some small ST-segment changes were not recognized by ED physicians.

Similarly, in a multicenter study by Lee et al. (14), it was reported that ED physicians could not detect the AMI findings on ECG in 21 of the 445 patients who were candidates for thrombolytic therapy.

Eken et al. (15), in their study investigating the accuracy and reliability of the interpretations of electrocardiograms in the emergency room, found that the most frequently unidentified cases were non-specific ST-T changes. Wong et al. (12) found that the questions about ECG findings of posterior MI were answered incorrectly more often and those of ECG findings of anterior and inferior MI were answered correctly more often. Incorrect assessment of these findings may be due to reciprocal features (mirror image) of ECG findings that could not be detected easily and suggest that more training is required.

In our study, the question about the second-degree AV block type-1 ECG findings was the most frequently incorrectly answered question. Parallel findings have been found in the literature. Wong et al. (12) noted that the most incorrect answers were given to the question about conduction disturbances, including AV blocks. In addition, in our study, the ratio of correct answers to the questions about SVT, AF, third-degree AV block, right bundle branch block, arrhythmia rate calculation, atrial tachycardia, and sinus arrhythmia by the EMPs whose duration of residency was longer was significantly higher. Our findings and similar findings in the literature suggest that the ECG findings of conduction abnormalities could be detected with more difficulty.

In our study, the most frequently correctly answered question was about calculating the speed with normal sinus rhythm ECG. This finding indicates the importance of ECG interpretation training and frequent repetition. In this study, the high rate of misinterpretation of ECGs among those whose duration of residency was shorter or who received few ECG trainings also shows the importance of ECG training.

In our study, constant repetition along with ECG training and seniority of residence have been identified as the most important factors in getting correct answers. It was seen that emergency department resident physicians who had just graduated from medical school do not have the desired level of knowledge about ECG interpretation. We found that physicians who have received 3 or more ECG trainings have a better level of knowledge.

The high ratio of incorrect answers to basic ECG problems among newly graduated physicians suggests that ECG training in basic medical education is not sufficient. The lack of statistically significant differences between the ratio of correct answers to the other category questions due to seniority can be explained by the small number of questions. However, the high ratio of some pathological findings that could not be identified by final-year residents indicates that ECG training should be repeated frequently. In the emergency department, delayed diagnosis of acute MI may cause door-to-needle or door-to-balloon time to be prolonged and therefore may cause loss of heart functions and/or increases in mortality and may

cause legal troubles. Therefore, we suggest the priority of such an important diagnostic tool in the training of physicians.

The limitation of our study is that the sample size was limited with Ankara; a larger study across Turkey may be planned. The non-standardized format of ECG training might have influenced our results.

## Conclusion

We conclude that ECG interpretation skills are developed by increases in clinical knowledge and training. Effective and practical ECG courses and in-service training programs should be organized both within the organizations and outside the organizations. EMPs should always evaluate ECGs together with a senior EMP or emergency medicine specialist.

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**Ethics Committee Approval:** The approval of Yıldırım Beyazıt University School of Medicine Non-Drug Clinical Research Ethics Committee was obtained (noted in materials and methods section).

**Informed Consent:** All participants were informed verbally before they were given the survey.

**Peer-review:** Externally peer-reviewed.

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