Original Research Article

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Electrocardiography misreading among sixth-year medical students and interns in Taif University

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ABSTRACT

Background: The electrocardiogram (ECG) is the most important procedure to examine the cardiac rhythm and conduction system abnormalities. The common problem of ECG misinterpretation can lead to inappropriate diagnoses and clinical decisions. There is a limited number of studies identifying the size of the problem in Saudi Arabia. We aimed to assess the frequency of ECG misreading, address the nature of errors, and analyze the determinants of ECG interpretation accuracy among sixth-year medical students and interns of Taif University, Taif, Saudi Arabia.

Methods: Participants were given a quiz of 10 multiple-choice questions of commonly encountered ECG interpretations. Each correct answer was given a 1-point score. The overall score for each participant was calculated out of 10 points.

Results: A total of 297 participants took part in this study and achieved a median (IQR) overall score of 6.0 (4). The most frequent score was 9 (13.5%), followed by 8 (12.8%) and 4 (12.5%). Second degree AV block, type II was misread by 60.6% of the participants, 2nd-degree AV block, type I was misread by 50.2% while other abnormalities were less frequently misread. Academic year and gender showed no significant influence on ECG interpretation. On the other hand, interest in ECG reading and previous participation in ECG courses were associated with significantly better performance (p<0.001 and p=0.001, respectively).

Conclusions: Overall performance of medical students and interns was moderate. Self-learning and providing organized educational courses on ECG can positively improve ECG interpretation and allow adequate diagnosis and management of heart diseases.

Keywords: Electrocardiogram misreading, Medical students, Interns, Interpretation, Competency

INTRODUCTION

Practical clinical skills such as the physical examination remain an essential guide in the physician's daily practice. Electrocardiogram (ECG) is commonly used in recognizing of important and common heart diseases, including many life-threatening disorders. It has many clinical uses as arrhythmias and conduction disturbances diagnoses, which requires an adequate knowledge base including the ability to recognize and understand the basic pathophysiology of certain electrocardiographic

abnormalities.¹⁻³ Accuracy of the diagnosis derived from an ECG is a cornerstone to patient outcome, and misinterpretation could lead to erroneous management decisions and devastating consequences.^{4,5}

In a systematic review focusing on ECG identifying; in almost all kinds of patient care setting, A fundamental skill for physicians to be able to interpret an ECG.⁶ Yet, for maintaining ECG interpretations skill, there is no evidence-based minimum number of model ECG interpretations. Surveys of Internal medicine clerkship

directors at US and Canadian medical schools believed that ECG interpretation is crucial for undergraduates during their clerkships.⁷

Prior studies have been raised concerns about misreading ECG among medical students and residents. In the latter study, many clerkship directors who were surveyed state that the most of their students have not come close to mastering the skill of ECG interpretation. Recent surveys among medical school graduates in different countries showcased deficiency in the ability to reading ECG and the majority felt a low level of self-confidence. 10-12

Similar findings have been reported for young residents. Numerous studies have highlighted poor ECG diagnostic accuracy in ECG interpretation by emergency and internal medicine, paediatrics, and family medicine residents. ¹³⁻¹⁶

The final year of medical school and internships is an important milestone in undergraduate skills practicing and consists mainly of practical exercise of acquired competencies. Given the limitations in ECG interpretation, identifying and analysis of areas of weakness among the undergraduate students can help to implement various methods to optimize students' ECG interpretation skills during the medical education process.

Consequently, this study has been designed to assess skills in recognizing and interpreting important common abnormalities in the ECG among sixth-year medical student and interns in Taif University. Also, to determine the most common errors with ECG reading; as early detection will contribute to improving participants' performance, teaching procedures and an enhanced diagnosis of heart disease. In addition to and to correlate student performance with their academic year, gender, interesting in ECG reading and prior participation in ECG educational courses.

METHODS

A cross-sectional study was conducted among sixth-year students and interns in college of medicine, Taif University, Taif, Saudi Arabia during the period from the 17th march to the 30th April, 2018. We used a self-designed paper questionnaire (including a quiz) in order to assess the magnitude of ECG misreading among participants.

To assess determinant of ECG interpretation accuracy, four close-ended questions about personal information (academic year, gender, interest in ECG reading and participation in ECG course) were included in the quiz. In addition, ten multiple-choice questions regarding selected ECG strips (Table 1) were included with four answers (including only one correct answer) suggested for each question in order to assess participants' competency in ECG interpretation.

Table 1: ECG strips selected for students to recognize.

Selected ECG strips for students to recognize
2nd-degree AV block, type I
Sinus tachycardia
Normal ECG
Paroxysmal supraventricular tachycardia (PSVT)
2nd-degree AV block, Type II
Atrial flutter
Sinus bradycardia
1st-degree AV block
3rd-degree AV block
Atrial fibrillation

Data were statistically described in terms of frequencies (number of cases) and valid percentages for categorical variables. Comparison of non-parametric numerical variable (overall score) between the subgroups was done using Mann-Whitney U Test. P values less than 0.05 were considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 21 for Microsoft Windows.

During the research activities, each studied participant was informed about the study topic and objectives with stressing from our team on confidentiality of the collected data and sample results, and also on getting a verbal consent to share in the study.

RESULTS

Study population

A total of 297 sixth year students (52.5%) and interns (47.5%) from Taif University took part in the study. Out of them, 60.3% were males. Approximately, half of participants (50.2%) were interested in reading ECG and more than half of them (55.6%) participated in an ECG educational course before.

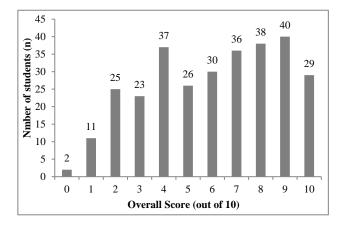


Figure 1: Overall scores of ECG interpretation (n=297).

Participants' scores in ECG interpretation

Out of 2970 total given answers (10 answers for each of the 297 participants), 1794 (60.4%) answers were correct. The median (IQR) overall score of all participants was 6 (4) out of 10.

The most frequent scores were: 9/10 as got by 13.5% of the participant followed by 8/10 (12.8%) and 4/10 (12.5%). More details about overall scores are shown in (Figure 1).

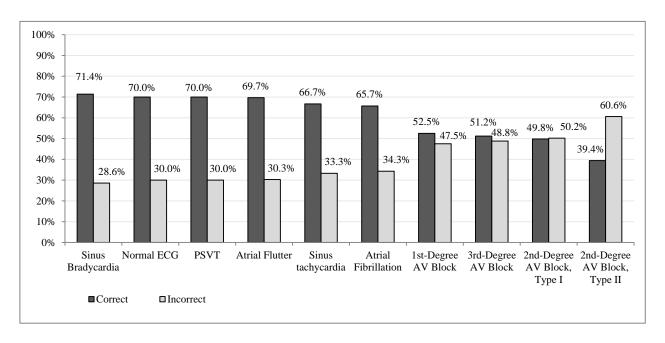


Figure 2: Results of ECG strips' interpretation.

Frequent errors in ECG reading

The most commonly misread abnormalities were 2nd-degree AV block, type II (60.6% error rate) and 2nd-degree AV block, type I (50.2% error rate). While participants had a higher ability of identifying sinus bradycardia, normal ECG, paroxysmal supraventricular tachycardia and atrial flutter with error rates of (28.6%, 30.0%, 30.0% and 30.3% respectively). The results of ECG strips' interpretation are shown in (Figure 2).

Determinants of ECG interpretation accuracy

By examining the potential effect of academic year, gender, interest in ECG reading and participation in ECG educational course on ECG interpretation accuracy, we found that interns had a tendency towards slightly lower scores compared to sixth-year students. However, this difference was not statistically significant (median (IQR) score was 6 (4) versus 7 (4) respectively, p=0.724). Scores were homogenously distributed amongst male and female participants (median score (IQR) was 6 (4) versus 6.5 (4) respectively, p=0.650).

On the other hand, participants interested in ECG reading achieved significantly higher scores compared to participants who did not (median score (IQR) was 7 (4) versus 5 (4) respectively, p<0.001). Moreover, prior

participation in an ECG course had significant impact on the overall scores (median score (IQR) was 7 (4) versus 6 (5) respectively, p=0.001).

DISCUSSION

The ability to correctly interpret ECG can be seen as a core competency for undergraduate medical students to help them in every day clinical decision making.^{2,7,9} As it is a critical aspect for graduating seniors entering residencies in most medical specialties.¹⁷

Previously published studies have demonstrated deficiencies and low self-confidence in ECG interpretation among medical students and residents from different countries. Though, the optimal way to acquire ECG interpretation skills is still under discussion.

Very little is known about ECG interpretative skills of Saudi Arabian medical students. Accordingly, it can be of great value to assess medical students in their final years regarding the percentage of wrong misreading and the common pattern mistaken responses. At the same time to address the factors that would affect students' competency in ECG diagnosis identifying.

This cross-sectional study was designed to observe the deficiencies in ECG interpretation across medical

students and interns of Taif University that may have important implications for future educational implementation and accordingly patient care.

As seen in our study, medical students of Taif University in their final clinical years showed a moderate level of competency in recognizing ECG strips of life-threatening disorders and common heart abnormalities. The overall ECG misreading constituted 40.6% of all readings. Out of all participants, 13.5% were able to correctly recognize 90% of the strips, 12.8% recognized 80% and 12.5% recognized 40% of the strips.

Our results concerning level of ECG competency were in accordance with a similar study conducted among Polish medical students (n=536). ¹⁹ They reported a low ability to recognize ECG signs of life threatening disorders and common heart abnormalities with a 66% overall accuracy.

In another study conducted at George Washington University School of Medicine, USA. The authors concluded that graduating medical students had a limited level of competency in ECG interpretation with a mean score of 8.2/22 (37.2%). The same was reported for graduating interns with a mean score of 13.9/22 (63.2%).²⁰

In Germany, Störmann et al evaluated a formative and oral-practical examination for undergraduate medical students in their final year revealed a deficit of practical clinical skills including reading an ECG with an overall mean score of 72.8%. The study didn't specify individual score for each clinical skill.²¹

In New Zealand, evaluating 52 final-year medical students in interpreting various ECGs, they reported a higher ECG misinterpretation (48%) in open-ended questions than our results which are more complex to analyze than closed-ended questions.¹⁰

Similarly, our results regarding ECG misreading for each individual ECG strip were lower than the results from South Asia study.²² The study showed a considerably low competency in 74 final year students who were asked 15 ECGs to be interpreted. However, they stated a separate score for each given ECG; the authors didn't state overall accuracy score.

Physicians in the emergency room usually misread T-waves and ST segments of patients who may have acute cardiac ischemia and they concluded that providing enough training to emergency physicians can make their interpretations more accurate and accordingly improve the level of medical care.²³

In the present study, we also analyzed the determinants of ECG interpreting accuracy. Academic year and gender have no influence on ECG interpretation. Our results showed a dedicated teaching program can improve ECG

interpreting either by self-learning or focused program from peer study.

Our result concerning gender influence on ECG misreading was in accordance with the previous studies published before. ^{13,19,21}

In the same time, our result concerning academic year impact on ECG misreading was in discordance with other studies. For family practice residents in the United Arab Emirates, Interns' diagnoses were significantly poorer than the other participants. While, in the previous George Washington University School of Medicine study, the interns' accuracy (13.9/22) was significantly higher than the undergraduate students (8.2/22).

In the latter study, the higher average score in the undergraduate students group was associated with previous degree of ECG exposure in years 3-4.²⁰ Likewise, in a study describing the comparison of 4th, 5th and 6th year medical students in the interpretation of electrocardiograms, self-study of ECG had a significant, positive influence ECG competency skill amongst participants, particularly in the sixth-year student population who had nearly two times higher percentages than that of those who did not self-study.²⁴

A number of studies, when analyzing both self-learning and being in teaching course among undergraduate students and residents, addressed contradictory results. In a correspondence paper by Kodra et al, they stated that residents who learned reading ECGs by themselves had lower average scores than those who learned by peer study.²⁵ Interestingly, a study about "Improving ECG Competence in Medical Trainees in a UK District General Hospital", they compared the effectiveness of self-learning and focus teaching program strategies on improving competence of UK trainees. A larger significant benefit was seen in those were in the teaching program.²⁶ On the contrary, Kopeć et al showed that competency in interpretation of the ECG is gained mainly by self-learning, whereas attendance at regular ECG classes failed to improve the skill of ECG reading.¹⁹

Our results show a moderately level of ECG misreading among sixth-year medical students and interns at Taif University. ECG interpretation skills can be significantly enhanced by self-education and attending ECG learning courses. On the other hand, gender and academic year have no significant influence on ECG competency skill. We recommend conducting an interventional prospective study that aim at comparing the awareness level of healthcare provides before and after attending a structured educational course on ECG interpretation.

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REFERENCES

- 1. Fisch C. Evolution of the clinical electrocardiogram. J Ame Coll Cardiol. 1989;14(5):1127-38.
- Kadish AH, Buxton AE, Kennedy HL, Knight BP, Mason JW, Schuger CD, et al. ACC/AHA clinical competence statement on electrocardiography and ambulatory electrocardiography: A report of the ACC/AHA/ACP-ASIM task force on clinical competence (ACC/AHA Committee to develop a clinical competence statement electrocardiography and ambulatory electrocardiography) endorsed by the International for Holter and noninvasive electrocardiology. Circulation 2001;104(25):3169-
- 3. Schlegel TT, Kulecz WB, DePalma JL, Feiveson AH, Wilson JS, Rahman MA, et al. Real-time 12-lead high-frequency QRS electrocardiography for enhanced detection of myocardial ischemia and coronary artery disease. Mayo Clinic Proceedings. 2004;79(3):339-50.
- 4. Trzeciak S, Erickson T, Bunney EB, Sloan EP. Variation in patient management based on ECG interpretation by emergency medicine and internal medicine residents. Am J Emerg Med. 2002;20(3):188-95.
- 5. Brady WJ, Perron AD, Chan T. Electrocardiographic ST-segment elevation: correct identification of acute myocardial infarction (AMI) and non-AMI syndromes by emergency physicians. Acad Emerg Med: Official J Society Acad Emerg Med. 2001;8(4):349-60.
- 6. Salerno SM, Alguire PC, Waxman HS. Competency in interpretation of 12-lead electrocardiograms: a summary and appraisal of published evidence. Annals Internal Med. 2003;138(9):751-60.
- Elnicki DM, van Londen J, Hemmer PA, Fagan M, Wong R. U.S. and Canadian internal medicine clerkship directors' opinions about teaching procedural and interpretive skills to medical students. Acad Med: J Assoc Am Med Coll. 2004;79(11):1108-13.
- 8. Davidenko JM, Snyder LS. Causes of errors in the electrocardiographic diagnosis of atrial fibrillation by physicians. J Electrocardiol. 2007;40(5):450-6.
- 9. Elnicki DM, Shumway JM. Interpretive and procedural skills of the internal medicine clerkship: Performance and supervision. Southern Med J. 1996;89(6):603.

- 10. Lever NA, Larsen PD, Dawes M, Wong A, Harding SA. Are our medical graduates in New Zealand safe and accurate in ECG interpretation? The New Zealand Med J. 2009;122(1292):9-15.
- 11. Ochsmann EB, Zier U, Drexler H, Schmid K. Well prepared for work? Junior doctors' self-assessment after medical education. BMC Med Edu. 2011;11:99.
- 12. Stopa M, Sevenathan H, Bogusławski M, Pałasz I. Assessment of ECG interpretation skills among Polish medical students, nursing, emergency medicine and English Division medical students. Porto Biomed J. 2017;2(5):231-2.
- 13. Eslava D, Dhillon S, Berger J, Homel P, Bergmann S. Interpretation of electrocardiograms by first-year residents: the need for change. J Electrocardiol 2009;42(6):693-7.
- 14. Berger JS, Eisen L, Nozad V, D'Angelo J, Calderon Y, Brown DL, et al. Competency in electrocardiogram interpretation among internal medicine and emergency medicine residents. Am J Med. 2005;118(8):873-80.
- 15. Snyder CS, Bricker JT, Fenrich AL, Friedman RA, Rosenthal GL, Johnsrude CL, et al. Can pediatric residents interpret electrocardiograms? Pediatric Cardiol. 2005;26(4):396-9.
- 16. Margolis S, Reed R. EKG analysis skills of family practice residents in the United Arab Emirates: a comparison with US data. Family Med. 2001;33(6):447-52.
- 17. O'Brien KE, Cannarozzi ML, Torre DM, Mechaber AJ, Durning SJ. Training and assessment of ECG interpretation skills: results from the 2005 CDIM survey. Teaching Learning Med. 2009;21(2):111-5.
- 18. Jablonover RS, Stagnaro-Green A. ECG as an Entrustable Professional Activity: CDIM Survey Results, ECG Teaching and Assessment in the Third Year. Am J Med. 2016;129(2):226-30.
- Kopeć G, Magoń W, Hołda M, Podolec P. Competency in ECG Interpretation Among Medical Students. Medical Science Monitor. Int Med J Exp Clin Res. 2015;21:3386-94.
- 20. Jablonover RS, Lundberg E, Zhang Y, Stagnaro-Green A. Competency in electrocardiogram interpretation among graduating medical students. Teaching Learning Med. 2014;26(3):279-84.
- 21. Störmann S, Stankiewicz M, Raes P, Berchtold C, Kosanke Y, Illes G, et al. How well do final year undergraduate medical students master practical clinical skills? GMS J Med Educ. 2016;33(4):58.
- 22. Matthias AT, Indrakumar J. Competency of final year medical students in ECG Interpretation an experience of a medical school in South Asia. Asian Student Med J. 2013;13(6):1-6.
- 23. Jayes RL Jr., Larsen GC, Beshansky JR, D'Agostino RB, Selker HP. Physician electrocardiogram reading in the emergency department--accuracy and effect on triage decisions: findings from a multicenter study. J General Internal Med 1992;7(4):387-92.

- 24. Pudlo J, Wierdak M, Maciol K, Gumul K, Lelakowski J. The comparison of 4th, 5th and 6th year medical students knowledge of rules and practical skills in the interpretation electrocardiograms at Jagiellonian University. Przeglad Lekarski. 2012;69(4):143-8.
- 25. Kodra A, Rambhatla T, Patel S, Coplan N. Assessing the competency of internal medicine residents in electrocardiogram interpretation. Int J Cardiol. 2016;214:288-90.
- McAloon C, Leach H, Gill S, Aluwalia A, Trevelyan J. Improving ECG Competence in Medical Trainees in a UK District General Hospital. Cardiology Res. 2014;5(2):51-7.

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