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Electrocardiogram Interpretation: An Exploration of Knowledge and Practice among Secondary Care Hospitals Emergency Physicians

Aamir Hussain*

Affiliation: Murshid Hospital and Health Care Centre, Karachi, Pakistan

***Corresponding author:** Aamir Hussain, Deputy Administrator, Department of Administration, Murshid Hospital and Health Care Centre, Karachi, Pakistan, Tel: +92 333 2336984, E-Mail: dr.aamirhussain786@gmail.com

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Abstract

Background: An electrocardiogram (ECG) is a simple, easy, low cost and routine diagnostic tool. Nearly all private secondary hospitals of Pakistan have this facility. It is non-invasive, cardiac evaluation test. It has unsophisticated handling procedure. It is very important for duty doctors in their busy clinical practice to have good command on ECG interpretation. Likewise it is prime responsibility of doctors to timely order the ECG when warranted. A good physician has to interpret ECG precisely for timely manage and refer the cardiac related patients to tertiary care facility.

Aim and Objectives: The aim of this study was to take a survey among the secondary level private hospital doctors, regarding their knowledge and interpretation skills for timely decision making.

Methodology: Total five lethal ECGs were recorded and distributed among 470 doctors, working in the emergency departments of 12 private secondary hospital, of Karachi city, in different shifts from June, 2017 to December, 2017. They were asked to give only one diagnosis with at least five interpretation points to support their diagnosis. The answers were matched with definite diagnosis made by a cardiologist who has more than 15 years experience and currently working as Professor in cardiology.

Results: Almost all of the doctors (93%) had readily asked for ordering an ECG for certain epigastric and chest pain evaluation. However, only 30% given the correct diagnosis regarding the lethal cardiac conditions. Interestingly, only 23% rightly interpret the lethal ECGs.

Conclusion: According to results shown, the doctors working in private secondary hospitals of Karachi city were good at initiating the ECG recording order. However, ER doctors are advised strongly to gain in depth knowledge and correct interpretation skills as it can save millions of lives in their career.

Keywords: Electrocardiogram; Lethal ECG; Definite diagnosis; Private secondary hospital; Interpretation; Knowledge; Cardiology professor; Tertiary level facility.

Introduction

The 12-lead electrocardiogram (ECG) is a daily routine diagnostic test specially in the emergency rooms. It is simple, cost efficient and non invasive procedure for suspected cardiac abnormalities like acute tachycardia infarction. It is both specific and sensitive test for patients with cardiac complaints [1].

The human heart consisting of four chambers. The main chamber considered as left ventricle. Other chambers include, right ventricle, right atrium and left atrium. Like other tissues, heart as a specialized aggregation of cells needs oxygen and nutrients for survival. This is achieved by the coronary circulation [2]. Heart pumps blood with a specific rhythm. The pacemaker of heart is called SA node (sinoatrial node). SA node take the lead as it has the fastest rate than other specialized tissue if they are not diseased [3]. The cardiac output is the

prime cardiovascular event. It is necessary to maintain blood pressure of the body during whole cardiac cycle. It includes contractions and relaxations. During this automaticity, electrical impulses generated which could be recorded on graph paper, called ECG (EKG; from Greek, kardia=heart) [4]. Any irregularity within this system could resulting compromising cardiac output. Ultimately this will cause arrhythmias or dysrhythmias with potential life threatening situation for the patient [5].

The x-axis baseline of the ECG is termed as an isoelectric line. The 1st deflection in the ECG denoted as the P wave. It shows the depolarization of right and left atrium. We have to look on the shape and consistency of the P waves [6]. Next deflection denoted as QRS complex. It shows the depolarization of left and right ventricles. The Q portion is the initial downward deflection, the R portion is the initial upward deflection, and the S portion is the return to the baseline. After depolarization, repolarization shown on ECG tracing as the T wave. Sometimes a U-wave on the ECG tracing is also found which represent

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the delayed repolarization [7]. The identification of abnormal PR-interval, QRS complex, QT-interval, corrected QT, PR segment, shapes of the each wave made ECG as an lethal ECG, because every second is important in interpretation of the cardiac issue in ECG for timely treatment and referral to experienced cardiologist [8].

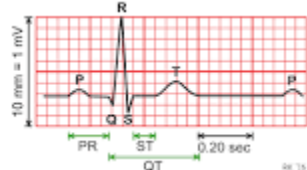


Figure 1: ECG tracing with all waves and intervals.

The role of emergency physician is important in acute conditions. The doctors expanding scope of practice has moved beyond managing the care of patients with minor injuries, to cardioverting the cardiac patients in ER. In daily clinical practice, it is important for doctors to know when and where order the ECG test. The skills related to obtaining, reading and interpreting the ECG in order to correctly include the cardiac issues and correctly exclude the heart diseases. This is very important when resources are limited. As in primary or secondary level health care facilities, where diagnosing the cardiac abnormalities with the help of ECG (without availability of cardiac markers), managing the patients or promptly referring the cardiac patients to tertiary level hospital towards the cardiologist [9]. Knowledge and skills related to ECG for an ER physician is rewarding. Patient may come back on correct diagnosis or could die in front if diagnosed lately. Very few research surveys have been done to evaluate the knowledge and ECG interpretation skills from ER physicians [9]. The studies were performed using a limited number of selected ECGs [10]. For this study we have selected the five lethal ECGs [11]. The proper diagnosis is very crucial on the basis of ECG for referral to echocardiography or MPS studies [12]. The literature shown that there is very scarce knowledge of ECG among GPs and family practice residents. They had profound difficulties in the ECG interpretation [13].

However, it should be keep in mind that ECG reading and interpreting is challenging. Each and every physician has different style of reading ECG. However, ER physician must adopt a sequence of analysis. He or she must accommodates personal methods of reasoning and proper justification. This activity can save the lives of patients. It has been recommended that more correct interpretations of ECGs may be achieved by gaining in depth knowledge and enhancing the interpretive ECG recorders in general practice. It could be achieved through discussions with senior cardiologists and attending CMEs and workshops related to ECG time to time. It is also the responsibility of private hospital owners to organize these type of sessions for ER doctors specially [14].

Methodology

For this study with a purposive sampling technique, a quantitative cross-sectional survey was conducted from June, 2017 to December, 2017. A written consent was obtained from each ER physician ,after telling the utility of the study. Total 470 participants randomly selected from 12 local private secondary care hospitals of Karachi city. This sample is quite representative of Pakistani ER physicians population [15].

All the five lethal 12-lead ECGs were recorded with participants in a supine position obtained from previous hospital records in tertiary care hospital. The ECGs shown a paper speed of 25 mm/s and a voltage of 10 mm/mV on the tracing [16]. These five lethal ECGs were discussed with the professor of cardiology for the diagnosis and interpretation points for supporting the diagnosis. The data on tracings were omitted

and only shown ECG pattern in black lines. Furthermore they had no access to patient history or other clinical data as well. Then they were invited to give only single definitive diagnosis with at least five interpretation points to support their diagnosis. The answers were matched with definite diagnosis as a gold standard made by a cardiologist who has more than 15 years experience and currently working as Professor in cardiology.

Ethical Consideration

The selection of 12 private secondary hospitals were random selected. Emergency doctors requested to participate voluntarily. They were not offered any incentives. There is no conflict of interest in any aspect.

Statistical analysis

IBM-SPSS version 22 has been employed for statistical analysis. Significance for all measures is appreciated at the 5% level ($\alpha = 0.05$) with 95% Confidence Interval (CI).

Results

A total of five lethal ECGs were specifically and deliberately selected for interpretation. A sample of 470 ER physicians was readily available. From 470, twenty were discarded because of inadequate identification and information.

Table 1 showed that there were 320 were male physicians and 130 were female physicians who participated in this study. Median age was 39 years for both male and female ER physicians. Almost all of the participants (93%) had showed the concern about ECG ordering when asked to evaluate the nonspecific epigastric pain and typical chest pain irrespective of the age, gender, family history and comorbid.

Gender	Age <30 years	Age >30 years	Ordering of ECG Test
Total	147	303	418
Male	101	219	297
Female	46	84	121

Table 1: Study participants ER physicians demographic information and willingness to order an ECG test for patients.

Following are the lethal ECGs and interpretation came from 450 physicians:



Figure 2: ECG-1 tracing, showing Ventricular Tachycardia, no P waves visible, PR interval not identifiable, broad QRS complexes, regular R-R intervals, rhythm is rapid, SA node not properly available to fire and heart is being paced by the ventricular tissues etc.

ECG-1	Correctly Diagnosed	Correctly Interpreted
Total	67	48
Male	29	19
Female	38	29

Table 2: Study participants ER physicians who correctly diagnosed and correctly interpreted the ECG-1.



Figure 3: ECG-2 tracing, showing Supra-Ventricular Tachycardia (SVT), no P waves visible, or one can conclude that T wave is overlapping with p wave here, PR interval not identifiable, narrow QRS complexes, regular R-R intervals, rhythm is rapid, however the heart is being paced by somewhere above the ventricular tissues etc.

ECG-2	Correctly Diagnosed	Correctly Interpreted
Total	72	51
Male	37	23
Female	35	28

Table 3: Study participants ER physicians who correctly diagnosed and correctly interpreted the ECG-2.

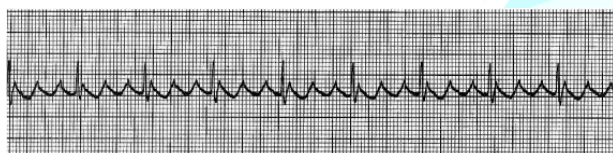


Figure 4: ECG-3 tracing, showing Atrial Flutter (AF), no P waves or T wave certainty, saw-toothed pattern, PR interval not identifiable, many waves before QRS complex, regular R-R intervals, rhythm is rapid, however the heart is being paced by somewhere above the ventricular tissues etc.

ECG-3	Correctly Diagnosed	Correctly Interpreted
Total	61	40
Male	22	21
Female	39	19

Table 4: Study participants ER physicians who correctly diagnosed and correctly interpreted the ECG-3.

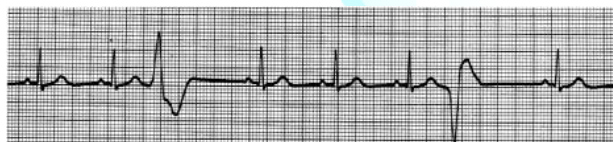


Figure 5: ECG-4 tracing, showing Premature Ventricular Complexes (PVCs), P waves are present, T waves are present, PR interval identifiable, most cycles with narrow QRS complexes, occasional sudden wide QRS complex, after which a brief pause is identifiable, irregular R-R intervals, however the heart is being paced by somewhere above the ventricular tissues etc.

ECG-4	Correctly Diagnosed	Correctly Interpreted
Total	42	29
Male	15	9
Female	27	20

Table 5: Study participants ER physicians who correctly diagnosed and correctly interpreted the ECG-3.



Figure 6: ECG-5 tracing, showing Third Degree Heart Block (Complete Heart Block), P waves are present, inconsistent PR interval identifiable, consistent R-R intervals, inverted T waves, ST segment also depressed, however the heart is being paced by somewhere above the ventricles separately and below the ventricles separately, atrio-ventricular dissociation etc.

ECG-5	Correctly Diagnosed	Correctly Interpreted
Total	23	18
Male	7	5
Female	16	13

Table 6: Study participants ER physicians who correctly diagnosed and correctly interpreted the ECG-3.

Discussion

The response rate is exceptionally high for this survey. The higher rate of correct diagnoses made by the ER female physicians were expected. However, low rate of correctly interpretation was unexpected from those who made correct diagnosis. The level of correct diagnoses and correct interpretation is over all very less for both male and female ER physicians.

It is important to stress that the topic of the present study is the presence or absence of abnormal electrocardiographic findings and not the actual presence or absence of heart disease. Moreover, failure to interpret an ECG correctly may not always be a hazard to the patients health, as White et al. found a misinterpretation rate of 33% to result in serious management error in only 3.3% of cases [17].

Presence of the blinding with respect to the history, age, gender and other factors maybe possibly mislead the diagnosis and interpretation accordingly. It was a great challenge for ER physician to diagnose only on ECG tracing. However, ECG changes were quite obvious on first glance. A strength of the present study is that it is based on lethal ECGs which could be encountered by ER physician at any time.

Whether the ER physicians in the current study are representative of the average ER physicians in Pakistan can be further discussed. We have no reason to believe, however, that their ECG knowledge and interpretation skills are not good at all.

It is not correct that the ECG is a single best test for precisely evaluating the existing coronary heart or excellent predictor of future heart disease. However, it could be probably be of value for ER physicians to spend some time on ST-segment elevation or depression, T-wave inversion or tall tented T-wave, the presence of Q-waves. It is strongly suggestive in the best interest of the patient and the private hospital that if there is any click, it is recommended to have an immediate opinion from senior cardiologist or from an experienced ECG interpreter or at least refer to tertiary care hospital as soon as possible.

Conclusion

In this study it has been observed that emergency physicians are readily order the ECG for the chest pain evaluation. However, they are less able to diagnose and interpret the ECG findings correctly. Measures should be operationalized for their training in this neglected area.



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