Accuracy of 12 Lead ECG For Diagnosis of Posterior Myocardial Infarction Taking 15 Lead ECG As Gold Standard

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Abstract

INTRODUCTION
The acute management of ST-elevation myocardial infarction (STEMI) is based on interpretation of the ECG. This is typically undertaken by doctors in the emergency department (ED) and acute medical unit. Increasingly, the ECG diagnosis is being made by paramedics, allowing them to pre-alert the ED or even initiate thrombolytic therapy in regions where primary angioplasty is unavailable. Identification of ST-segment elevation or presumed new left-bundle branch block in combination with a history of cardiac chest pain results in prompt initiation of reperfusion therapy.

SUBJECT AND METHOD
A cross sectional study was done at Cardiology Department, Bolan Medical College, Quetta. Total duration was from 01/02/2018-30/07/2018. 196 patients were recruited from Out Patient Department and Emergency Department of Bolan Medical Complex, Quetta on the basis of inclusion/exclusion criteria, that is all patient with chest pain and age >18 and < 70 with posterior MI as per operational definition presenting within 12 hours of symptoms were included and all patients with underlying LBBB on ECG, PPM and paced rhythm on ECG and pericardial effusion were excluded as they are effect modifiers and bring bias in study.

RESULTS
Total 196 patients were included in the study according to the inclusion criteria of the study. Mean age (years) in the study was 40.28±14.38 whereas there were 123 (62.8) male and 73 (37.2) female patients in the study. The diagnostic accuracy, sensitivity, specificity, PPV and NPV of 12 lead ECG for diagnosis of posterior myocardial infarction taking 15 lead ECG as gold standard was 82.14%, 87.12%, 57.58%, 91.03% and 47.50% respectively.

CONCLUSION
The study concludes that diagnostic accuracy of 12 lead ECG for diagnoses of posterior wall myocardial infarction was high. The high sensitivity identified more patients to be re vascularized early.

Keywords
Posterior Myocardial Infarction, ST-elevation myocardial infarction, Electrocardiogram

INTRODUCTION
The acute management of ST-elevation myocardial infarction (STEMI) is based on interpretation of the ECG. This is typically undertaken by doctors in the emergency department (ED) and acute medical unit. Increasingly, the ECG diagnosis is being made by paramedics, allowing them to pre-alert the ED or even initiate thrombolytic therapy in regions where primary angioplasty is unavailable. Identification of ST-segment elevation or presumed new left-bundle branch block in combination with a history of cardiac chest pain results in prompt initiation of reperfusion therapy. Raised markers of myocardial necrosis (troponins, creatinine kinase) and regional wall motion abnormalities on echocardiography are also seen, but the diagnosis does not require waiting for the presence of these. Isolated posterior myocardial infarction (PMI) accounts for 21% is usually caused by occlusion of the left circumflex artery. However, the standard 12-lead ECG is an insensitive tool in identifying PMI since it does not directly view the posterior wall. The typical ST-segment elevation seen in infarcts affecting other territories of the heart is therefore absent in PMI. It is hence easily misinterpreted. American College of Cardiology guidelines suggest that indirect changes are seen in the anterior leads (ST depression and dominant R-wave in V1-V2) which should raise suspicion of PMI. Prompt use of ‘posterior’ ECG leads (V7-V9) demonstrating ST-segment elevation of 1 mm allows these changes to be distinguished from anterior ischemia and the diagnosis of PMI to be made.

A study investigating the use of 12-lead ECG in comparison with 15-lead ECG in every emergency chest pain patient showed that sensitivity and positive predictive value of 12-lead ECG for the diagnosis of MI was 88.4 to 96.8%, respectively, but the specificity for MI was from 91 %.

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Early recognition of isolated posterior wall infraction is essential because its management is different from acute coronary syndrome including unstable angina and non-ST Elevation MI. Therapy with only nitrates and morphine is associated with precipitation of complications as it deprives the patient from thrombolytic therapy and so increases the loss of myocardium.

**Rationale**

The rationale of my study is to assess how well the 12 lead ECG can predict posterior wall MI. Currently 15 lead ECG is considered as gold standard for detection of posterior wall MI but due to the necessity for correct placement and interpretation of additional ‘posterior’ leads, doctors are less competent in diagnosing PMI than other STEMIs. In addition, due to the paucity of use of posterior leads, nursing staff is less competent in positioning these leads than the ‘standard’ 12 leads. This could lead to PMI being missed, resulting in patients failing to receive reperfusion therapy. If sensitivity and specificity of 12 lead ECG for diagnosing PMI comes high in my study then I would recommend 12 lead ECG for diagnosing PMI.

**Methodology**

**Study Design:**

Cross sectional Study

**Study Settings:**

Department of Cardiology, Bolan Medical College, Quetta.

**Duration of Study:** 06 months from 01/02/2018-30/07/2018

**Sample Size.** Sample size will be calculated by sensitivity, specificity calculator using statistics

- Expected sensitivity 88.4%
- Expected specificity 91%
- Confidence interval 95%
- Expected prevalence 0.21
- Absolute precision required 0.10
- Sample size 196

**Sample Technique**

Non-probability purposive sampling

**Sample Selection**

**Inclusion Criteria**

- New presentation at CCU.
- Patient of age >18 and <70 years of either gender
- PMI as per operational definition
- Presenting within 12 hours of symptoms

**Exclusion Criteria**

- Patient having underlying LBBB on ECG.
- Patient having PPM with paced rhythm on ECG.
- Patient with pericardial effusion.

Above mentioned conditions are effect modifiers and can bring bias in study.

**DATA COLLECTION PROCEDURE**

After taking ethical committee approval and explaining the procedure and informed consent was taken. 196 patients were recruited from Out Patient Department and Emergency Department of Bolan Medical Complex, Quetta on the basis of inclusion/exclusion criteria, that is all patient with chest pain and age >18 and <70 with posterior MI as per operational definition presenting within 12 hours of symptoms were included and all patients with underlying LBBB on ECG, PPM and paced rhythm on ECG and pericardial effusion were excluded as they are effect modifiers and bring bias in study. Detailed history and physical examination were carried out in standardized protocol without any discomfort to the patient. ECG was captured on a standard 12 lead and 15 lead formats. Keeping privacy of female patient in consideration ECG was captured by female staff and confidentiality of each patient ensured. The diagnosis of PMI was made based on a single recording of ECG with 12 & 15 each done at the time of presentation. All the data collected was recorded on a pre-described performa attached at the end.

**DATA ANALYSIS**

Data was analyzed in SPSS version 20. The frequencies were calculated for qualitative variables like gender and other descriptive statistics were calculated for quantitative variables like age, troponin levels and duration of symptoms.

All the data collected with the help of proforma was entered and analyzed through SPSS version 20. Frequency and Percentages were calculated for categorical variables like gender. Mean + standard deviation was calculated for quantitative variables like age.

The sensitivity and specificity, PPV, NPV by using operational definitions of PMI diagnosed on 12 lead ECG and 15 lead ECG was calculated using $2 \times 2$ table

**RESULTS**

Data was entered and analyzed in SPSS version 20.0. Total 196 patients were included in the study according to the inclusion criteria of the study.

Descriptive statistics of age (years) was calculated in terms of mean and standard deviation. Mean age (years) in the study was 40.28+14.38 with ranges from 18 to 70 years, as shown in Table 1

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>196</td>
<td>18.00</td>
<td>70.00</td>
<td>40.28</td>
<td>14.38</td>
</tr>
</tbody>
</table>

Descriptive statistics of troponin levels (ng/ml) was calculated in terms of mean and standard deviation. Mean troponin levels (ng/ml) in the study was 0.01+0.008, as shown in Table 2

Similarly, descriptive statistics of duration of symptoms (hours) was calculated in terms of mean and standard deviation.
deviation. Mean duration of symptoms in the study was 4.25±1.83, as shown in Table 3

<table>
<thead>
<tr>
<th>Duration of Symptoms (hours)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>196</td>
<td>01</td>
<td>10</td>
<td>4.25</td>
<td>1.83</td>
</tr>
</tbody>
</table>

Distribution of gender was calculated in terms of frequency and percentages of male and female patients. There were 123 (62.8%) male and 73 (37.2%) female patients as shown in Table 4

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>123</td>
<td>62.8</td>
</tr>
<tr>
<td>Female</td>
<td>73</td>
<td>37.2</td>
</tr>
<tr>
<td>Total</td>
<td>196</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The outcome of the study was to determine the diagnostic accuracy of 12 lead ECG for diagnosis of posterior myocardial infarction taking 15 lead ECG as gold standard. A 2x2 table was used to calculate the diagnostic accuracy, sensitivity, specificity, PPV and NPV of 12 lead ECG which was 82.14%, 87.12%, 57.58%, 91.03% and 47.50% respectively, as shown in Table 5

<table>
<thead>
<tr>
<th>15 Lead ECG Findings</th>
<th>Total</th>
<th>Positivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>142</td>
<td>87.1%</td>
</tr>
<tr>
<td>Negative</td>
<td>21</td>
<td>12.9%</td>
</tr>
<tr>
<td>Total</td>
<td>163</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12 Lead ECG Findings</th>
<th>Total</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>14</td>
<td>87.12%</td>
<td>57.58%</td>
</tr>
<tr>
<td>Negative</td>
<td>33</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

PPV: 91.03 %
NPV: 47.50 %
Diagnostic Accuracy: 82.14 %

DISCUSSION

The acute management of ST-elevation myocardial infarction (STEMI) is based on interpretation of the ECG. This is typically undertaken by doctors in the emergency department (ED) and acute medical unit. Increasingly, the ECG diagnosis is being made by paramedics, allowing them to pre-alert the ED or even initiate thrombolytic therapy in regions where primary angioplasty is unavailable. Identification of ST-segment elevation or presumed new left-bundle branch block in combination with a history of cardiac chest pain results in prompt initiation of reperfusion therapy. Raised markers of myocardial necrosis (troponins, creatinine kinase) and regional wall motion abnormalities on echocardiography are also seen, but the diagnosis does not require waiting for the presence of these.

Isolated posterior STEMI (PMI) accounts for 3-7% of STEMI and is usually caused by occlusion of the left circumflex artery. However, the standard 12-lead ECG is an insensitive tool in identifying PMI since it does not directly view the posterior wall. The typical ST-segment elevation seen in infarcts affecting other territories of the heart is therefore absent in PMI. It is hence easily misinterpreted.

American College of Cardiology guidelines suggest that indirect changes are seen in the anterior leads (ST depression 6 dominant R-wave in V1-V2) which should raise suspicion of PMI. Prompt use of ‘posterior’ ECG leads (V7-V9) demonstrating ST-segment elevation of $1 \text{mm}$ allows these changes to be distinguished from anterior ischemia and the diagnosis of PMI to be made.

Due to the necessity for correct placement and interpretation of additional ‘posterior’ leads, we postulated that doctors and paramedics would be less competent in diagnosing PMI than other STEMIs. In addition, due to the paucity of use of posterior leads, we postulated that nursing staff would be less competent in positioning these leads than the ‘standard’ 12 leads. This could lead to PMI being missed, resulting in patients failing to receive reperfusion therapy.

In our study, mean age (years) in the study was 40.28±14.38 with ranges from 18 to 70 years. Whereas in a study by Din et al., found that the mean age of patients was 58±0.5 ranged from 40 to 80 years.

A study conducted in 2014 observed that the frequency and percentage of male patients were 90(51.1) and female patients 90 (51.1) and female patients were 86(48.9). Similarly, in our study there were 123 (62.8) male and 73 (37.2) female patients.

A study by Brady et al., the sensitivity and positive predictive value of 12-lead ECG for the diagnosis of MI was 88.4 to 96.8%, respectively, but the specificity for MI was 91%. Similarly, in our study, the diagnostic accuracy, sensitivity, specificity and PPV of 12 lead ECG which were 82.14%, 87.12%, 57.58% and 91.03% respectively.
CONCLUSION
The study concludes that diagnostic accuracy of 12 lead ECG for diagnoses of posterior wall myocardial infarction was high. The high sensitivity identified more patients to be revascularized early and at risk of future adverse events.

References
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