Diagnostic Accuracy of Clinical History for Detection of Acute Myocardial Infarction: A Cross-Sectional Study

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ABSTRACT

Introduction: Acute myocardial infarction (AMI) is an important cause of admission in the intensive care unit in hospitals. AMI ranks very high in the differential diagnosis of acute chest pain because prompt diagnosis and early treatment can save a life, preserve left ventricular function, reduce complications and can also impact the quality of life.

Aim: Current study was done to evaluate the diagnostic accuracy of clinical history for detecting acute myocardial infarction compared to the reference standard.

Result: Our final dataset comprises of 450 patients (279 [62%] men, 171 [38%] women) ages 20 to 90 years. The prevalence of acute myocardial infarction was 41% (187 of 460, 95% CI 37% to 46%). Of the 450 patients, 47 (10%) died during the hospital stay. Those who died were significantly older than those who survived (63.4 vs. 57.01 years). Patients with AMI were more likely to die (26%; 38 of 147) compared to those without MI (9 of 263; 3%).

Conclusion: Of the 187 patients with acute AMI, 145 (78%) were assigned a discharge diagnosis of ST elevated myocardial infarction (STEMI) and 42 (22%) were assigned a diagnosis of non-ST elevated myocardial infarction. A total of 34 of 145 (23%) patients with STEMI died, compared to 4 of 42(10%) patients with non-STEMI. Even in a high prevalence setting, no sign or symptom exhibited by patients presenting with possible acute MI proved effective enough alone to rule in or out Acute Myocardial Infection (AMI).

Key Words: Acute myocardial infarction, STEMI, Clinical history, Intermittent, Pain, AMI.

INTRODUCTION

Despite advances in diagnosis, physicians miss up to 10% of AMI presenting with acute chest pain1,2,3. Conversely, a large proportion of people with chest pain who are admitted, do not turn out to AMI. According to the American Heart Association criteria, patients with proven AMI must receive thrombolysis within 30 minutes of their arrival to the hospital (door to needle time). To ensure that patients with AMI receive evidence-based therapies, it is important that AMI is ruled in or ruled out, quickly and accurately. No less important is to exclude other life-threatening conditions such as pulmonary embolism, tension pneumothorax and aortic dissection.

History and physical examination are key elements used by physicians to triage patients with acute chest pain4,5. Typically physicians take a quick but focused history (quality, site, intensity, radiation and aggravation of pain), note the presence or absence of risk factors (smoking, obesity, hypertension and diabetes) and perform a physical examination (vital signs, assessment of heart size, third heart sound and crackles)6,7,8. In the initial management of patients presenting with suspected MI, the history and physical examination help physicians decide which diagnostic tests to order (ECG, biomarkers of AMI, biomarkers, chest radiogram or endoscopy) or plan therapeutic interventions (aspirin, streptokinase or primary angioplasty).

AIMS & OBJECTIVES

To evaluate the diagnostic accuracy of clinical history for detecting acute myocardial infarction compared to the reference standard.
SUBJECTS AND METHODS

We conducted this study in an intensive care unit (ICU) of the Department of Medicine. The Medicine department has an ICU (10 beds) and a step-down unit (18 beds). The ICU is equipped with ventilators, monitoring systems and electronic hospital information system. The hospital offers basic cardiac diagnostic and therapeutic facility but lacks set up for cardiac catheterization or cardio-vascular thoracic surgery and therefore cannot offer primary angioplasty to patients reporting within 90 minutes of AMI. This is a prospective cross-sectional study in which consecutive patients with acute chest pain and possible ACS presenting to the intensive care unit were enrolled. Before we began the study, we formulated the research question, wrote research protocol, and obtained approval from the institutional research committee and a waiver for obtaining informed consent from the study participants.

We conducted this study according to the principles of the Declaration of Helsinki and after the study protocol was approved by the institutional ethics committee. The diagnosis of acute myocardial infarction was based on the criteria proposed by the World Health Organization (WHO). We summarized data with the mean and median as measures of central tendency and standard deviations and interquartile ranges as measures of spread for continuous variables.

RESULTS

We used STARD (Standards for Reporting Diagnostic Accuracy Study) guidelines to report this study. We screened patients, 30 years of age and older suspected to have acute myocardial infarction and admitted to the intensive care unit. The total number of patients presenting with acute chest pain and admitted to the intensive care unit were 481. Out of which 31 were excluded due to death or incomplete data. So final study subjects were 450. Out of which 187 had AMI & 263 had chest pain other than AMI. Out of total 187 cases of AMI, 145 had ST-elevated myocardial infarction & 42 had Non-ST- elevated myocardial infarction.

Thus, our final dataset comprises of 450 patients (279 [62%] men, 171 [38%] women) ages 20 to 90 years. The prevalence of acute myocardial infarction was 41% (187 of 460, 95% CI 37% to 46%). Of the 450 patients, 47 (10%) died during the hospital stay. Those who died were significantly older than those who survived (63.4 vs. 57.01 years). Patients with AMI were more likely to die (26%; 38 of 147) compared to those without MI (9 of 263; 3%). Of the 187 patients with acute AMI, 145 (78%) were assigned a discharge diagnosis of ST elevated myocardial infarction (STEMI) and 42 (22%) were assigned a diagnosis of non-ST elevated myocardial infarction. A total of 34 of 145 (23%) patients with STEMI died, compared to 4 of 42(10%) patients with non-STEMI.

After analysis of the character of pain during acute myocardial infarction, we found out that squeezing or gastric type of pain are good predictors of acute myocardial infarction. While sharp/ stabbing/ burning pain is poor predictors. In maximum cases of acute myocardial infarction, the location of the pain is substernal.

Table 1: Diagnostic accuracy of history (character of pain & location).

| Symptoms          | With AMI | Without AMI | Total  | P-value |
|-------------------|----------|-------------|--------|---------|
| Character of pain |          |             |        |         |
| Squeezing         | Present  | 110         | 49     | 159     | 0.001   |
|                   | Absent   | 77          | 214    | 291     |         |
| Heavy             | Present  | 57          | 109    | 166     | 0.018   |
|                   | Absent   | 130         | 154    | 284     |         |
| Burning           | Present  | 26          | 48     | 74      | 0.220   |
|                   | Absent   | 161         | 215    | 376     |         |
| Gastric           | Present  | 5           | 31     | 36      | <0.001  |
|                   | Absent   | 182         | 232    | 414     |         |
| Sharp/stabbing    | Present  | 67          | 92     | 159     | 0.853   |
|                   | Absent   | 120         | 171    | 291     |         |
| Location of pain  |          |             |        |         |
| Substernal        | Present  | 103         | 107    | 210     | 0.003   |
|                   | Absent   | 84          | 156    | 240     |         |

In most cases, the pain radiated to right arm or both arms or individual shoulder or both shoulders. While in a maximum of the cases, that pain is of intermittent type. While regarding frequency, there was no specific relation. In all the cases it was either first episode or had some history of the episode.

Table 2: Diagnostic accuracy of history (radiation of pain, its pattern & frequency).

| Symptoms | With AMI | Without AMI | Total  | P-value |
|----------|----------|-------------|--------|---------|
| Radiation|          |             |        |         |
| Left arm | Present  | 27          | 24     | 51      | 0.080   |
|          | Absent   | 160         | 239    | 399     |         |
| Right arm| Present  | 18          | 5      | 23      | <0.001  |
|          | Absent   | 169         | 257    | 426     |         |
| Both arms| Present  | 37          | 20     | 57      | 0.001   |
|          | Absent   | 160         | 242    | 392     |         |
| Left shoulder| Present  | 30          | 19     | 49      | 0.003   |
|          | Absent   | 157         | 243    | 400     |         |
Table 2: (Continued)

| Symptoms            | With AMI | Without AMI | Total | P-value |
|---------------------|----------|-------------|-------|---------|
| Right shoulder      | Present  | 16          | 5     | 21      | 0.001   |
|                      | Absent   | 171         | 258   | 429     |         |
| Both shoulders      | Present  | 49          | 36    | 85      | 0.001   |
|                      | Absent   | 138         | 227   | 365     |         |
| All over chest      | Present  | 61          | 86    | 147     | 0.986   |
|                      | Absent   | 126         | 177   | 303     |         |

**Pattern**

|                    | With AMI | Without AMI | Total | P-value |
|--------------------|----------|-------------|-------|---------|
| Intermittent       | Present  | 49          | 104   | 153     | 0.003   |
|                    | Absent   | 138         | 159   | 297     |         |
| Continuous         | Present  | 134         | 158   | 292     | 0.011   |
|                    | Absent   | 53          | 105   | 158     |         |

**Frequency of pain**

|                    | With AMI | Without AMI | Total | P-value |
|--------------------|----------|-------------|-------|---------|
| First Pain, ever   | Present  | 144         | 155   | 299     | <0.001  |
|                    | Absent   | 43          | 108   | 151     |         |
| Previous pain      | Present  | 42          | 106   | 148     | <0.001  |
|                    | Absent   | 145         | 157   | 302     |         |

In most of the cases, the episode was aggravated by exertion & coughing, while it was relieved by nitroglycerine or rest or by taking an analgesic. There was no significant effect of taking antacids.

Table 3: Diagnostic accuracy of history (aggravating & relieving factors).

| Symptoms            | With AMI | Without AMI | Total | P-value |
|---------------------|----------|-------------|-------|---------|
| **Aggravating factors** |          |             |       |         |
| Exertion            | Present  | 51          | 113   | 164     | 0.001   |
|                     | Absent   | 136         | 150   | 286     |         |
| Emotion             | Present  | 11          | 15    | 26      | 0.936   |
|                     | Absent   | 176         | 248   | 424     |         |
| Coughing            | Present  | 9           | 47    | 56      | <0.001  |
|                     | Absent   | 177         | 216   | 293     |         |
| **Relieving factors** |          |             |       |         |
| Nitroglycerine      | Present  | 118         | 94    | 212     | <0.001  |
|                     | Absent   | 69          | 169   | 238     |         |
| Antacids            | Present  | 7           | 16    | 23      | 0.263   |
|                     | Absent   | 180         | 246   | 426     |         |
| Rest                | Present  | 32          | 88    | 120     | <0.001  |
|                     | Absent   | 155         | 175   | 330     |         |
| Analgesics          | Present  | 2           | 40    | 42      | <0.001  |
|                     | Absent   | 185         | 223   | 408     |         |

Along with chest pain, most of the patients experienced sweating & few experienced dyspnea. Rest of the factors like associated nausea, vomiting, palpitation, giddiness etc are not of much having predictive value.

Table 4: Diagnostic accuracy of history (associated factors).

| Symptoms          | With AMI | Without AMI | Total | P-value |
|-------------------|----------|-------------|-------|---------|
| Nausea            | Present  | 35          | 53    | 88      | 0.705   |
|                    | Absent   | 152         | 210   | 362     |         |
| Vomiting          | Present  | 35          | 42    | 77      | 0.446   |
|                    | Absent   | 152         | 221   | 373     |         |
| Palpitation       | Present  | 61          | 77    | 138     | 0.449   |
|                    | Absent   | 126         | 186   | 312     |         |
| Sweating          | Present  | 118         | 83    | 201     | <0.001  |
|                    | Absent   | 69          | 180   | 249     |         |
| Giddiness         | Present  | 29          | 54    | 83      | 0.176   |
|                    | Absent   | 158         | 209   | 367     |         |
| Dyspnoea          | Present  | 47          | 91    | 138     | 0.032   |
|                    | Absent   | 140         | 172   | 312     |         |

When we consider history, hypertension and angina are the most important findings which can’t be missed. While findings like diabetes, Hyperlipidaemia or smoking are of not much predictive value. While the family history of coronary heart disease or diabetes also having not much predictive value.

Table 5: Diagnostic accuracy of history (personal & family history)

| Symptoms            | With AMI | Without AMI | Total | P-value |
|---------------------|----------|-------------|-------|---------|
| Personal history    |          |             |       |         |
| Angina              | Present  | 27          | 57    | 84      | 0.052   |
|                     | Absent   | 160         | 206   | 366     |         |
| Diabetes            | Present  | 49          | 60    | 109     | 0.408   |
|                     | Absent   | 138         | 203   | 341     |         |
| Hypertension        | Present  | 26          | 55    | 81      | 0.056   |
|                     | Absent   | 161         | 208   | 369     |         |
| Hyperlipidaemia     | Present  | 4           | 3     | 7       | 0.399   |
|                     | Absent   | 183         | 260   | 443     |         |
| Smoking             | Present  | 26          | 45    | 71      | 0.358   |
|                     | Absent   | 161         | 218   | 379     |         |
| Family history      |          |             |       |         |
| Coronary heart disease | Present  | 8           | 9     | 17      | 0.639   |
|                     | Absent   | 179         | 254   | 433     |         |
| Diabetes            | Present  | 5           | 12    | 17      | 0.300   |
|                     | Absent   | 182         | 251   | 433     |         |
After analysis, following features of history emerged as independent predictors of AMI: crushing chest pain, pain radiating to the right arm, heavy chest, burning character of chest pain, male sex, sweating, apprehension, pain relieved with nitroglycerine, and pain radiating to both shoulders.

DISCUSSION

The main finding of our study which is explicitly demonstrated in the table (1,2,3,4,5), clearly demonstrate that in patients presenting with and admitted because of acute chest pain, the presence of any of the following characteristics of pain increased the likelihood of AMI: male sex, patients perceiving a sense of impending doom, chest pain radiating to either right arm, or both shoulders, squeezing chest pain, burning pain and so on. Fourteen studies 4,9,12-17 have assessed the accuracy of the medical history, physical examination, and ECG in the diagnosis of acute MI 9, 13,14,15,16. In this study, we compare and contrast our results with those from the studies that enrolled patients with suspected AMI in the ICU setting. 18,19.

The diagnosis of AMI in the setting of acute chest pain is a challenging task. Although doctors and patients believe that classic ischemic chest pain chooses the substernal or left chest area, few studies have assessed whether specific chest pain locations predict AMI or ACS. The word chest pain radiation typically refers to pain that originates in the chest but spreads to places other than the chest, such as the neck, back or arm. Ischemic chest pain is classically characterized as radiating from the chest through one arm or both, a lesson supported by several studies. 9,12,17 Physicians teach that Chest pain that is pleuritic, positional, or reproducible with chest wall palpation is unlikely to be due to acute MI. This teaching is supported by a systematic review 3 that showed that clinical features that decrease the probability of MI in patients presenting with acute chest pain are pleuritic chest pain.

There is a well-known correlation between exercise and angina. However, there is a less direct link between exercise and AMI. Mittleman et al. 11 reported that AMI patients were more likely to report heavy exertion in the hour preceding their event, confirming an association between exercise and AMI. Several studies 4,9,12,14,15,16 have examined the ability of associated symptoms such as nausea, vomiting and diaphoresis to predict AMI. Two meta-analyses show that nausea or vomiting and diaphoresis aid in the diagnosis of AMI. However, in the study by Goodacre et al. 19 vomiting and diaphoresis failed to retain their place in the final multivariate logistic regression model.

CONCLUSION

Based on our study result showed in table no 6, out of the 187 patients with acute AMI, 145 (78%) were assigned a discharge diagnosis of ST elevated myocardial infarction (STEMI) and 42 (22%) were assigned a diagnosis of non-ST elevated myocardial infarction. A total of 34 of 145 (23%) patients with STEMI died, compared to 4 of 42(10%) patients with non-STEMI. Even in a high prevalence setting, no sign or symptom exhibited by patients presenting with possible acute MI proved effective enough alone to rule in or out AMI.

Acknowledgement: Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Conflict of Interest: Nil

Source of Funding: Nil

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Table 6: Is this a heart attack?

| Symptoms          | With AMI | Without AMI | Total | P-value |
|-------------------|----------|-------------|-------|---------|
| Is this a heart attack? | Present  | 92          | 76    | 168     | 0.001   |
|                    | Absent   | 95          | 186   | 281     |         |
Wasalwar et al.: Diagnostic accuracy of clinical history for detection of acute myocardial infarction: a cross-sectional study

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