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Value and Limitations of Chest Pain History in the Evaluation of Patients With Suspected Acute Coronary Syndromes

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Abstract

Context The chest pain history, physical examination, determination of coronary artery disease (CAD) risk factors, and the initial electrocardiogram compose the information immediately available to clinicians to help determine the probability of acute myocardial infarction (AMI) or acute coronary syndrome (ACS) in patients with chest pain. However, conflicting data exist about the usefulness of the chest pain history and which components are most useful.

Objective To identify the elements of the chest pain history that may be most helpful to the clinician in identifying ACS in patients presenting with chest pain.

Evidence Acquisition MEDLINE and Ovid were searched from 1970 to September 2005 by using specific key words and Medical Subject Heading terms. Reference lists of these articles and current cardiology textbooks were also consulted.

Evidence Synthesis Certain chest pain characteristics decrease the likelihood of ACS or AMI, namely, pain that is stabbing, pleuritic, positional, or reproducible by palpation (likelihood ratios [LRs] 0.2-0.3). Conversely, chest pain that radiates to one shoulder or both shoulders or arms or is precipitated by exertion is associated with LRs (2.3-4.7) that increase the likelihood of ACS. The chest pain history itself has not proven to be a powerful enough predictive tool to obviate the need for at least some diagnostic testing. Combinations of elements of the chest pain history with other initially available information, such as a history of CAD, have identified certain groups that may be safe for discharge without further evaluation, but further study is needed before such a recommendation can be considered reasonable.

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Differentiating acute coronary syndromes (ACS) from benign causes of chest pain is critical because of the consequences of misdiagnosis in either direction. Despite diagnostic advances, missed acute myocardial infarction (AMI) and ACS remain problematic, with estimates ranging between 2% and 10%.[1-5] Conversely, a large proportion of patients with chest pain who are admitted do not turn out to have ACS.[6] This overtriage has enormous economic implications for the US health care system, estimated at $8 billion in annual costs.[7,8]

Distinguishing whether a patient presenting with chest pain has ACS or a non-ACS problem is at best difficult. The differential diagnosis of chest pain is broad and includes many systems, such as pulmonary, musculoskeletal, gastrointestinal, dermatologic, psychiatric, and cardiovascular (including ACS and non-ACS).[9,10] In addition to ACS, this differential includes other immediately life-threatening diseases such as pulmonary embolism, tension pneumothorax, and aortic dissection, necessitating rapid diagnosis and treatments that are markedly different than those for ACS.

The tools most readily available to guide disposition of the patient with chest pain are the patient's age and sex, history of coronary artery disease (CAD) or its risk factors, and the chest pain history. Usually, an initial 12-lead electrocardiogram (ECG) is added as well. In patients without significant ECG changes, risk factors for CAD have been shown to be poor predictors of AMI or ACS.[4,11,12] The initial 12-lead ECG has a sensitivity of only 20% to 60% for AMI,[13-15] and a single set of biochemical markers also has poor sensitivity.[14-16] Because none of these tools used alone is a reliable predictor of ACS, the chest pain characteristics are usually used in conjunction with them to help determine disposition. Although this article discusses the chest pain history, AMI and ACS may also present with nonpain equivalent symptoms or be truly silent.[17,18]

Typical and atypical chest pain

Although a consensus exists about what represents a typical chest pain description, the equivalent definition for atypical chest pain is less clear. Heberden[19] provided the first description of typical ischemic chest pain in 1768: a painful sensation in the breast accompanied by a strangling sensation, anxiety, and occasional radiation of pain to the left arm. He also observed an association with exertion and relief with rest.[20]

Chest pain symptoms that do not fall into this typical category have been termed *atypical*. However, authors and clinicians using this term often fail to define it or disagree on its definition, making its use potentially confusing. We have reviewed the literature to identify the elements of the chest pain history that may be most helpful to the clinician and to identify its limitations.

Methods

We performed a MEDLINE search of articles written between 1970 and 2005 by using the following search terms: *chest pain*, *atypical*, *myocardial infarction*, *acutecoronary syndrome*, *clinical characteristics*, *esophageal*, *location*, *quality*, *severity*, *duration*, *pleuritic*, *positional*, *chest wall tenderness*, *exercise*, *rest*, *emotion*, *nitroglycerin*, *GI cocktail*, *diabetic*, *elderly*, and *gender*. In addition, the following Medical Subject Heading terms were used: *myocardial infarction* (subheading *diagnosis*), *chest pain* (alone and with subheading *classification*), *angina pectoris*, and *medical history taking*. An Ovid search was performed with the aid of a professional librarian, and the following

We present data from prospective and retrospective observational investigations, as well as systematic reviews. We required that observational studies include at least 80 patients. Studies were included if at least 1 chest pain characteristic was described and if diagnosis of either ACS or AMI was made with appropriate diagnostic testing. We also reviewed the most recent editions of commonly used textbooks.[21-23] Some articles addressed the predictors of AMI; others, ACS. We have attempted to maintain that distinction. We have quoted positive likelihood ratios (and 95% confidence intervals) from published meta-analyses when they exist and otherwise calculated them from published raw numbers. If published likelihood ratios differed, we presented the one with the narrowest 95% confidence interval. We included the number of subjects included in these analyses. For areas of controversy, such as those in which likelihood ratios did not achieve statistical significance or study results conflicted, we commented in text but did not tabulate.

Data synthesis

A Review of Chest Pain Characteristics

Table 1 identifies standard questions and suggests some considerations. Table 2 guides the interpretation of the patient's chest pain history and summarizes the results of our literature review.

Table 1. Specific Details of the Chest Pain History*

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Table 2. Value of Specific Components of the Chest Pain History for the Diagnosis of Acute Myocardial Infarction (AMI)

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Quality. Typical chest pain qualities, such as pressure or aching, are generally thought to be indicative of cardiac ischemia. However, formal investigations have yielded conflicting findings and have demonstrated that these descriptors predict AMI weakly or not at all.[2,3,24-28] Extensive meta-analyses by Chun and Magee[29] and Panju et al[24] determined that typical predictors of pain such as pressurelike were associated with positive likelihood ratios of 1 to 2, which are values that are not robust enough to be independently useful in establishing a myocardial infarction (MI) diagnosis.

On the other hand, studies have shown that certain descriptors such as *sharp* and *stabbing* more powerfully differentiate nonischemic from ischemic pain. Both Lee et al[2] and Panju et al[24] found that pain described as sharp or stabbing significantly decreased the likelihood of chest pain representing an AMI. Cultural differences may play

helpful historical item in identifying ACS is chest pain that is worse than previous angina or similar to previous MI.[25,29]

Location. Classic ischemic chest pain is often described as occurring in the substernal or left chest area, but few studies have examined whether specific chest pain locations predict AMI or ACS. Everts et al[31] concluded that a pain location of central or midchest has little value for predicting AMI. The physiologic explanation for this may be that esophageal pathology typically induces retrosternal pain as well.[9] The same authors also found that pain in the middle-left chest (inframammary region) was more common in patients without AMI, although differences may be too small to be useful.[31,32]

Many studies have shown that the region of infarction (inferior/posterior vs anterior) is not associated with differences in pain location,[33-35] although patients with inferior AMI more often have abdominal pain or other gastrointestinal symptoms than those with anterior infarctions.[33]

Radiation. The term *radiation* of chest pain usually refers to pain that originates in the chest but travels to nonchest areas, such as the jaw, back, or arm. Ischemic chest pain is classically described as radiating from the chest to one arm or both arms, a teaching supported by several studies.[3,14,24,25,27,29] In the study by Goodacre et al[14] of 893 chest pain patients with nondiagnostic ECGs, likelihood ratios were determined independently through the use of multiple logistic regression. For pain radiating to the shoulders or both arms, the adjusted positive likelihood ratio for AMI was 4.07 (2.53-6.54).

Size of the Area of Chest Pain. In addition to the location and radiation of chest pain, the size of the area involved deserves consideration. One study examined the traditional teaching that localized pain suggests a musculoskeletal or psychiatric (DaCosta's syndrome) origin.[31,36] In this study, 27 of 403 AMI patients (7%) vs 46 of 419 non-AMI patients (11%) localized their pain to a small area (a point or the size of a coin),[31] which yielded a likelihood ratio of 0.6, but the 95% confidence interval was 0.3 to 1.0.

Severity. Eriksson et al[35] conducted a study of consecutive patients admitted to a cardiac care unit to compare the severity of chest pain in ACS vs nonischemic groups and found no statistically significant difference. Others have conducted similar studies and also found no differences.[37]

Time Variables. Chest pain indicative of ACS is typically described as having a crescendo pattern, reaching maximal intensity only after several minutes. In a review article, Constant[32] states that pain that is maximal in intensity at onset is unlikely to represent cardiac ischemia. In contradistinction, pain from aortic dissection is described by patients as "severe" or "the worst pain ever" in 91% of cases and of abrupt onset in 85%.[38] Traditional teaching states that the classic duration of angina pectoris is 2 to 10 minutes, with 10 to 30 minutes suggesting unstable angina.[23,32] Pain lasting more than 30 minutes is considered indicative of either an AMI or a nonischemic etiology.[32] Experts consider recurrent pain that lasts for many hours or days with each episode unlikely to be cardiac.[32] Unfortunately, the data to support these timing distinctions are limited.[27,39] For chest pain lasting longer than 30 minutes, the diagnosis most often confused with AMI is gastroesophageal disease.[9,40] At the other extreme, consensus among experts is that pain that lasts only seconds is rarely indicative of ischemic chest pain, although this has not been demonstrated in formal studies.[32]

Precipitating and Aggravating Factors

Pleuritic Chest Pain. Chest pain that is reproduced on deep inspiration or with coughing is often associated with non-ACS diseases such as pulmonary embolism or costochondritis and has been shown by several studies to be suggestive of non-AMI.[2,3,25] In the study by Lee et al,[2] chest pain that was only partially pleuritic (deep breathing reproduces the pain only sometimes) was a less valid discriminant than pain that was fully pleuritic.

Positional Chest Pain. Chest pain that is exacerbated by changes in position is thought to be more indicative of nonischemic causes. For example, pericarditis is often alleviated by leaning forward, whereas musculoskeletal chest pain can typically be reproduced by arm or neck movement.[32,41] Several studies have confirmed that a positional component of chest pain represents a non-ACS etiology.[2,25]

Palpable Chest Pain. Although chest-wall tenderness is technically part of the physical examination, not the medical history, several studies have demonstrated that it suggests a non-ACS etiology.[2,3,14,25]

Exercise. The association between exercise and angina is well established in the literature.[23,39,42] However, the relationship between exercise and AMI is less clearly elucidated. Mittleman et al[43] established that, among AMI patients, heavy exertion in the hour preceding their event was common, confirming a correlation between exercise and AMI. In addition, Goodacre et al[14] found that exertional pain is associated with AMI. Furthermore, when exertional pain is lacking, the likelihood of AMI decreases.

Emotion and Stress. Although several studies have suggested linkages between emotional stress and AMI, attributing this relationship to high sympathetic activity, data to support using this as a discriminant to identify ACS have not been established.[44-46] Of note, a syndrome of reversible cardiomyopathy triggered by emotionally stressful events and occurring primarily in women may mimic evolving ACS.[47]

Relieving Factors

Nitroglycerin. Previous thought held that rapid relief of chest pain with sublingual nitroglycerin strongly supports the diagnosis of angina.[48,49] In addition to relaxing coronary smooth muscle, nitroglycerin causes relaxation of esophageal muscle and thus can alleviate esophageal causes of chest pain as well. Conventional teaching states that relief of cardiac pain is rapid (less than 5 minutes), whereas esophageal pain takes more than 10 minutes to subside.[9] However, recent studies indicate that there is no association between AMI and relief of chest pain with nitroglycerin.[50,51]

"GI Cocktail." The GI cocktail is commonly used in emergency departments to treat dyspepsia. Compositions vary, but it is usually a mixture of viscous lidocaine, a liquid antacid, and Donnatal (composed of several anticholinergics and a barbiturate). It has been common practice to use the GI cocktail to differentiate cardiac from esophageal chest pain according to a study from the 1970s.[52] However, more recent studies and case series have contradicted these findings.[53,54]

Rest. Rest characteristically relieves the pain associated with *stable* angina within 1 to 5 minutes.[23] If pain continues for longer than 10 minutes after rest, the patient has traditionally been considered to be experiencing unstable angina, an AMI, or noncardiac pain. In a comparison of cardiac and esophageal patients, 32 of 52 (62%) with cardiac and 9 of 18 (50%) with esophageal pathology experienced relief of pain by rest (P = .39).[9] This lack of significance from this small study makes it unclear whether relief of chest pain with rest is helpful in differentiating ACS from noncardiac pathology.

Several studies have examined the ability of associated symptoms such as nausea, vomiting, and diaphoresis to predict AMI.[3,14,25-27] Two meta-analyses discovered that nausea and diaphoresis predict AMI.[24,29] However, in the study by Goodacre et al,[14] the association between nausea, vomiting, diaphoresis, and AMI disappeared on multivariable testing.

Combinations of Characteristics of the Chest Pain History to Formulate Low-Risk Groups

No single element of the chest pain history is a powerful enough predictor of non-ACS or non-AMI to allow the clinician to make decisions according to it alone. However, some authors have made efforts to combine elements.[2,28,55-64] Several simply combined atypical features into a decision rule or a scale,[2,55-57] whereas others used computer-aided algorithms.[58-64] Although several of these studies have demonstrated an ability to improve triage decisions within an experimental framework, these protocols have either not been validated or have demonstrated mixed results when implemented in clinical settings.[2,58-64] Recently, a semiquantitative chest pain score was used to improve risk stratification as compared with the Thrombolysis In Myocardial Infarction risk score.[56] In a patient population with negative troponin and ECG test results without ST-segment deviation, this chest pain score was used to assist with risk stratification. In this study, no patients in the lowest-risk category (n = 111) met the end point of mortality or MI at 1 year.[56]

Among the efforts to combine elements of the chest pain history with other available data is the work by Lee et al[2] that identified 3 variables that defined a very low-risk group for AMI. When chest pain was sharp or stabbing; was positional, pleuritic, or reproducible with palpation; and occurred in patients with no history of angina or MI, none of 48 patients were diagnosed with an AMI at hospital discharge. Unfortunately, only 8% of their overall study population (596 patients) were in this category.

Chest Pain Characteristics Associated With High or Low Probabilities for ACS and AMI: Typical and Atypical Chest Pain

Although Heberden's[19] description of typical chest pain contains many features that have been substantiated by formal studies, the concept of atypical chest pain is more elusive. There is no standard, uniformly agreed-on definition of atypical chest pain. One broadly used definition is any chest pain that does not meet Heberden's[19] classic description.[20] The other is one that indicates a decreased likelihood of cardiac etiology.[41,49] For example, Diamond[49] classified chest pain into typical angina and atypical angina according to the number of criteria it met when substernal location, precipitation by exertion, and relief by nitroglycerin were considered. However, distinctions between these terminologies have become blurred. Furthermore, evidence correlating chest pain characteristics with ACS or AMI likelihood is either sparse or, in many cases, conflicting.

According to this literature review, we can categorize characteristics of chest pain into groups by quality and amount of evidence. For pain that is stabbing, pleuritic, positional, or reproduced by palpation, likelihood ratios of 0.2 to 0.3 suggest that this pain more likely represents a non-ACS syndrome. For other chest pain characteristics, such as pain limited to the inframammary region or that is nonexertional, there is weaker evidence. Although chest pain that lasts only seconds or is constant over days may also fall into this category, data are limited.

Conversely, for chest pain that radiates to one or both arms or shoulders or is precipitated by exertion, likelihood ratios of 2.3 to 4.7 suggest that this pain more likely represents an ACS syndrome. There is weaker evidence that other features of the chest pain history suggest an ACS etiology, including chest pain that is associated with

Limitations of the Chest Pain History

Likelihood ratios for various elements of the chest pain history that are bracketed by the values 0.2 and 4.7 make it a helpful but imperfect tool. In addition, because many of the likelihood ratios published treat elements of the chest pain history as independent rather than interdependent variables, they most likely overestimate their strength as predictors.

The quality component of the chest pain history lends itself to a high degree of subjectivity. For example, in certain cultures the term *sharp* actually denotes pain that is severe, rather than knifelike.[30] Beyond cultural and linguistic differences, certain subpopulations may present with chest pain symptoms that differ from those in a general population. Women, patients with diabetes mellitus, and elderly persons represent particular groups that have been the subjects of research in this area.[65-74] In these populations, the predictive power of the chest pain history may be even further weakened. Finally, variability in physician history-taking adds to subjectivity because of poor interphysician reliability and problems with medical record entry.[75]

Determining Patient Risk and Disposition: The Chest Pain History in Context

When treating a patient with chest pain, the goal of the clinician is to determine the likelihood of ACS or non-ACS, as well as that of other life-threatening conditions. In general, the chest pain history has been used to predict the likelihood of AMI and ACS, not final outcomes such as mortality. For these final outcomes, it represents a less powerful risk stratification tool than biomarkers or even the initial ECG.[76-80] In particular, no single element of the chest pain history conveys a powerful enough likelihood ratio to safely allow the clinician to discharge a patient without some additional testing. Despite this limitation, the chest pain history is of value and conveys useful information. At the initial encounter, it represents one of the few data points available to establish formal or informal path probabilities for ACS (Box). In this context, it is used in conjunction with other information available initially, including the patient's age, sex, and history of coronary disease and, to a lesser degree, findings on physical examination. Although risk factors for CAD are often considered as well, their appropriate use as applied to individual patients has been subject to debate.[12,81-83] The initial ECG is easy to obtain and immediately available and thus is also included in this set of initially available information.

Box. Risk Stratification for Acute Myocardial Infarction and Acute Coronary Syndrome According to Components of the Chest Pain History

Low Risk

Pain that is pleuritic, positional, or reproducible with palpation or is described as stabbing[2,3,24,25,29]

Probable Low Risk

Pain not related to exertion or that occurs in a small inframammary area of the chest wall[14,31,42]

Probable High Risk

Pain described as pressure, is similar to that of prior myocardial infarction or worse than prior anginal pain, or is accompanied by nausea, vomiting, or diaphoresis[3,14,24,25,27-29]

High Risk

By virtue of this integration into other initially available information, the chest pain history is potentially useful in 3 ways. The first is the yet-unachieved goal of identifying patients who can be sent home safely without further immediate evaluation. Although confirmatory studies need to be undertaken, existing literature suggests that certain features of the chest pain history, in conjunction with other initially available information, may be able to achieve this goal.[2,56,57] Second, because the chest pain history helps to establish previous probabilities of the likelihood of ACS or AMI, it is an integral part of determining the need for and intensity of additional testing and the necessary period of observation. Finally, the chest pain history may point the clinician to other diagnostic possibilities. Although some of these possibilities, such as gastroesophageal reflux disease, can be evaluated on outpatients, others such as pulmonary embolus or aortic dissection require immediate evaluation.

Conclusion

The chest pain history joins demographic information, the history of CAD and its risk factors, and the physical examination as information immediately available to the clinician to determine the likelihood of AMI and ACS when a patient is first evaluated with chest pain.

Although certain chest pain characteristics decrease or increase the likelihood of ACS or AMI, with likelihood ratios that range from 0.2 to 4.7, none of them are powerful enough to support discharging patients according to the chest pain history alone.

Certain combinations of components of the chest pain history, in conjunction with other information available immediately to the clinician, have been associated with low risk of AMI.[56-64,78,79] However, combination protocols have yet to prove successful when implemented in the clinical setting.[6,79] The identification of a group at low risk for short-term mortality and morbidity and reproducible identification of that group within a nonexperimental framework remains an important area of future research.

Despite this limitation, the chest pain history, when interpreted in light of existing literature, allows the clinician to establish approximate probabilities for acute cardiac ischemia. In combination with other initially available data, it helps the clinician determine how intensive a diagnostic and monitoring strategy for AMI or ACS to pursue and whether to consider other life-threatening illnesses requiring immediate evaluation. Despite its shortcomings, the chest pain history represents a diagnostic tool that is commonly used, relatively inexpensive, and universally available.

Article Information

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