International Journal of Cardiology 219 (2016) 373–379

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Review

Prehospital factors associated with an acute life-threatening condition in non-traumatic chest pain patients — A systematic review

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ARTICLE INFO

Article history:
Received 19 April 2016
Accepted 19 June 2016
Available online 21 June 2016

Keywords:
Prehospital
Chest pain
Acute coronary syndrome
Emergency medical services
Risk assessment

ABSTRACT

Background: Chest pain is a common symptom among patients contacting the emergency medical services (EMS). Risk stratification of these patients is warranted before arrival in hospital, regarding likelihood of an acute life-threatening condition (LTC).
Aim: To identify factors associated with an increased risk of acute LTC among patients who call the EMS due to non-traumatic chest pain.
Methods: Several databases were searched for relevant articles. Identified articles were quality-assessed using the Scottish Intercollegiate Guidelines Network checklists. Extracted data was analysed using a semi-quantitative synthesis evaluating the level of evidence of each identified factor.
Results: In total, 10 of 1245 identified studies were included. These studies provided strong evidence for an increased risk of an acute LTC with increasing age, male gender, elevated heart rate, low systolic blood pressure and ST elevation or ST depression on a 12-lead ECG. The level of evidence regarding the history of myocardial infarction, angina pectoris or presence of a Q wave or a Left Bundle Branch Block on the ECG was moderate. The evidence was inconclusive regarding dyspnoea, cold sweat/paleness, nausea/vomiting, history of chronic heart failure, smoking, Right Bundle Branch Block or T-inversions on the ECG.
Conclusions: Factors reflecting age, gender, myocardial ischemia and a compromised cardiovascular system predicted an increased risk of an acute life-threatening condition in the prehospital setting in cases of acute chest pain. These factors may form the basis for prehospital risk stratification in acute chest pain.

1. Introduction

Chest pain and discomfort are two of the most common symptoms among patients who contact the emergency medical services (EMS). More than 10% of all EMS missions concern patients with chest pain as their chief complaint [1] and 20% of all EMS missions with the highest priority concern patients with chest pain [2]. Symptoms of chest pain and discomfort signify disorders of various origins. Some potentially life-threatening disorders are acute myocardial infarction (AMI), pericarditis, myocarditis, pulmonary embolism and aortic dissection [3]. Less severe diseases such as anxiety, gastritis and musculoskeletal injuries can also cause chest pain [4].

Along with the general increase of EMS utilization, [5] the number of patients with chest pain is increasing. [6] The incidence of life-threatening disease among patients who contacted the EMS due to chest pain has been reported to be about 15%, of which almost 80% involved AMI [7]. While the number of patients contacting the EMS due to chest pain is rising, the proportion of patients dialling the national emergency number with chest pain caused by an AMI is falling. In the 1980s, 28% percent of all prehospital patients with chest pain ended up with a diagnosis of AMI. The corresponding figure in 2008 was 17% [8] and in 2010 it was 12% [7].

The vast majority of chest pain patients contacting the EMS today are transported to the emergency department regardless of the seriousness of their condition, despite the fact that a considerable group of patients contacting the EMS due to chest pain have less severe conditions suitable for primary care [9]. It has also been shown that some chest pain patients have an increased risk of serious complications when waiting in crowded emergency departments [10] and would possibly benefit from direct admission to a more appropriate care unit.

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http://dx.doi.org/10.1016/j.ijcard.2016.06.066
0167-5273/

Previous reports indicate that patients with ST elevation myocardial infarction (STEMI) benefit from direct admission to a percutaneous coronary intervention laboratory (PCI-lab) by ambulance [11]. Therefore, considerable focus has been directed to the prehospital presence of ST elevation on the prehospital electrocardiogram (ECG). The vast majority of patients contacting the EMS with non-traumatic chest pain show no ST elevation on the ECG on ambulance admission [12]. For the large and growing population of patients with chest pain the EMS personnel is referred to the use of other assessment factors to distinguish acute and severely ill patients from those with less serious causes of their chest pain.

The systematic use of such factors, for example in a protocol or a scoring-tool, could support the EMS personnel in their assessment and improve triage of prehospital chest pain patients. Such a tool has been called for in previous studies [13,14].

The ability already in the prehospital setting to assess the likelihood of an acute life-threatening condition (LTC) based on such a tool would clearly be beneficial to the patient. In some cases, this would mean that more adequate treatment could be initiated in the ambulance and transportation directed straight to a care unit providing definite care, such as a coronary care unit (CCU) or a PCI-capable hospital. In cases where the likelihood of an acute LTC is low, referral could be made to primary care. This emergency department avoidance would not only be beneficial to the patient but also protect the emergency departments from overloading.

The aim of this review was to identify factors associated with an acute life-threatening condition among patients calling the EMS due to non-traumatic chest pain.

2. Methods

2.1. Search method and selection criteria

The databases CINAHL, Cochrane Libraries, PubMed, Scopus and Web of Science were searched for relevant articles and abstracts published from January 1980 until November 2015. The search was conducted in order to identify studies examining the relationship between separate factors and an acute LTC in patients with non-traumatic chest pain contacting the EMS system.

P	patients contacting the EMS due to non-traumatic chest pain
I	factors measurable in the EMS
C	no acute life-threatening condition
O	acute life-threatening condition

The following search string was constructed with the assistance of qualified librarians:

(*chest AND* (*pain OR discomfort*))

AND

(*prehospital OR* "*pre hospital*" *OR* "*dispatch center*" *OR* "*dispatch centre*" *OR* "*emergency medical services*" *OR EMS OR* "*emergency medical technician*" *OR EMT OR paramedic OR paramedics OR ambulance**).

Inclusion criteria:

- Population consisting of patients contacting the EMS due to non-traumatic chest pain
- Reporting separate statistics regarding the relationship between each investigated factor and any of the following outcomes:
  - o Acute life-threatening diagnosis (acute coronary syndrome, pulmonary oedema, aortic aneurysm or dissection, cardiac arrest, pulmonary embolism, myocarditis, endocarditis, gut perforation, pancreatitis, severe heart valve disease or severe arrhythmia.)
  - o Major Adverse Cardiac Event (MACE) <30 days, defined as death, myocardial infarction or revascularization
  - o Short-time survival (<30 days)
- Written in English
- Published in peer-reviewed journal

First all duplicates generated by the search were removed. Thereafter remaining items were screened by title and, if in doubt, by abstract against the inclusion criteria in order to identify potentially relevant studies. Titles that appeared to meet inclusion criteria were then screened full-text and their reference lists checked for additional studies. Reference lists of relevant reviews identified through the search were also checked for additional studies. For screening process see Fig. 1.

2.2. Study quality assessment

All remaining studies fulfilling the inclusion criteria were rated by the Scottish Intercollegiate Guidelines checklists for cohort studies [15] and studies of diagnostic accuracy [16] in order to assess risk of bias. These checklists were modified using only those components applicable in the present studies. The modified checklist for cohort studies included 8 statements and the checklist for studies of diagnostic accuracy (e.g. studies on biochemical cardiac markers) included 13 statements. Each statement could be answered with yes, no, "can't say" or "does not apply". One point was given for each statement that is answered with a yes. For a cohort study, 4–6 points was rated as an "acceptable quality study" (+) and 7–8 points as a "high quality study" (++). The corresponding figures for studies of diagnostic accuracy were 6–9 points and 10–13 points respectively.

2.3. Data extraction and analysis

From the result of each study included, data was extracted with regard to the type of association that was identified for each examined factor. Association was deemed to exist when the threshold for significance given in each study had been reached. In cases where no threshold for significance was given, it was specified to $p < 0.05$. A semi-quantitative synthesis of data obtained was conducted on the basis of the procedure described by Zaal et al. [17]. Three criteria were used to determine the level of evidence for each reported factor: 1) number of studies evaluating the factor, 2) scored quality of each study evaluating the factor and 3) the consistency between studies regarding reported association between factor and outcome. The definition of each level of evidence is shown in Table 1. If a factor fulfilled the criteria for multiple levels of evidence, the highest level was chosen.

Data on association between biochemical cardiac markers and acute LTC in prehospital chest pain patients was not synthesized in this way. This is due to lack of data in combination with the use of inappropriate statistical methodology for the semi-quantitative synthesis (e.g. reporting sensitivity/specificity rather than statistical significance).

Search, screening, and data-processing were carried out by KW, and study quality assessment was carried out by KW and JH.

3. Results

3.1. Study identification

The search of the databases identified 1243 unique references, of which 1193 were excluded by title and abstract screening. Two titles were added by cross-reference checking, leaving 52 studies for full-text screening. After full-text screening, 12 studies remained that met all inclusion criteria. Two of those were excluded since they used the same study population and similar research questions as another study that was included. In these cases the articles judged to be the most relevant were included, considering the objective of this review (Fig. 1).