Chest wall syndrome in primary care patients with chest pain: presentation, associated features and diagnosis

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Background. Chest wall syndrome (CWS) is the most frequent aetiology of chest pain in a primary care setting.

Objective. The aims of the study are to describe the epidemiology, clinical characteristics and prognosis of CWS and to provide a simple decision rule for diagnosis.

Methods. We included 1212 consecutive patients with chest pain aged 35 years and older attending 74 GPs. GPs recorded symptoms and findings of each patient and provided follow-up information. An independent interdisciplinary reference panel reviewed clinical data of every patient and decided about the aetiology of chest pain at the time of patient recruitment. Multivariable regression analysis was performed to identify clinical predictors that help to rule in or out the diagnosis of CWS.

Results. GPs diagnosed pain originating from the chest wall in 46.6% of all patients. In most patients, pain was localized retrosternal (52.0%) and/or on the left side (69.2%). In total, 28.0% of CWS patients showed persistent pain and most patients reported no temporal association of pain (72.3%). In total, 55.4% of patients still had chest pain after 6 months. A simple score containing four determinants (localized muscle tension, stinging pain, pain reproducible by palpation and absence of cough) shows an area under the receiver operating characteristic curve of 0.78 (95% confidence interval: 0.75–0.81).

Conclusions. This study broadens the knowledge about pain characteristics and the diagnostic accuracy of selected signs and symptoms for CWS. A simple four-point score can help the GP in the diagnostic workup of chest pain patients.

Keywords. Chest pain, chest wall, diagnosis, prevalence, primary health care.

Introduction

Chest pain is a common complaint and reason for consultation in primary care. It affects ~20% to 40% of the general population during their lifetime.¹ However, incidence varies according to setting, country and inclusion criteria.²–⁴

Chest pain can be caused by a wide range of different diseases.⁵,⁶ Although of the greatest immediate concern, serious cardiovascular disease is not the most common reason for chest pain in primary care. Musculoskeletal pain is the most frequent aetiology in several studies.³–⁷ Physicians tend to describe the different diseases and syndromes that contribute to chest pain of musculoskeletal origin as separate entities. A variety of diagnostic terms like costochondritis, costosternal syndrome, sternalis syndrome, Tietze’s syndrome, rib-tip syndrome or xiphoidalgia have been used in the past to describe and differentiate musculoskeletal causes of chest pain.⁸–¹³ Since these ailments can be located to the chest wall, which also includes the spine with its joints, ligaments and related muscles, the morphological and physiological basis of these syndromes remained obscure. Especially, in the individual clinical case, no more than an educated guess is possible regarding the exact nature of the problem. We consequently decided...
Methods

We conducted a cross-sectional diagnostic study with a delayed-type reference standard in a primary care setting. The final diagnosis was established by an expert panel after 6 months of follow-up. As the principal aim of our study, we investigated the diagnostic accuracy of signs and symptoms for chest pain patients in regard to coronary heart disease (CHD). In this article, we report results of a secondary analysis for CWS as reference diagnosis.

Participating GPs

We approached 209 GPs in the state of Hesse of whom 35.4% agreed to participate in the study. Only GPs being prepared to undergo random recruitment audits could take part. Participating doctors had to recruit consecutively every attending patient with chest pain both as presenting complaint and on questioning. The recruitment period lasted 12 weeks for each practice. For logistical reasons, recruitment was staggered in four waves between October 2005 and July 2006.

For each GP, all patient contacts were counted during a randomly selected week of the recruitment interval and extrapolated for the whole recruitment period to calculate the incidence of chest pain and CWS among practice attendees.

Patients

Every patient >35 years with pain localized in the area between clavicles and lower costal margins and anterior to the posterior axillary lines was to be included. Doctors were also asked to recruit during home visits and emergency calls. Patients were eligible irrespective of the acute or chronic nature of their complaints, of previously known conditions including CHD or related risk factors. Patients whose chest pain had subsided for >1 month, whose chest pain had been investigated already and/or who came for follow-up for previously diagnosed chest pain were excluded. In emergency situations without sufficient time for collecting patient information and written consent, relevant clinical items were documented on a case report form (CRF) kept by the GPs. Later on, e.g. after discharge from hospital, the patient was asked to participate in the study. Only in the case of given informed consent, the CRF was handed over to the study personnel. Like the whole study protocol, this procedure was approved by the Ethics Committee of the Faculty of Medicine, University of Marburg. The study complies with the declaration of Helsinki.

Data collection

GPs took a standardized history and performed a physical examination according to a CRF that was piloted and modified accordingly. The CRF was developed using information from qualitative interviews conducted with GPs about the way how they approach patients with chest pain. It covered information on basic patient and pain characteristics, accompanying symptoms and risk factors for CHD. GPs also recorded their preliminary diagnoses, investigations and management related to the patients’ chest pains. Patients were contacted by phone 6 weeks and 6 months after the index consultation. Study assistants, who were blinded to clinical data previously recorded, asked about the course of the patients’ chest pain and treatments including hospitalizations and drugs. During the follow-up period, we collected GP records as well as discharge letters from specialists and hospitals.

Precautions against bias

Participating GPs were recruited from a network of research practices associated with our department. Towards GPs, we emphasized the importance of recruiting every single patient with chest pain. Practices were visited at 4-week intervals to check CRFs, recruitment logs and compliance with study procedures. Random audits were performed by searching routine documentation of participating practices to identify cases of chest pain not included in the study.

Reference standard

A reference panel consisting of one cardiologist, one GP and one research associate of the Department of Family Medicine reviewed baseline and follow-up data of each patient. They decided on the most likely medical condition having caused the individual patient’s chest pain at baseline. There is no clearly defined algorithm for diagnosing CWS. Diagnosis by the reference panel was based on criteria like general pain characteristics (e.g. sharp or stinging pain), pain associations (e.g. with movement or inspiration), the lack of cardiac events during follow-up investigations and the lack of major cardiac findings during the index consultation.

The panel was not blinded to the results of the CRF. The GP’s initial diagnosis contributed to the decision made by the panel.

The diagnosis of other underlying conditions was whenever possible based on existing guidelines. For diagnosis of CHD, the panel was in a first round blinded to the results of the CRF in order to reduce incorporation bias. Decision making of the panel was
in this case based on recommendations of the CHD guideline of the German program for disease management guidelines.19

Statistical analysis

Descriptive epidemiology. Our main analysis for distinctive clinical characteristics associated with CWS is based on the sample of all patients with chest pain where diagnostic classification was possible. Basic general and pain characteristics were analysed for the cohort of CWS patients. For univariate analyses, we calculated sensitivities, specificities, positive and negative predictive values and diagnostic odds ratios (ORs) for all items covered by the CRF. Proportions were calculated using two-by-two frequency tables.

Diagnostic part. To arrive at a small subset of criteria for clinical recommendation, we selected those index test items that had a \( P \) value <0.05 and ORs indicating at least moderate diagnostic accuracy, i.e. OR >2 or <0.6 (univariate analysis). Those were included as independent variables in multivariate logistic regression analysis. Known CHD, cerebrovascular diseases and peripheral arterial disease were grouped into a combined variable ‘clinical vascular disease (CVD)’, which was positive if at least one of the variables was positive. The dependent variable was CWS. Variable selection was conducted using the backward stepwise procedure (\( P < 0.05 \)). OR and 95% confidence intervals (CIs) were calculated. Reliability (goodness of fit) of the model was estimated using the Hosmer and Lemeshow test.20 Rounding the coefficients of the logistic regression to the nearest unit, an initial score was defined and the area under the receiver operating characteristic curve (AUC) was calculated. In a sensitivity analysis, we simplified the score by stepwise reduction of contributing variables. The guiding principle of this process was to prevent significant changes in the AUC. The final model consisted of four different variables. The prognostic ability of the CWS score to discriminate between patients with and without disease was assessed by analysing the AUC. We formed three risk categories according to score values and calculated sensitivities, specificities and post-test probabilities. All analyses were performed with SPSS software version 14.0.

Results

Study population characteristics

The majority of the participating 74 GPs were male (67%); mean age of GPs was 49 years. Two-thirds of the practices were located in urban areas (63.5%). The participating GPs’ demographic characteristics are similar to the population of GPs in the state of Hesse (data available upon request). According to our estimate, participating GPs encountered \( \sim 190,000 \) patients during the study period and approached 1355 patients with chest pain. Seven patients did not meet the inclusion criteria and 99 refused to participate in the study. Sixty cases were lost to follow-up and 11 died. However, both groups provided enough information to be judged by the reference committee. Three cases were early dropouts and were therefore not included. For 34 cases, follow-up information was lacking, incomplete or ambiguous so that no final diagnosis could be made. We thus analysed 1212 patients for the aetiology of their chest pain; of these, 565 were diagnosed as having CWS (Fig. 1).

Descriptive epidemiology of CWS

The incidence of chest pain of all patient contacts during the study period was 0.71% (95% CI: 0.67–0.74%) and the incidence of CWS was 0.30% (95% CI: 0.28–0.32%).

Compared with the whole study population (all patients presenting with chest pain), patients with CWS showed similar basic characteristics. There were more women than men. Mean age was the same in both groups. In both groups, the vast majority of patients were known by their GP from former consultations and most patients were quoting chest pain as a reason for the actual consultation (Table 1).

In total, 15.6% of CWS patients had dyspnoea and 29.6% tightness as accompanying symptoms. In 39.1% of the patients, pain depended on movement and in 16.6% on exertion. In 62.1%, chest pain could be reproduced by palpation.

In the majority, pain was localized retrosternal and/or on the left side with pain mainly radiating to the left side and left arm. Most CWS patients showed either continuous pain or pain lasting up to 30 minutes and reported no characteristic time pattern. Pain character was perceived in half of the patients as stinging and in one-third as pressing. Pain characteristics are listed in detail in Table 2. During follow-up, 74.5% of

![Figure 1](https://academic.oup.com/fampra/article-abstract/27/4/363/532785/100476)
the 565 patients with CWS continued to consult their GP because of chest pain symptoms. In total, 72.8% of these patients still had chest pain after 6 weeks and 55.4% after 6 months.

**Diagnosics**

**Univariate analysis.** Table 3 lists all clinical characteristics that show an association with CWS. Sensitivities, specificities and predictive values are for most index tests in a medium range with the majority of ORs ranging from 0.5 to 2. Only parameters like localized muscle tension, stinging pain and pain reproducible by palpation or worse with movement show higher ORs.

**Table 1 Basic characteristics of the whole study population (n = 1212) and of patients presenting with CWS (n = 565)**

<table>
<thead>
<tr>
<th>Basic characteristics</th>
<th>Whole study population</th>
<th>Patients with CWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (range)</td>
<td>59 years (35–93 years)</td>
<td>58 years (35–90 years)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female patients, n (%)</td>
<td>678 (55.9)</td>
<td>330 (58.4)</td>
</tr>
<tr>
<td>Chest pain at the time</td>
<td>645 (53.2)</td>
<td>323 (58.1)</td>
</tr>
<tr>
<td>Known by the GP, n (%)</td>
<td>1114 (91.9)</td>
<td>526 (93.4)</td>
</tr>
<tr>
<td>Chest pain as reason for consultation, n (%)</td>
<td>1061 (87.5)</td>
<td>493 (87.4)</td>
</tr>
<tr>
<td>Acute chest pain (&lt;48 hours), n (%)</td>
<td>359 (29.6)</td>
<td>158 (28.4)</td>
</tr>
</tbody>
</table>

*Slightly changing denominator because of missing data.

**Table 2 Pain characteristics of patients presenting with CWS (n = 565)**

<table>
<thead>
<tr>
<th>Pain localization</th>
<th>n (%)</th>
<th>Pain onset</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrosternal</td>
<td>294 (52.0)</td>
<td>Early morning</td>
<td>16 (3.4)</td>
</tr>
<tr>
<td>Left side</td>
<td>391 (69.2)</td>
<td>Morning</td>
<td>21 (4.4)</td>
</tr>
<tr>
<td>Right side</td>
<td>99 (17.5)</td>
<td>Noon</td>
<td>11 (2.3)</td>
</tr>
<tr>
<td>Epigastric</td>
<td>87 (15.4)</td>
<td>Evening</td>
<td>47 (9.9)</td>
</tr>
<tr>
<td>Pain duration</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent</td>
<td>158 (28.0)</td>
<td>Pain radiation</td>
<td>n (%)</td>
</tr>
<tr>
<td>Up to 24 hours</td>
<td>27 (4.8)</td>
<td>Retrosternal</td>
<td>20 (3.5)</td>
</tr>
<tr>
<td>Up to 12 hours</td>
<td>65 (11.5)</td>
<td>Left side</td>
<td>69 (12.2)</td>
</tr>
<tr>
<td>Up to 1 hour</td>
<td>85 (15.0)</td>
<td>Right side</td>
<td>17 (3.0)</td>
</tr>
<tr>
<td>Up to 30 minutes</td>
<td>143 (25.3)</td>
<td>Left arm</td>
<td>77 (13.6)</td>
</tr>
<tr>
<td>Up to 1 minute</td>
<td>82 (14.5)</td>
<td>Right arm</td>
<td>15 (2.7)</td>
</tr>
<tr>
<td>Pain frequency</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1 x/day</td>
<td>309 (62.9)</td>
<td>Pressing</td>
<td>198 (35.1)</td>
</tr>
<tr>
<td>1 x/day</td>
<td>70 (14.3)</td>
<td>Burning</td>
<td>60 (10.6)</td>
</tr>
<tr>
<td>&lt;1 x/day</td>
<td>80 (16.3)</td>
<td>Stinging</td>
<td>299 (53.0)</td>
</tr>
<tr>
<td>Other</td>
<td>32 (6.5)</td>
<td>Null</td>
<td>81 (14.4)</td>
</tr>
</tbody>
</table>

Not all categories are mutually exclusive; percentages can sum up to >100%.

**Multivariate analysis.** Nineteen items (listed in the footnote of Table 3) fulfilled our univariate selection criteria and were selected for multivariable analysis. The results are reported in Table 4.

Localized muscle tension, stinging pain and pain reproducible on palpation were associated positively with CWS. Negative associations were found for CVD, dyspnoea, respiratory infection, need for home visit and cough.

**Discriminative power of the model**

We used the variables of the final regression model (see Table 4) to build an initial score using the regression coefficient rounded to the next integer as weighting factor for the different variables and calculated the AUC. In order to derive the best possible user-friendly version of the score, we stepwise excluded different variables and analysed whether this would lead to a reduction of the AUC. Removing four variables (symptoms of respiratory infection, known CVD, dyspnoea and need for home visit) and weighting the remaining variables equally affected the AUC only minimally.

The final resulting score contained four determinants (localized muscle tension, stinging pain, pain reproducible by palpation and absence of cough) and ranged from 0 to 4 points (Table 5). When applied to the patients from our study sample, the AUC (Fig. 2) was 0.78 (95% CI: 0.75–0.81). Table 6 shows sensitivities, specificities, likelihood ratios and predictive values for two different cut-off points.

**Discussion**

**Summary of main findings**

Among primary care patients, the incidence of chest pain was 0.7%, CWS being with 46.6% the most common aetiology. In most patients with CWS, pain was localized retrosternal (52.0%) and/or on the left side (69.2%) and showed no temporal association (72.3%). In total, 55.4% of CWS patients still complained about chest pain after 6 months. Localized muscle tension, stinging pain, pain reproducible on palpation and absence of cough equally contribute to a simple four-point score that can support the GP’s decision to include or exclude CWS.

**Strengths and limitations**

To our knowledge, this is the largest study investigating the epidemiology and aetiology of chest pain in primary care. Patients were consecutively recruited in a large number of urban and rural practices. Study procedures, including random audits, reduced the possibility of selection bias.

We did not interfere with the workup provided by participating GPs. As a result of this, for some patients, only
limited clinical data were available to the reference panel. Since data from the original questionnaire including GPs’ diagnoses were also used by the panel for decision making, there may be a certain degree of incorporation bias in regard to CWS as the final diagnosis.22

Descriptive epidemiology
In our study, CWS was present in 46.6% of patients presenting with chest pain.23 This corresponds well with 42.7% of CWS quoted by a Swiss study group, which analysed painful conditions of the anterior chest wall.
caused by a musculoskeletal disorder. An Iceland study group described with 48.9% a similar proportion of musculoskeletal diseases in chest pain patients summarizing disorders like intercostal myalgia, bruising and sprain. Two other studies showed a lower proportion of musculoskeletal aetiology in chest pain patients. A possible explanation may be the different inclusion criteria.

While our study also included patients with a history of trauma or chest pain not being the main reason for consultation, these patient groups were excluded in the study conducted by Klinkman et al., which might have led to a shift to other potentially more serious diagnoses.

Verdon et al. report in an overview of a cohort of 300 patients with CWS similar findings for duration and radiation of pain. It is noteworthy that pain mainly was localized on the left side. Pain radiation, although less frequently present, affected the left chest and the left arm as well. Presumably, patients with pain in this area are more worried and inclined to consult their GP than those with a different localization of chest pain.

In our study, more than half of patients with CWS (55.4%) still had chest pain after a follow-up period of 6 months. This corresponds to the findings of the Swiss study group where 57% of patients were found to have suffered from CWS more than once during the year of follow-up.

Diagnostics
Although localized tenderness was present on palpation in nearly two-thirds of CWS patients, this sign alone is not very specific for the diagnosis of CWS. Tenderness and tender points have also been documented in patients with CHD or pulmonary embolism. For the diagnosis of CWS, most authors recommend a combination of information gained from patient history and physical examination. The clinician therefore has to combine different clinical symptoms and signs following the Bayesian approach. In our study, single likelihood ratios for each sign and symptom were at best moderate. However, after combining these in a simple four-point score, they can contribute to the GP’s decision to include or exclude CWS.

Conclusions
In conclusion, in a primary care setting, CWS constitutes a common underlying aetiology in patients presenting with chest pain. This study broadens the knowledge about pain characteristics and the diagnostic accuracy of selected signs and symptoms for CWS. The simple four-point score can help the GP in the diagnostic workup of chest pain patients.

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Declaration
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Conflict of interests: JRS acts as scientific advisor for MSD and ESSEX. All other authors do not declare any conflict of interest.

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