Non-cardiac chest pain: a clinical assessment tool

A simple clinical approach to patients presenting with chest pain is outlined, which is easily taught and can be quickly applied. This approach was demonstrated in a large cohort of patients and this article discusses the characteristics of the various diagnostic sub-groups.

Introduction

Non-cardiac chest pain is one of the commonest acute hospital presentations, but this is a poorly developed field with a weak evidence base and poor management (Burgstaller et al, 2014). It does not belong to one single speciality; cardiologists are primarily interested in ischaemic pain, rheumatologists are criticized for their limited contribution (Best, 2013) and gastroenterologists focus on oesophageal causes (Williams et al, 2009). Many patients are seen by cardiology specialist nurses whose remit is only to identify coronary artery disease. Doctors are not formally trained to assess these patients and little effort is made to reach a substantive diagnosis; management often involves nothing more than exclusion of a cardiac source. Moreover, the only textbook on the subject in the UK is addressed to a nursing audience by authors drawn mainly from the nursing profession (Albarran and Tagney, 2007).

Better management of non-cardiac chest pain requires more accurate diagnosis and a better understanding of the causes. When patients present with chest pain, the initial medical history quickly identifies those with an obvious visceral cause: myocardial ischaemia, oesophageal reflux or pleuritic pain. But it is the majority with non-cardiac chest pain who provide the real diagnostic challenge. This is addressed with a clinical assessment tool, BLADE, designed to elucidate musculoskeletal sources and identify patients who may have a covert visceral cause. This article describes the findings when this approach is taught to clinicians without musculoskeletal experience and applied to the largest cohort in the literature of hospital patients with non-cardiac chest pain.

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Methods

The consultant author developed the BLADE approach based on a pilot study of 160 patients and trained the other participants: two medical students and a specialist cardiology nurse. Each had two training sessions and then intermittent bedside observation by the consultant. Patients with acute anterior chest pain presenting to a district general hospital were assessed over a 2-year period; the patients were seen either in the accident and emergency department, the acute admissions wards or in a rapid access chest pain clinic. These were unselected patients without an obvious visceral cause for their chest pain. Each participant made a clinical diagnosis having collated data on a BLADE-based pro forma which included pain mapping.

The BLADE approach

There are four initial history steps followed by a six-stage examination procedure.

Background

Enquiry was made into cardiac risk factors and the likelihood of other visceral causes of chest pain. Patients were excluded if they had known cardiac disease, exercise-induced chest pain or positive troponin tests. Patients with dyspepsia or reflux symptoms were excluded, as were patients with obvious pleuritic pain. A background of fibromyalgia, chronic pain or regular analgesic use was recorded.

Location and nature of the pain

The distribution of the anterior pain was noted and placed into four quadrants with the horizontal dividing line at midsternal level. Pain in the centre of the chest was divided into two groups according to the site and nature of the pain and designated either as 'costochondral' or 'central'. Additional sites of pain were also recorded.

Association

Factors associated with the onset of the pain were noted. These were infection, anxiety/depression (including acute emotional stress and bereavement) and unusual physical activity; patients with direct trauma were excluded. A note was also made of the association of pain with position, particularly sleeping position, as well as movement and activity.

Duration

Short duration pain was recorded as lasting 10 minutes or less; long duration pain, either continuous or recurring, lasted 3 months or more.

Examination

The six steps are shown in *Figure 1*. The patient is asked initially whether the pain persists and then at each step the patient is asked whether the manoeuvre brings on or worsens the pain. Firm pressure is applied by the examiner to achieve the fullest range of each movement while the patient's face is observed for discomfort. In the final step, firm pressure is applied to the site of anterior pain to identify local tenderness.

Results

The study included 1122 patients with no gender predominance. The majority of patients (60%) were aged 40–60 years with equal numbers distributed above and below these ages. The consultant assessed 662 patients, the cardiology nurse 340 and the medical students 120. There were no major differences in the findings between

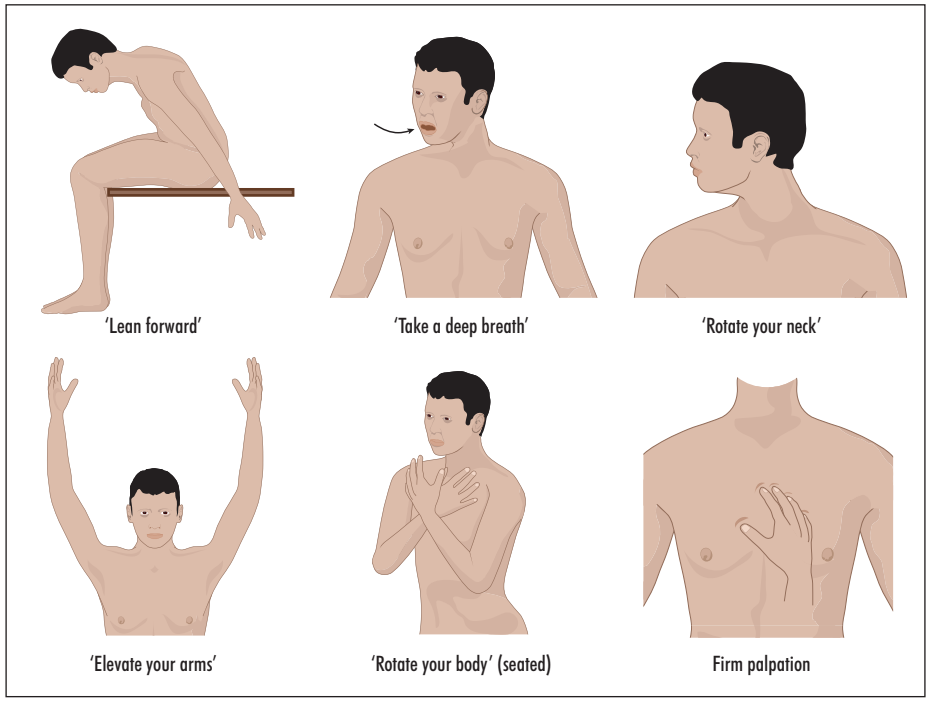


Figure 1. The six examination steps: 'Do these manoeuvres bring on the pain or make it worse?'.

the observers, apart from the consultant recording more patients with fibromyalgia and the nurse more patients with associated thoracic pain.

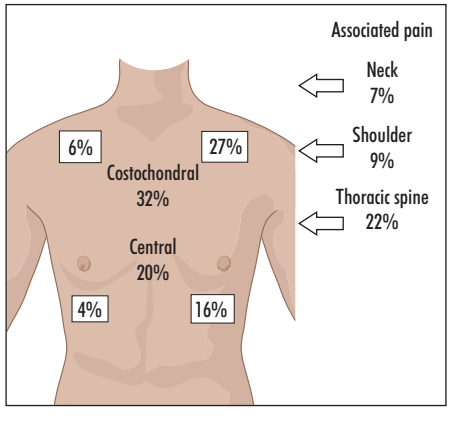
A likely musculoskeletal origin could be identified in 80% of patients with remaining patients in the 'central chest pain' group being more likely to have pain of visceral origin. The frequency of pain in each location is shown in *Figure 2*. Some patients had pain in more than one site and the data are presented as the percentage of all patients. This figure presents collated data from clinical findings and is not just a pain map; in most patients distinctive diagnostic patterns could be discerned but in some it was only possible to assign a location of pain. The figure also shows the frequency of associated pain in the spine and shoulders.

Costochondritis was the commonest cause of non-cardiac chest pain with the upper costochondral junctions being most frequently affected; 49% had bilateral sites while 43% had pain localized to the junctions on the left and 8% on the right. *Table 1* presents data on the location of pain in other patient groups.

Previous studies have not distinguished between patients who still had pain when examined and those who did not. Pain had already resolved in 36% of our patients and the six step examination procedure either exacerbated or induced pain in 66%. Of those without residual pain, examination only induced it in 19%. While a substantial majority of all the diagnostic groups had residual and/or inducible pain, the notable exception was the 'central pain' group where only 24% had residual pain and it was only inducible in 16%. Of the costochondral patients, 81% had residual pain and in 89% the pain was inducible at examination.

Only 49 patients had isolated costal margin pain and there were no salient associations in this group apart from the absence of associated neck and shoulder pain. The data did not identify any specific pain pattern where the following possible causative factors were recorded: anxiety, depression, trauma, post-surgery and infection. In this cohort 7% presented with episodes of pain lasting 10 minutes or less and 10% had ongoing or intermittent pain lasting more than 3 months. Patients with short and long duration pain were evenly spread across diagnostic sub-groups although patients with fibromyalgia or chronic pain were over-represented in both.

Figure 2. Pain frequency in the four quadrants, costochondral junctions and central pain. Arrows on margin show frequency of pain in other sites.



Discussion

The safe diagnosis of non-cardiac pain requires consideration of many clinical features. No single feature is reliable and this includes the location of pain (Bosner et al, 2013) and reproducibility by palpation (Ronga et al, 2012). BLADE is the first attempt at describing an assessment procedure; its application to this large cohort produces many novel findings and expands the clinical parameters on which diagnosis is based.

Costochondral junction pain

Costochondritis is a misnomer as costochondral junction inflammation is unproven; these terms are used interchangeably as this is the norm. Local tenderness is usually found, but sometimes it is only inducible

Table 1. Location of the anterior chest pain in patients with pain in another site and those with chronic pain or fibromyalgia

	Costochondral	Central	Upper quadrant	Lower quadrant	Costal margin
Neck pain (79 patients)	11%	0%	86%	8%	0%
Shoulder pain (106 patients)	5%	1%	91%	4%	3%
Thoracic spine (243 patients)	43%	7%	24%	29%	9%
Fibromyalgia or chronic pain (151 patients)	40%	16%	28%	21%	9%

Note that some patients had pain in more than one site

by stressing the chest wall. Occasionally, it is just the history of focal movement-related pain that suggests the diagnosis. Tietze's syndrome is characterized by localized junction swelling; it is rare and was not found in this study. Costochondritis can cause chronic pain (Freeston et al, 2004), but in this cohort it was no more likely to do so than other diagnostic sub-groups. There was a strong association between costochondritis and pain in the thoracic spine which may be relevant to pathogenesis.

Upper quadrant pain

In these patients it is important to seek a source in the cervical spine or shoulders. The authors' experience indicates that inciting lesions in the neck and shoulder are often otherwise missed. The associated neck pain is usually the result of cervical osteoarthritis, acute disc prolapse or cervical strain. Associated shoulder pain requires further examination beyond the BLADE protocol to identify acromioclavicular joint osteoarthritis, rotator cuff lesions or shoulder capsulitis as specific diagnoses. Treatment can then be directed at these lesions thereby ameliorating the anterior chest pain.

Lower quadrant pain and associated thoracic spine pain

Pain in the thoracic spine was associated with non-cardiac chest pain in 22% of these patients and was mostly located in the mid-thoracic spine and adjacent posterior chest wall. It was particularly associated with costochondritis, and was seen more often in lower rather than upper quadrant presentations. This thoracic pain may be relevant to the genesis of anterior pain. The authors confirm that pain related to sleeping position is a characteristic clinical feature in non-cardiac chest pain (Hamberg and Lindahl, 1981) and they observed a particular association with putative thoracic origin pain.

Costal margin pain

This is also called 'the painful rib syndrome' and is the smallest sub-group. Local tenderness is identified over the lower ribs and in some patients a 'slipping rib' is the apparent source. Patients with costal margin pain are of interest to gastroenterologists; Scott and Scott (1993) reported that these patients accounted for 3% of clinic referrals and emphasized its diagnostic importance where there are incidental gallstones, as eight of their patients had non-curative cholecystectomies.

Central chest pain

This second largest sub-group is important because the clinical picture is so different from the others with obvious musculoskeletal pain. These patients describe their central pain as 'pressing', 'squeezing' or 'tight' and these findings indicate that they are least likely to have an associated spinal or shoulder source. Moreover, their pain had usually resolved by the time of presentation and was generally not inducible by the examination procedure. This is the sub-group with a likely visceral origin, but it is also the commonest pattern in patients with anxiety and depression. Previous studies have not distinguished between those patients who still had pain when examined and those who did not. This is worth recording as it highlights another characteristic of the 'central pain' group: while a substantial majority of all the diagnostic groups had residual and/or inducible pain, this was the notable exception.

Fibromyalgia and chronic pain background

It is surprising that fibromyalgia is not a more frequent cause in patients with non-cardiac chest pain given its prevalence. Moreover, the second costochondral junction is one of the nine paired fibromyalgia diagnostic sites of point tenderness. It was noted in 5% of these patients and another 9% had a chronic pain condition. This is in line with previous unselected non-cardiac chest pain studies (Almansa et al, 2010), but the fibromyalgia prevalence rises to 25% in patients requiring admission (How et al, 2005).

Most patients with fibromyalgia were identified by the rheumatologist, suggesting that other clinicians missed the diagnosis through inexperience. The majority of fibromyalgia patients were women whereas there was a small male preponderance in the chronic pain group. Otherwise, the clinical profile of patients with chronic pain and those with fibromyalgia is similar; this is not surprising as both are central sensitization syndromes. Many of these patients had pain at multiple sites with symptoms of long duration; they accounted for 28% of the patients with pain lasting over 3 months.

The distribution of pain, apart from being more widespread, is not distinctive in this patient group. Patients with fibromyalgia experience their pain as more intrusive and severe and are more likely to present to hospital and more likely to be admitted; they have higher pain scores than other non-cardiac chest pain patients as well as higher anxiety and depression scores (Almansa et al, 2010). All clinicians should be trained to recognize patients with fibromyalgia; their unexplained symptoms and many sites of pain lead to attendance in multiple specialist clinics and overinvestigation.

Distinguishing between chest wall and pleuritic pain

Inexperienced doctors overdiagnose pleuritic pain; when pain is associated with breathing it is invariably construed as having a pleural origin. However, a chest wall source is likely when full inspiration is possible and where the pain induced in step 1 of the BLADE examination (often with wincing on full flexion) exceeds that in step 2. This 'pseudopleuritic pain' is generally costochondral or lower quadrant and its recognition may obviate the need for thromboembolism imaging.

Oesophageal origin chest pain

Clinicians view non-cardiac chest pain according to their speciality. While patients with obvious reflux were excluded, a large study by gastroenterologists began with the premise that 'the source of most cases of non-cardiac chest pain is thought to be the esophagus' (Williams et al, 2009); unsurprisingly they found the clinical characteristics of oesophageal reflux and non-cardiac chest pain to be significantly different, but they both had a similar benign outcome. In contrast, a large primary care study only diagnosed a gastrointestinal cause in 5.8% of unselected patients with chest pain against 46% with musculoskeletal pain and 11% with myocardial ischaemia (Bosner et al, 2009).

The authors' premise is that the initial diagnosis of non-cardiac chest pain should exclude patients with dyspeptic or reflux symptoms, while recognizing that some will have an occult oesophageal source. Patients with covert reflux would fall into the 'central

pain' group and may constitute a majority of patients in this group given that other visceral sources are unlikely and oesophageal spasm and achalasia is rare (Bennett, 2001).

Duration of chest pain

This has not been recorded in previous studies, but is worth noting. Pain of very short duration is invariably benign and occurred in a few patients in all sub-groups (between 5 and 11%). Long duration pain was particularly seen in the group with fibromyalgia or chronic pain with an even small distribution across other sub-groups.

Causes and mechanisms

Events in the cervical spine and shoulders are an important source of upper quadrant pain, and a primary thoracic spine lesion may be responsible for lower quadrant and costochondral pain. This may result from segmental stiffness disturbing chest wall dynamics leading to strain on the junctions and soft tissues. Alternatively, non-cardiac chest pain may just be referred spinal pain; an acute cervical disc prolapse would be an example where upper anterior quadrant pain dominates the presentation but other clinical findings and imaging indicate the source. However, in the thoracic spine, disc prolapse is unusual and a specific diagnosis is more elusive. The deep somatic structures between the T4 and T8 vertebrae are the usual source (Stochkendahl and Christensen, 2010) and both thoracic intervertebral dysfunction and costovertebral joint dysfunction are described as initiating quadrant pain (Arroyo et al, 1992; Yelland, 2001).

Most non-cardiac chest pain studies record few patients with rheumatic disease apart from fibromyalgia and this was the authors' experience too. However, rheumatic disease is much more prevalent when selected cases referred to rheumatology are reported (Freeston et al, 2004) or where patients require admission (How et al, 2005). Spondyloarthropathy is the rheumatological condition that most often causes anterior chest pain, with sternoclavicular joint arthritis being quite common (Wendling et al 2013), although initial presentation as non-cardiac chest pain is rare. Only the 6th to the 9th costochondral junctions are synovial joints (the other junctions are synchondroses) and they are not generally affected by rheumatoid arthritis or the other inflammatory arthropathies.

Precipitants of non-cardiac chest pain were sought, but a cause was only evident in a small minority. Preceding acute mechanical stress was recorded in a few patients and only 6% had preceding infections; these were mainly chest infections and were evenly spread across the sub-groups. Acute anxiety is an obvious causative factor in some patients. Individuals with anxiety disorders are particularly vigilant and fearful of possible cardiac sensations and are often refractory to reassurance (White et al, 2010). Depression or recent bereavement appears to predispose to presentation with chest pain and this may be particularly important in fibromyalgia (Almansa et al, 2010). However, these psychological factors were only recorded in 10% of these patients. The authors did not specifically ask about cocaine use but chest pain is a common complaint among cocaine users and the drug can be associated with myocardial infarction. Consequently, cocaine users with chest pain receive special scrutiny, but in a large prospective study of users with chest pain, none had a myocardial infarct in the following year (Cunningham et al, 2009).

Management of non-cardiac chest pain

A more specific diagnosis of non-cardiac chest pain leads to more specific treatment. Reassurance is often all that is needed and is most convincing if the source of pain can be explained. Investigation is often unnecessary where a benign specific diagnosis can be made, but when required, should be determined by the clinical pattern. Recognition of the 'central pain' presentation is particularly important as management is different: it starts with a trial of a proton pump inhibitor followed by endoscopy if symptoms are refractory (Burgstaller et al, 2014). There should also be a lower threshold for further cardiac investigation in this group.

Patients with recurring or severe anterior pain associated with thoracic or neck pain may require spinal magnetic resonance imaging. Recognition of spinal origin non-cardiac chest pain is important as physiotherapy with mobilization of the spine can ameliorate the anterior pain. Shoulder-associated upper quadrant pain may easily be remedied by a local steroid injection. Intercostal blocks are underused and costochondral pain can respond well to local steroid injection with sulfasalazine reported as useful in refractory costochondritis (Freeston et al, 2004).

Conclusions

Doctors should be trained to evaluate patients with non-cardiac chest pain systematically and encouraged to make specific diagnoses with tailored management. BLADE is an approach which is easily taught and when applied in a hospital setting demonstrates the range of different presentations, with 80% of patients having obvious musculoskeletal pain. The remaining 20% with central pain are an important sub-group with special characteristics: their pain is of a different quality, is not associated with spinal pain, has usually resolved by the time of examination and is not inducible. These patients are most likely to have an occult visceral cause and require a different management pathway.

Costochondral pain is the commonest presentation, usually on the left or bilateral. As with lower quadrant pain, it is often associated with pain in the thoracic spine. Upper quadrant pain is particularly associated with neck and shoulder pain. The BLADE six-step examination procedure facilitates diagnosis, but where pain has resolved when the patient is examined, it is generally not inducible. **BJHM**

Conflict of interest: none.

KEY POINTS

- Systematic evaluation of patients with non-cardiac chest pain leads to more precise diagnosis.
- The BLADE approach is easily learned and can be quickly applied.
- About 80% of patients have a musculoskeletal source; costochondritis is the commonest presentation.
- The central chest pain presentation is most likely to have a visceral cause and requires a different management pathway.
- Upper quadrant chest pain often has its source in the neck and shoulders.

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