



Chest Wall Syndrome

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Abstract

Chest wall syndrome is the most frequent cause of chest pain complained by patients admitted to the physician's office, in outward as well as in emergency department. It may affect all ages with sex ratio of 1:1 between man and woman. History of illness and sensibility to palpation or tenderness were the keys to the diagnostic approach. Pain was generally moderate, well localized, continuous or intermittent over a number of hours to days or weeks and was amplified by position or movement that was commonly located on the left side of the chest. Chest wall syndrome is usually a common and benign condition, but it leads to anxiety and frequent recurrence. Definitive treatment is not yet confirmed and treatment for the different condition causing isolated musculoskeletal chest pain is poor. Therefore, some options to avoid aggravating physical activities, stretching, and simple analgesics as needed are the best choices of current management.

Keywords: aggravating activities, chest wall syndrome, tenderness

INTRODUCTION

Chest wall syndrome is the most frequent cause of chest pain admitted in the physician's office in outward as well as in emergency department. However, the situation remains poorly recognized, particularly in the outward department. The chest wall contains a range of bony and soft tissue structures, including the spine therefore it may be difficult to pinpoint the exact source of pain in an individual patient. Costochondritis, anterior chest wall syndrome, atypical chest pain or musculoskeletal pain syndrome are some of the terminologies described for the

condition above. The etiology of chest wall syndrome are varies, from light to life-threatening conditions accompanied by anxiety that may beyond the heart attack sensation as the patient thought to have a cardiovascular disease and daily activity impairment.¹⁻³

Chest wall syndrome prevalence are 20% to 46.6% cases in outward department and only 6.2% cases were admitted to the emergency department. A systematic review result that most chest pain (56%) was acute coronary syndrome, and the rest (44%) was non-specific chest pain in origin. In most patients, pain was

localized in the retrosternal area, and/or on the left side without temporal association. Complaints of pain is continued after 6 months. Localized muscle tension, stinging pain, palpable pain, and the absence of cough all contribute equally to a simple four-point score that can be used to include or exclude the diagnosis. However, the high prevalence is not yet compared with comprehensive definitive therapy. Indonesia's data specific to chest pain shows that it mostly caused by malignancy.¹⁻³

CHEST WALL

The thoracic wall consists of a bony framework held together by twelve thoracic vertebrae posteriorly that give rise to ribs that encircle the lateral and anterior thoracic cavity. The first nine ribs curve around the lateral thoracic wall and connect to the manubrium and sternum. Ribs 10-12 are relatively short and attach to the costal margins of the ribs just above them and do not reach the sternum.¹⁻³

The first seven ribs are true ribs, attach to the manubrium and directly attach to the sternum body. Ribs eight to ten only attach to the inferior part of the sternum via the costal cartilages. Ribs 11-12 are termed floating ribs because they do not attach directly to the sternum. Ribs eight to ten are the false ribs due to a lack of direct attachment to the sternum. At the level of the spine, the ribs articulate with the costal facet of two opposing vertebrae. An articular capsule surrounds the head of each rib and the attachment to the

transverse process is made with the help of the radiate ligament. As the ribs leave the vertebrae, they curve around the lateral thoracic wall and approach the anterior wall of the thoracic cavity.¹⁻³

The vertical bone of the chest, the sternum, defines the anterior chest wall. The three separate bone segments of the sternum with different sizes and shapes include 1) the thick manubrium, 2) the long body of the sternum, and 3) the xiphoid process. It develops independently of the ribs. In sporadic cases, the sternum may not fully form, and the underlying heart may be exposed. The most superior portion of the sternum is the manubrium, and it is also the first to form during embryogenesis. The sternal body and xiphoid process soon follow the manubrium in development.^{1,2}

Anatomically, the manubrium is located at the level of thoracic vertebral bodies T3 and T4. The manubrium is also the widest and thickest segment of the sternum. During a physical exam of the chest, one noticeable feature of the manubrium is the presence of the suprasternal notch. On either side of this notch, one will feel the thick attachment of the clavicles. For access to the superior mediastinum, suprasternal goiter or thymus, some thoracic surgeons will only make a midline incision in the manubrium.^{1,2}

The sternal body is located at the level of vertebral bodies T5-T9. It covers a significant portion of the mid-chest and is very strong. The xiphoid process is a thin and very small bone. Its size may vary

from two to five centimeters (cm) with a variable shape. The xiphoid may appear bifid, oval or be curved inwards/outwards. In younger individuals, the xiphoid is mostly cartilaginous but is nearly wholly ossified by age 40. By the age of 60 and over, the xiphoid is almost certainly completely calcified. To perform pericardiocentesis safely, the needle has to be placed directly underneath the xiphoid because the heart is just a few fingerbreadths below.^{1,2}

The thoracic cavity subdivides into three compartments; the mediastinum and two pleural cavities, one on each side. The mediastinum is the median compartment containing the heart and great vessels, whereas the pleural cavities contain the lungs. The thoracic cage protects the lungs and the heart as well as provides attachments for the muscles of the thorax, upper extremities, back, and abdomen.^{1,2}

It communicates superiorly with the neck via the thoracic outlet and inferiorly separates the abdomen from the respiratory diaphragm. The boundaries of the thoracic wall are important landmarks. The thoracic wall is bounded anteriorly by the sternum and costal cartilages; laterally by the ribs and intercostal spaces; posteriorly by the thoracic vertebrae and intervertebral discs; superiorly by the suprapleural membrane and inferiorly by the respiratory diaphragm.^{1,2}

There are three intercostal muscles; the external intercostal, internal intercostal, and innermost intercostal muscles. These muscles are present in the intercostal spaces and the intercostal

nerves and blood vessels run between them. The most superficial layer is the external intercostal muscle. The external intercostal muscles extend posteriorly from the rib tubercle to the costochondral junction anteriorly, where the anterior (external) intercostal membrane takes the place of the muscle fibers. The internal intercostal muscle forms the intermediate layer. This muscle extends anteriorly from the sternum to the rib cage posteriorly, where the muscle fibers are replaced by the posterior (internal) intercostal membrane. The innermost intercostal muscle forms the deepest layer and is lined internally by the endothoracic fascia, which in turn is lined internally by the parietal pleura.^{2,4,5}

Associated within each rib is the intercostal bundle, consisting of the vein, artery, and nerve that travel along the underside of the inferior aspect of each rib. The nerve is the most inferior structure in the bundle and travels within the layers of intercostal muscles. As the nerves continue travelling from posterior to anterior and the innermost intercostal muscle layer thins, the lower intercostal nerves (7-11) are found between the parietal pleura and the posterior aspect of the intercostal muscle, prior to crossing the posterior surfaces of the costal cartilages and continuing to the abdominal wall.³

CHEST WALL SYNDROME

Chest wall syndrome/chest wall pain syndrome is a painful condition that manifests as direct or referred pain to the chest wall as a result of stress or injury to

the body. There are numerous pathological processes that may result in self-limiting or chronic conditions. The history and examination target the musculoskeletal as well as other systems that may provide diagnostic information for rheumatic or non-rheumatic systemic causes. The chest pain needs to be fully characterised in terms of onset, site(s), radiation, relieving and exacerbating factors (in particular, any relationship to postures, specific activities or acute trauma). Atypical symptoms, such as night pain or severe pain, alert the General Practitioner (GP) to look for systemic causes such as fractures, infection or neoplasms. The presence of other musculoskeletal or other symptoms assists in diagnosis of other conditions.^{6,7}

It has been suggested the cause of chest wall syndrome can be grouped into three categories and individual conditions can be broadly considered as more or less common. These are conditions causing isolated musculoskeletal pain, rheumatic diseases, and systemic non-rheumatological conditions.^{7,8}

- a. Isolated musculoskeletal pain
 1. More common
 - a) Costochondritis
 - b) Lower rib pain syndrome
 - c) Pain from thoracic spine, costovertebral joints
 - d) Sternalis syndrome
 2. Less common
 - a) Stress fracture
 - b) Tietze's syndrome
 - c) Xiphoidalgia

- d) Spontaneous sternoclavicular subluxation
- b. Rheumatic diseases
 1. More common
 - a) Fibromyalgia
 - b) Rheumatoid arthritis
 - c) Axial spondyloarthritis (including ankylosing spondylitis)
 - d) Psoriatic arthritis
 2. Less common
 - a) Sternoclavicular hyperostosis
 - b) Systemic lupus erythematosus
 - c) Septic arthritis of the chest wall
 - d) Relapsing polychondritis
- c. Non-rheumatic systemic causes
 1. Osteoporotic fracture
 2. Neoplasms
 - a) Pathological fracture
 - b) Bone pain
 3. Sickle cell diseases (rare)

PATHOGENESIS AND PATHOPHYSIOLOGY

Pathogenesis of chest wall syndrome is not well understood. The whole process relevant with pain sensation is related to the complexity of chest wall anatomy. Bony framework is vulnerable to fracture as well as joints and articulation are vulnerable to injury. Innervation of the thoracic wall arise from intercostal nerves at anterior rami of spinalis nerves. This system is walking along under every rib. Every disruption to rib, rami or any connected fiber may cause pain.⁹

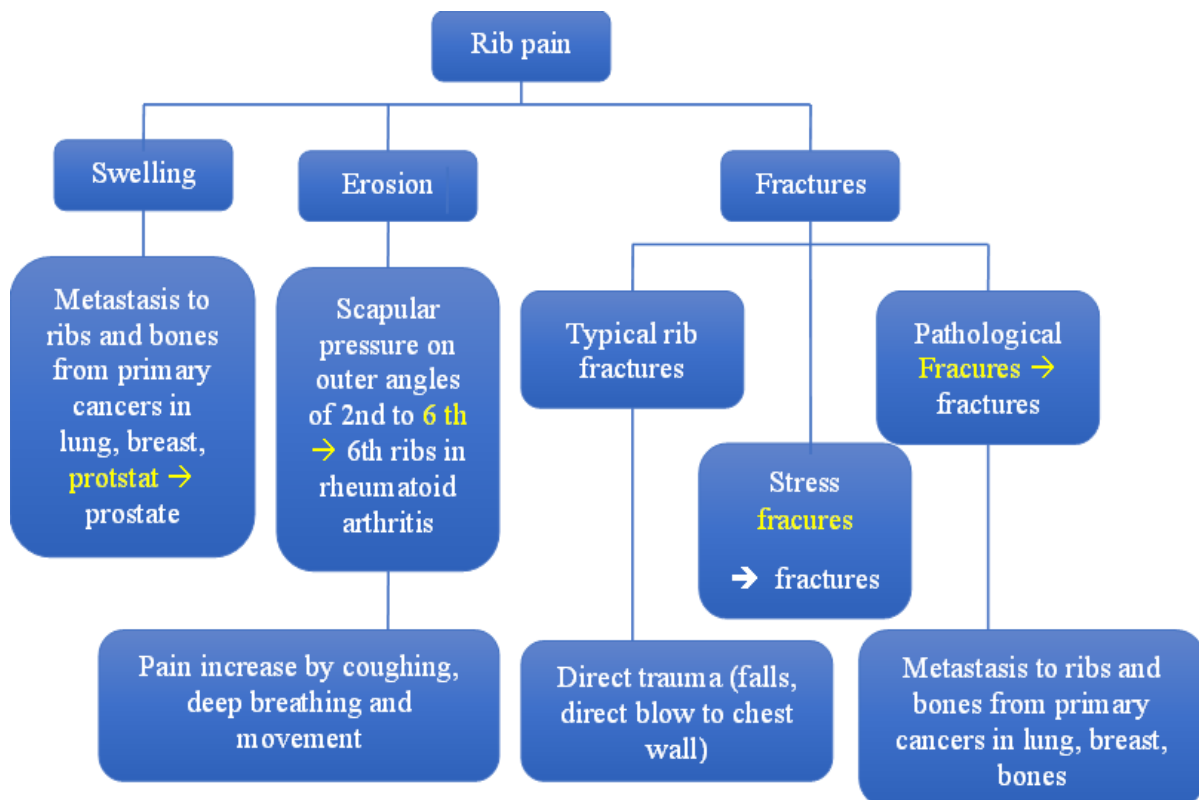


Figure 1. Algorithm causes of rib pain⁹

The visceral pain receptor is found in almost every visceral organs (thorax, pelvis, abdomen) surrounded with connective tissue. Noxious stimuli from this receptor activate the afferent fiber that not protected with myelin and lead to poor local response of pain.⁹

DIAGNOSIS

Musculoskeletal examination includes rib, chest wall, muscles of chest wall, lumbar and vertebrae. The key is to identify location of tenderness by active or passive movements (flexion, extension, lateral flexion and rotation) producing pain. Important areas to palpate are the costochondral joints, sternum, ribs, thoracic vertebrae, intercostal space, paraspinal muscle, trapezius muscle and pectoralis muscle. The palpation is

systematically performed to evaluate every structure at each thoracic level such as to palpate centrally over the spinous processes then 2–3 cm laterally on each side (zygapophyseal joints), then transversely on the side of the spinous processes, then 4–5 cm from midline (costotransverse junctions) and, finally, over the posterior ribs.⁷

Ruling out the non-musculoskeletal cause can be accomplished solely by history and physical examination. Common causes and key features of musculoskeletal chest wall syndrome are listed in Table 1. The key features may be required in some instances to complete the diagnostic process. Cough, fever, chest wall swelling, or other respiratory findings on history or examination should have chest radiography.

Table 1. Key feature of common causes of musculoskeletal chest wall pain⁷

Chest Wall Pain	Common Causes
Isolated musculoskeletal chest wall pain	
Costochondritis	Tenderness in multiple areas over the costochondral or costosternal junctions; palpation reproduces the pain, no associated swelling; mostly affects 2nd to 5th ribs. ⁸
Lower rib pain syndrome	Pain in the lower chest or upper abdomen with a tender spot on the costal margin; pain reproduced by pressing on the spot. ^{7,10}
Sternalis syndrome	Localised tenderness over the body of the sternum or sternalis muscle; palpation often causes radiation of pain bilaterally.
Thoracic costovertebral joint dysfunction	Localised pain approximately 3–4 cm from the midline and possibly referred pain ranging from the posterior midline to the lateral chest wall, and anterior chest pain. Movement of the rib provokes pain at the costovertebral joint and reproduces referred pain. ¹¹
Rheumatic causes	
Fibromyalgia	Widespread musculoskeletal pain and tenderness, poor quality, unrefreshing sleep, fatigue and cognitive disturbances, not accounted for by another condition. Diagnosed by American College of Rheumatology criteria. ^{12,13}
Rheumatoid arthritis	Swelling and/or tenderness of multiple small and/or large synovial joints, positive for rheumatoid factor and/or anti-citrullinated protein antibody, and abnormal C-reactive protein or erythrocyte sedimentation rate. Diagnosed by American College of Rheumatology criteria. ¹⁴
Axial spondyloarthritis (including ankylosing spondylitis)	Back pain for 3 months or longer with onset under 45 years of age, together with either: 1) imaging features of sacroiliitis on MRI or X-ray, and one other feature of SpA* 2) HLA-B27 and two other features of SpA* ¹⁵
Psoriatic arthritis	Inflammatory articular disease (joint, spine, or enthesitis) with three out of five of the following: 1) evidence of current psoriasis, past history or a family history of psoriasis, 2) current psoriatic nail changes, 3) negative for rheumatoid factor, 4) current or a history of dactylitis, 5) radiographic evidence of juxta-articular new bone formation on plain radiographs of the hand or foot. ¹⁶
Non-rheumatic systemic causes	
Osteoporotic fracture	Acute back pain, loss of height or kyphosis for thoracic spine fractures, acute localised pain for rib fractures corticosteroid uses and other osteoporosis risk factors for both. ¹⁷
Neoplasm with pathological fracture or bone pain	Severe and/or night pain, and associated non-musculoskeletal symptoms.

Note: *SpA, spondyloarthritis: features are inflammatory low back pain, arthritis, enthesitis, uveitis, dactylitis, psoriasis, inflammatory bowel disease, good response to non-steroidal anti-inflammatory drugs, family history of SpA, HLA-B27, elevated C-reactive protein

Imaging of the chest with computed tomography (CT) can delineate pathology in costal cartilages and rule out underlying pathology such as tumors. Routine laboratory testing is not necessary unless the diagnosis is uncertain or if there is a sign of inflammation.⁷

DIFFERENTIAL DIAGNOSIS

It is important to rule out visceral and life-threatening causes of chest pain, such as ischemic heart disease and pulmonary embolism, as well as non-musculoskeletal causes, such as gastro-oesophageal reflux disease, through appropriate clinical assessment and investigations. Current

methods for scoring features of musculoskeletal causes of chest pain that differentiate them from cardiovascular causes have had inadequate diagnostic performance. The clinician's thorough assessment, therefore, remains the best approach. In particular, the localisation of pain and presence of chest wall tenderness or reproduction of pain by movements are insufficient to justify ruling out serious non-musculoskeletal causes.⁹

TREATMENT

Specific treatment has not been established. The treatment approach is directed at pain relief with acetaminofen,

nonsteroidal anti-inflammatory drugs when safe and appropriate, or other analgesics. Heat compresses or pads may help, especially in the case of muscle overuse. Minimizing activities that provoke the symptoms, like reducing the frequency and intensity of the activities, are also helpful. In some condition, physical therapy has also applied for persistent musculoskeletal chest pain. Stretching, exercise, mobilization and soft tissue therapy as well as fixing the body posture. Severe cases like in persistent pain, particularly at night and early in the morning, may be treated with administration of local injections of lidocaine and corticosteroid into areas with severe pain, which is a necessary.⁸

Table 2. Differential Diagnosis and Treatment of Chest Wall Syndrome⁸

Diagnosis	Diagnostic consideration	Treatment
Arthritis or sternoclavicular, sternomanubrial, or shoulder joints	Tenderness to palpation of specific joints of the sternum; evidence of joint sclerosis can be seen on radiography.	Analgesics, intra-articular corticosteroid injections, physiotherapy.
Costochondritis	Tenderness to palpation of costochondral junctions; reproduces patient's pain; usually multiple sites on same side of chest.	Simple analgesics; heat or ice; rarely, local anesthetic injections or steroid injections.
Destruction of costal cartilage by infections or neoplasm	Bacterial or fungal infections or metastatic neoplasms to costal cartilages; infections seen post-surgery or in intravenous drug users; chest computed tomography imaging useful to show alteration or destruction of cartilage and extension of masses to chest wall; gallium scanning may be helpful in patients with infection.	Antibiotics or antifungal drugs; surgical resection of affected costal cartilage; treatment of neoplasm based on tissue type.
Fibromyalgia	Symmetric tender points at second costochondral junctions, along with characteristic tender points in the neck, back hip, and extremities, and widespread pain.	Graded exercise is beneficial; cyclobenzaprine (Flexeril), antidepressants, and pregabalin (Lyrica) may be beneficial.
Herpes zoster of thorax	Clusters of vesicles on red bases that follow one or two dermatomes and do not cross the midline; usually preceded by a prodrome of pain; postherpetic neuralgia is common.	Oral antiviral agents (e.g., acyclovir [Zovirax], famciclovir [Famvir], valacyclovir [Valtrex]); analgesics as needed for pain; may require narcotics or topical lidocaine patches (Lidoderm) to control pain.

Diagnosis	Diagnostic consideration	Treatment
Painful xiphoid syndrome	Tenderness at sternoxiphoid joint or over xiphoid process with palpation	Usually self-limited unless associated with congenital deformity of xiphoid; analgesics; rarely, corticosteroid injection.
Slipping rib syndrome	Tenderness and hypermobility of anterior ends of lower costal cartilages causing pain at lower anterior chest wall or upper abdomen; diagnosis by "hooking maneuver": curving fingers under costal margin and gently pulling anteriorly - a "click" and movement is felt that reproduces patient's pain.	Rest, physiotherapy, intercostal nerve blocks; or, if chronic and severe: surgical removal of hypermobile cartilage segment.
Tietze syndrome	A single tender and swollen, but non-supportive costochondral junction; usually in costochondral junction of ribs two or three.	Simple analgesics; usually self-limiting; rarely, corticosteroid injections.
Traumatic muscle pain and overuse myalgia	History of trauma to chest or recent new onset overuse myalgia of strenuous exercise to upper body (e.g. rowing); may be bilateral and affecting multiple costochondral areas; muscle groups may also be tender to palpation.	Simple analgesics; refrain from doing or reduce intensity of strenuous activities that provoke pain

CONCLUSION

Chest wall syndrome is the most common cause of chest pain admitted to the physician's office, in outpatient as well as in emergency departments, with a low morbidity and mortality rate. Diagnosis is established, particularly with specific anamnesis and physical examination. Pain sensations and high recurrency rates cause anxiety in some cases and lead to acute or chronic conditions. Because our understanding of this disease is still incomplete, more research and study are needed.

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