Evaluation and Treatment of Musculoskeletal Chest Pain

Amba Ayloo, MD*, Teresa Cvengros, MD, CAQSM, Srimannarayana Marella, MD

INTRODUCTION

Chest pain is one of the most common reasons for seeking medical attention worldwide. In the United States alone, there are about 7.16 million visits annually to the emergency room with chest pain and most of these patients have noncardiac causes of chest pain.1 Chest pain accounts for 1% to 3% of office visits to the primary care provider. Of these visits, 21% to 49% of patients are diagnosed with musculoskeletal chest pain, making it the most common cause of chest pain.2

Causes of chest pain include cardiovascular, pulmonary, musculoskeletal, gastrointestinal, and psychogenic. Pain can also radiate to the chest from the shoulders,
cervical and thoracic spine, lower neck, and structures below the diaphragm (Fig. 1).³

An important mechanism of chest pain may be referred pain from intrathoracic structures, including the heart, lungs, and esophagus.³ Pain occurs because free nerve endings that transmit pain from visceral thoracic structures, including the heart, synapse on the same spinal cord dorsal horn interneurons that receive afferent input from the skin, muscles, and joints. The convergence of visceral and somatic pain fibers on the same interneurons causes the referred visceral pain that is perceived in somatic areas remote from involved viscera.² Thus, it can sometimes be difficult to delineate the precise cause of chest pain as musculoskeletal or visceral in origin.²

It is important to rule out visceral causes of chest pain, including cardiac, esophageal, or pulmonary causes, such as angina, myocardial infarction, malignancies, or pulmonary embolism, before definitively diagnosing musculoskeletal chest pain.³,⁴ For example, anginal pain may occur along with underlying costochondritis or subacromial bursitis, which may influence the distribution of anginal pain.³ In middle-aged and elderly patients with strong, relevant risk factors for cardiac disease, it is recommended to order an electrocardiogram, echocardiogram, and even stress testing as necessary to definitively rule out cardiac causes of chest pain before treating for musculoskeletal chest pain.³,⁴

Musculoskeletal chest pain includes pain related to the anterior chest wall bony and cartilaginous structures, chest wall musculature, and the thoracic spine.³ In addition, other causes of pain may include skin conditions, neoplasms, and infections of chest

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**Fig. 1.** Diverse origins and causes of chest pain. (From Cava JR, Sayger PL. Chest pain in children and adolescents. Pediatr Clin North Am 2004;51(6):1553–68. Philadelphia: Elsevier; with permission.)
wall structures, metabolic causes (vitamin D deficiency), and rheumatologic disorders (Box 1). The term chest wall syndrome refers to nontraumatic causes of musculoskeletal chest wall pain, which may include diagnoses such as costochondritis, atypical chest pain, and cervicothoracic angina. A good history and physical examination are crucial to accurately diagnosing musculoskeletal chest pain (Box 2, Table 1).

MUSCULOSKELETAL CHEST PAIN RELATED TO BONY AND CARTILAGINOUS STRUCTURES OF THE CHEST WALL

Costochondritis and Tietze Syndrome

These are conditions characterized by pain and tenderness in costochondral junctions. The comparative characteristics between the 2 conditions are listed in Table 2. The possible mechanism of pain is believed to be mechanical derangement, muscular imbalance, or neurogenic inflammation. The pathogenesis of costochondritis is unclear. Because of its frequent association with other primary causes of chest pain, including anginal pain, it is important, especially in patients with relevant risk factors, to rule out any associated cardiac chest pain.

**Box 1**

Diverse causes of musculoskeletal chest pain

- **Pain related to bony and cartilaginous structures of the chest wall**
  - Costochondritis
  - Tietze syndrome
  - Rib pain
    - Fractures related to trauma
    - Stress fractures
    - Slipping rib syndrome
    - Painful xiphoid syndrome

- **Pain related to muscles**
  - Muscle strains
    - Pectoralis muscle strains
    - Injuries to internal oblique/external oblique muscles
    - Serratus anterior muscle injury
  - Myofascial pain
  - Fibromyalgia
  - Precordial catch syndrome
  - Epidemic myalgia

- **Pain related to thoracic spine**
  - Thoracic disc herniation

- **Miscellaneous causes of chest wall pain**
  - Skin-related conditions
    - Herpes zoster
    - Neoplasms
  - SAPHO syndrome
Chest pain involving costochondral joints has also been described in association with vitamin D deficiency. The mechanism involved is believed to be defective bone mineralization caused by lack of vitamin D. This mechanism is shown by findings of rachitic rosary in children with rickets and tenderness of costochondral joints in adult patients with osteomalacia. Low vitamin D should be suspected in people with poor dietary intake of vitamin D or limited exposure to sunlight. Supplementation of vitamin D was associated with improvement of chest pain and overall quality of life. Further studies are needed to definitively associate vitamin D deficiency and costochondritis.

**Box 2**

**Key points in physical examination**

<table>
<thead>
<tr>
<th>Swelling</th>
<th>Erythema</th>
<th>Heat</th>
<th>Tenderness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurologic examination to rule out compressions of nerve roots originating in lower cervical or thoracic segments of spinal cord</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory disturbances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscular strength</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral reflexes of upper and lower extremities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**Box 3**

**Prevalence of costochondritis**

| Emergency room | 30% of chest pain visits were because of costochondritis |
| Primary care office | 20% of chest pain visits were because of musculoskeletal chest pain |
| Of these visits, 13% were because of costochondritis |

Evaluation

Physical examination helps in diagnosis. The “crowing rooster” maneuver reproduces the pain of costochondritis (Fig. 3).

Treatment

Conservative treatment is generally recommended (see Table 2). Stretching exercises have been studied recently in the treatment of costochondritis. In a retrospective open study of patients with a definitive diagnosis of costochondritis who were taking nonsteroidal antiinflammatory drugs (NSAIDs) in the last 2 to 3 months, there was statistically significant improvement in pain in the study group treated with exercises and NSAIDs, compared with the group on NSAIDs only (Fig. 4). 8

Table 2

Comparisons between costochondritis and Tietze syndrome

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Costochondritis</th>
<th>Tietze Syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs of inflammation</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Swelling</td>
<td>Absent</td>
<td>Presence or absence indicate severity of problem</td>
</tr>
<tr>
<td>Joints affected</td>
<td>Multiple and unilateral &gt;90%</td>
<td>Usually single and unilateral</td>
</tr>
<tr>
<td></td>
<td>Usually second to fifth costochondral junctions involved (Fig. 2)</td>
<td>Usually second and third costochondral junctions involved3,9,10</td>
</tr>
<tr>
<td>Prevalence4</td>
<td>Relatively common (Box 3)</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Age group affected</td>
<td>All age groups, including adolescents and elderly</td>
<td>Common in younger age group</td>
</tr>
<tr>
<td>Nature of pain</td>
<td>Aching, sharp, pressure like</td>
<td>Aching, sharp, stabbing initially, later persists as dull aching</td>
</tr>
<tr>
<td>Onset of pain</td>
<td>Repetitive physical activity provokes pain, rarely occurs at rest11</td>
<td>New vigorous physical activity such as excessive cough or vomiting, chest impact9</td>
</tr>
<tr>
<td>Aggravation of pain9</td>
<td>Movements</td>
<td>Movements</td>
</tr>
<tr>
<td>Association with other conditions</td>
<td>Seronegative arthropathies, angina pain12</td>
<td>No known association</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Crowing rooster maneuver3</td>
<td>Physical examination, exclude rheumatoid arthritis, pyogenic arthritis2,3</td>
</tr>
<tr>
<td>Imaging studies</td>
<td>Chest radiograph, computed tomography scan, or nuclear bone scan to rule out infections or neoplasms if clinically suspected4</td>
<td>Bone scintigraphy and ultrasonography can be used for screening for other conditions10,11</td>
</tr>
<tr>
<td>Treatment</td>
<td>Reassurance, pain control, NSAIDs, application of local heat and ice compresses, manual therapy with stretching exercises.8,13</td>
<td>Reassurance, pain control with NSAIDs3,9 and application of local heat. Corticosteroid and lidocaine injections to the cartilage, or intercostal nerve block in refractory patients1,10</td>
</tr>
</tbody>
</table>

Abbreviation: NSAIDs, nonsteroidal antiinflammatory drugs.
Rib Pain

Rib pain can be caused by swelling, erosions, and trauma causing fractures (Figs. 5 and 6).3,14

Evaluation
There is usually a history of initial vague chest pain that increases with inspiration, with movements of the chest and upper limb movements.3,14 Dull, aching pain is more localized around the scapula, neck, and clavicle and may radiate to the sternum in first rib fractures.15 Physical examination reveals point tenderness at the site of trauma, with or without local swelling on palpation.14–16

It is important to suspect and look for trauma to underlying viscera, including lung contusions, injury to liver, spleen, kidney, or any pneumothorax or hemothorax in multiple rib fractures and also in fractures of the first 4 or last 2 ribs, because these are not commonly seen. Child abuse should always be suspected in any child presenting with rib fractures, especially in infants and toddlers, because routine causes of injury and trauma in children do not cause rib fractures (Fig. 7). Imaging studies can help in diagnosing or confirming the fracture (Box 4).15–18

Treatment
Symptomatic treatment with good pain control for at least 3 weeks is generally recommended for non–sports related injuries.14 Deep breathing is encouraged to prevent lung

Fig. 2. Rib cage with costal cartilages and inflamed cartilages in costochondritis. (A) Labeling of rib cage. (B) Inflammation of coastal cartilages.

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Symptomatic treatment with good pain control for at least 3 weeks is generally recommended for non–sports related injuries.14 Deep breathing is encouraged to prevent lung
collapse, atelectasis, and lung infections. Splinting, local nerve blocks, and anesthetic injections are not routinely indicated because of poor efficacy and the associated risk of causing pneumothorax.\textsuperscript{14} For athletes with first rib fractures, rest is recommended until symptoms resolve, followed by a gradual return to overhead activity, with correction of technique and biomechanical modification. Full recovery may take up to a year.\textsuperscript{16,18} Fractures of the fourth to eighth ribs may need pain control and rest, with gradual return to activity at 4 to 6 weeks, then full activity as tolerated at 8 to 10 weeks.\textsuperscript{16}
Slipping Rib Syndrome

This condition occurs when interchondral fibrous attachments between the lower ribs, usually the 9th and 10th ribs, are inadequate, or rupture and loosen, allowing costal cartilage tips to curl up and override the inner aspect of the rib above, impinging on the intercostal nerve.\textsuperscript{20,21} It is a recognized cause of chronic pain syndrome in children with recurrent pain in the lower chest and upper abdomen, but is less common compared with adults because of more flexible chests in children.\textsuperscript{21} Repetitive trunk motion in athletes involved in sports such as running can cause slippage of a hypermobile rib under the superior rib, causing nerve impingement and pain.\textsuperscript{15,16}

There may be a remote history of trauma.\textsuperscript{2} Pain is insidious in onset, severe, sharp, and felt in the abdominal wall or anterior costal cartilage. It may be felt as local somatic

Fig. 6. Algorithm for causes of stress fractures.

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Fig. 7. Rib fractures in a child (arrows). (From Rubio EI. How do you read these images? Hone your interpretive skills. Rib fractures in a child. 2008. Available at: http://www.pediatricsconsultantlive.com/display/article/1803329/1405067. Accessed March 30, 2013; with permission.)
Pain or as visceral pain, which may mimic biliary colic, peptic ulcer disease, and renal colic. 3, 16, 21

**Evaluation**
Diagnosis is clinical. Examination shows increased tenderness and mobility of the anterior end of the costal cartilage, with an occasional painful click over the tip of affected cartilage. This pain can be reproduced by the hooking maneuver (Fig. 8). 2, 16, 20–23

**Treatment**
Reassurance, pain control with analgesics, and avoidance of movements and positions that cause the loose costal cartilage to move upwards suddenly and provoke pain are recommended. 2, 16, 22 Strapping and local infiltration of lidocaine and corticosteroids for intercostal nerve block may be needed, more commonly in children. 16, 20–22 Subperi-chondrial resection of involved costal cartilages is reserved for refractory cases in children (Box 5).

**Painful Xiphoid Syndrome**
Painful xiphoid syndrome is characterized by pain and tenderness in the region of the xiphoid cartilage. Pain may be low substernal or epigastric, with radiation to the precordium or abdomen. 3, 16

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**Box 4**
**Rib fracture imaging findings**

| Radiographs show a fracture line in about a half to two-thirds of fractures |
| In cases with no initial radiographic evidence of fracture, a healing callus may be seen after a few weeks on the radiograph or ultrasonogram |
| Triple phase bone scan or magnetic resonance imaging (MRI) may be used for early diagnosis. |

*Data from Refs. 3, 15–17, 19*

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Evaluation
Painful xiphoid syndrome is a diagnosis of exclusion. Clinical examination by exerting pressure on xiphoid cartilage reduplicates the pain and tenderness. It is important to definitively rule out other serious causes of chest pain, such as myocardial infarction, before reaching this diagnosis.24

Treatment
Symptomatic treatment with good pain control is generally recommended. Local injections of corticosteroids or lidocaine are recommended in refractory cases. Surgical excision of xiphoid cartilage is reserved for severe cases.3

MUSCULOSKELETAL CHEST PAIN RELATED TO MUSCLES

Muscle strains comprise one of the most common causes of musculoskeletal chest pain. They are usually acute in onset, caused by trauma or overuse.3 Gradual onset of the muscle pain has also been reported as a result of tension or anxiety in the patient.2 The commonly involved muscles include the intercostal muscles, pectoralis muscles, internal and external oblique muscles, and serratus anterior muscles.

Intercostal Muscle Strains

Intercostal muscles are the most commonly affected muscles, in almost 50% of patients,2 followed by the pectoralis muscle group. There may be a history of excessive exertion of untrained muscles with activities like painting a ceiling, chopping wood, or coughing, and in sports with intense upper body activity, such as rowing.3,16

Evaluation
Diagnosis is clinical, based on a good history and physical examination. Localized pain or tenderness over the affected muscle groups is seen, which increases with stretching or contracting the involved muscles with activities such as deep inspiration and coughing.3,16 Muscle tenderness on manual palpation is the most common finding.

Treatment
Reassurance, local application of heat, or use of analgesics for good pain control are recommended, along with avoiding activities that cause recurrence of the pain. Local injections of lidocaine or corticosteroids are reserved for refractory cases.3,15,16

Pectoralis Muscle Strains

The pectoralis muscle is one of the most important muscles for various movements of the upper limbs and chest wall (Fig. 9).25 Tears to the pectoralis muscle can be caused

Box 5
Subperichondrial resection

<table>
<thead>
<tr>
<th>Subperichondrial resection</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is important to mark the point of maximum tenderness on the patient while they are awake and supine before going to the operating room</td>
</tr>
<tr>
<td>Affected cartilage is excised and perichondrium is preserved</td>
</tr>
<tr>
<td>Surgery can be performed as an outpatient procedure</td>
</tr>
<tr>
<td>Cryotherapy can help decrease postoperative pain21</td>
</tr>
</tbody>
</table>

by direct blow or indirect trauma. The tears can be classified by either cause or location of tear (Figs. 10 and 11). Indirect injury occurs when muscle under full tension is subjected to additional stress (eccentric muscle contraction), causing high-grade injuries in athletes in sports such as weight lifting or rugby. Non-sports injury occurs most commonly because of forced abduction with extension or external rotation during a fall or when lifting weights.

**Evaluation**

History and physical examination can help in diagnosis, but imaging is usually advised for correct diagnosis, because clinical assessment can be misled by hematoma or muscle injury. Tears can present as sudden pain in the arm or shoulder accompanied with an audible pop, followed by swelling and ecchymosis. Inspection shows loss of the anterior axillary fold and asymmetry when compared with the other side with palpation of a defect on the side of injury. Loss of arm adduction may be a subtle but important finding in athletes such as weight lifters. Radiographs at initial assessment may show soft tissue swelling with absent pectoralis shadow. Ultrasonography and MRI are modalities of choice and help in making correct decisions about optimal management (Box 6).

**Treatment**

Proper documentation and determination of injury site and mechanism determine the management (Box 7).
Injuries to Internal Oblique/External Oblique Muscles

Injuries at the rib and costal cartilage insertion of internal and external oblique muscles are commonly referred to as side strains (Fig. 12). They are uncommon, mostly seen

Classification of pectoralis muscle injury (tear)

Fig. 10. Algorithm for pectoralis muscle injury based on cause of injury. (Data from Hopper MA, Tirman P, Robinson P. Muscle injury of the chest wall and upper extremity. Semin Musculoskelet Radiol 2010;14(2):122–30.)

Injuries to Internal Oblique/External Oblique Muscles

Fig. 11. Algorithm for pectoralis muscle injury based on location of injury. (Data from Hopper MA, Tirman P, Robinson P. Muscle injury of the chest wall and upper extremity. Semin Musculoskelet Radiol 2010;14(2):122–30.)
in athletes such as bowlers (cricket), javelin throwers, rowers, swimmers, or ice hockey players. The mechanism of injury is muscle lengthening followed by sudden eccentric contraction.\textsuperscript{14,25,31,32} The injury is particularly seen in cricket fast bowlers and is seen in the nonbowling arm.\textsuperscript{14}

**Evaluation**

Physical examination elicits pain and tenderness over the lower 4 costal cartilages, increased by resisted side flexion to the affected side.\textsuperscript{31} Diagnosis is clinical, but imaging helps in evaluating the severity of injury and in determining the course of management (\textbf{Box 8}, Figs. 13 and 14).\textsuperscript{25}

MRI may show hematoma, periosteal stripping, or any stress injury to the underlying rib.\textsuperscript{31} It is particularly useful in assessing acute concomitant injury to external oblique muscles. It can help in the follow-up of patients who failed to respond to conservative measures, but can be complicated by respiratory motion artifact.\textsuperscript{25,33}

**Treatment**

Conservative treatment is recommended, with rest, strengthening exercises, and return to activity gradually. A period of 4 to 6 weeks may be needed for complete return to activity, especially in fast bowlers.\textsuperscript{14} Reoccurrence of injury is common, especially in the first 2 years of initial injury.\textsuperscript{14}

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**Box 6**

\textbf{Ultrasonography and MRI for diagnosis of pectoralis muscle tears}

<table>
<thead>
<tr>
<th>Ultrasonography is helpful in initial rapid assessment of acute muscle injury and surrounding structures when performed by an experienced clinician.\textsuperscript{30}</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI is gold standard for:</td>
</tr>
<tr>
<td>Accurate assessment of site and severity of injury and bony structures</td>
</tr>
<tr>
<td>Identifying patients who benefit most from surgery</td>
</tr>
</tbody>
</table>


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**Box 7**

\textbf{Treatment of pectoralis muscle tears}

<table>
<thead>
<tr>
<th>Early surgical intervention\textsuperscript{25,29,30}:</th>
</tr>
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<tbody>
<tr>
<td>Complete pectoralis major tendon avulsion at humeral attachment</td>
</tr>
<tr>
<td>Helps athletes in early return to sports</td>
</tr>
<tr>
<td>Optimum functional recovery</td>
</tr>
<tr>
<td>Good cosmetic results</td>
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</table>

<table>
<thead>
<tr>
<th>Nonsurgical treatment\textsuperscript{29}:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscular or musculotendinous tears</td>
</tr>
<tr>
<td>Low-grade partial tears</td>
</tr>
<tr>
<td>Older, sedentary patients for whom loss of strength may not cause significant impairment or debility</td>
</tr>
</tbody>
</table>

Serratus Anterior Muscle Injury

Serratus anterior muscle injury is seen in athletes involved in sports such as rowing and weight lifting caused by overuse. Pain is typically located around the medial border of the scapula on the affected side and may radiate to the anterior chest.\(^{15}\)

Evaluation

Diagnosis is clinical. Physical examination shows reproducible typical pain on resisted scapular protraction.\(^{15}\)

Treatment

Improvement is seen with rest from activities that increase the pain, but may take several weeks.\(^{15}\)

Box 8

Ultrasonographic findings in internal oblique muscle injury

Acute injury shows:

- Hematoma
- Fluid between muscle layers
- Loss of normal architecture
- Gap in the insertion of the internal oblique into costal cartilages and ribs (see Fig. 14)

Not sensitive to assess chronic injury and small muscle tears\(^{12}\)

Myofascial Pain

As the name implies, myofascial pain is defined as pain originating from muscles or fascia. This type of pain is described as dull and aching, with a stiff feeling. It may be caused by muscle injury or overuse. Myofascial pain may be aggravated by muscle

Fig. 13. Ultrasonographic appearance of normal external oblique (black arrow) and internal oblique (white arrow) muscles. (From Obaid H, Nealon A, Connell D. Sonographic appearance of side strain injury. AJR Am J Roentgenol 2008;191(6):265. Available at: http://www.ajronline.org/doi/full/10.2214/AJR.07.3381. Accessed March 12, 2013; with permission.)

use, postural imbalance, cold, anxiety, and psychological stressors. What defines myofascial pain clinically is the identification of a trigger point. A trigger point is “a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band” of muscle. Additional clinical features of trigger points are listed in Box 9.

Trigger points in the pectoral major and minor muscles, intercostal muscles, anterior serratus muscles, scalenus muscles, and sternalis muscles can be a source of pain referred to the chest wall. For example, trigger points in the pectoral major or minor muscle may cause ipsilateral chest pain that radiates down the ulnar side of the arm. Sternalis muscle trigger points may cause a deep substernal ache. Myofascial trigger points are common yet often not identified or treated properly, because the initial training of so few medical providers includes adequate education in their identification and treatment.

**Evaluation**

Carefully examine the chest wall and cervical muscles for active trigger points. The physical examination skills for identifying trigger points are not commonly taught in medical training, and practice is required in order to become competent at this skill. Myofascial pain may not be the sole reason for the pain, but may be a contributing factor in some cases. Therefore, evaluation for other causes of pain is important.

**Treatment**

It is important to address postural and ergonomic factors and proper stretching and strengthening of muscles when treating myofascial pain. There are several options for local treatment of active trigger points (Box 10).

Medications that may be helpful include NSAIDs, tricyclic antidepressant drugs, or muscle relaxants, particularly tizanidine (Zanaflex). Consider referral to a provider with experience in treating trigger points and myofascial pain. If myofascial pain is not treated appropriately and underlying predisposing factors are not addressed, it may lead to chronic pain syndromes such as fibromyalgia, through the mechanism of central sensitization.

**Fibromyalgia**

Fibromyalgia is a distinct complex clinical syndrome that belongs to a group of clinical syndromes characterized by chronic pain, called the central sensitization syndromes. The other members of this group include restless leg syndrome, functional gastrointestinal disorders, and chronic fatigue syndrome. Fibromyalgia and other central sensitivity syndromes are characterized by a range of symptoms that include chronic pain, sleep disturbances with decreased rapid eye movement

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**Box 9**

**Trigger points**

<table>
<thead>
<tr>
<th>Feature</th>
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<tbody>
<tr>
<td>Tender ropelike induration in muscle</td>
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<tr>
<td>May produce a twitch response, which is contraction of the muscle, when palpated or needled</td>
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<tr>
<td>May cause restricted range of motion or weakness in the affected muscle</td>
</tr>
<tr>
<td>May cause radiation of pain or paraesthesias in a myotomal distribution</td>
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<tr>
<td>Firm pressure on a trigger point for at least 5 seconds may elicit referred pain in a myotomal distribution</td>
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sleep, other somatic symptoms, and psychological symptoms. The current hypothesis is that these syndromes represent a spectrum of disorders that result in expression of different symptoms over time, as a result of a complex interplay of various psychological, social, and biological factors, called the biopsychosocial model.

According to various studies that evaluated the prevalence of fibromyalgia in patients with musculoskeletal causes of noncardiac chest pain, prevalence ranges between 2.7% and 30%. Both fibromyalgia and noncardiac chest pain seem to share the same pathogenesis of long-standing pain hypersensitivity, which presents as alldynia and hyperalgesia. The other accompanying somatic and visceral complaints are believed to be caused by hypothalamic-pituitary-adrenal axis abnormalities and autonomic dysfunction. Mechanism of central sensitization with somatic or visceral hypersensitivity manifests as noncardiac chest pain in patients with fibromyalgia.

Fibromyalgia is characterized by chronic widespread pain, unexplained somatic symptoms, which include nonrestorative sleep, dysesthesias, cognitive difficulties, dizziness, syncope, dry mouth, and headaches, and psychological symptoms, such as anxiety or depression. Another characteristic feature of fibromyalgia is the presence of specific points of tenderness at 9 symmetric body sites (Fig. 15). It is more common in women, in those 50 years or older, and in those with low educational and household income levels.

Evaluation
History and physical examination are important in diagnosing fibromyalgia. The American College of Rheumatology (ACR) established diagnostic and severity criteria in 1990, which were revised in 2000 (Box 11).

Treatment
Various pharmacologic and nonpharmacologic treatments have been shown to be beneficial in fibromyalgia (Box 12).

A holistic approach that addresses the various symptoms of fibromyalgia including pain, fatigue, sleep, and mood disorders has been shown to be effective and deliver the most effective results in the long-term.

Precordial Catch Syndrome
Precordial catch syndrome is an uncommon condition characterized by episodes of localized, stabbing, or sharp pain catches in the anterior chest, usually in the left parasternal area or near the cardiac apex in healthy young individuals. Pain occurs in a bent-over or slouched position and is increased by deep breathing. It is relieved by shallow respirations and by correcting posture. Local tenderness is absent. The cause is believed to be intercostal muscle spasm caused by postural defects.
Evaluation
Precordial catch syndrome is a diagnosis of exclusion.

Treatment
Reassurance, correcting postural defects, and good pain control are generally recommended.\textsuperscript{3,53}

Epidemic Myalgia
Epidemic myalgia is also called devil’s grip, caused by acute viral illness with pain in the chest wall and epigastrium.\textsuperscript{3} The usual causes are the group B coxsackie viruses, which usually affect intercostal and upper abdominal wall muscles, and rarely the pleura. A prodrome of 1 to 10 days is followed by severe, sharp pain in the lateral chest

<table>
<thead>
<tr>
<th>Box 11</th>
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<tbody>
<tr>
<td><strong>Diagnostic and severity criteria for fibromyalgia</strong></td>
</tr>
<tr>
<td>ACR criteria (1990)\textsuperscript{49}: presence of chronic widespread pain and tenderness at 11 of 18 body sites</td>
</tr>
<tr>
<td>Chronic widespread pain is presence of pain in the upper and lower body, axial skeletal, and left and right sides for at least 3 months, without any history of lesion or trauma to explain the symptoms</td>
</tr>
<tr>
<td>ACR revised criteria (2000)\textsuperscript{50}: presence of chronic widespread pain and a symptom severity scale (includes fatigue, cognitive disturbances, nonrestorative sleep, and other somatic symptoms)</td>
</tr>
<tr>
<td>New criteria offer greater sensitivity for diagnosis of fibromyalgia</td>
</tr>
</tbody>
</table>
Evaluation and Treatment of Musculoskeletal Chest Pain

**Box 12  
Treatment of fibromyalgia**

<table>
<thead>
<tr>
<th>Pharmacologic treatment: for pain control</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Antidepressants: amitryptiline, cyclobenzaprine, fluoxetine^{51}</td>
</tr>
<tr>
<td>- Opiates: tramadol</td>
</tr>
<tr>
<td>- Central nervous system agents: gabapentin, pregabalin</td>
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<tr>
<th>Nonpharmacologic treatment</th>
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<tbody>
<tr>
<td>- Graded aerobic exercise regimen^{52}: helps with pain, avoid overexhaustion</td>
</tr>
<tr>
<td>- Sleep evaluation and treatment: helps with nonrestorative sleep and to correct other sleep problems, such as obstructive sleep apnea</td>
</tr>
<tr>
<td>- Cognitive behavioral therapy: promotes and reinforces positive behaviors, helps with treatment of pain, fatigue, and other somatic symptoms</td>
</tr>
</tbody>
</table>

Treatment of other coexisting symptoms (psychological, somatic, such as gastrointestinal, etc)

wall in adults or the upper abdomen in children. Pain is increased by breathing, coughing, and other thoracic movements and lasts 3 to 7 days, with frequent recurrences.^{3}

**Evaluation**

Diagnosis is usually clinical, with good history and physical examination, with local tenderness of involved muscle groups. Isolation of the virus from the throat or feces or showing increasing titer levels of type-specific neutralizing antibodies can confirm the diagnosis.^{3}

**Treatment**

Symptomatic treatment with good pain control is recommended.^{3}

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**MUSCULOSKELETAL CHEST PAIN RELATED TO THORACIC SPINE**

**Acute Thoracic Disc Herniation in Athletes**

Thoracic disc herniation does not have a typical clinical presentation and most commonly presents as a nonspecific, often acute-onset, midline pain in the thoracic area. It can be unilateral or bilateral. It can be intermittent or constant and may be increased by coughing and straining.\(^{54}\) Radicular distribution of pain depends on the thoracic spinal segment involved and may be followed by sensory and motor disturbances caused by spinal cord compression. The usual cause is believed to be degeneration, although acute trauma has to be considered in young patients, especially in athletes.\(^{54}\)

**Evaluation**

MRI is the imaging of choice and shows thoracic disc herniation.\(^{54}\)

**Treatment**

Conservative management is successful in most patients. Selective spinal root or intercostal nerve blockade and epidural steroid injections are used. If there is no improvement in symptoms after 2 to 3 months, or if there is progression of symptoms with new neurologic deficits, operative treatment is recommended, with a success rate of about 80%.\(^{54}\)

Long-term prognosis is considered to be good, but recurrences of pain and other symptoms are not uncommon. It is important to explain the possibility of recurrent pain to patients, especially young athletes, because it can cause them to prematurely end their sporting careers.\(^{54}\)
MISCELLANEOUS CAUSES OF MUSCULOSKELETAL CHEST PAIN

Herpes Zoster of the Chest Wall

Herpes zoster is caused by the reactivation of the latent varicella zoster virus, which has been dormant in dorsal root ganglion of the spinal cord since the initial chicken pox infection. About 50% of elderly patients older than 80 years are believed to develop this infection over their lifetime. It presents as a vesicular eruption of the skin, and is dermatomally distributed. The rash is usually unilateral and confined to a single dermatome, but involvement of multiple, bilateral dermatomes is seen. Severe pain is a hallmark of herpes zoster and often precedes, accompanies, and follows resolution of rash.

Involvement of thoracic dermatomes, especially in elderly patients, can cause diagnostic confusion with cardiac and pulmonary causes of pain, particularly before development of the rash. Rash usually involves thoracic dermatomes with grouped vesicles and pustules present on erythematous base. Infection typically resolves completely in 4 weeks. Scarring and depigmentation in the area of the rash may be seen.

Evaluation

Diagnosis during the prodromal phase before appearance of skin lesions is difficult. A history of varicella zoster in the past and hyperesthesia and skin tenderness on physical examination that follows a dermatomal distribution are clues to the diagnosis. A dermatomally distributed skin rash with grouped vesicles and pustules on an erythematous base is diagnostic. Clinical diagnosis can be confirmed by Tzanck smear (swabs from the base of the vesicles show varicella zoster virus DNA on polymerase chain reaction testing).

Treatment

Pain control and antivirals are mainstays of treatment.

SAPHO Syndrome

SAPHO syndrome is a chronic disease that is characterized by association of synovitis, acne, pustulosis, hyperostosis, and osteitis. It usually presents with cutaneous manifestations (neutrophilic eruptions, such as palmoplantar pustulosis and hidradenitis suppurativa) and aseptic inflammatory bone lesions with associated findings that include hyperostosis and arthritis of adjacent joints (osteoarthropathy). SAPHO syndrome has a predilection to affect the bony structures of the anterior chest, including

**Box 13**

Characteristics of pain in herpes zoster

- Preherpetic neuralgia: prodromal pain that precedes the development of skin eruption (usually by 4 days)
  - Leads to diagnostic confusion depending on the dermatomes affected
  - Fever, malaise, and skin tenderness over affected area may accompany the pain
- Postherpetic neuralgia: pain that persists or is recurrent more than 1 month after the onset of initial herpes zoster infection
  - More common in elderly women with history of severe prodromal pain and severe skin rash
  - Pain is debilitating and resistant to treatment
  - Zoster sine eruption: prodromal pain is not followed by skin eruption
  - Leads to diagnostic difficulties
the sternum and medial end of clavicle. Anterior chest pain is one of the most common symptoms.69

The pathogenesis of SAPHO syndrome is unclear. One of the proposed mechanisms is a possible autoimmune response triggered by a microorganism producing sterile inflammation in the joints and bones.69–71 Propionibacterium acnes is the most commonly cultured microorganism in skin and bone specimens obtained from patients with SAPHO syndrome.72 Genetic factors and stress are other important factors that are correlated with the syndrome.69–71

Evaluation
Although there are no validated criteria, standard diagnostic criteria agreed on by most clinicians and researchers can be used in diagnosis (Box 15).73

Laboratory findings are nonspecific and include mild leukocytosis, mild anemia, and an increased erythrocyte sedimentation rate. Serum levels of complement C3 and C4 may be increased or normal and serum IgA levels are usually increased.69

Treatment
Symptomatic relief with NSAIDs and analgesics are the mainstay of therapy. Corticosteroids, sulfasalazine, and isotretinoin have been used in some cases. Use of tumor necrosis factor inhibitors (such as infliximab and etanercept) and immunomodulators (such as leflunomide and methotrexate) have been proposed in some studies.69,72,74,75

Box 14
Treatment of herpes zoster

Start treatment with antiviral agents (acyclovir, valacyclovir) within 72 hours of appearance of skin eruption and continue for 7 days65

Postherpetic neuralgia: gabapentin, pregabalin, topical agents (capsaicin cream) and tricyclic antidepressants are commonly recommended59,66

Epidural injections of steroid and local anesthetic are used in selective cases67

Fig. 16. Dermatomal distribution of herpes zoster skin rash. (From Swartz MH. Textbook of physical diagnosis: history of examination. Philadelphia: Saunders; 2009. p. 137–95; with permission.)
SUMMARY

Musculoskeletal chest pain can be a cause of significant morbidity and anxiety for a patient. Better understanding of the various causes of musculoskeletal chest pain can help prevent unnecessary testing and anxiety for patients and ensure timely treatment.

REFERENCES


Box 15
Standard diagnostic criteria for SAPHO syndrome

- Local bone pain with gradual onset
- Multifocal lesions involving long tubular bones and spine
- Failure to culture an infectious microorganism
- Neutrophilic skin eruptions (palmoplantar pustulosis, nonpalmoplantar pustulosis, psoriasis vulgaris, or severe acne)
- Protracted course for several years, with exacerbations and improvement with antiinflammatory drugs

13. Rabey MI. Costochondritis: are the symptoms and signs due to neurogenic inflammation. Two cases that responded to manual therapy directed towards posterior spinal structures. Man Ther 2008;13:82–6.