Imaging evaluation of acquired chest wall masses affecting ribs in adults

Poster No.: C-2168
Congress: ECR 2010
Type: Educational Exhibit
Topic: Musculoskeletal
Authors: E. Romá de Villegas, B. Pellicer, M. Vega, M. Graells, G. Cabrera; Valencia/ES
Keywords: chest wall mass, rib lesion, costal
DOI: 10.1594/ecr2010/C-2168

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR’s endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

* We review and illustrate the radiologic features of a variety of pathologic conditions that cause acquired chest wall tumors involving ribs in adults.

* We focus on conventional radiographs, computed tomography studies (CT) and magnetic resonance imaging (MRI), describing those findings which may help to the differential diagnosis of the underlying disease causing costal chest wall masses, exemplifying with representative cases.

* We also show that both CT and MR imaging give relevant and distinctive information for its correct diagnosis and further treatment.

Background

Ø Ribs inspection is often missed out at chest radiographies. A careful observation must be carried out to discard pathologic findings and recognize normal anatomy, since frequently these are the first imaging studies where a costal lesion is reported, most times incidentally.

Ø Since CT is useful for a further characterization of the lesion, the radiologist must be prepared to recognize the normal anatomy, congenital rib variants (like cervical ribs, fusion) and distinguish them from pathologic conditions; this is crucial for an appropriate diagnosis and management.

The thorax, speaking in terms of skeletal anatomy, is composed by:

- 12 pairs of ribs:
The anterior costal arches end at the costal cartilages, which tend to calcify in patients over 30 years old. Costal cartilages calcification presented earlier may reflect diverse disorders (like thyroid disease, chronic renal failure, chondral tumours).

The posterior costal edge is formed by a head, neck and tubercle.

- 12 thoracic vertebrae
- the sternum

The ribs articulate anteriorly to:

- The manubrium through the costal cartilages of first ribs
- The 2nd - 7th ribs articulate with the manubrium or body of the sternum
- The 8th - 10th ribs form a synchondrosis with the 7th costal cartilage.
- The last two ribs have no anterior articulation to other structures ("floating ribs").

They articulate posteriorly with the corresponding vertebras (through the costovertebral joints).

**IMPORTANT:** in the inferior portion of the rib

there is the costal groove, which contains the intercostal vessels and nerves: we must avoid this area when evaluating possible access to pleural drainages or biopsies [23]

At radiology, chest wall masses involving ribs can be studied with up to four different types of studies:

**Ultrasound:**

Some prominent and superficial chest wall masses [10] can be investigated with ultrasonography. In the long axis, ribs appear as continuous and echogenic lineal structures. On transverse projection, they are watched as curvilinear shapes (bellow soft tissues) with posterior acoustic shadowing. The presence of vascularity and density of different components inside the mass can be visualized.
Plain-film radiograph:

FRONTAL CHEST RADIOGRAPH --- the posterior portion of ribs has a horizontal orientation. Anterior and lateral costal portions are inferior to the costochondral junction.

LATERAL RADIOGRAPHS --- Helpful for visualizing the posterior part of the ribs.

However, chest wall masses are often difficult to evaluate by conventional radiography. In most cases, an adequate evaluation is required using cross-sectional imaging techniques (CT versus MR imaging)

CT scan:

It demonstrates higher spatial resolution, is useful for a further evaluation of these lesions and determines if cortical bone destruction is associated better than MRI. However, MRI is better in detecting soft-tissue invasion and bone marrow's infiltration.

MR Imaging:

It has been demonstrated that MRI allows the detection of muscle, bone, or vascular invasion by chest wall tumours, better than with CT scans. In our studies, images were obtained on 1.5-T imagers with the use of T1 and T2-weighted images in axial, coronal, and sagittal planes.

** T1-weighted images provide more accurately the extent of the mass and invasion of ribs but also other structures [20]**

** T2-weighted images give further characterization of the chest wall mass and presence of adjacent muscle invasion. They also provide a greater differentiation between tumoral, oedematous or normal tissue.**

The advantages of MR imaging include its multiplanar capability, improved contrast among soft tissues, and flow-sensitive pulse sequences [8]. Nevertheless, it has some disadvantages:

- MRI of ribs is not usually performed.
- No standard technique is established, up to know, for the evaluation of chest wall masses.
- Signal void (calcium)
- Artefacts related to breathing.
Primary bone tumors at ribs are unusual, they only represent 5 -10% of all bone neoplasms; they affect the bony skeleton of chest wall and the costal cartilages and may arise from any of the main osseous components. Although chest wall neoplasms are uncommon, there is a wide spectrum of diseases affecting ribs, being metastatic disease the most frequent one followed by multiple myeloma in adults. Rib fractures are also very frequent and a callous formation could mimic chest wall lytic lesions.

However, some thoracic wall masses facilitate a specific imaging appearance suggestive of a particular diagnosis. Chest wall diseases that arise within a rib can be classified in three major groups: primary benign disorders (tumour-like lesions), malign bone tumours (primary neoplasms of the bone and lesions secondary to a cancer extension) and inflammatory-infectious disease (SAPHO, chest wall tuberculosis...)

Imaging findings OR Procedure details

- We review a series of 300 cases of adult patients studied at our radiology department for chest wall masses (non congenital) with rib destruction or involvement. In this exhibit, their radiologic characteristics and morphology are evaluated, correlating CT with MRI and other imaging studies (chest plain radiograph or ultrasound).

- The key radiologic features are indicated in acquired rib masses such as benign processes (bone island, fibrous dysplasia, Paget disease or giant cell tumour), metastases (from subtle costal changes to big masses, either lytic or blastic predominant lesions); primary bone neoplasms (like chondrosarcoma, osteosarcoma and multiple myeloma), Pancoast tumours (or lymphoma) with rib destruction, pyogenic osteomyelitis of ribs, TBC at chest wall and SAPHO between others.

BENIGN PROCESSES or TUMORLIKE LESIONS

1. Bone island:

(Also called enostoses, medullary osteoma or solitary enostosis) [28]
Normally and incidental finding, it is a slow-growth and benign bone-forming tumour and reflects failure of resorption during endochondral ossification [27].

After the pelvis, ribs are the most common location of the bone island. It may mimic osteoblastic metastasis.

1.1 AGE
Common in adult population (over 20 years)

1.2 IMAGING FEATURES

**General and Rx pattern:**

1. Homogeneous, defined and sclerotic focus in the cancellous bone (spongiosa) with distinctive radiating bony streaks ("**thorny radiation**") from the centre of the lesion, conforming a brush-like border.
2. The long axis of the bone island is aligned parallel to the long axis of the bone.
3. Reaching up to 3 cm in size.

**CT scan:**

- Low-attenuation lesion.
- Round-to-ovoid intramedullary focus.

**MRI:**

- Low signal intensity in T1, like cortical bone.
2. Rib Fracture on page 30:

Fractures are the most common lesions to affect the ribs overall. [23]

Acute fractures may be radiographically not visible or subtle on CT scan.

2.1 IMAGING FEATURES

**General and Rx pattern:**

1. Cortical interruption in one or both sides of the cortex.
2. **Callus formation** over a past rib fracture
3. The callus formation (about a healing rib fracture) may resemble a pulmonary nodule.
CT scan:
- Fracture lines, osseous fragments.
- Associated complications (hemothorax, pneumothorax, lung contusion)
- Sclerotic or osteolytic bone foci related with callus formation.
- Residual cortical deformity may be evident

3. Fibrous Dysplasia:

It comprehends nearly 30% of benign processes arising from ribs in chest wall [9]. Normally appears as a slow-growth asymptomatic mass, caused by a bone developmental alteration that affects osteoblasts maduration, resulting in fibrous tissue proliferation in bones. [24]

3.1 IMAGING FEATURES

General and Rx pattern:

1. Often allocated lateral or posterior in the rib, it can be monostotic or polyostotic.
2. Expanding lytic lesion with a trabeculated centre and cortical thinning.

CT scan:
- Bone expansion and lytic foci, cortical thinning, and modelling deformity.
- Ground-glass matrix when it calcifies. It can progress to a sclerotic lesion.
**Fig.**: Fibrous Dysplasia. Case 1

**References:** E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN

4. **Haemangioma:** on page 34

It is an uncommon benign lesion at bones.

4. 1 **IMAGING FEATURES**
   1. Radiolucent and well-defined image
   2. Typically trabecular pattern which may cause cortical thinning. Nevertheless, biopsy or surgical excision is often necessary for a precise diagnosis.

**MRI:**

- T1 and T2-weighted imaging: hyperintensity due to fat component.
- Contrast enhancement MRI: high signal intensity related to its present vascularity.

5. **Tuberous Sclerosis**: on page 35

Neurocutaneous syndrome (autosomal dominant inheritance), manifesting as: *central nervous system tumours, multiple hamartomas and developmental delay*. It is as well a cause of increase bone density. [24]

Differential diagnosis when there is rib involvement includes rib fractures, fibrous dysplasia, chronic infection, and post-surgical rib changes.

5.1 IMAGING FEATURES

- Multiple expansive and sclerotic lesions in ribs.

6. **Condroma**:

It usually appears at the chondrocostal junction.

6.1 IMAGING FEATURES

- Area of expanding pattern ("in iceberg") with cortical thinning (although no disruption)

7. **Paget disease** on page 36:

Metabolic disorder resulting in an increased bone resorption and formation; this leads to thickening and fragility of the affected bones.

It only involves the ribs in 1-4% of cases. [23]

Eventual complications include: rib fracture, degenerative joint disease or sarcomatous degeneration.
7.1 AGE  
Elderly people.

7.2 IMAGING FEATURES

- Radiographically three phases are distinguished:

1st >>> Lytic or initially active phase: lytic and well-defined foci, normally starting at the edge of the bone.

2nd >>> Sclerotic or active phase: unstructured thickening of osseous trabeculae.

3rd >>> Mixed or late phase (areas with mixed osteolytic and sclerotic pattern)

**Fig.**: Paget disease  
**References:** E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN
8. **Giant cell tumour** on page 37:

Also called *osteoblastoclastoma, osteoclastoma* or *myeloid sarcoma*. GCT occurring in ribs is quite unusual. It is considered a benign tumour, however 10% result to be malignant (manifested as post-treatment recurrence or pulmonary metastases). It is composed by vascular sinuses (lined or with abundant giant cells)

8.1 **AGE**

Adult patient between 20 and 50 years of age.

8.2 **IMAGING FEATURES**

**General and Rx pattern:**

1. Unique mass at the metaepiphysis with a lytic pattern.
2. Normally eccentric location in the bone.
3. Usually reaches the articular superficie (extending to subchondral bone) and cortical thinning may be seen.
4. 14% of GCT have a cystic component (*secondary aneurysmal bone cyst: OAQ*)
5. Well-defined margins
6. Some of them show a prominent trabeculation and a resultant multiloculated appearance.

**CT scan:**

- Useful (along with MRI) in determining soft-tissue extension.
- Also the osseous expansive remodelling and thinning of the cortex can be reported.
- Pathologic rib fractures and periosteal reaction are possible secondary findings.

**MRI:**

- Well-defined lesion with a low-signal-intensity borders, due to a bone sclerosis or a pseudocapsule.
- Areas of GCT: *hypointense* signal at T1 and hyperintensity at T2 -weighted images
- OAQ areas: *hypo-isointense* at T1-weighted and *high signal intensity* at T2-weighted.
Fig.: Giant cell tumor 3

References: E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN

9. **Osteoblastoma** on page 40:

It is a benign and rare tumour, histologically similar to *osteoid osteoma* but with a locally aggressive behavior. Certain authors consider it a Giant Osteoid osteoma.

9.1 **AGE**
Predominantly young adults (mean patient age of 20 years)

9.2 **IMAGING FEATURES**

**General and Rx pattern:**
1. Lytic and expansile lesion at the rib with bone production.
2. It resembles a large osteoid osteoma, with the characteristic radiolucent nidus (sometimes with central calcification) and surrounding reactive bone.

**CT scan:**

- Confirms the presence of a central nidus and matrix mineralization.

**MRI:**

- Better detects reactive marrow and soft-tissue edema.
- Defines soft-tissue extension.

---

**Fig.** Osteoblastoma III

**References:** E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN
10. Osteochondroma/exostosis:

Unique or multiple, it is a slow-growth lesion at the cortical of ribs. It is covered by cartilage and can potentially malignize to a chondrosarcoma or an osteogenic sarcoma.

10.1 IMAGING FEATURES

- At frontal radiographies it is typically seen as a mass at the rib with an associated distorsioned cortical.
- A thin border of calcification is present.

PRIMARY MALIGNANT BONE NEOPLASMS

Malignant lesions at ribs have some common characteristic at MRI which may help to their diagnosis: they tend to have irregular margins and most show heterogeneous signal intensity (predominantly hypointensity on T1-weighted: iso-hyperintensity on T2-weighted images)

1. **Chondrosarcoma on page 45:**

It is the most common primary (malignant) neoplasm at ribs.

Slow-growth tumour arising typically at the chondrocostal junction, as well as in the anterior chest wall and the first five ribs.

* **Secondary chondrosarcomas**: may arise from previous benign disorders such as Paget disease, fibrous dysplasia or exostosis.

1.1 AGE

Usually over 40 years of age.

1.2 IMAGING FEATURES
**General and Rx pattern:**

1. Large, lobulated and lytic destructive mass which contains scattered flocculent, stippled, or ring- and arclike **calcifications** (corresponding to the cartilaginous matrix) [23].

2. **Size** is useful for its differentiation from benign chondral lesions, considering malignant those ones **larger than 4cm.** [9]

**MRI:**

- T1-weighted imaging: signal intensity similar to muscle

- T2-weighted imaging: hyperintensity of a multilobulated anterior chest wall tumour; areas of **signal void** due to calcification at the chondroid matrix.

- Contrast enhancement is usually patchy with occasional high signal intensity of the periphery.

**Fig.:** Chondrosarcoma II

**References:** E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN
2. Osteosarcoma on page 50:

It is the most frequent primary malignant tumour in bones, and is a result of neoplastic new bone or disorganized ossification.

2.1 AGE
Generally young adults (under 30 years)

2.2 IMAGING FEATURES

**General and Rx pattern:**
- Mixed lytic and sclerotic pattern (produced by rib destruction plus neoplastic new bone altogether); occasionally they are completely lytic.

**CT scan:**
- Typically: mass with matrix mineralization dominant at the centre and decreasing towards the periphery.

**MRI:**
- T1-weighted images: higher intensity than muscle
- T2-weighted images: iso-hyperintensity signal.
- *Signal void* present when there is a dense matrix mineralization [7]
3. **Myeloma on page 53:**

Monoclonal neoplasm (involving plasmatic cells) arising from the bone marrow, associating in certain occasions with non-skeletal alteration.

3.1 **AGE**

Usually between 40 to 80 years old.

3.2 **IMAGING FEATURES**

**General and Rx pattern:**
1. Pattern of presentation can be unique (plasmacytoma) or multiple (multiple myeloma).
2. Well-defined "punched-out" lytic and diffuse appearance, with soft-tissue mass associated.

**CT scan:**
- Appears as a soft-tissue attenuation similar to muscle.
- *Certain enhancement* following iv contrast administration.
- It has been probed to be superior to MRI in detecting cortical breaches.
- Two possible patterns:
  *Acute myeloma* >> image of "soap bubble" pattern
  *Chronic myeloma* >> grosser pattern of dense and thickened bone trabeculae, resembling Paget disease.

**MRI:**
- T1-weighted images: uniform signal hypointensity.
- T2-weighted images: uniform high signal.
- When **multiple myeloma** progress, it extends to the surrounding soft-tissue.
- Sensitivity may improve by using a STIR (short-inversion-time inversion recovery) and contrast-enhanced fat suppressing techniques.
Metastatic disease is the most common malignant (non primary) rib lesion; 16% of metastasis involve the ribs.

**AGE**
Pathology to be considered at lytic lesions (even with an apparent benign radiographic aspect) in patients over 40 years of age

**IMAGING FEATURES**
- Rib metastases may be osteolytic, sclerotic, or mixed.
- Rib destruction and soft-tissue masses are associated in advanced cases.

- Usually the primary neoplasm is in the breast, kidney, prostate gland or lung, manifesting as lytic lesions (from hematogenic spread).

- Multiple sclerotic metastases in a male patient probably belong to a prostate cancer. on page 55 Diverse sclerotic focus in a woman may come from a breast cancer.

- Lytic-expanding metastases typically have a renal or thyroid origin.

Fig.: Metastases from cecal Cancer I

References: E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN

PANCOAST TUMORS WITH RIB DESTRUCTION

The most common cause of a Pancoast tumour on page 63 is an apical lung carcinoma; a Pancoast tumour is located at the superior sulcus and derives in invasion,
through the apical fat, of the brachial plexus, cervical sympathetic ganglia, and superior mediastinum.

Several tumours may occur in the mentioned sulcus (metastases, lymphoma, breast cancer, multiple myeloma,..) producing the Pancoast syndrome. **Pancoast syndrome** consists of: *Horner syndrome* (ptosis, miosis, enophthalmos, and anhidrosis), *hand musculature weakness/alteration* and *ipsilateral arm pain*. [23]

**IMAGING FEATURES**

MRI has been show to be more accurate than CT in evaluating Pancoast tumours, demonstrating extension into the bony thoracic wall; this is due to its multiplanar capability and precision for detecting subtle differences in soft-tissue contrast. [8]

However, the use of a **64-multislice CT scan** (along with multiplanar reconstructions) is generating an increasing sensitivity in this modality.

---

**Pancoast tumor with rib destruction**

*Same patient. (c) T1-weighted, (d) T1 TSE weighted, (e) STIR and (f) diffusion-weighted MRI better show the extension of the tumour to the chest wall and oedematous area at adjacent soft-tissues.*
CHEST WALL INVASION FROM LUNG CANCER on page 66

In patients with a lung neoplasm at other sites apart from the lungs apex, invasion of ribs adjacent to the tumour may occur due to a contiguous spread, resulting in cortical destruction.

IMAGING FEATURES

CT scan:
- Rib destruction is the best sign of chest wall invasion (well detected by means of CT).
- CT does not identify fat planes as MRI (loss of the normal extrapleural fat layer is suggestive of chest wall invasion)
- When CT reveals rib destruction, no further studies are required to prove it.

MRI:
- T1 / T2-weighted MRI: heterogeneous signal intensity of an intrathoracic mass with chest wall component. [19]
- Rib invasion: T1- / T2-weighted images show the cortex breached or abnormal signal intensity in the marrow cavity.

INFLAMMATORY - INFECTIOUS DISEASE

Clinical and laboratory findings may occasionally help and orientate to an infectious or inflammatory origin. This must be remembered since chest wall infections are uncommon but potentially life-threatening pathologies.

1. Pyogenic osteomyelitis of ribs:
Pyogenic infection is mainly caused by *S. Auerus and P. Aeruginosa* [3]. It usually derives from a subjacent focus of pneumonia, trauma or empyema. Haematogenous spread is extremely rare, and when it occurs, it places near the chondrocostal junction or posteriorly near the rib angle.

1.1 IMAGING FEATURES

**General and Rx pattern:**

1. Rib lesion occasionally with a thick and not well-defined sclerotic periphery.
3. *Chronic osteomyelitis*: periosteal reaction or **bone sequestrum**.

**CT scan:**

- It better demonstrates if *rib destruction* is present.
- Utility to guide an eventual aspiration or drainage.

**MRI:**

- Both CT and MRI are helpful in evaluating infections, so the choice of the imaging modality will relay on the clinical question to be addressed. [8]
- **Soft-tissues involvement and inflammation** of the chest wall are better visualized.

2. **Chest wall TBC on page 71:**

Tuberculosis is the most common origin of an infectious disease at ribs; chest wall TBC comprehends 5% of all cases of osteoarticular TBC. However, in patients with *heroin's addiction* history, ribs are the most commonly involved bones. [21]

It derives from an adjacent pleural disease, empyema or due to hematogenous dissemination.

2.1 IMAGING FEATURES

- **Juxtacortical soft-tissue mass**, it may present peripheral ring contrast enhancement.
- Rib destruction (occasionally with costal cartilage involvement)

- Possible calcification area present.

- CT and MRI are useful at depicting chest wall abscesses and cutaneous sinus tracts.

**Fig.**: Chest wall TBC. III

**References**: E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN

**3. SAPHO syndrome**:

It refers to the osteoarticular manifestations of psoriasis disease:

*Variety of bone and joint lesions* (hyperostosis, and osteitis)

*Synovitis*
3.1 IMAGING FEATURES

Osteoarticular pathology at SAPHO commonly arises at the upper anterior chest wall: sclerotic foci, hyperostosis, arthritis of the adjacent joints.

4. **Hydatid disease** on page 75:

Although it primarily affects the liver, hematogenous dissemination is possible in almost any anatomic location, including bones [14].

There is bone involvement in 0.5-4% of hydatid disease, being relatively uncommon on ribs. At the bony chest wall, the parasite replaces the normal tissue between trabeculae and if progresses it may result in a cortical destruction.

IMAGING FEATURES

**General and Rx pattern:**

1. Different-sized lytic areas, sometimes confluent.
2. Lesion growth causes: cortical thinning, breaking of the cortex and extension to the surrounding soft tissues
3. Calcification of intraosseous cysts is very rare.

**CT scan:**

- Cystic-lytic mass (unusual with a calcified margin) within a rib.
**Fig.**: Hydatidosis II

**References**: E. Romá de Villegas; Department of Radiology, Hospital Dr. Peset, Valencia, SPAIN

**Images for this section:**
**Fig. 1:** Bone island. Case 1. I

(a). **Bone island** seen as a nodular opacity projected at the anterior portion of the 2nd rib, detected at a frontal chest radiograph.  
(b). CT scan. A very sclerotic focus which correlates with radiograph finding.
Fig. 2: Bone island. Case 2. I

(a). Irregular opacity projected over the anterior portion of the sixth rib of the right side. (b). Thoracic CT for other underlying pathology study confirmed the diagnosis of a bone island or medullary osteoma.
Fig. 3: Bone island. Case 2. II
Fig. 4: Costal fracture
Fig. 5: Fibrous Dysplasia. Case 1

Multiple expanding foci in costal arcs. Sclerotic borders and soft tissues content are seen. Location and imaging features suggest a non-aggressive lesion like fibrous dysplasia.
Fig. 6: Fibrous Dysplasia. Case 2

(a). Partial chest radiograph: expanding lytic lesion in left rib.

(b). CT scan confirmed the existence of a expanding lytic process with a ground-glass matrix, corresponding with fibrous dysplasia.
Fig. 7: Fibrous Dysplasia. Case 3

CT in another patient; lytic and expanding area with sclerotic margins in the right rib. The interior of the tumour is solid and partly calcified (arrows)
Fig. 8: Haemangioma

(a). Plain film: expanding area within a left rib with trabecular pattern

(b). T1-weighted image of MRI. The costal haemangioma is highly intense due to the fat component. Also low intensity signal points are seen, produced by the abundant trabeculation in the bone and presence of small vessels.
Fig. 9: Tuberous sclerosis

CT study in a patient with tuberous sclerosis: diverse areas of sclerotic lesions are obvious at osseous structures including costal wall.
Fig. 10: Paget disease

(a). Gammagrapy of a costal lesion with intense captation; (b). Radiograph shows this portion of the left rib thickened and sclerotic. Findings concordant with Paget disease.
Fig. 11: Giant cell tumor 1
Fig. 12: Giant cell tumor 2

(a) Same patient, T1-weighted dynamic MRI shows the GCT as an heterogeneous chest wall mass with isointense areas due to the aneurismal bone cyst. (b) In a T2-weighted MR image there are foci of high intensity of signal related to the cyst component.
Fig. 13: Giant cell tumor 3

Same patient, a STIR MR imaging (short inversion time inversion recovery), designed to suppress signal from fat, still shows heterogenous areas of high intensity related with the cyst component of the Giant cell tumor.
Fig. 14: Osteoblastoma I

Frontal chest radiograph: this osteoblastoma appeared as a lytic and expansive lesion of the fifth left rib, with a central area of sclerosis (red arrows).
**Fig. 15:** Osteoblastoma II

Same patient. Axial CT scan image which confirms a tumour in the posterior part of the rib. This lesion is osteolytic, with expansion and a calcified centre. Reactive sclerosis in the rib (arrows) Findings are suggestive of an osteoid osteoma although due to its size bigger than 1cm it must be considered a **osteoblastoma.**
Fig. 16: Osteoblastoma III

(a). T1-weighted MR image shows low signal intensity of the lesion. (b) T2 EG weighted: presence of a central calcification is confirmed (blue arrow). (c) STIR sequence images where peritumoral oedema is visualized (red arrows) at the rib, adjacent soft tissues and left transverse apophysis. This oedema is characteristic of certain tumours with Prostaglandin production, like the Osteoblastoma.
**Fig. 17:** Osteoblastoma IV

*Dynamic Contrast Enhanced MRI*. The analysis of the dynamic curve reveals an important and early enhancement of the tumour, even before than arterial enhancement. This finding is identified in some benign tumours.
**Fig. 18:** Osteoblastoma V

Same patient. Late study, iv contrast MRI, shows progressive enhancement of bone structures and soft tissue adjacent, produced by the intense inflammatory reaction of the tumour. The osseous involvement correlates with the periostic reaction at previous CT images.
Fig. 19: Chondrosarcoma I
Fig. 20: Chondrosarcoma II

(a) T1-weighted MRI and (b, c) STIR MRI: mass composed by little foci corresponding to cartilage, which show the distinctive high signal intensity of cartilaginous tumors at STIR. The areas with low signal intensity at both sequences belong to calcium (arrows).
Fig. 21: Chondrosarcoma III

Same patient, Dynamic Contrast Enhanced MRI. There is early enhancement of the tumour, very similar from the arterial enhancement curve. This enhancement curve suggests the diagnosis of malignity in cartilaginous tumours.
Fig. 22: Chondrosarcoma V
Fig. 23: Chondrosarcoma IV
(a). Ultrasound of a chest wall mass reveals the existence of a tumour at the 12th left rib with calcium inside and peripherally. It has a partial anechogenic component.

(b, c) The lesion appears to be vascularised.
Fig. 25: Osteosarcoma II
Fig. 26: Osteosarcoma III

Same patient. (a) T2-weighted image, (b) T1-weighted Dynamic Contrast Enhanced MRI and (c) STIR MR image show this osteosarcoma as a solid and multiloculated mass in the rib, with homogeneous contrast enhancement (arrows).
Fig. 27: Myeloma I

(a) A high density mass was incidentally found projected over the left chest wall (b). Further CT scan showed a lytic and expanding lesion. Multiple myeloma was later demonstrated.
(c, d). Same patient undergone a MRI study, which revealed multiple skeletal lesions, including vertebrae, with similar imaging characteristics. Multiple myeloma was later confirmed.

Fig. 28: Myeloma II
Fig. 29: Metastases from Prostate Cancer. Case 1. I

(a, b). Frontal and lateral radiographs incidentally showed diverse areas of increased bone density. (c). CT scan confirmed the existence of increased bone density lesions, mainly sclerotic, in multiple ribs and vertebrae.
Fig. 30: Metastases from Prostate Cancer. Case 1. II
Fig. 31: Metastases from Prostate Cancer. Case 2.

Other patient.
CT scan, axial image: there is diverse bone involvement, mainly osteoblastic, at multiple ribs (and also iliac bone). This finding suggests a metastatic disease, which turned out to be related with a prostate gland cancer.
Fig. 32: Metastases from cervix cancer I

(a) Plain chest film shows multiple nodular costal lesions corresponding to metastases from cervix cancer. (b) CT axial view shows one of these lytic lesions at the 6th left costal arch; there is also a lytic mass at the left scapula. This patient associated as well osteoblastic images at the axial skeleton and ribs.
Fig. 33: Metastases from cervix Cancer II
Fig. 34: Metastases from GIST rectal cancer
Fig. 35: Metastases from cecal Cancer I
(d). T2-weighted and (e, f) STIR sequence MR images confirm the presence of multiple chest wall metastasis with pleural infiltration. There is furthermore a soft-tissue mass extending towards the left transverse apophysis.

**Fig. 36:** Metastases from cecal cancer II
Fig. 37: Pancoast tumor I

(a). Frontal radiograph: mass at the left pulmonary apex.

(b). CT scan: left apical mass (Pancoast tumour) with marked invasion of chest wall and destruction of 2nd and 3rd ribs.
Fig. 38: Pancoast tumor II

Same patient. CT coronal images show the Pancoast tumour at the left apex with thoracic wall invasion. CT scan proved that there was neither infiltration of other bone structures (apart from ribs) nor involvement of the subclavian vessels or brachial plexus.
Fig. 39: Pancoast tumor III
Fig. 40: Lung cancer I

(a, b). Frontal and lateral radiographs of a mass, with aggressive appearance, in the upper right lobe.

(c). CT axial view: right lung tumour with posterior pleural irregular thickening and cortical disruption of the adjacent rib. Patchy consolidations and ground-glass areas where also found due to an obstrusive pneumonitis.
Fig. 41: Lung cancer II

(d) T2/TSE coronal image and (e, f) T2-weighted/SPAIR axial and coronal images were used to better determine the presence of chest wall invasion including pleura and ribs.
Fig. 42: Lymphoma invasion I
Fig. 43: Lymphoma invasion II

Same patient. (c) STIR MR image with axial view and (d) spin-echo T1-weighted coronal MRI show accurately an important mass with invasion of chest wall tissues and ribs involvement.
Fig. 44: Lymphoma invasion III
Fig. 45: Chest wall TBC. I

(a) Frontal and (b) lateral chest radiograph show a diffuse opacity projected at the right lung due to a prominent chest wall mass.
Fig. 46: Chest wall TBC. II

Same patient. (c, d) Ultrasonography: transversal images show a big, heterogeneous and solid mass with some vascularity. (e) CT scan: right thoracic anterior mass with destruction of the rib.
Fig. 47: Chest wall TBC. III

Same patient. (f, g, h) CT scan: axial and coronal images show the mass at the right rib but also diverse vertebral affection. Clinical and analytical values suggested a possible infectious origin. Patient was immunocompromised.
Fig. 48: Chest wall TBC. IV

Same patient. (l, j) T1-weighted Dynamic enhanced MRI show the concomitant vertebral lesions with marked soft tissues component. (k) T2-weighted and (l) STIR MR imaging confirmed multiple vertebral lesions with high signal intensity. **Tuberculosis** was the cause of the infectious disease.
Fig. 49: Hydatidosis I
Fig. 50: Hydatidosis II

Same patient. (a) T1-weighted TSE dynamic contrast enhanced MRI: regular and ovoid mass within the posterior portion of the 10th right rib. (b) T2-weighted image: high signal intensity at the ovoid and well defined lesion, corresponding to a hydatid cyst. Diverse hydatid cysts where visualized at multiple ribs.
Conclusion

# The differential diagnosis for chest wall acquired masses in adults includes diverse disorders. Several of these diseases affecting ribs show distinctive characteristics at CT or MR imaging, allowing the radiologist to suggest a diagnosis approach and help guide the correct treatment.

# While CT study is better determining the cortical bone destruction, MRI shows more accurately the presence of infiltration and extent of masses in soft tissue. Moreover, in lung cancer with suspect of chest invasion, MRI may show rib destruction unapparent in CT studies.

Personal Information

References


2. "Fundamentos de la radiología del esqueleto" HELMS

3. "Keep your eyes on the ribs: the spectrum of normal variants and diseases that involve the ribs" September 1999 RadioGraphics; Adam R. Guttenaqt, Julia K. Salwen.


5." Patología Estructural y Funcional", 2a edicion 1984. P. Robbins S. C


8. "CT and MR imaging evaluation of chest wall disorders". Radiographics May 1994


Am. J. Roentgenol., Jun 1987 AM Haggar, JL Pearlberg, JW Froelich, DO Hearshen, GH Beute, JW Lewis

21. "Helical CT of Rib Lesions: A Pattern-Based Approach ", AJR 2004 Michel De Maeseneer, Johan De Mey, Leon Lenchik, Hendrik Everaert and Michel Osteaux


