International Journal of Radiology Research
www.radiologyjournal.in
E-ISSN: 2663-4562, P-ISSN: 2663-4554
Received: 07-12-2024; Accepted: 06-01-2025; Published: 21-01-2025
Volume 7, Issue 1, 2025, Page No. 5-8

Radiological overview of chest wall malignant mass lesions

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Abstract
Background: Malignant chest wall mass lesions are consider rare, it represent only 5% of the thoracic neoplasm, they divided into primary and secondary according to their origin, primary masses originates from osseous, soft tissue, cutaneous or nerve sheath, while the secondary mass lesions occur as direct invasion from lung or breast masses, metastasis from distant tumors, it can be part of systemic disease such as lymphoma or as a complication or radiation.
Aim: To evaluate the role of imaging in diagnosis, prognosis and follow up of patients with malignant chest mass lesions, discuss the radiological characteristics of different chest mass lesions and determine if representing malignant or benign lesion.
Method: Our study will collect data and reports of patients with malignant chest wall mass lesions at King Hussein Medical Center, Amman Jordan during the 2023-2024 period.

Keywords: Chest wall, mass lesion, malignant neoplasm

Introduction
Malignant chest wall mass lesions are rare, they represent only 5% of thoracic malignancies, the majority of the chest wall tumors are malignant. they can be primary which arises from the chest wall or more commonly secondary from direct invasion or metastasis from distant tumor.

Materials and methods
this is retrospective study which is performed at Radiology department at King Hussein hospital of the Royal Medical Services, for 21 patients of both genders with ages between 3-77 years, presented with chest wall mass lesions during 2023-2024. Chest CT scans or and Chest MRI with and without IV contrast were done with no specific exclusion criteria. patients preparation prior to exam included kidney function test, anesthesia for patients less than 6 years were done to prevent motion artifacts during MRI examination. Images were viewed at the PACS station and multiplanar reconstruction and 3-dimensional reconstruction reformat was applied. The patients images were reviewed by two body imaging radiologist, then the results analyzed by simple statistical methods.

Results
This study included 21 patients, with 13 (61.9%) males and 8 (38.1%) females, the ages ranged between 3-77 years with median age of 40 years. the most common symptom was chest pain seen in 11 (52.3%) patients followed by palpable mass in 6 (28.5%) patients, 4 (19%) female patients were known case of breast cancer with chest wall invasion. the most common tumor was metastasis seen in 9 (42.8%) patients, followed by chondrosarcoma seen in 5 (23.8%) patients, followed by ewing sarcoma seen in 3 (14.2%) patients, the other 4 (19%) cases include two multiple myloma patients, one liposarcoma and one humerus bone osteosarcoma with chest wall invasion.

Discussion
The chest wall is consist of bones, muscle and joints, malignant chest wall neoplasms can arise from the bone, soft tissue or cartilage, it is heterogeneous group of neoplasms and usually presented as a large, palpable and rapid growth masses, unlike benign chest wall masses they are symptomatic and the most common symptom is chest pain.

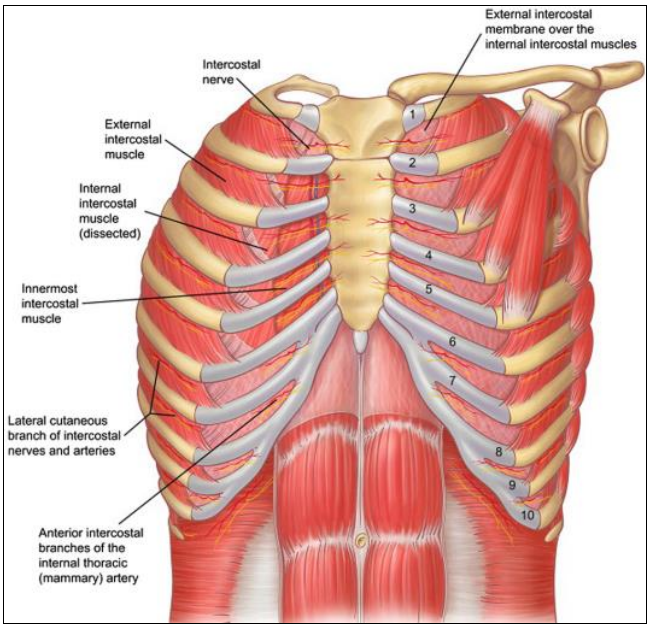

Fig 1: Anatomy of the Chest wall showing bones, muscles and joints.

Primary malignant chest wall lesions are generally classified into soft tissue tumors that include adipocystic, fibroblastic and fibrohistiocytic. other types include peripheral nerve sheath tumors, vascular tumors and cutaneous neoplasms (melanoma). While the secondary subtype includes metastatic disease, invasion by adjacent cancer such as lung or breast cancers, lymphoma and post radiation chest wall malignancy.
Chest wall tumors can be detected by chest radiograph initially, then chest computed tomography (CT) and

magnetic resonance imaging (MRI) with intravenous contrast materials are considered the modality of choice, the first step is to differentiate between benign and malignant tumors and in cases of malignancy multi disciplinary teams meeting is necessary for further workup and treatment approach.

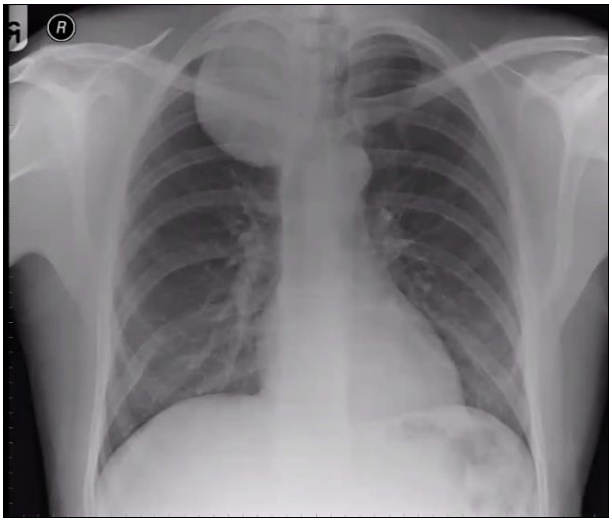

Fig 2: Posterior chest wall soft tissue mass lesion on chest radiograph

The chest radiographs can be used to determine the location, size of the chest wall mass lesion, presence of bony cortical destruction, tumor matrix such as calcification or ossification, serial radiographs can be used to detect the growth rate of the chest wall malignancies. The most important finding in the radiograph is the incomplete border sign which defined as well defined and ill-defined border of the tumor indicating extra pulmonary tumor location. Sometimes features of malignant chest wall mass can be nonspecific or it can be small in size which cannot be detected by the radiograph.

Computed Tomography (CT) enables more accurate information about the tumor characterization, it identify the site of the tumor, the origin of the tumor which can be from soft tissue such as fat, muscle and skin or it can be from bone and cartilage. CT scans is superior to conventional radiographs in detection of the tumor internal components and matrix such as calcification or presence of fat, the tumor vascularity can be seen by the post intravenous contrast material images. the disadvantages of the CT scans include the use of ionizing radiation, inability to give intravenous contrast in end stage kidney disease patients.

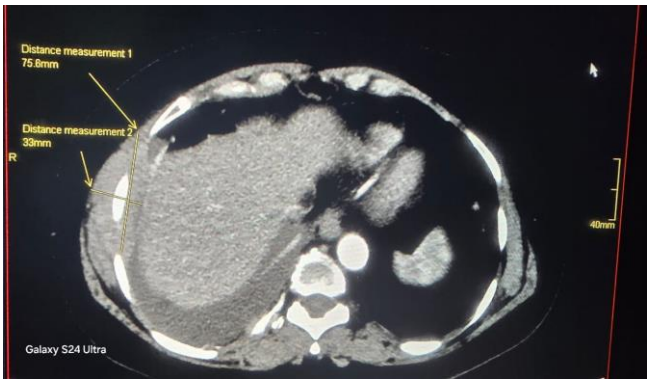

Fig 3: Chest CT with intravenous contrast shows right chest wall soft tissue mass lesion surrounding the right rib.

Magnetic Resonance Images (MRI) proved superior soft tissue contrast in comparison with the CT scan images, the MRI is considered the modality of choice to determine the extension of the chest wall soft tissue mass lesion, the use of the intravenous contrast material can be used to differentiate between malignant lesion and nonmalignant normal chest wall structure, in the setting of post treatment intravenous contrast material used to identified residual lesion post to surgery or chemotherapy and to exclude recurrence of the tumor, MRI is optimal to rule out the presence of inflammation or infection which can mimic the malignancy.

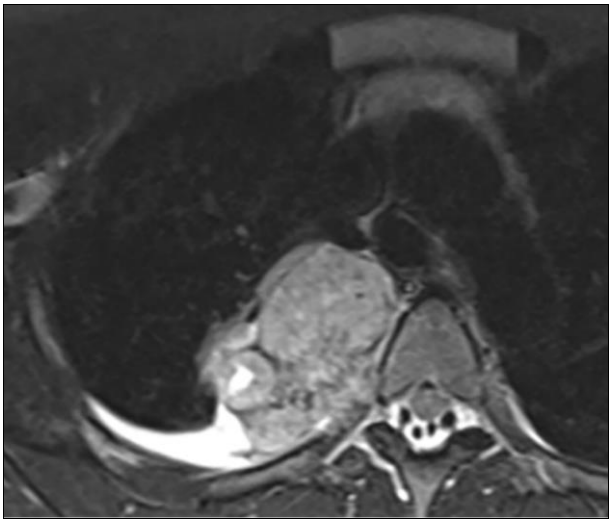

Fig 4: Axial T2 MRI showed lobulated soft tissue mass lesion in the right posterior chest wall.

The standard sequences of MRI in cases of malignant chest wall lesions includes axial T1 and T2 with T1 coronal and sagittal reformations, gradient echo MRI sequence also known as T2* used to reveal blooming artifacts which is caused by hemosiderin components in the lesion, the short TI inversion recovery sequence also known as STIR is used also for masses with increased water content, fast spin echo technique with cardiac gating and respiratory compensation is beneficial to reduce motion artifacts and minimize image timing.

MRI coils are used to improve the signal of the images and enhance the quality of the sequences, the surface coil is typically used in cases of superficial chest wall mass lesions, while the torso coils used in cases of deep chest wall masses and to determine intra thoracic cavity extension, the spine coil is used when there is involvement of the dorsal vertebra or posterior spinal elements.

The limitation of MRI modality is being not optimal for evaluation of bony involvement or define the matrix or mineralization of osseous mass lesions in which CT scans are best, the other thing that the MRI is consider operator dependent in cases of malignant chest wall lesions which mean it depend on the technician experience.

Nuclear modality of positron emission tomography (PET/CT) will show increase in the FDG uptake in the chest wall malignant lesions, and can be used to detect any further FDG uptake elsewhere in the body representing metastatic deposits, as in MRI it can be used in cases of post treatment to assess response of tumor to therapy and to rule out recurrence of the malignancy.

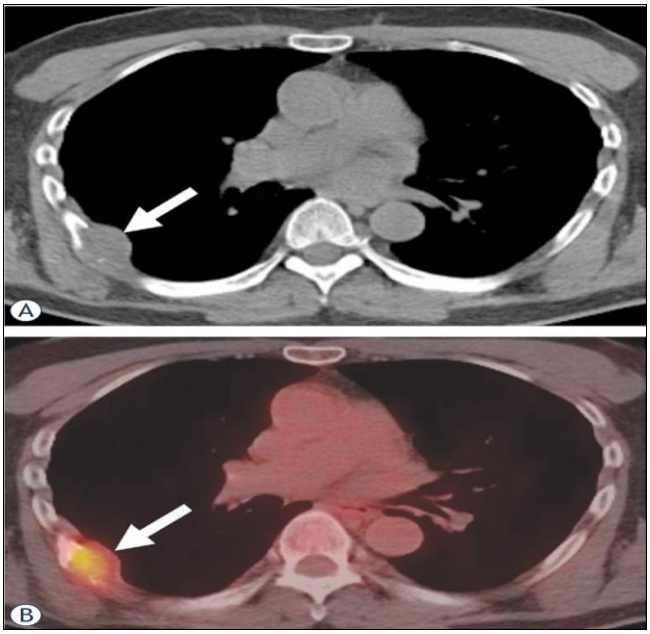

Fig 5: (A) Chest CT showed right rib mass lesion with rib destruction, on (B) the PET/CT showed increase FDG uptake.

Ultrasonography is not routinely performed in the workup of chest wall malignant lesions, but can be used to guide needle biopsy in cases of superficial mass lesion.

When a chest wall mass lesions is diagnosed the most important step is to determine if it is benign or malignant lesion, if the mass lesion showed invasion of adjacent structure or presence of pulmonary or hepatic deposits both are consider pathognomonic for malignant nature of the mass lesion, the osteiod or chondroid matrix (mineralization) within the mass lesion or extra osseous soft tissue mass lesions are malignant findings seen in cases of osteosarcoma and chondrosarcoma of the chest wall. Benign lesions will not cause any invasion of the adjacent structure, the ground glass matrix seen in cases of fibrous dysplasia and the rings and arcs matrix seen in cases of enchondroma is considered benign matrix.

Ewing sarcoma and Askin tumors are considered highly aggressive tumors, both tumors are the most common malignant chest wall in children and adolescent age groups, on CT scans they appears heterogeneous due to central necrosis, cystic changes or hemorrhage, calcification are rarely seen in these tumors, invasion of the adjacent structure is commonly seen with these tumors, in MRI they show heterogeneous signal in T1 and T2 MRI due to internal necrosis and hemorrhage, they show avid and heterogeneous enhancement after giving of intravenous contrast materials, they will also show increase in the FDG uptake in the PET/CT scans.

Pedunculated chest wall mass lesions which showed well defined continuity with medullary cavity or the cortex of the affected bone is diagnostic of osteochondroma, in osteochondroma cases further evaluation of the cartilaginous cartilage cap is mandatory to rule out malignant transformation which is diagnosed when it measures more than 2 cm.

Masses with fat density (hounsfield unit between -10 and -110 HU) at the CT images which showed uniform high T1 signal within the MRI with homogenous loss of signal in the fat suppressed MRI sequence is diagnostic for benign chest wall lipoma, however malignant liposarcoma can show fatty density in addition to internal septations and soft tissue nodules, these septations and nodules will showed avid enhancement after giving of intravenous contrast material.

Hemangiomas are common chest wall benign mass lesion of vascular in origin, which contains variable amount of fat and showed increase T2 MRI intensity signal, they usually contain soft tissue calcifications known as phleboliths, in angiosarcoma which is vascular malignant lesion will manifested as heterogeneous mass in both T1 and T2 MRI sequences, without any fatty component and associated sinister behavior like invasion of adjacent structure.

Neurofibroma and schwannoma are benign nerve sheath neoplasms they contain cystic or fatty components and appears as low-density masses on CT scans, they can cause erosion on the adjacent rib or other bony structure without invasion or cortical breakdown, Malignant peripheral nerve sheath tumors (MPNST) will manifested as large heterogeneous masses with sinister behavior such as invasion of the adjacent structure and will show increase in the FDG uptake within the PET/CT scans.

Myeloma can affect the thoracic cage bones or the thoracic spine, it is presented as multiple lytic lesions on CT and hypointense to the muscle in T1 and hyperintense in T2 in MRI with or without soft tissue masses, after giving of intravenous contrast materials it showed heterogeneous enhancement, it showed increase in FDG uptake in PET/CT scans which also be helpful to detect any extramedullary bony involvement, while absent or decrease in the uptake representing treated disease.

Secondary chest wall neoplasms Metastatic disease is seen in status of widespread bony metastasis elsewhere in the body and it is considered as poor prognosis factor, in CT scan sclerotic lesions are predominantly originate from prostate cancer in male and breast cancer in female patient, lytic expansile lesions arise from bronchogenic, renal and thyroid cancers, while lytic non expansile lesions seen associated with multiple myloma disease.

Secondary chest wall invasion by malignancy, chest wall can be invaded directly by aggressive thoracic malignancy such as breast cancers, lung cancers, bony cancer or mediastinal cancers, MRI is superior to CT scan in these cases scenarios, due to better spatial resolution and soft tissue contrast, the usage of intravenous contrast materials can confirm any chest wall invasion.

Primary lymphoma of the chest wall is considered rare and involvement of the chest wall is secondary by invasion, the most common type of chest wall lymphoma is Hodgkin lymphoma, cases of Hodgkin lymphoma that cause invasion of the chest wall is 10% and these patients showed poor prognosis, CT scans will show infiltrative masses in the parasternal soft tissues and prevascular compartment, the MRI will show isointense to hyperintense signal on T1 and hyperintense signal in T2, the uptake of the FDG in PET/CT is increased and can be used in staging and monitor the treatment and rule out recurrence of the disease.

Radiation associated chest wall malignancy occur after prolong thoracic radiation in patients with leukemia, lymphoma or breast cancer patients, the malignancy can be develop 3 to 50 years after the radiation therapy, with peak within 10-15 years, these malignancies arise at the site of radiation or just adjacent to it, the most histological type in radiation associated malignancies are sarcomas which are aggressive with distant metastasis at the time of diagnosis and high recurrence after treatment, they manifest by bony

destruction and surrounding soft tissue mass within the irradiated area.

The treatment of choice for chest wall malignancy is surgical resection in most tumors, the safety margin is important to prevent tumor recurrence and measures for the low-grade malignancies 1-2 cm, while the safety margin for high grade malignancies measures 4 cm, preoperative neoadjuvant chemotherapy or radiotherapy is used to decrease the size of the tumor.

Conclusion

Chest wall mass lesions are considered rare, they only represent 5% of thoracic cavity malignancy. most of the chest wall mass lesions are malignant, they can be diagnosed by chest radiograph initially and must be followed by Chest CT scan or MRI imaging for better evaluation, identification and treatment planning and determine the outcome and prognosis for the patients. Radiologist must be familiar with the differentiation between the radiological features of benign and malignant chest wall lesions.

References

1 Primary chest wall tumors. J Am Coll Surg. Shah AA, D'Amcio TA,2010:210(3):360-6.
2 Surgical treatment of chest wall tumors. World J Surg Incarbone M, Pastorino U,2001;25(2):218–230.
3 Soft tissue tumours and mass-like lesions of the chest wall: a pictorial review of CT and MR findings. Br J Radiol O'Sullivan P, O'Dwyer H, Flint J, Munk PL, Muller N,2007:80(955):574–580.
4 Chest wall tumors, introduction. Semin Thoracic Cardiovascular Surg, Faber LP,1999:11(3):250.
5 Review of chest wall tumors, a diagnostic, therapeutic, and reconstructive challenge. Semin Plastic Surgery. David EA, Marshall MB,2011:25(1):16-24.
6 Primary chest wall tumors: factors affecting survival. Ann Thoracic Surgery. King RM, Pairolero PC, Trastek VF, Piehler JM, Payne WS, Bernatz PE,1986:41(6):597-601.
7 Imaging of primary chest wall tumors with radiologic pathologic correlation. Radio Graphics, Nam SJ, Kim S, Lim BJ,,2011:31(3):749–770.
8 MR imaging of chest wall tumors. Magn Reson Imaging Clin N Am Carter BW, Gladish GW,2015:23(2):197–215.
9 Imaging of chest wall disorders. Radio Graphics Jeung MY, Gangi A, Gasser B, *et al*,1999:19(3):617–637.