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RESEARCH ARTICLE

SPECTRUM OF CT FINDINGS IN POSTERIOR MEDIASTINAL MASSES.

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Abstract

Mediastinal masses can be encountered on imaging in many patients whether symptomatic or asymptomatic. Location and characterization of lesion is important for the differential diagnosis of mass. Computed tomography is the modality of choice for the evaluation of mediastinal masses. In this article, we discuss various posterior mediastinal masses and identify their origin and cause.

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Introduction:-

Mediastinum is demarcated by the thoracic inlet superiorly, diaphragm inferiorly and pleural cavities laterally. Mediastinum is divided into superior and inferior compartments by imaginary line joining the manubriosternal joint and 4th thoracic vertebra.^[1,2]

Felson divided the mediastinum on lateral chest radiograph. A line extending from diaphragm to thoracic inlet along back of heart and anterior to trachea separates anterior and middle mediastinum. A line 1cm behind the anterior margins of vertebral bodies separates middle and posterior mediastinal compartments. Posterior mediastinum according to Felson is paravertebral area.^[3]

Zylak divided the mediastinum into compartments on computed tomography (CT). Middle mediastinum is vascular space containing pericardium and its contents and great vessels. Anterior mediastinal compartment is prevascular space. Posterior mediastinal compartment is posterior to pericardium and great vessels.^[2]

However these divisions are only theoretical. Disease can spread from one compartment to another.

Posterior mediastinum contains esophagus, descending aorta, azygous and hemiazygous veins, thoracic duct, lymph nodes, neural structures and paravertebral areas.^[4,5]

In this article, we study the imaging features of various posterior mediastinal masses on CT.

Diagnosis:-

Chest radiograph in the initial imaging used in patients with suspected thoracic disease. Computed tomography (CT) is the modality of choice for evaluation of suspected mediastinal mass.^[6] CT helps to confirm the mass, localize the lesion and its extent and also helps in adjacent organ and vascular involvement. CT can distinguish among various masses on basis of their appearance and origin.^[4,6] At our institution, CT chest is performed on Ingenuity CT (128 slice, Philips Medical System) with 5mm thick contiguous axial sections and reformatted coronal and sagittal sections. MR usually provides similar information comparable to CT but has the advantage of direct multiplanar imaging and better contrast resolution. It can differentiate vascular and non-vascular lesions without intravenous contrast and is better to evaluate spine and spinal canal abnormalities.^[4] MR has disadvantage in demonstrating calcification and also its spatial resolution is poor.

Classification of posterior mediastinal masses-^[4,5]

- 1) **Congenital abnormalities** including aberrant right and left subclavian arteries, double aortic arch and pulmonary sling
- 2) **Neurogenic tumors**
 - a) **Peripheral nerve origin (most common)**
 - i) Schwannoma
 - ii) Neurofibroma
 - iii) Malignant peripheral nerve sheath tumor (MPNST)
 - b) **Sympathetic ganglion tumors**
 - i) Ganglioneuroma
 - ii) Ganglioneuroblastoma
 - iii) Neuroblastoma
 - c) **Parasympathetic ganglion tumors**
 - i) Paraganglioma
 - ii) Pheochromocytoma
- 3) **Posterior mediastinal lymphadenopathy**
- 4) **Hernia** including hiatus and Bochdalek hernia
- 5) **Esophageal lesions** including neoplasms and esophageal/paraesophageal varices
- 6) **Foregut cysts** including bronchogenic cysts, esophageal duplication cysts and neuroenteric cysts
- 7) **Mediastinal pancreatic pseudocyst**
- 8) **Aortic aneurysm and dissection of descending aorta**
- 9) **Infectious spondylitis with paravertebral abscesses**
- 10) **Extramedullary hematopoiesis**
- 11) **Spinal neoplasms** (primary and metastatic)
- 12) **Spinal trauma with paraspinal hematoma**
- 13) **Inflammation**-mediastinitis
- 14) **Mediastinal lipomatosis**
- 15) **Thoracic meningocele**
- 16) **Fat containing tumors** including lipoma, liposarcoma and teratoma

Congenital Abnormalities:-

Aberrant right subclavian artery is the most common aortic arch anomaly. It is the last branch off the aortic arch and crosses to mediastinum posterior to esophagus.[Figure 1] A diverticulum can be seen at origin of artery from aorta.



Figure 1. Axial CECT chest shows aberrant right subclavian artery coursing posterior to esophagus.

Right aortic arch can be associated with aberrant left subclavian artery. Left subclavian artery arises from descending aorta from diverticulum.^[7]

Double aortic arch occurs less commonly. Each arch gives rise to subclavian and carotid arteries. Symptoms occur due to vascular rings and may require surgery.

Pulmonary sling is anatomical variant in which there is anomalous origin of left pulmonary artery from the posterior wall of right pulmonary artery. It courses posterior to trachea and anterior to esophagus.^[8]

Neurogenic tumors:-

They are the most common cause of posterior mediastinal mass and constitute approximately 20% of adult and 35% of pediatric mediastinal tumors.^[9,10]

They are divided into three categories on basis of origin of tumor- peripheral nerves, sympathetic ganglia or paraganglia.

Peripheral nerve tumors are the most common mediastinal neurogenic tumors and include schwannoma, neurofibroma and also MPNST.^[4,9,10] They are more common in adults. Most common location is paravertebral region. Schwannomas are encapsulated tumors that arise from nerve sheath. Neurofibromas are unencapsulated and arise from proliferation of all nerve elements.

On CT, they appear as well defined soft tissue masses in paravertebral region and may show heterogenous appearance due to hemorrhage, necrosis, cystic degeneration or calcification.^[4,5][Figure2]

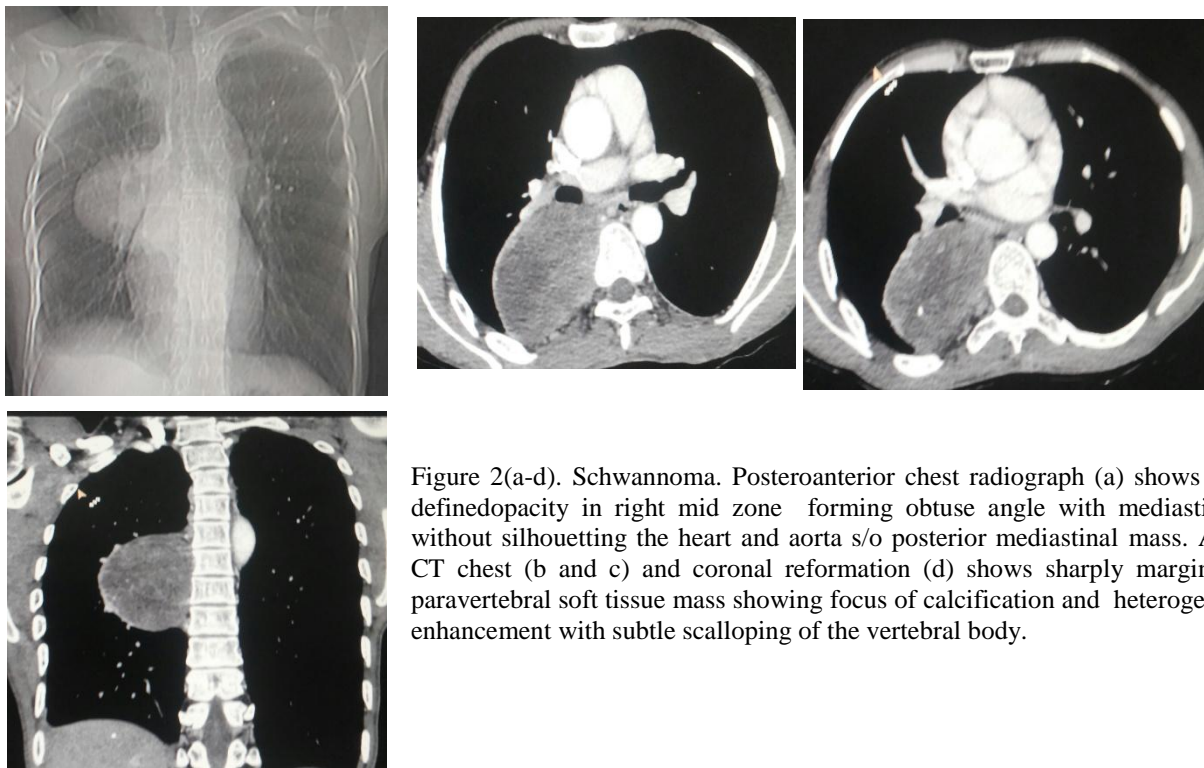


Figure 2(a-d). Schwannoma. Posteroanterior chest radiograph (a) shows well defined opacity in right mid zone forming obtuse angle with mediastinum without silhouetting the heart and aorta s/o posterior mediastinal mass. Axial CT chest (b and c) and coronal reformation (d) shows sharply marginated paravertebral soft tissue mass showing focus of calcification and heterogenous enhancement with subtle scalloping of the vertebral body.

Neurofibromas are usually more homogenous in appearance than Schwannomas. They may cause enlargement of neural foramina or pressure erosion of adjacent rib/scalloping of posterior vertebral bodies. Intraspinous extension may occur. They may show “dumbbell” appearance if they extend through the inter-vertebral foramen.^[10] MRI is the preferred modality for demonstrating intraspinal extension of tumor. On MRI, neurofibromas show “target” appearance on T2W with low signal intensity in center and high signal intensity rim.^[5] Presence of multiple target signs throughout the lesion on MRI favors the diagnosis of plexiform neurofibroma.

Malignant tumors of peripheral nerve are mostly larger than 5cm in diameter. Sudden change in size of pre-existing mass favors malignancy.^[9]

Sympathetic ganglia tumors are more common in children and includes ganglioneuroma, ganglioneuroblastoma and neuroblastoma.^[9] Neuroblastoma is the most aggressive form. Posterior mediastinum is the most common extra-abdominal site for neuroblastomas.

On CT and MRI, ganglioneuromas and ganglioneuroblastomas usually appear as well marginated elliptical masses with long axis along the spine and may contain calcifications on CT. On T2W MRI, ganglioneuromas may show “whorled” appearance.^[11][Figure 3]

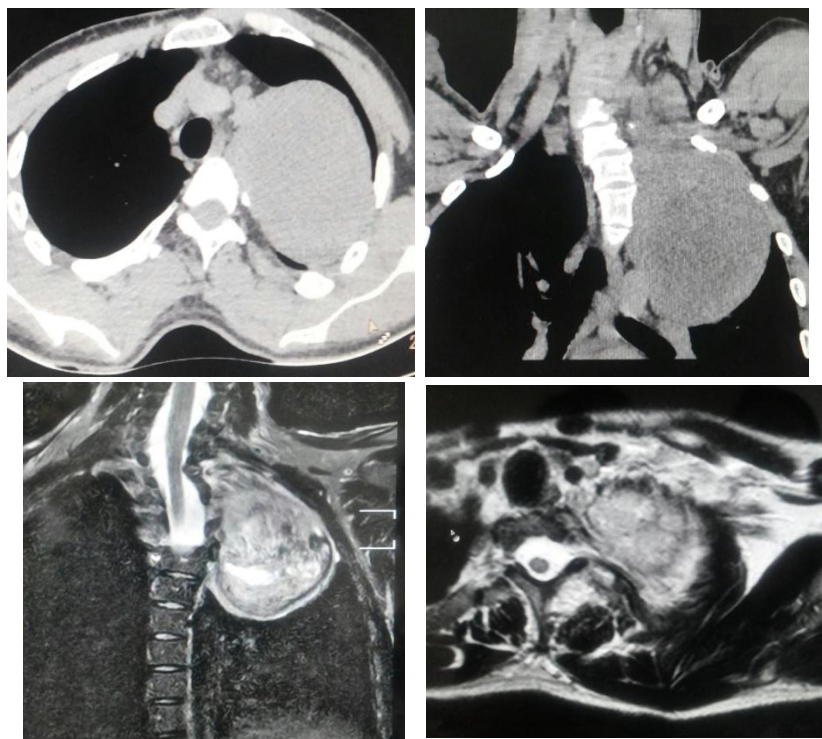


Figure 3. (a-d). Ganglioneuroma. Axial image and Coronal reformatted CT (a and b) shows left paravertebral soft tissue mass. T2W MRI in axial and coronal sections shows heterogenous signal intensity of mass with whorled appearance of the mass.

Neuroblastomas are more heterogenous paraspinal masses and often shows irregular margins and local invasion. They have a tendency to cross midline.

Paraganglionictumors are rarer in posterior mediastinum. They are heterogenous and enhance intensely with i/v contrast. Paragangliomas show characteristic “salt and pepper” appearance on T1W due to multiple signal voids.^[5,6]

Posterior mediastinal lymphadenopathy:-

There are many causes of posterior mediastinal lymphadenopathy including lymphoma, granulomatous disease or metastasis.^[4,12] Lymph node metastasis can occur in both intra and extra thoracic tumors.

Enlarged lymph nodes in lymphoma are usually bulky, discrete homogenous soft tissue attenuation masses.^[13][Figure 4] Rarely in lymphoma, adenopathy may appear as paravertebral mass, erode the vertebra and extend into the spinal canal.^[13,14]

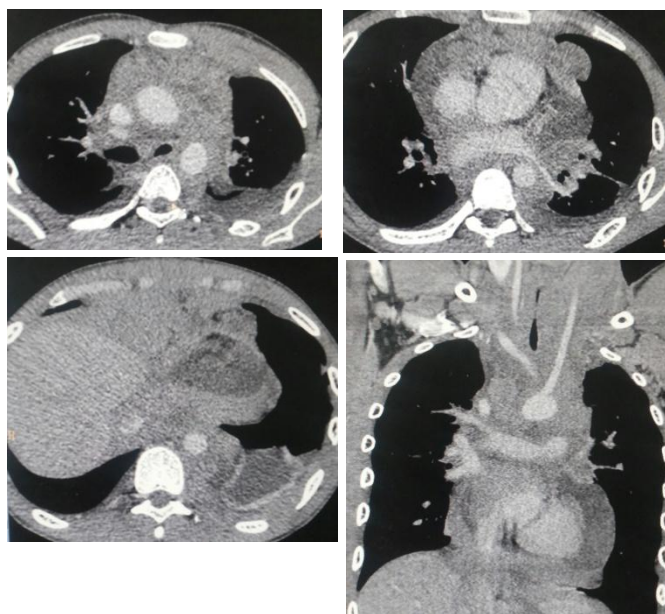


Figure 4 (a-d). Lymphoma. Axial CECT chest (a-c) at various levels show sheath like soft tissue mass in various mediastinal compartments encasing various vessels. There is encasement of the descending aorta with extension of mass into the bilateral paravertebral regions. Mild bilateral pleural effusion also seen. Coronal reformation (d) shows extension of soft tissue mass into the neck.

Enlarged lymph nodes with low attenuation center are more common in mycobacterial infection and metastasis from squamous cell carcinoma or testicular carcinoma.

Castleman's disease is an uncommon benign lymphoproliferative disorder. It may be unicentric or multicentric on basis of lymph node involvement. CT may show solitary mediastinal mass, infiltrative mass of multiple lymph nodal mass. Arborising calcification may be seen within the mass. Rarely it occurs in posterior mediastinum as paravertebral mass. It usually demonstrate intense enhancement with i/v contrast.^[15]

CT is highly sensitive for detection of lymphadenopathy [Figure 5,6] but cannot always distinguish among various causes, however CT can guide needle aspiration for histology examination or culture.^[4]

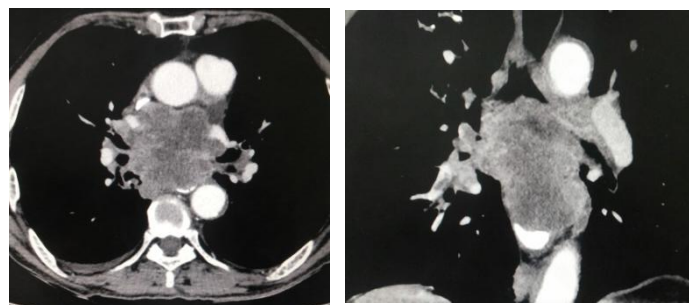


Figure 5 (a and b). Metastatic lymphadenopathy. Axial CECT chest and coronal reformation shows heterogenous lymph nodal mass showing necrotic areas in the middle and posterior mediastinum causing compression of the esophagus.



Figure 6. Axial scan shows posterior mediastinal lymphadenopathy from lung carcinoma.

Hernia:-

Hiatus hernia is the herniation of abdominal contents through the esophageal hiatus into the thoracic cavity. Sliding hernia is more common than paraesophageal hernia in which gastro-esophageal (GE) junction is displaced above the esophageal hiatus. Air-fluid level or herniation of gastric folds can be seen in hiatal sac. [Figure 7] It is most commonly associated with gastro-esophageal reflux.^[16] Paraesophageal hernia may present acutely with obstruction due to gastric volvulus.^[16]

Another hernia is Bochdalek hernia in which there is herniation of abdominal contents through defect in posteromedial portion of diaphragm. Multiplanar CT and MRI can show the diaphragmatic defect and contents of hernia sac.

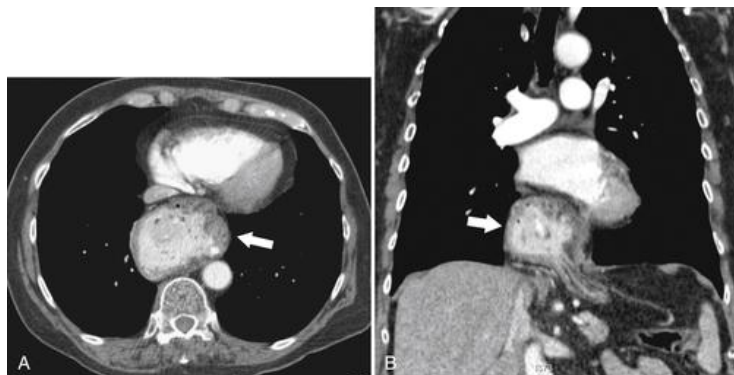


Figure 7 (a and b). Hiatus hernia. Axial section with coronal reformation show sliding type of hiatus hernia with herniation of stomach into the posterior mediastinum.

Esophageal neoplasms:-

They can be either malignant (80%) or benign (20%).^[17] Endoscopy usually allows detection of even small esophageal lesions. CT chest is recommended to assess the extent of the lesion. Oral and i/v contrast are given to better delineate the esophageal lumen. CT may show soft tissue mass, focal wall thickening or circumferential thickening of esophageal wall.[Figure 8]Extent of mass and invasion of adjacent structures and involvement of lymph nodes can be better delineated.^[17]

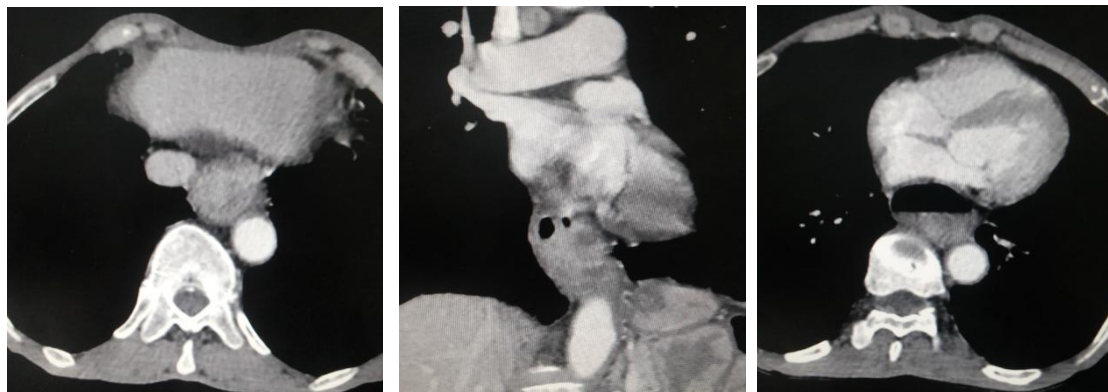


Figure 8. (a-c). Esophageal carcinoma. Axial section and coronal reformation (a and b) show circumferential thickening of the esophageal wall in its lower 1/3rd with involvement of gastro-esophageal junction. Proximal dilatation of esophagus with air-fluid level is seen(c).

Benign lesions are usually leiomyoma which appears as homogenous submucosal mass in mid to lower esophagus. Fibrovascular polyps are rare benign lesions that arise from cervical esophagus and extends into distal esophagus. CT scan shows heterogenous intraluminal pedunculated lesion. They cause symptoms when polyp reaches a large size and include progressive dysphagia and respiratory symptoms. They may get regurgitated into mouth and can lead to aspiration and even asphyxia due to mechanical obstruction of larynx.^[18] Leiomyosarcomas are usually large heterogenous masses.

Esophageal varices:-

They usually occur in the distal esophagus as retrocardiac mediastinal mass in patients with portal hypertension. CECT chest shows multiple enhancing nodular lesions within the esophageal wall or in close proximity to it. [Figure 9] Associated CT findings include evidence of liver cirrhosis and portal hypertension with abdominal varices.^[19]

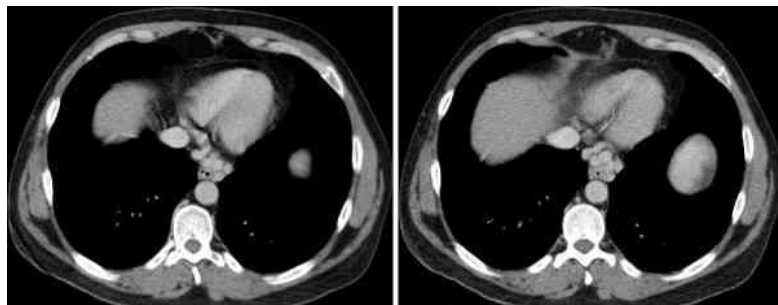


Figure 9(a and b). Paraesophageal varices. Axial CECT chest shows multiple enhancing vessels adjacent to lower part of esophagus.

Foregut cysts:-

They arise due to mal development of primitive foregut. It includes bronchogenic cyst, esophageal duplication cyst and neuroenteric cyst. They are mostly asymptomatic but symptoms can occur due to airway/esophageal compression.^[20,21]

Bronchogenic cysts are the most common. They arise from abnormal budding of ventral foregut. Most common location of sub-carinal region. On CT, they appear as round and sharply marginated homogenous masses with thin smooth walls and non-enhancing contents showing water attenuation. High attenuation may be seen due to proteinaceous or mucoid contents.^[20]

Esophageal duplication cysts are located along the esophagus in lower posterior mediastinum. [Figure 10] CT features are similar to bronchogenic cyst except for their location. They may be adherent to esophageal wall. Rarely ectopic gastric mucosa may occur in the cyst.^[20]

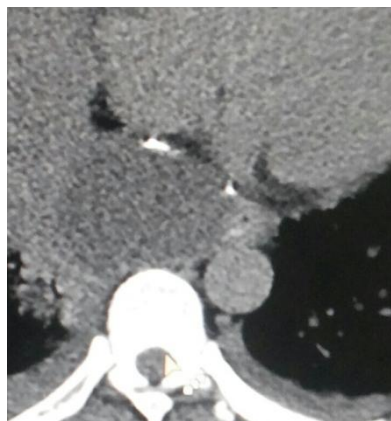


Figure 10. Esophageal duplication cyst. Axial section shows a well defined thin walled non-enhancing cystic lesion in close association with lower part of esophagus.

Neuroenteric cysts communicate with meninges and are associated with vertebral anomalies. On CT, they appear as well defined thin walled non-enhancing cystic lesions with density similar to CSF.^[21] MRI can demonstrate relationship of neuroenteric cyst to spinal canal.

Mediastinal pancreatic pseudocyst:-

Pseudocyst formation is common complication of both acute and chronic pancreatitis. They mostly occur in the peripancreatic region. Mediastinal pseudocysts usually occurs by rupture of pancreatic duct posteriorly into the retroperitoneal space. Pancreatic fluid then tracks through diaphragmatic hiatuses into the posterior mediastinum. CT is the modality of choice as it shows connection between the mediastinal mass and abdominal pancreatic pseudocyst. [Figure 11] Complications can be superadded infection or hemorrhage. There can be compression/invasion of adjacent structures or rupture of pseudocyst. Thick and irregular wall suggests infected pseudocyst while high attenuation suggests intracystic hemorrhage.^[22]

Large pseudocysts may require endoscopic drainage, CT-guided percutaneous drainage or even surgery.

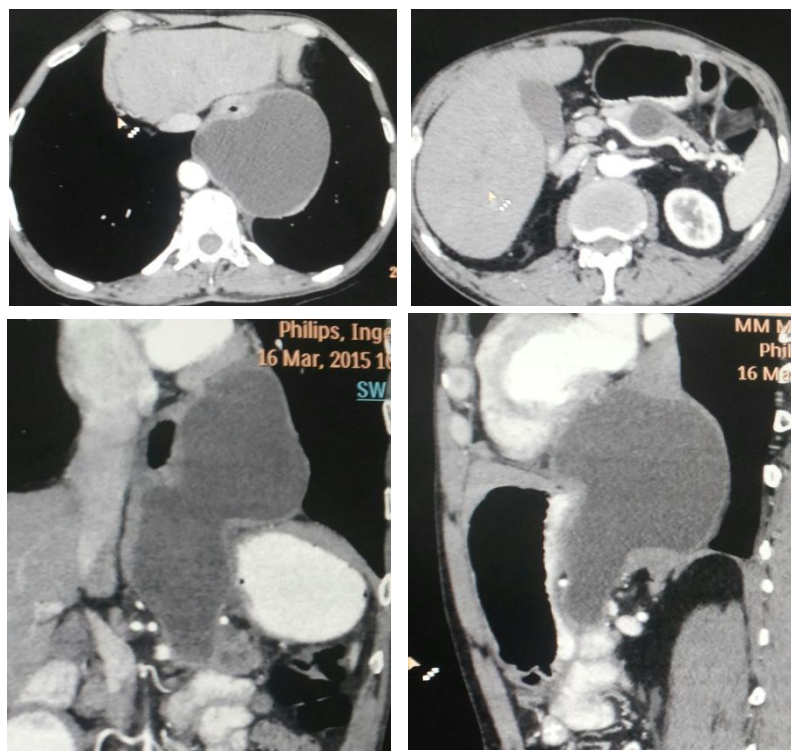


Figure 11(a-d). Mediastinal pancreatic pseudocyst. Axial CT chest (a) shows thin walled cystic lesion in posterior mediastinum in left para-aortic region with anterior displacement of esophagus. Axial CT upper abdomen (b) shows pseudocyst in pancreas. Coronal and sagittal reformations (c and d) show communication of pancreatic pseudocyst with posterior mediastinal cystic lesion extending through the hiatus.

Aortic aneurysm:-

Thoracic aortic aneurysms are the most common vascular cause of posterior mediastinal mass in adults. The most common etiology is atherosclerosis. Most patients are asymptomatic with incidental detection of aneurysm on imaging. They can be saccular or fusiform in configuration. CT can demonstrate aortic dilatation, intimal calcification, intramural thrombus, enhancement of patent lumen, displacement of adjacent structures and occasionally erosion of vertebral bodies.[Figure 12]

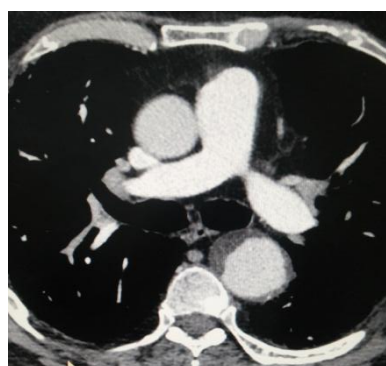


Figure 12. Axial CT chest shows aneurysm of descending thoracic aorta with intramural thrombus.

Thoracic aortic aneurysms can be stable or unstable. It is considered unstable when it rapidly enlarges or shows signs of rupture/impending rupture such as intramural hematoma seen as high attenuation crescent within the aortic wall, focal discontinuity of intimal calcifications or eccentric shape of aorta.^[23] Rupture usually occurs into the mediastinum leading to periaortic hematoma or hemothorax. Contrast blush of active extravasation can be seen at site of rupture. Rupture usually occurs when maximum diameter is >6.5cm and is an indication for surgery.^[23,24]

Paravertebral abscesses:-

It occurs due to infective spondylitis with involvement of vertebral bodies and inter-vertebral discs. Tuberculosis is the most common cause with spine being the most frequent location of musculoskeletal TB. Spine is usually involved by hematogenous spread.

Radiographic findings includes narrowing of disc space, lysis/destruction of the adjacent vertebral bodies and pre/paravertebral soft tissue masses. In TB, there may be involvement of vertebral bodies alone with relative preservation of discs due to subligamentous spread of infection underneath the longitudinal ligaments and can result in gibbus deformity due to more destruction of anterior portions of vertebral bodies.^[25] Later, large paraspinal abscesses can develop. CT findings include osteolytic destruction of vertebral bodies and pre/para-vertebral abscesses. Pyogenic abscesses usually have thick and irregular enhancing walls while tubercular abscess has thin and smooth enhancing wall. Calcifications are usually seen in tuberculous infection. There is relative sparing of intervertebral discs in tuberculous infection.^[25,26] [Figure 13]

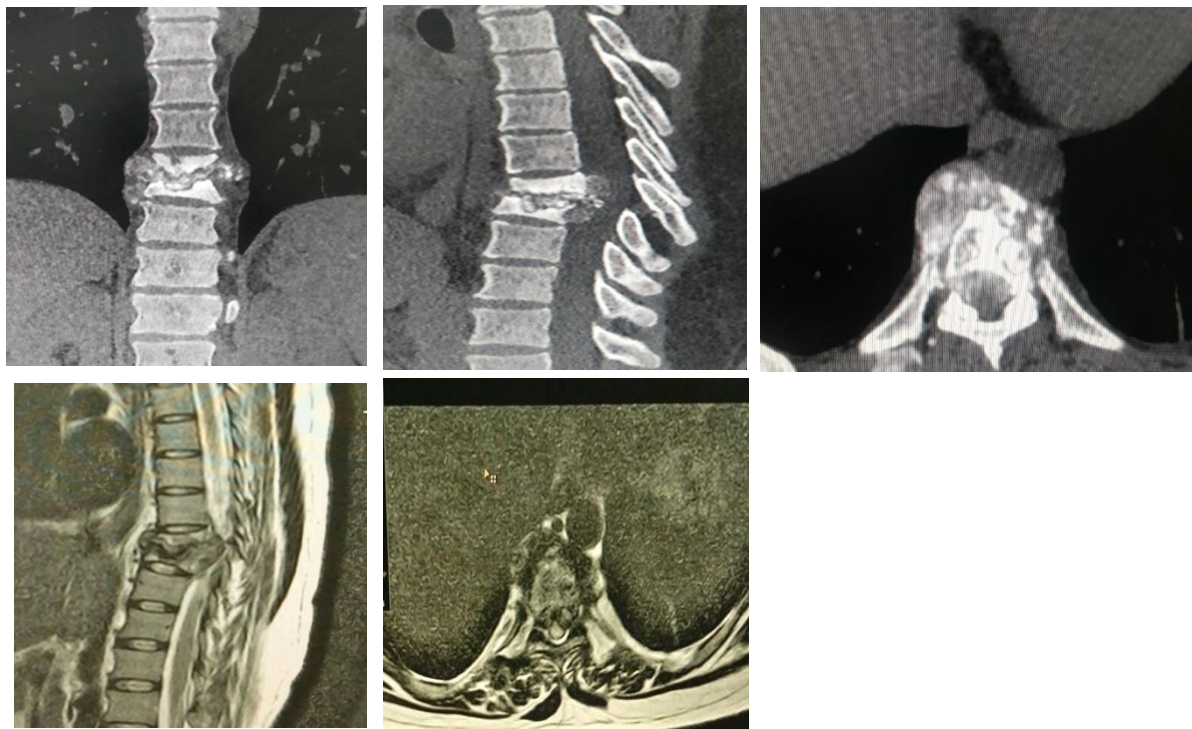


Figure 13 (a-e). Tubercular spondylitis with calcified paravertebral abscess. Coronal and sagittal reformatted CT images (a and b) shows fragmentary destruction of two contiguous thoracic vertebral bodies with destruction of intervening disc. Axial CT image (c) shows associated calcified paravertebral abscess. T2W MRI in sagittal and axial sections (d and e) shows large epidural component of abscess causing compression of thecal sac and spinal cord.

Extramedullary hematopoiesis:-

It is the compensatory phenomena which occurs when erythrocyte production is diminished or destruction is increased. It usually occurs due to chronic hemolytic anemia such as thalassemia or due to bone marrow replacement by myeloproliferative disorders.

CT demonstrates unilateral or bilateral smooth sharply margined lobulated paravertebral masses along lower thoracic spine.^[27][Figure 14] Most of the patients are asymptomatic. Fat content may be seen in inactive lesions. These masses don't calcify or cause bone erosion. Widening of the ribs can be seen in chronic anemia.^[28]

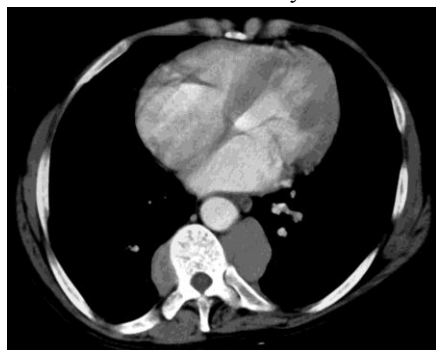


Figure 14. Extramedullary hematopoiesis in patient with myelofibrosis. Axial image shows bilateral well defined homogenous paravertebral soft tissue masses.

Other causes:-

Other causes of posterior mediastinal masses are **primary or metastatic tumors of spine** with associated soft tissue component like multiple myeloma or metastasis which can extend into adjacent paravertebral area and produce soft tissue mass.^[4] [Figure 15]

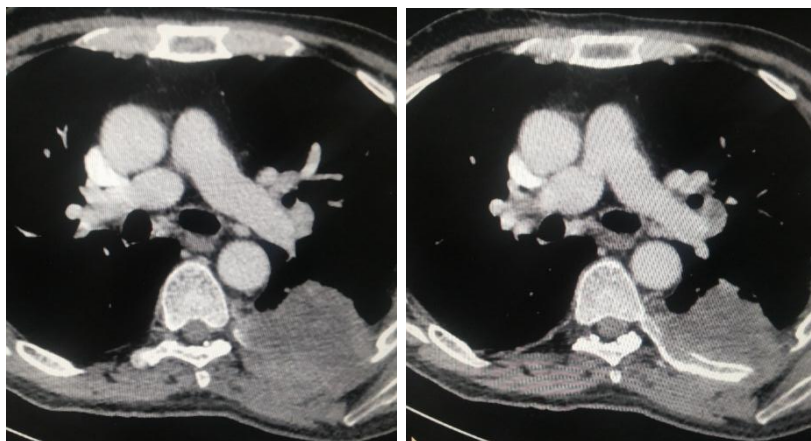


Figure 15 (a and b). Multiple myeloma. Axial images show destruction of the posterior rib with associated large soft tissue component extending upto paravertebral region.

Paravertebral hematoma can occur in case of spinal trauma seen as high density on CT.^[4]

Rarely **mediastinal lipomatosis** can occur in posterior mediastinum. It is benign condition caused by deposition of excess fat in the mediastinum. It usually doesn't cause compression of adjacent structures.^[5]

Lateral thoracic meningocele can occur which is protrusion of meninges through intervertebral foramen and contains CSF. They are usually associated with neurofibromatosis type I. On CT, they appear as well defined homogenous non-enhancing paraspinal masses and demonstrate water attenuation. They show extension from spinal canal into posterior mediastinum and mostly occur on right side due to aorta on left side.^[29] Adjacent neural foramen is enlarged. CT myelography or MRI can demonstrate communication with subarachnoid space.

Rarely **lipomatous tumors** may occur in posterior mediastinum like lipoma, liposarcoma and teratoma.^[30]

Conclusion :-

CT is the modality of choice in evaluation of posterior mediastinal masses. Radiologist can provide valuable information about the location and extent of lesion. Relationship with surrounding structures and extent of invasion can be accurately assessed by CT scan. Assessment of nature of mass whether solid or cystic, presence of fat or calcium can be detected within the tumor mass. Familiarity with the radiological features of mediastinal masses helps in accurate diagnosis, differentiation from other mediastinal processes and thus optimal patient treatment.

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