

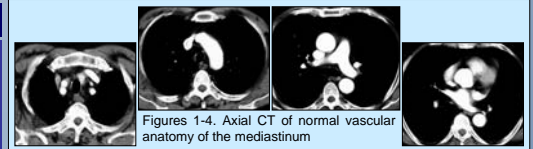
MEDIASTINAL VASCULAR ANOMALIES. CORRELATION WITHIN HELICAL CT AND CONVENTIONAL CHEST RADIOGRAPHY

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PURPOSE

- To describe the normal vascular anatomy of the mediastinum (Figs. 1-4) and to describe the mediastinal vascular anomalies.
- To present the correlation within the conventional chest radiography and helical CT of the mediastinal vascular anomalies diagnosed in our institution.
- To review the literature of the mediastinal vascular (venous and arterial) anomalies.



Figures 1-4. Axial CT of normal vascular anatomy of the mediastinum

MATERIAL AND METHODS

We revised all of the reports at three years old of thoracic CT to make in our institution. We selected the cases of mediastinal vascular anomalies were present and finally retrospectively two radiologist who were unaware of conventional chest radiography and helical CT findings.

Usually the studies consist: 7-mm collimation, pitch: 1.5, 100 ml of contrast medium, rate: 2.5 ml/sec, delay: 25-30 sec.

Since November 2001 to to November 2004 we found 4610 consecutives thoracic CT. We encountered 91 cases (1.97% of the studies) of mediastinal vascular anomalies.

VENOUS

- Depends of the SVC (19)
- Depends of the the azygos system (29)
- Depends of the pulmonary veins (3)

ARTERIALS

- Aberrant subclavian artery (29)
- Right aortic arch malformations (8)
- Double aortic arch (n=3)

RESULTS

VENOUS ANOMALIES

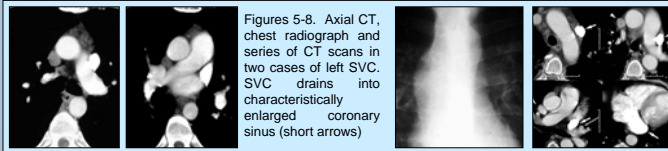
Anomalies of the great thoracic veins rarely result in symptoms but can cause confusing mediastinal contours on chest radiographs that call for further evaluation using CT or MR. They may also produce unusual vascular structures that can be seen incidentally on CT or MR obtained for other reasons. It is important to recognize them and to know their appearances.

Anomalies of the SVC

Venous anomalies of the thorax are the result of complex variations in the persistence and regression of segments of three sets of veins during the first 2 months of fetal development.

Left SVC

A persistent left SVC is an incidental finding in less than 0.3% of the general population but occurs in 4% of patients with congenital heart disease. As an isolated anomaly in the absence of congenital heart disease (Figs. 5-6), a left SVC or left component of a duplicated SVC almost always drains into the coronary sinus. Drainage to the left atrium is associated with many types of congenital heart disease but is rare if the heart is normal. The left SVC descends lateral to the aortic arch and anterior to the hilum, enters the pericardium in the posterior atrioventricular groove, and drains into the coronary sinus. The coronary sinus is usually enlarged and may be densely opacified on CT when IV contrast material is injected into the left arm (Figs. 7-8).



Figures 5-8. Axial CT, chest radiograph and series of CT scans in two cases of left SVC. SVC drains into characteristically enlarged coronary sinus (short arrows)

Right SVC

Isolated anomalies of the right SVC are rare. This anomaly is usually an incidental finding but has been associated with thrombosis leading to embolization and SVC obstruction.

Anomalies of the azygos system

The azygos system is a paired paravertebral venous pathway in the posterior thorax (Figure 9). The azygos vein originates at the junction of the right ascending lumbar and subcostal veins, enters the chest through the aortic hiatus, and ascends along the anterolateral surface of the thoracic vertebrae. At T5-T6, it arches ventrally just cephalad to the right main bronchus and drains usually into the SVC. Similar to the azygos vein, the hemiazygos vein originates at the junction of the left ascending lumbar and left subcostal veins and often receives tributaries from the left renal vein and IVC. The hemiazygos vein ascends along the left anterolateral aspect of the thoracic vertebrae and at T8-T9 crosses dorsal to the descending thoracic aorta to join the azygos vein.

Absent azygos vein. Is very rare. Enlargement of the hemiazygos, accessory hemiazygos, and left superior intercostal veins is associated with it (Figure 10).

Azygos lobe. An anomalous course of the azygos vein occurs in approximately 0.4-1.0% of the population. This anomaly is easily identified on imaging studies (Figure 11). The abnormally located vessel indents the lung and its overlying parietal and visceral layers of pleura. This situation results in four pleural layers that form a mesentery-like structure, the mesoazygos, containing the azygos vein.

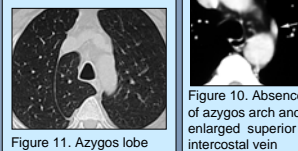


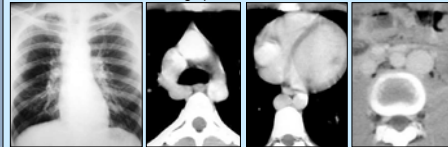
Figure 9. Azygos anatomy on venogram of 60-year-old woman with IVC stricture

Figure 10. Absence of azygos arch and enlarged superior intercostal vein

Figure 11. Azygos lobe

Azygos and hemiazygos continuation of the IVC. These anomalies may be isolated or associated with other anomalies. The incidence in patients with congenital heart disease undergoing cardiac catheterization ranges from 0.2% to 1.3%. Azygos continuation is common in patients with polysplenia but rare in patients with asplenia. Other associated anomalies have included abnormal abdominal situs (Figure 16) and a left or duplicated IVC.

Figures 12-15. Azygos and hemiazygos continuation in a patient with absence of IVC. Chest radiograph and CT scan



Imaging features (Figs. 12-15): dilatation of the azygos vein, azygos arch, and SVC caused by increased flow. The hepatic veins drain into the right atrium. The hepatic segment of the IVC is absent or hypoplastic. Hemiazygos continuation of a left IVC has several variations



Figure 17. Azygos and hemiazygos continuations with IVC in a case of situs inversus

ARTERIAL ANOMALIES

The ascending aorta (AAo) divides into a right and left arch (Figure 18). The right arch gives rise to the common carotid artery (RCCA) and right subclavian artery (RSA), whereas the left arch branches off the left common carotid artery (LCCA) and left subclavian artery (LSA). The aortic arches unite behind the trachea (Tr) and esophagus (Eo) to form the descending aorta (DAo).

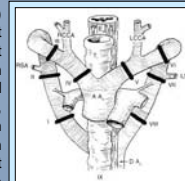


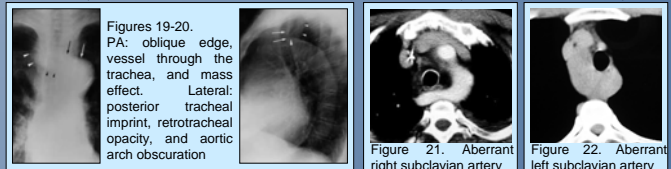
Figure 18. Representation of the embryonic development of the paired aortic arches with sites of potential interruption

I: Normal. II: Left aortic arch with aortic diverticulum. III: Left aortic arch with an aberrant right subclavian artery. IV: Left aortic arch with an aberrant right innominate artery. V: Right aortic arch with an aberrant left innominate artery. VI: Right aortic arch with an aberrant left subclavian artery. VII: Right aortic arch with mirror-image branching (rare). VIII: Right aortic arch with mirror-image branching (common). IX: Double aortic arch (no interruption).

The majority of patients with aortic arch anomalies are asymptomatic, but patients may present with respiratory and gastrointestinal symptoms. When a complete vascular ring is present, symptoms can result from airway or esophageal compression. Most patients with arch malformations have a mediastinal abnormality on a chest radiograph that can be mistaken for a mass or can be suggestive of the anomaly.

Aberrant subclavian artery

Aberrant right subclavian artery. Is the most common anomaly of the aortic arch, occurring in approximately 1 in 200 people. The anomalous vessel arises from the distal aortic arch as its last major vessel (Figs. 19-21). The aberrant artery crosses the posterior mediastinum obliquely upward from left to right. Symptoms are uncommon. Several CT findings reflect the aortic maldevelopment. Dilatation of the origin of the aberrant right subclavian artery is common (>60% of the cases) and if excessive is called a diverticulum of the aorta (Kommerel diverticulum).



Figures 19-20. PA: oblique edge, vessel through the trachea, and mass effect. Lateral: posterior tracheal imprint, retrotracheal opacity, and aortic arch obscuration

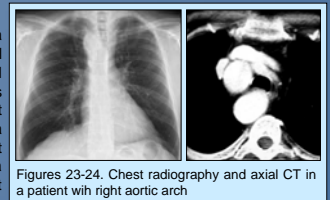
Figure 21. Aberrant right subclavian artery

Figure 22. Aberrant left subclavian artery

Aberrant left subclavian artery. Is less common than an aberrant right subclavian artery (Figure 22). That anomaly is encountered in approximately 1 in 1000 people. About 10% of patients with this anomaly also have congenital heart diseases.

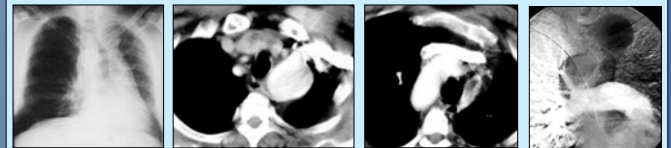
Right aortic arch malformations

A right aortic arch is to the right of the trachea and esophagus (Figs. 23-24). The normal arrangement of the arch vessels is determined by the site at which the left aortic arch is embryologically interrupted. Three types: right aortic arch with aberrant left subclavian artery, (a vascular ring is present) (Figs. 25-28), right aortic arch with aberrant left innominate artery (a symptomatic vascular ring is present) and right aortic arch with mirror-image branching.



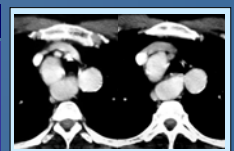
Figures 23-24. Chest radiograph and axial CT in a patient with right aortic arch

Figures 25-28. Chest radiograph, axial CT and pulmonary arteriography in a case of left hypoplasia pulmonar, right aortic arch and left subclavian artery aneurism



Double aortic arch

Is the most important of the arch anomalies producing a vascular ring (Figures 29-30). It is rarely associated with congenital heart disease, but the symptoms of tracheo-esophageal compression are common. Two broad groups of double aortic arch are found. In the first, both arches are patent and functional; in the second group, a portion of the left arch is atretic.



Figures 29-30. The right arch is usually the larger and higher, and it courses behind the esophagus to join the left arch

CONCLUSION

- Mediastinal vascular anomalies are very common. It is important to recognize the mediastinal vascular anomalies for two reasons: they may be associated with other vascular and cardiac abnormalities and may cause diagnostic difficulties.
- Errors in diagnosis can result from the presence of primary intrathoracic tumors, concomitant mediastinal lymphadenopathy and from a lack of intravenous contrast usage.
- However, conventional radiographic appearances of normal and abnormal vascular structures can be misinterpreted as representing neoplasm and lead to inappropriate diagnostic procedures. Helical CT is the election technique if anomalous mediastinal contour is present.