

CT APPEARANCE OF THE ABERRANT SUBCLAVIAN ARTERY**HUSSEIN. A .HASSAN^{a1}, TAHER OSMAN ALI^b AND CAROLINE .E.AYAD^c**^aCollege of Medical Radiological Science, Sudan University of Science and Technology, Khartoum, Sudan
E-mail: husss1959@hotmail.com^bCollege of Medicine, The Nation Ribat University, Khartoum, Sudan
E-mail: ali.taher@yahoo.com^cCollege of Medical Radiological Science, Sudan University of Science and Technology, Khartoum, Sudan
E-mail: carolineayad@yahoo.com**ABSTRACT**

The aim of this study was to characterize aberrant right subclavian artery (ARSA) on chest Computed Tomography (CT). The results are obtained from a review of 328 patients who were scanned for CT chest examination with different complications. ARSA was seen in 5 (1.5%) of 328 study group. It was identified in one (0.6%) of 174 male and four (2.6%) of 154 female patients. All five patients have no symptoms of lusoria, respiratory distress or dysphagia. The ARSA was within normal diameter (mean 8.1±3.9) throughout its course and wider than 9 in its origin. Correlation of the ARSA and gender showed that females were affected more than males significantly. Familiarity with the normal CT appearance of the great blood vessels can be helpful in differentiating an aberrant subclavian artery in upper chest.

KEYWORDS : CT, Aberrant Subclavian Artery, Upper Thorax

Computed tomography (CT) has become a principal imaging method for the assessment of thoracic vascular anomalies. The advantages of CT angiography in comparison with digital subtraction angiography; are that it is a non-invasive technique and it enables complete assessment of the vascular and cardiac anomalies, and their spatial relationships with adjacent organs within the same study (Gilkeson et al., 2003; Lee et al., 2004).

There are three arteries that arise from the arch of the aorta, those are the brachiocephalic, the left common carotid and the left subclavian arteries, and the extra branch is sometimes the right subclavian artery. The right subclavian artery, if it is the last branch, will be retro esophageal this may be associated with aortic arch abnormalities (Aysel et al., 2009).

The right subclavian artery arises from the descending portion of aortic arch. In such cases the subclavian passes either behind the esophagus or between the trachea and esophagus arteria subclavia dextra lusoria, (ASDL) to reach the right side of the body. This variation was found in the previous studies by (Demos et al., 2004; Raider, 1967).

On radiographic images, the anomalous position; the aberrant right subclavian artery can be mistaken for a calcified lymph node, mass, aneurysm or lymph node on unenhanced images. Familiarity with the most common vascular anomalies helps avoid misinterpretation (Caroline

Chiles et al., 1999).

Knowledge of the normal CT anatomy of the aberrant right subclavian artery is important to avoid mistaking an aberrant right subclavian artery for a lesion on cross-sectional imaging and to avoid unnecessary and wrong interventions. The purpose of this study was to determine how often the aberrant right subclavian artery can be identified on chest CT images and to characterize its appearance on Sudanese population.

MATERIALS AND METHODS

This study was done in Modern Medical Center-Khartoum Sudan and The Ribat University Hospital during the period from 2008 up to 2011.

CT machine.

Dual CT scanner GE with gantry specifications of: Aperture of 65cm, tilting ±20°, focus iso center is 541mm and focus to detector is 949 and rotation speed 360 in the range between 1.0 -5.0 seconds and X-ray tube specifications : focal spot of 0.7mmX0.6mm ,slice thickness options (0.6,1.0,2.0,3.0,5.0,7.0 and 10.0mm) and scan mode 0.75:1/1.5:1 ,matrix 256X256 ,mA 60-160,Kv 120-140 .Siemens SOMATOM Sensation 16 multislice helical CT scanner was also used . Aperture of 70cm,maximum scan field of view 50-70 cm, slice width for axial scans is 0.6-10 mm.60 KW generator,5.3 MHU tube ,gantry rotation time 0.42 seconds and is capable of imaging

¹Corresponding author

16 slices per rotation with slice width of 16X1.5mm and 16X0.75.

Patients

A total of 328 patients were included in the study: 174 (53%) of the patients were males and 154 (47%) were females. The mean age of the subjects was 46 years with a range of 15-82 years. These patients underwent spiral CT scan for thorax, they had different clinical symptoms. All patients were studied for clinical purposes rather than research interest. The consents were taken from all patients included in this study.

Examination Technique And Image Interpretation

All patients were examined in supine position; IV contrast material was administered to each patient through an antecubital vein in either the left or the right arm. In some patients, streak artifact from an undiluted contrast bolus in the subclavian vein prevented evaluation of upward continuation to the right subclavian artery.

All CT scans were obtained after administration of 75 -100 ml of nonionic IV contrast material and was injected automatically at a rate of 2-2.5 ml/second. Scan delay time for chest was 35 second. The caudocranial helical acquisitions were planned on the bases of frontal view of the chest, starting at upper abdomen to the root of the neck.

The selected field of view (FOV) is 40; slice thickness was 5mm, Slice space was 5mm, 140Kv, 300mA, and scanning time 35 second. Interpretation was rendered by expert CT technologist and radiologist. Both were well trained and possessed certificates of added qualification in CT, and both spend most of their clinical time on CT imaging. Images were viewed on a workstation in axial stack mode without reconstructions. The following strict criteria were required for identifying origin and confluence of aberrant subclavian artery; postero-medial origin as last branch of aortic arch and ascend upward behind the trachea and esophagus; upward continuation to the right side of the body. When both interpreting radiologist and technologist were convinced of the presence of an aberrant right subclavian artery, the artery was tabulated as aberrant subclavian artery.

RESULTS AND DISCUSSION

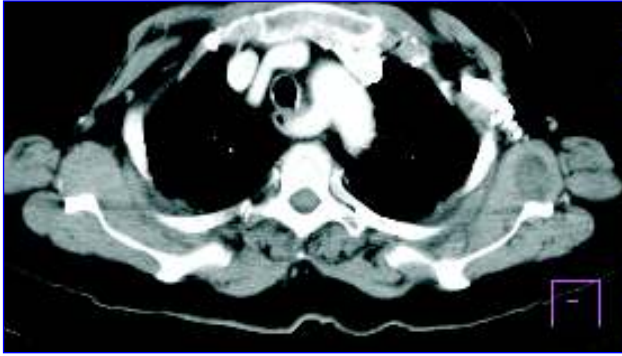
Identification and Characterization of aberrant right subclavian artery (ARSA)

The (ARSA) was identified in five (1.5%) of 328 study group. The aberrant right subclavian artery was identified in one (0.6%) of 174 male patients and four (2.6%) of 154 female patients.

It was noticed that for each of the identified right aberrant subclavian artery it was dilated in its origin and trachoesophageal retro-position with upward ascending to the right side of the body as well as encircling trachea and esophagus was detected figure,1 and figure,2. By analyzing the patient's images, it was revealed that the aberrant right subclavian artery was within normal diameter (mean 8.1 ± 3.9) throughout its course and larger in its origin than 9.0. The correlation between the presence of the aberrant right subclavian artery and gender showed that females were affected more than males.

The left aortic arch with ARSA is the most common aortic arch anomaly, with a reported incidence of 0.52% (Lee et al., 2004). In this anomaly, the right carotid artery arises as the first branch directly from the aortic arch. An ARSA takes its origin from the descending aorta at a distal point to the left subclavian artery, instead of arising from the innominate artery, and crossing the mediastinum from left to right passing behind the esophagus and trachea (Lee et al. 2004). This was what was found in this study because it was located right to the esophagus or encircling the esophagus and trachea, This was demonstrated at axial CT at the level of T2.

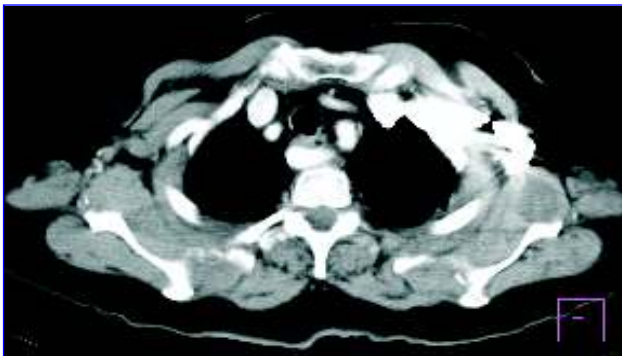
The aberrant subclavian artery may be associated with other cardiovascular anomalies. An ARSA is associated with coarctation of the aorta, patent ductus arteriosus and intracardiac defects, (Lee et al. 2004) Whereas aberrant left subclavian artery (ALSA) may be associated with tetralogy of Fallot, atrial septal defect (ASD), ventricular septal defect (VSD) or coarctation of aorta (Stewart et al., 1964). In the present study; none of these anomalies were registered in all of the five patients with identified aberrant right subclavian artery, and no respiratory distress, dysphagia or other associated symptoms were detected. This can be justified as that the



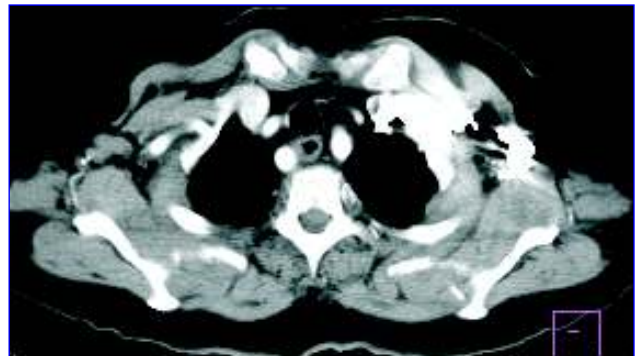
[A]



[B]

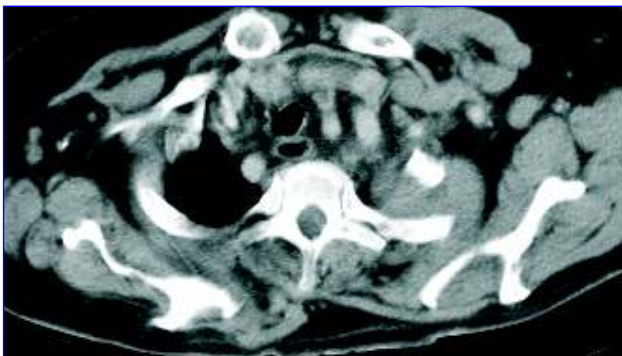


[C]



[D]

Figure 1: [A,B, C,D] Contrast-enhanced axial CT scan of chest for 76-year-old woman show aberrant subclavian artery encircling the esophagus and trachea (arrows)



[A]



[B]

Figure 2 : Contrast-enhanced axial CT scan of chest for 62-year-old woman shows aberrant subclavian artery (A) right to the esophagus.(B) encircling the esophagus and trachea (arrows)

artery was not pressing on the esophagus from behind which allows the occurrence of compression. Although patients having large arteries retroesophageally, but no respiratory distress or dysphagia have been noted, symptoms arise only if the flexible trachea and esophagus are hindered from being bent forward at the crossing with the retro-esophageal vessel. Symptoms can occur when the right and left carotid arteries arise together or close to each other from the aortic arch, this also was mentioned in previous studies (Goldbloom, 1922; Holzapfel et. al, 1899, Adrianus Klinkhamer 1966) . This was not presented in the present cases hence all the subjects do not complain of any similar symptoms.

CONCLUSION

Axial chest CT angiography is non invasive technique and is able to display the detailed anatomy of the vascular structures and relationships with adjacent organs.

Recognition of aberrant subclavian arteries has clinical significance since they may be associated with different clinical symptoms and be accompanied by other vascular and cardiac anomalies. In patients with unexplained dysphagia, aberrant subclavian arteries should be considered and surgery should not be delayed in order that serious complications can be avoided.

REFERENCES

Adrianus C. Klinkhamer, 1966. Aberrant Right Subclavian artery clinical and roentgen logic aspects, **97**:2439-2346.

- Aysel Türkvtan, Fatma Gül Büyükbayraktar, Tülay Ölçer and Turhan Cumhuri, 2009. Multidetector computed tomographic angiography of aberrant subclavian arteries *Vascular Medicine*, **14**: 51.
- Caroline Chiles, Kirkland W. Davis, Daniel W. Williams, 1999. Navigating the Thoracic Inlet September *Radio Graphics*, **19**, 1161-1176.
- Demos T.C., Posniak H.V., Pierce K.I., Olson M.C. and Muscato M., 2004. Venous Anomalies of Thorax .*American Journal Of Rontgenology*, **182**:1139-1150.
- Gilkeson R.C., Ciancibello L., Zahka K., 2003. Multidetector CT evaluation of congenital heart disease in pediatric and adult patients. *Am J Roentgen*, **180**: 973-980.
- Goldbloom A. A., 1922. Anomalous right subclavian artery and its possible clinical significance. *Surg. Gynec. & Obst.*, **3**: 378-384.
- Holzapfel G. Ungewöhnlicher Ursprung und Verlauf der, 1899. *Arteria subclavia dextra. Anat. Hefte, Wiesbaden*, **12**:369-521.
- Lee E.Y., Siegel M.J., Hildebolt C.F., Gutierrez F.R. Bhalla S., Fallah J.H., 2004. MDCT evaluation of thoracic aortic anomalies in pediatric patients and young adults: comparison of axial, multiplanar, and 3D images. *Am J Roentgen*, **182**: 777-784.
- Raider 1967. Aberrant Right Subclavian Artery .*South Med J.*, **60**:145-151.
- Stewart J.R., Kincaid O.W. and Edwards J.E., 1964. An atlas of vascular rings and related malformations of the aortic arch system. Springfield, IL, Charles C Thomas,.