High Brachiocephalic Artery
CT Appearance and Clinical Implications

Pierre D. Maldjian, MD, Muhamed Saric, MD,† and Steve C. Tsai, MD†*

Abstract: We present a case of a high brachiocephalic artery extending as far superiorly as the thyroid gland. Recognition of this rare anomaly is necessary to avoid potential catastrophic hemorrhage or other complications during percutaneous and surgical procedures on the trachea and neck.

Key Words: brachiocephalic artery, innominate artery, anomalous brachiocephalic artery

(*J Thorac Imaging* 2007;22:192–194)

A high brachiocephalic artery is a rare anomaly that can result in catastrophic hemorrhage if unrecognized during invasive procedures on the neck. In this report, we present a case of a high brachiocephalic artery extending as far superiorly as the thyroid gland and discuss the clinical implications.

CASE REPORT

Routine physical examination on an asymptomatic 66-year-old woman revealed a pulsatile mass in the anterior right neck at about the level of the thyroid gland. Because of suspicion for a vascular anomaly, a computed tomography (CT) angiographic study of the neck and chest was performed. CT was performed on a LightSpeed Pro16 scanner (GE Medical Systems, Milwaukee, WI) during the arterial phase after intravenous administration of contrast using a pitch of 1.375, slice thickness of 1.25 mm and image reconstruction interval of 1.25 mm. Image reformatting was performed on a GE Advantage workstation. The study showed that the right brachiocephalic artery ascended vertically to the level of the seventh cervical vertebra before crossing to the right, anterior to the trachea and right lobe of the thyroid gland. The brachiocephalic artery then bifurcated into the right common carotid artery and right subclavian artery at the base of the neck (Fig. 1). The right common carotid artery ascended posterior to the thyroid, slightly more dorsal than usual. Although the origin of the right subclavian artery was high, the vessel descended to its usual level, below the clavicle, so that the origins of the internal thoracic artery and vertebral artery were normally situated.

From the *Department of Radiology; and †Department of Medicine, Division of Cardiology, University Hospital, UMDNJ-NJ Medical School, Newark, NJ.

Reprints: Pierre D. Maldjian, MD, Department of Radiology, UMDNJ-NJ Medical School, University Hospital, 150 Bergen Street, UH C-320, Newark, NJ 07103-2406 (e-mail: maldjipd@umdnj.edu).

DISCUSSION

The brachiocephalic artery is the first and largest branch of the aortic arch. Normally, it arises from the convexity of the aortic arch in the midline, ascends posterolaterally to the right of the trachea, and divides into the right common carotid artery and the right subclavian artery posterior to the right sternoclavicular joint. A high brachiocephalic artery extending superiorly to the level of the thyroid gland is rare. To our knowledge, there are only 4 prior reports of this anomaly in the English literature although the CT findings have not been previously described.[1–4]

The developmental abnormality that results in the unusually high course of the right brachiocephalic artery is unknown. Embryologically the great vessels evolve from the aortic sac and 6 pairs of aortic arches corresponding to the 6 branchial arches. Not more than 4 pairs of aortic arches are present at the same time during embryogenesis and most of the 6 arch arteries obliterate partially or completely by the eighth week of development. The right brachiocephalic artery derives from both the aortic sac and the proximal right fourth aortic arch, the proximal right subclavian artery derives from the right fourth aortic arch and the proximal right common carotid artery develops from the right third aortic arch.[5] A possible explanation for a high brachiocephalic artery might be the persistence of a longer portion of the proximal segment of the right fourth arch resulting in elongation of the brachiocephalic artery. The added length of the brachiocephalic artery may result in posterior displacement of the origin of the right common carotid artery.

Recognition of this anomaly is important as catastrophic hemorrhage can result as a complication of needle biopsy, percutaneous placement of a vascular catheter, tracheostomy, or other invasive procedure involving the neck. Even if tracheostomy is initially successful, there is significant risk of erosion of the rigid cannula into the adjacent vessel secondary to the patient's neck movements.[1] Another significant consideration is the possibility of an abnormal course of the right recurrent laryngeal nerve. On the right side the inferior laryngeal nerve wraps around the undersurface of the subclavian artery near its origin forming the recurrent portion of the laryngeal nerve. During embryogenesis, growth of the neck and descent of the heart result in inferior displacement of the inferior laryngeal nerve and elongation of the recurrent portion. With a high

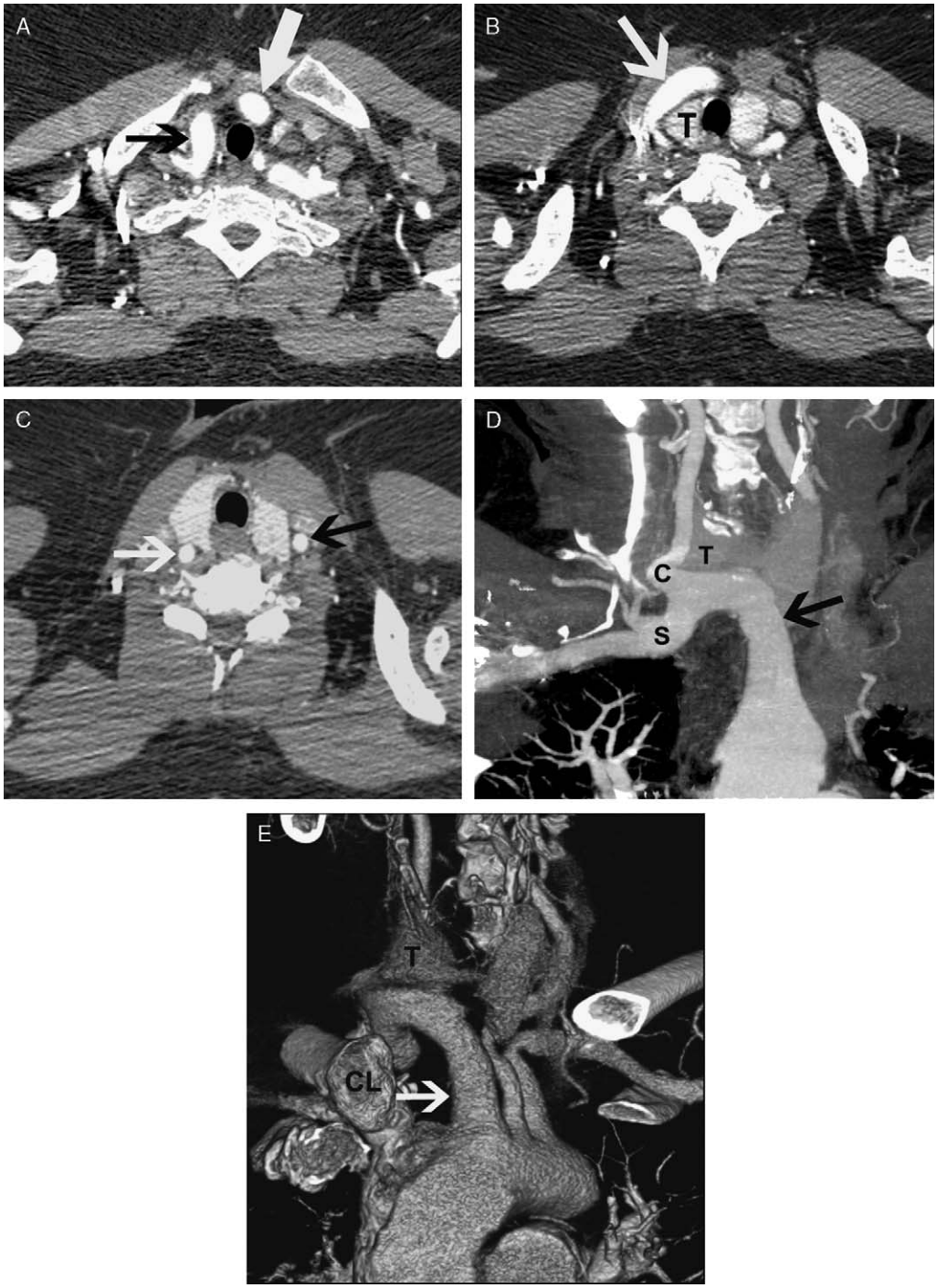

FIGURE 1. A 66-year-old woman who presented with a pulsatile mass in the neck. A, Axial image from CT scan at the level of the first thoracic vertebral body shows the right brachiocephalic artery (white arrow) just anterior to the trachea. The proximal portion of the right subclavian artery (black arrow) is also seen at this level. B, Axial image at a slightly superior level shows the right brachiocephalic artery (arrow) crossing anterior to the right lobe of the thyroid gland (T). C, Axial image at a more cranial level shows that the right common artery (white arrow) is posterior to the thyroid gland. Note the left common carotid artery (black arrow) in its normal location lateral to the thyroid. D, Coronal maximum intensity projection image demonstrates the right brachiocephalic artery (arrow) ascending to the level of the thyroid gland (T) before branching into the common carotid artery (C) and subclavian artery (S). E, Volume-rendered image from a shallow left anterior oblique perspective depicts the course of the right brachiocephalic artery (arrow) from its origin off the aortic arch to the level of the right lobe of the thyroid gland (T). Note that the right brachiocephalic artery rises well above the medial end of the right clavicle (CL). Although the trachea is not visualized, its position can be inferred from the location of the thyroid gland. The proximal portions of the left common carotid and left subclavian arteries are also shown.

brachiocephalic artery and a superiorly displaced origin of the right subclavian artery, the recurrent portion of the inferior laryngeal nerve will be shortened in length as it begins higher in the neck. Unexpected variation of the anatomy of the recurrent laryngeal nerve increases the risk of injury during thyroid and parathyroid surgery.[6] Therefore, the surgeon needs to be informed of this possibility preoperatively.

Before any invasive procedure is performed on the neck, the possibility of a major arterial anomaly should be excluded. A thorough physical examination of the region is mandatory. Preoperative clinical inspection of the neck in the sitting position can be unreliable as the pulsations from an anomalous vessel may only be apparent with the patient supine and the neck hyperextended.[4]

In addition to a high brachiocephalic artery, the differential diagnosis for an anomalous artery at the base of the neck also includes a tortuous carotid artery, cervical aortic arch, and cervical origin of the right subclavian artery.[7,8] A cervical aortic arch is a rare congenital anomaly thought to result from persistence of the third aortic arch with regression of the normal fourth arch.[5] Cervical origin of the right subclavian artery is an abnormally high origin of the right subclavian artery from the common carotid artery close to the bifurcation of the internal and external carotid arteries. The subclavian artery then descends inferiorly within the neck to the right arm. This abnormality is a specific marker of monosomy 22q11 and the affected patients may also have associated conotruncal cardiac malformations such as truncus arteriosus, tetralogy of Fallot, pulmonary atresia with ventricular septal defect, or interrupted aortic arch.[8] In this condition, the right recurrent laryngeal nerve also has an aberrant course as it passes beneath the take-off of the superiorly displaced subclavian artery.[9]

Venous anomalies should also be considered as a possible etiology for an abnormal blood vessel near the airway within the neck. Fusiform dilatation or phlebectasia of the internal or external jugular vein has been reported as a cause of a vascular mass at the base of the neck.[10,11] Aneurysmal dilatation of the communicating vein (the vein connecting the common facial vein to the anterior jugular vein) can result in an enlarged vessel that overlies the trachea.[12] Clinical findings that strongly suggest venous phlebectasia are: unilateral easily compressible neck mass, increase in prominence of the mass with Valsalva's maneuver and collapse of the mass with patient relaxation.[10]

In summary, we have presented the CT findings in a case of an abnormally high brachiocephalic artery. Recognition of this abnormality is important to avoid hemorrhage or other complications during invasive procedures on the neck. In cases where such a vascular abnormality is suspected, Doppler ultrasound or CT should be used for evaluation.

REFERENCES

1. Mukadam GA, Hoskins D. Aberrant brachio-cephalic artery precluding placement of tracheostomy. *Anaesthesia*. 2002;57:297–298.
2. Comert A, Comert E, Ozlugedik S, et al. High-located aberrant innominate artery: an unusual cause of serious hemorrhage of percutaneous tracheotomy. *Am J Otolaryngol*. 2004;25:368–369.
3. Racic G, Matulic J, Roje Z, et al. Abnormally high bifurcation of the brachiocephalic trunk as a potential operative hazard: case report. *Otolaryngol Head Neck Surg*. 2005;133:811–813.
4. Ozlugedik S, Ozcan M, Unal A, et al. Surgical importance of highly located innominate artery in neck surgery. *Am J Otolaryngol*. 2005;26:330–332.
5. Oddone M, Granata C, Vercellino N, et al. Multi-modality evaluation of the abnormalities of the aortic arches in children: techniques and imaging spectrum with emphasis on MRI. *Pediatr Radiol*. 2005;35:947–960.
6. Toniato A, Mazzarotto R, Piotto A, et al. Identification of the nonrecurrent laryngeal nerve during thyroid surgery: 20-year experience. *World J. Surg*. 2004;28:659–661.
7. Choi G, Han SH, Choi JO. Tortuous common carotid artery encountered during neck dissection. *Eur Arch Otolaryngol*. 1998;255:269–270.
8. Rauch R, Rauch A, Koch A, et al. Cervical origin of the subclavian artery as a specific marker for monosomy 22q11. *Am J Cardiol*. 2002;89:481–484.
9. Kutsche LM, Van Mierop LH. Cervical origin of the right subclavian artery in aortic arch interruption; pathogenesis and significance. *Am J Cardiol*. 1984;53:892–895.
10. Stofman GM, Schneidermann T, Sasson HZ, et al. Aberrant external jugular vein phlebectasia with tongue pain. *Am J Otolaryngol*. 1997;18:148–150.
11. Garrow EL, Kirschtein M, som ML. Internal jugular phlebectasia: case report and review of the literature. *Am J Surg*. 1964;108:380–383.
12. Gilbert MG, Greenberg LA, Brown WT, et al. Fusiform venous aneurysm of the neck in children: a report of four cases. *J Pediatr Surg*. 1972;7:106–111.