CASE REPORT

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The simultaneous presence of a bicarotid trunk and a retroesophageal right subclavian artery: a case report with clinical impact

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SUMMARY

Many variations exist in the branching pattern of the aortic arch. One variation exists in which there is a common origin of the carotid arteries, known as a bicarotid trunk, coexisting with a retroesophageal right subclavian artery. This anomaly is associated with a right non-recurrent laryngeal nerve. Aortic arch anomalies are clinically applicable to the fields of anatomy, radiology, general medical practice, as well as thoracic and cardiovascular surgery. Here, we report a case of an uncommon branching pattern of the aortic arch identified during anatomical dissection and supported by antemortem diagnostic imaging.

The anatomical variant was discovered in an 89-year-old Caucasian male during a routine anatomical dissection and was characterized by a bicarotid arterial trunk, left subclavian artery, followed by a retroesophageal right subclavian artery. Additionally, a right non-recurrent inferior laryngeal nerve was present. In the absence of clinical symptoms, the relevance of this variant is most evident in the case of cardiovascular or laryngeal surgeries. With advanced imaging such as CT and MRI, this type of vascular anomaly should be properly identified and described. The variation presented has particular interest to general practitioners, radiologists, and cardiovascular and thoracic surgeons.

Key words: Bicarotid trunk – Aorta – Retroesophageal right subclavian artery – Arteria lusoria – Non-recurrent laryngeal nerve

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INTRODUCTION

The most common branching pattern of the aortic arch, as described by all primary anatomy reference texts (Snell, 2012; Pansky, 2013; Moore, 2014) is the brachiocephalic trunk (BCT), left common carotid artery (LCCA) and left subclavian artery (LSA), listed sequentially from proximal to distal. Anatomical variations in the branching pattern of the aortic arch (AA), while being rare, represent an interesting anatomical finding during routine dissections. A comprehensive description and classification of aortic arch variations was developed in 1928 by Adachi, and since then many authors have reported similar variations based on anatomical and angiographic imaging (Williams et al., 1932; McDonald and Anson, 1940; Nelson and Sparks, 2001; Nayak et al., 2006; Natsis et al., 2009, 2011; Bergman, 2012; Patil et al., 2012).

The pattern referred as “Type A” by Adachi (1928) is detected in a variable incidence among several populations (Natsis et al., 2011), with higher incidences in Japanese (94.3%) (Nayak et al., 2006), Indians (91.4%) (Nayak et al., 2006) and Caucasians (83%) (Natsis et al., 2009). Following the systematic classification of the variable aortic arch branches, an aberrant right subclavian artery (RSA) may occasionally arise next to a normally positioned LSA, as the last branch of the AA, in 0.16-25% of the individuals (Bergman, 2012; Natsis et al., 2009).

Variations in the branching pattern of the AA ex-

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ist, and are the result of changes in fetal development. The embryological origin of the brachiocephalic artery is the left and right horns of the aortic sac (Sadler, 2010; Schoenwolf et al., 2009). The common carotid arteries and the LSA and RSA are formed from the third and fourth aortic arches, respectively. Therefore, variations in the branching pattern of the AA are closely related to the development of the third and fourth aortic arches. An abnormal RSA occurs when the artery is formed by the distal portion of the aorta and the seventh intersegmental artery. Instead of forming the RSA, the fourth aortic arch and proximal dorsal aorta are eliminated (Sadler, 2010; Schoenwolf et al., 2009). The absence of the BCT and the presence of the RRSA are the features used to identify the right non-recurrent laryngeal nerve.

We are presenting a case in which the branching pattern is a BT, LSA, followed by a RRSA. This anatomical variation is known as a Type H aortic arch (McDonald and Anson, 1940; Natsis et al., 2011). While this variation is quite rare, it is also an interesting case due to the fact that it was visualized using two different methods: an anatomical dissection and ante-mortem CT scan.

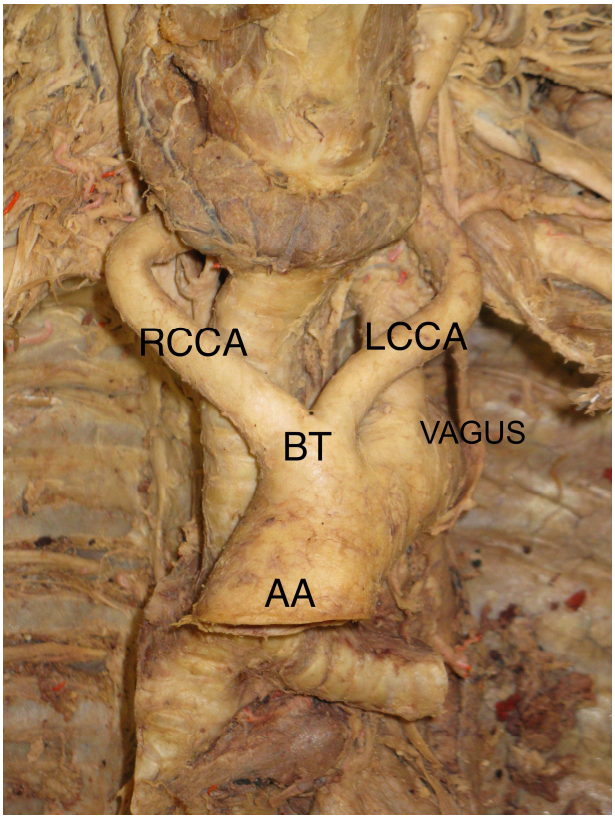
MATERIALS AND METHODS

The anatomical variation was discovered in an 89-year-old Caucasian male during a routine anatomical dissection at the Canadian Memorial Chiropractic College, Toronto, Canada. Investigation into the history of the cadaver revealed that the anatomical variant was documented by ante-mortem CT images, performed due to complaints unrelated to this vascular anomaly.

RESULTS

Case report

The variation consisted of a RCCA and LCCA that shared a common trunk, known in the literature as a BT. The LSA was adjacent to the BT, followed by the RSA (Figs. 1, 2). The RSA emerged from the distal aspect of the AA and traveled posterior to the esophagus to reestablish its normal course in the right side of the body. As a result of its development, the unusual course of the RSA had interfered with the normal course of the right non-recurrent laryngeal nerve, which was not found in the upper part of the thorax looping around the right subclavian artery. Instead, the inferior laryngeal branches of the right vagus nerve directly projected into the larynx. The left recurrent laryngeal nerve took its normal route under the AA (Figs. 1, 2), posterior to the *ligamentum arteriosum* before ascending to the larynx.



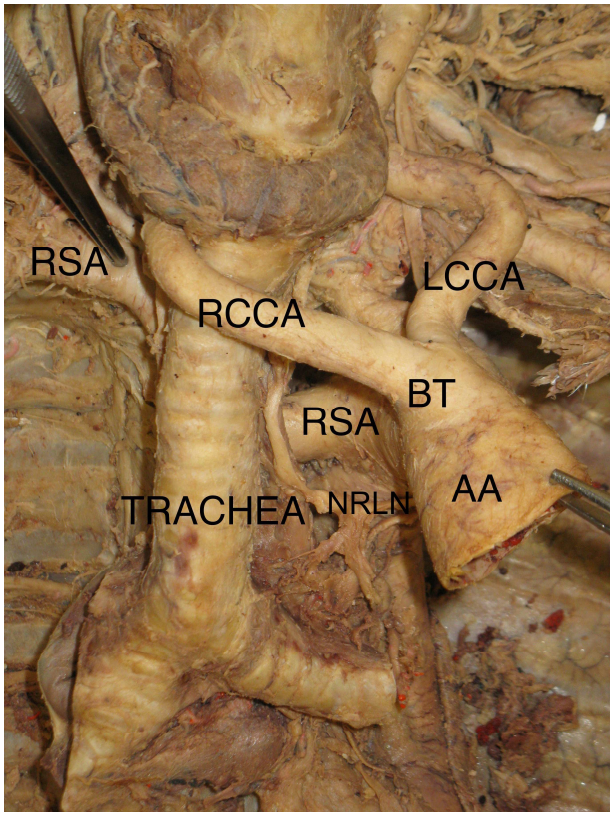


Fig. 1 (left). Bicarotid trunk (BT) positioned anterior to the trachea. Right common carotid artery (RCCA); left common carotid artery (LCCA); aortic arch (AA); non-recurrent laryngeal nerve (NRLN).

Fig. 2 (right). Right subclavian artery (RSA) passing posterior to the esophagus. Bicarotid trunk (BT); right common carotid artery (RCCA); left common carotid artery (LCCA); aortic arch (AA); non-recurrent laryngeal nerve (NRLN).

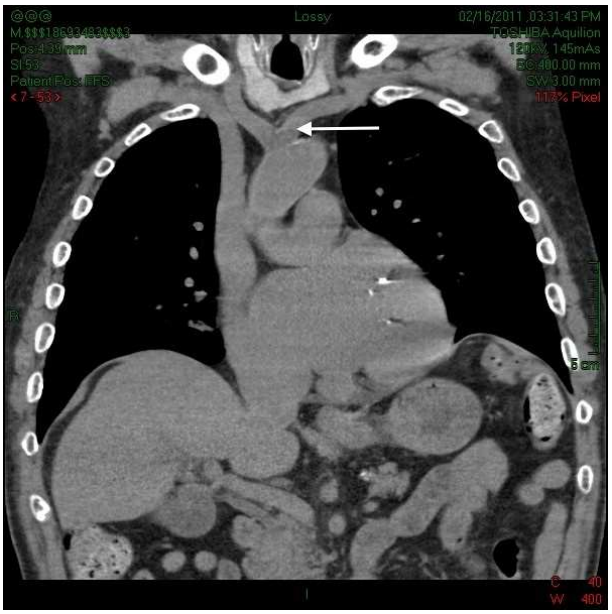


Fig. 3. Coronal CT showing the bicarotid trunk (arrow).

There were no previous medical reports of digestive or vascular complaints, and although the anatomical variation may have been known based on the CT scans, it was not associated with the cause of death. CT imaging (Fig. 3), performed after complaints unrelated to this vascular anomaly, show the bicarotid trunk in situ.

DISCUSSION

There are many variations of the aortic arch presented in the literature. The four most common morphologies are Types A, B, C, and D. While the Adachi classifications are the most frequently used in the literature (Williams et al., 1932; McDonald and Anson, 1940; Nelson, 2001; DeGaris, 1923; Saito et al., 2005), it should be noted that several authors have reported other classifications based on the frequency of occurrence in their given population (Nayak, 2006; Natsis et al., 2009; Patil et al., 2012; Thomson, 1893; Rekha and Senthilkumar, 2013; Maranillo et al., 2008).

In historical terms, Hunauld (as cited by Chahwan et al., 2006) first described the presence of a RSA as the 3rd branch of the aorta in 1735. Thomson (1893) described one case of a retroesophageal right subclavian artery (RRSA) out of 500 cadavers in 1893. In 1928, Adachi reported that approximately 80% of individuals had three branches arising from the aortic arch: the BCT, the LCCA, and the LSA. This pattern was classified as “Type A” (McDonald and Anson, 1940).

A bicarotid trunk (BT) is a feature of “Type H”, and shows the right common carotid artery (RCCA) and LCCA sharing a common origin. McDonald et al. (1940) reported this variant in 0.4% of 1453 cases. According to Klinkhamer (1966), the BT is present in 29% of those with RRSAs. The existence of both a BT and a RRSA is reported in up to 4.0% in the general population and is apparently more common in females of African descent (McDonald and Anson, 1940; DeGaris, 1923). Natsis (2011) reported this combination in 2.5% of Caucasians. The aberrant RSA (arteria lusoria) is associated with a right non-recurrent laryngeal nerve (Natsis, 2011), and is not always associated with symptoms. While a RRSA does not typically have serious clinical consequences, it has been reported that this anomaly, when associated with a BT, may contribute to “dysphagia lusoria,” a condition defined as difficulty swallowing due to an aberrant artery (Natsis et al., 2009; Klinkhamer, 1966; Mok et al., 1979; Ehren et al., 1985; Saito et al., 2005). It is suggested that the RRSA puts pressure on the esophagus, compressing it anteriorly against the trachea; the presence of this, in association with a stiffer trachea in adults, compresses the esophagus and leads to a primary symptom such as dysphagia. In children, the trachea is less rigid and compression often leads to respiratory distress (Natsis et al., 2011; DeGaris, 1923). In both cases, it is the BT that does not allow forward translation of the trachea and esophagus, leading to the associated symptoms. The arteria lusoria is also associated with aortic coarctation, a replaced right or left vertebral artery, ventricular septal defects, and tetralogy of Fallot (Molz and Burri, 1978).

Associated with a RRSA is a change in location of the right recurrent laryngeal nerve, which no longer loops under this vessel. Instead, the recurrent laryngeal either: arises directly from the cervical part of the vagus nerve and runs together with the vessels of the superior thyroid peduncle; or it follows a transverse path parallel to the inferior thyroid artery (Natsis et al., 2011). The variation is clinically applicable because the nerve course may expose the recurrent laryngeal nerve to injury during cervicotomy, thyroid, and parathyroid surgeries (Nakatani et al., 1998; Maranillo et al., 2008; Toniato et al., 2004; Natsis et al., 2009).

A BT is also associated with other vascular and genetic anomalies. Reinshagen (2014) noted that the most common vascular anomalies among 2,033 patient with a BT were ventricular septal defects, valvular pulmonary stenosis, and atrial septal defects. The most common genetic syndromes with a BT were Down’s, Williams, and CHARGE. In neonates, the arteria lusoria may coexist with long gap esophageal atresia and tracheaesophageal fistula (Canty et al., 1997). Calleja et al. (1990) also reported a BT and RRSA associated with incomplete vascular ring in patients aged 3 -9 months.

With advanced imaging such as CT. MRI, and duplex sonography (Tartaglia et al., 2011), this type of vascular variation should be properly identified and described when imaging is available.

While this variation is applicable to the field of anatomy, it is of particular interest to general practitioners, radiologists, and cardiovascular and thoracic surgeons. Considerations of these variations must be given in newborns with coexistent genetic and vascular abnormalities.

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