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CASE REPORT

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A retroesophageal right subclavian artery originating from the left aortic arch — a case report and review of the literature

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The retroesophageal right subclavian artery is an anatomical abnormality encountered by anatomists and pathologists and recently interventional cardiologists and thoracic surgeons have also come across this phenomenon. We report a case of a retroesophageal right subclavian artery arising from a normally located left aortic arch in a young male autopsied in the Department of Forensic Service of Warsaw Medical University. In addition to the aforementioned anomaly, the presence of a right non-recurrent inferior laryngeal nerve was noticed. The possible embryonic development of these branching patterns and their clinical significance is discussed.

Key words: retroesophageal right sublcavian artery, arteria lusoria, aortic arch

INTRODUCTION

In about 80% of individuals 3 branches arise from the aortic arch: the brachiocephalic trunk, the left common carotid artery, and the left subclavian artery [8]. Adachi first described this branching pattern as type A [2]. Another 11% of reported cases exhibit Adachi's type B pattern, which consists of a common trunk for the left common carotid artery and the brachiocephalic artery. This branching results in only 2 trunks originating from the aortic arch. The third most common pattern, type C, is characterised by the vertebral artery originating proximally to the left subclavian artery as a 4th branch of the aortic arch. The remaining 1% of cases is composed of numerous other aortic arch branching pattern variations [26]. We report a case in which the right subclavian artery arises from the distal aortic branch and follows a retroesophageal course.

CASE REPORT

The Department of Forensic Service of Warsaw Medical University performed an autopsy on the body of a male of approximately 30 years of age following his death in a car accident. During the examination, the right retroesophageal subclavian artery (RRSA) anomaly was recognised, and the patient's aorta (along with the proximal parts of its branches and its associated thoracic viscera) was removed en bloc from the body. The specimen was then cleaned, dissected to expose silent features and photographed. After careful examination, the examiners returned the specimen to the body.

The young male did not possess any abnormalities apart from the anomalous right subclavian artery, which originated from the descending aortic arch as the last branch. It crossed the oesophagus

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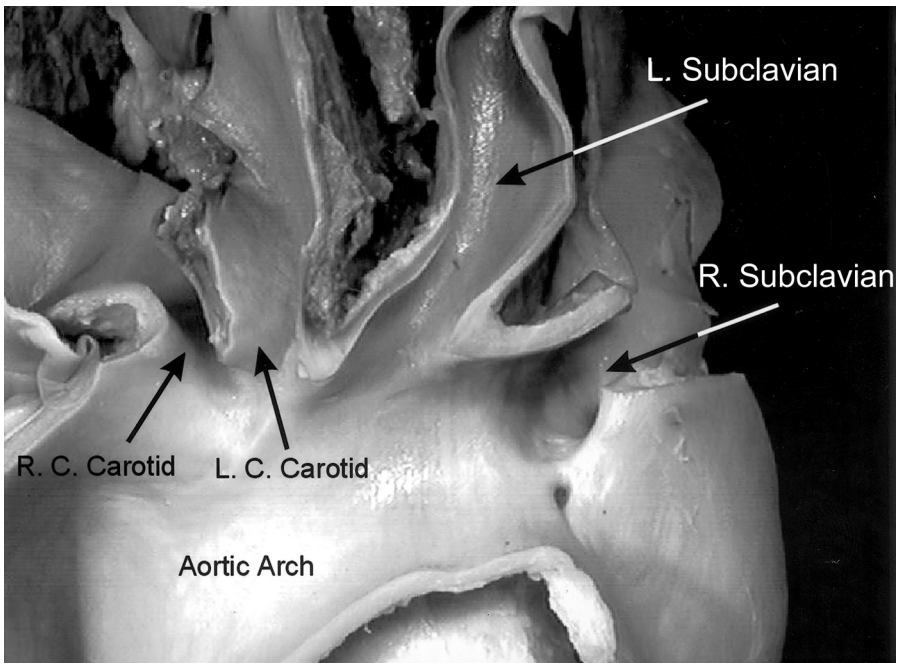

Figure 1. A longitudinal cut through the horizontal axis of the aortic arch with the abnormal branching pattern of the RRSA evident.

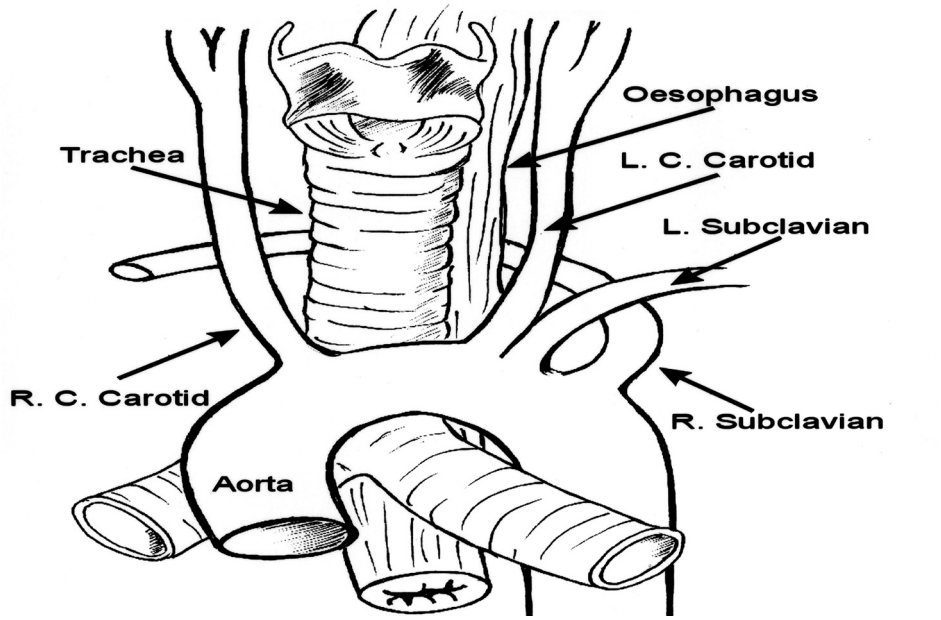

Figure 2. A diagrammatic illustration of the aortic arch with the abnormal branches. Notice the course of RRSA, which runs behind the oesophagus.

and the trachea in a posterior position to reach the right upper limb. The aortic arch appeared to be normally located above the heart and was of normal length and width. Furthermore, it gave rise to 4 branches. From right to left these were as follows: the right common carotid, the left common carotid and the left subclavian and right subclavian arteries. The right subclavian artery coursed posterior to the trachea and oesophagus, thus allowing it to be more accurately described as a retroesophageal right subclavian artery (RRSA-arteria lusoria) (Fig. 1, 2). Consequently, the brachiocephalic trunk was absent.

As Figure 1 reveals, the RRSA located distally on the aortic arch exhibited the largest diameter of the

4 branches, and arose slightly posterior to the midline of the aorta. The left subclavian artery was slightly anterior to the aortic midline of the aorta and 1 cm proximal to the RRSA. The first branch of the aortic arch was the right common carotid artery. There were no noticeable abnormalities or differences in the heart or the remaining thoracic organs.

The trachea and oesophagus were positioned normally. The vertebral column showed a mild scoliosis in the mid-thoracic region with a slight bend to the left. All abdominal viscera were normally located without any malformation or disease.

Surprisingly, the right recurrent laryngeal nerve did not recur. Instead, anomalous right inferior laryngeal nerves arose from the cervical portion of the vagus nerve at the level of the upper pole of the thyroid lobe, turning transversely by a very short course towards the larynx and running a nearly horizontal course to their point of entrance into the larynx.

The left recurrent laryngeal nerve, on the other hand, looped typically around the aortic arch, and the cardiac branches of both vagus nerves entered the cardiac plexus normally.

DISCUSSION

The origin of the RRSA as the last branch of the aortic arch is a common congenital aortic arch anomaly, with a reported prevalence of 0.4–2% [23, 25]. The earliest reported description of this anomaly was published by Hunald in 1735 [22]. The clinical syndrome of RRSA was found to be associated with dysphagia, thus termed "dysphagia lusoria" by Bayford in 1787 [6]. In 1823 Stedman [35] described the entire anatomical picture associated with RRSA.

Since Hunald, Bayford and Stedman's work there have been a number of case reports describing different origins of RRSA, although these descriptions lack clinical correlations as well as possible embryological explanations. Therefore, in order to highlight the clinical significance of RRSA, we have, to a certain degree, extended our description into the field of embryology.

Initially 5 paired arches develop in the first month of embryonic life. These are numbers I–IV and VI, the presence of arch V being rare in man. Several segments involute, leading to the normally branching left aortic arch: 1) the distal portion of the right dorsal aortic root, 2) the first and second aortic arches on both sides, 3) both dorsal aortas between the third and fourth aortic arches resulting in the common carotid arteries bifurcating into internal and external carotid branches, 4) the distal right sixth aortic arch, and 5) the upper dorsal intersegmental arteries except number 7 on both sides [5, 27, 34].

In the embryo, the fixed position of the left seventh intersegmental artery prevents its caudal displacement as the heart descends from the cervical to the thoracic region [5, 27, 34]. This brings what will soon be the left subclavian artery toward aortic arch VI (the ductus arteriosus). The embryonic intersegmental arteries primarily supply the body wall, most persisting as intercostals and lumbar arteries in the adult. The developing common carotid arteries arise from the roots of the ventral aortas between aortic arches III and IV [5, 27, 34] with aortic arch III forming the proximal part of the internal carotid artery. The left ventral aortic root between arches III and IV is somewhat proximal to aortic arch IV. Therefore, the left common carotid artery is typically proximal to the left subclavian artery in the adult.

In terms of the developmental RRSA anomaly, involution of the fourth vascular arch, along with the dorsal aorta, leaves the seventh intersegmental artery attached to the descending aorta. This persistent seventh intersegmental artery assumes a retroesophageal position as it proceeds out of the thorax into the right arm and becomes the RRSA in the adult.

The RRSA however, is closely associated with the inferior laryngeal nerve. Many authors [10, 12, 17, 18, 29, 32] have postulated that in almost all the cases of RRSA the inferior laryngeal nerve will be also affected.

In their primitive form, the inferior laryngeal nerves of the sixth visceral arches would come from the vagus nerve and take a recurrent course under the distal part of the left and right sixth aortic arches. In normal evolution, the fifth left and right aortic arches, as well as the distal part of the right sixth aortic arch, would regress. Therefore, on the left side the inferior laryngeal nerve would run under the fourth arch, which will become the right subclavian artery, and pass under the distal part of the sixth arch-ductus arteriosus and under the fourth arch, which will form the aortic arch. Thus, the inferior laryngeal nerve would follow its recurrent course towards the cricothyroid membrane differently on the right side. In terms of the developmental inferior laryngeal nerve anomaly, a regression of the fourth aortic arch would result in the right inferior laryngeal coming directly from the cervical part of the vagus nerve without taking a recurrent course to reach the cricothyroid membrane.

The clinical symptoms of RRSA vary from patient to patient, but the most common are listed below. In

adults RRSA produces a vascular ring known as Kommerell's diverticulum. The majority of patients are usually asymptomatic, but can present with significant tracheoesophageal compression [3, 4]. In elderly patients, an RRSA occasionally becomes tortuous and ectatic resulting in oesophageal or tracheal compression, for which surgery is indicated if the symptoms are severe [33]. Furthermore, many authors have reported that the RRSA has been found to be present along with patent ductus arteriosus, aortic coarctation and aneurysmal formation [2, 4, 14, 15, 17, 20, 27].

The RRSA is also clinically important to the angiographer who uses the right axillary, brachial or radial approach to the ascending thoracic aorta [1, 13]. The presence of a RRSA is suspected in cases in which catheterisation of the ascending aorta proves difficult. Using the right radial approach, access to the ascending aorta is usually easy, as the brachiocephalic trunk is the first branch of the aortic arch permitting direct access to the ascending aorta. Thus, in the presence of RRSA angiography could be very challenging [11, 24, 28].

Finally, the inferior right recurrent laryngeal nerve is an asymptomatic variation-anomaly, which can be an important obstacle and be seriously damaged during cervicotomy, thyroid and parathayroid surgery. In such cases the inferior right recurrent laryngeal nerve is a classic risk and must be eliminated by location and routine dissection of the nerve [11, 19, 26, 30, 31]. The importance of the diagnosis of a RRSA and/or inferior right recurrent laryngeal nerve differs according to whether the patient is a child or an adult. This is of particular importance when the diagnosis concerns an asymptomatic neural anomaly [12, 17, 18, 21, 29, 32] discovered by dissection or a vascular anomaly whose symptoms are very variable [4, 7, 9, 16, 30].

CONCLUSIONS

RRSA in association with the inferior right recurrent laryngeal nerve can be potential risk factors that lead to surgical intervention. Both can also be present in a patient asymptomatically. In order to provide adequate care for patients, knowledge of the exact anatomical and clinical implications of RRSA and the inferior right recurrent laryngeal nerve is crucial.

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