

Simultaneous Occurrence of Three Anatomical Variations: Anomalous Right Subclavian Artery, Non-Recurrent Inferior Laryngeal Nerve and Right Thoracic Duct

Ocurrencia Simultánea de Tres Variaciones Anatómicas: Arteria Subclavia Derecha Anómala,
Nervio Laríngeo Inferior no Recurrente y Conducto Torácico Derecho

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SUMMARY: In one male cadaver of Colombian nationality, dissected by a group of medical students during a gross anatomy course at the Universidad del Valle in Cali, Colombia, three anatomical variations were found: an anomalous or aberrant right subclavian artery (ARSA), a non-recurrent inferior laryngeal nerve and a right thoracic duct. The aortic arch gave origin to four instead of three arteries, which, from right to left, were the right common carotid, the left common carotid, the left subclavian and the right subclavian arteries. The anatomical variation of the right subclavian artery is known also as lusoria artery, in which case the artery passes behind the esophagus and the trachea in its course towards the right side of the neck. The perimeters of the aortic arch and of the lusoria artery were measured in different sites; those of the lusoria artery gradually reduced during the course of the artery towards the right side of the neck. The non-recurrent inferior laryngeal nerve originated at a right angle from the right vagus nerve, at the level of the thyroid gland. The nerve described a horizontal course in its way towards the larynx, passing behind the right lobe of the gland, in close relation with the branches of the inferior thyroid artery. Of the three possible variations in the course of the non-recurrent inferior laryngeal nerve, the one found corresponds to the horizontal course or type II. The course of the thoracic duct in the thorax was normal, situated behind the esophagus, between the azygos vein and the thoracic aorta, but it gradually deviated towards the right side of the neck to end in the internal jugular vein. Out of the extensive databases that were consulted, only one report was found of these three simultaneous variations.

KEY WORDS: Aberrant right subclavian artery; Recurrent laryngeal nerve; Thoracic duct; Genetic variation.

INTRODUCTION

At present, a significant number of worldwide reports can be found in the area of the anatomical variations. These are important because they can be the cause of clinical manifestations, such as dysphagia due to compression of the esophagus in the case of an anomalous right subclavian artery or dysphagia lusoria (Epstein & Debord, 2002) or by the vascular ring formed by a double aortic arch (Marquez & García, 2004). In surgery, the knowledge of the possible anatomical variations that can be found in a determined organ or structure can prevent injuries in the patient, many of them possibly irreversible.

CASE REPORT

In a male cadaver of Colombian nationality, dissected by a group of medical students during a gross anatomy course

at the Universidad del Valle, in Cali, Colombia, the simultaneous occurrence of three anatomical variations was found. It is to be noted that of all the approximately 360 or more cadavers dissected in the cadaver lab of this University during the last 35 or more years, it was the first time that a case like this was detected.

In this cadaver, the aortic arch gave origin to four instead of three arteries which, from right to left, were the right common carotid artery that coursed towards the right side of the neck passing in front of the trachea, the left common carotid artery, the left subclavian artery and the right subclavian artery, which in its course towards the right side passed behind the esophagus (Fig. 1). This variation is known as lusoria artery (Algieri *et al.*, 2008), anomalous right subclavian artery (ARSA) or retroesophageal right subclavian artery (RRSA) (Nathan & Gitlin, 1968).

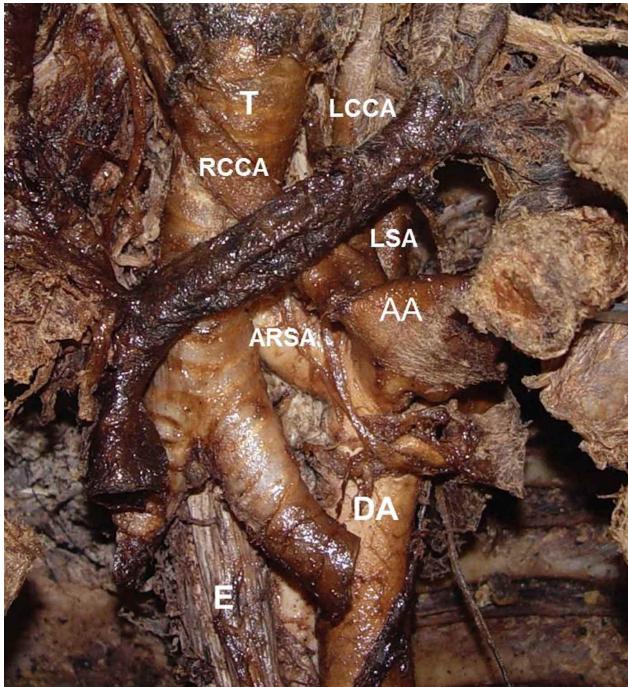


Fig. 1. Anterior view of the mediastinum. The aortic arch (AA) has been reclined upwards to expose the origin from it of the anomalous right subclavian artery (ARSA), which courses from left to right behind the esophagus (E) and the trachea (T). The right common carotid artery (RCCA) appears as the first branch of the arch, crossing in front of the trachea. Arising also from the arch are the left common carotid artery (LCCA) and the left subclavian artery (LSA). Descending aorta (DA).

The perimeter of the aortic arch was measured in two parts and that of the aberrant right subclavian artery in three. The perimeter of the aorta before giving rise to the right common carotid artery was 67 mm and before the origin of the lusoria artery was 68 mm. The lusoria artery had a perimeter of 41 mm in its pre-esophageal portion, 34 mm in its retroesophageal portion and 31 mm in its post-esophageal portion, which means that the perimeter diminished gradually as the artery coursed towards the right side of the neck.

Figure 2 corresponds to the right side of the neck. The right common carotid artery was displaced to the left in order to observe the vagus nerve which, at the level of the thyroid gland originates a non-recurrent inferior laryngeal nerve at a right angle. The nerve follows a horizontal trajectory on its way towards the larynx, passes behind the thyroid gland, in close relation with the branches of the inferior thyroid artery, and enters the larynx as the inferior laryngeal nerve. There are three types of variations for this non-recurrent laryngeal nerve: type I with descending trajectory, type II with horizontal trajectory and type III with ascending trajectory (Weinand & Mangold, 2004); type II is the one found in the case of this report.

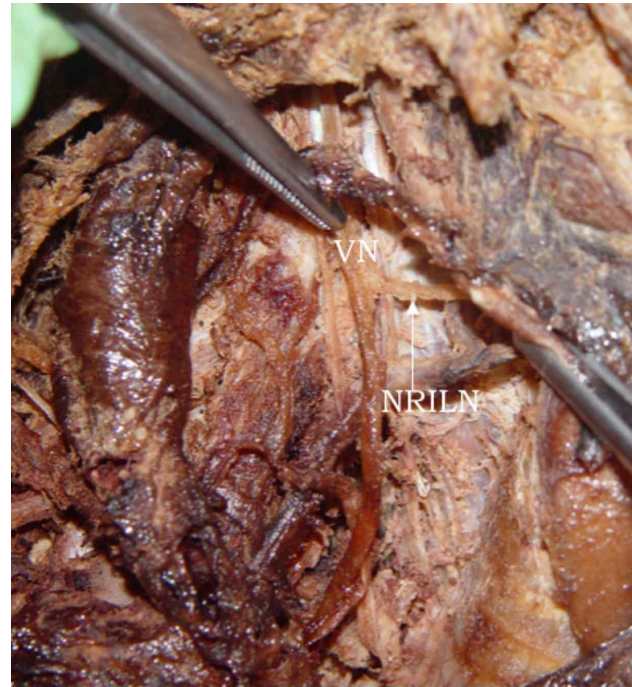


Fig. 2. Anterior view of the right side of the neck. The great vessels were separated to show the vagus nerve (VN) giving origin to a right non-recurrent inferior laryngeal nerve (NRILN), which arises at a right angle and follows a horizontal trajectory in its way towards the larynx, passing behind the right lobe of the thyroid gland. Out of the three possible variations of the NRILN, this corresponds to the type II.

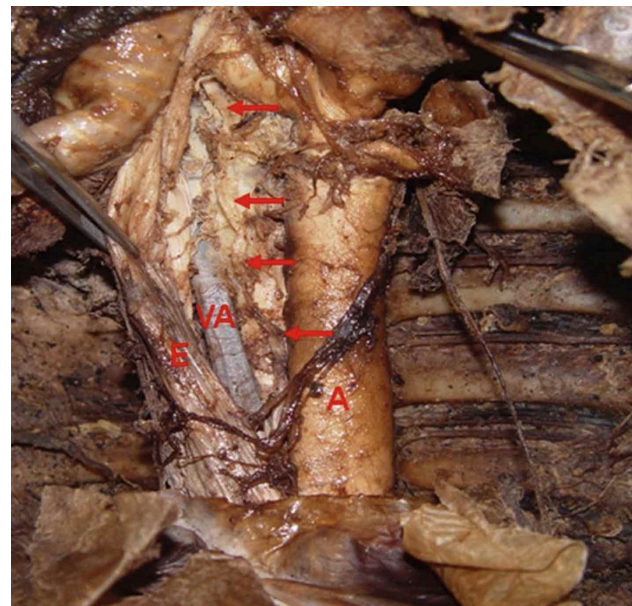


Fig. 3. Anterior view of the posterior mediastinum. The esophagus (E) was displaced to the right to show the thoracic duct (arrows) in front of the vertebral bodies, between the azygos vein (VA) and the descending aorta (A). In its upper part the duct gradually deviates towards the right side of the mediastinum. Reproduced with permission of the Editorial Board of Biomedical. Published in: Peña & Zuñiga (2009).

Figure 3 corresponds to the posterior mediastinum of the thoracic cavity. The thoracic aorta can be observed to the left and the esophagus was displaced to the right, in order to discover the thoracic duct. This appears as a slender, white and sinuous duct situated between the aorta and the azygos vein, in front of the vertebral bodies. In the upper part of the thorax the duct gradually deviates towards the right side of the mediastinum.

Figure 4 is the right side of the neck, where the thoracic duct can be appreciated describing a slight curve of superior convexity before opening in the right internal jugular vein.

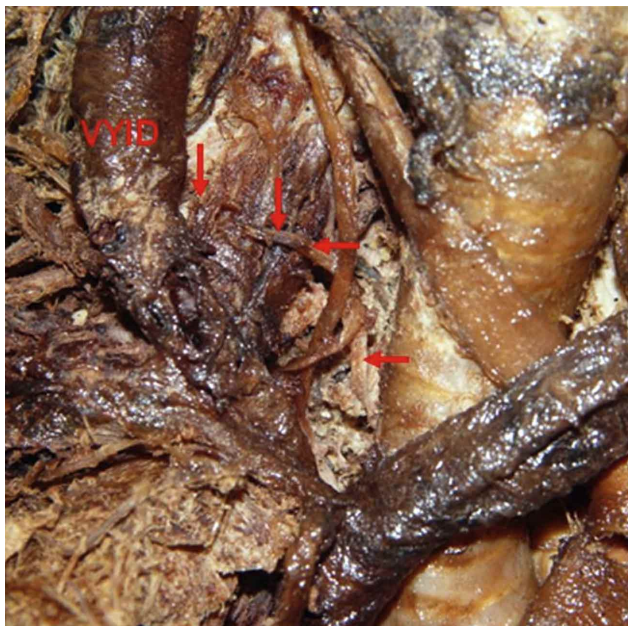


Fig. 4. Anterior view of the right side of the neck. The arrows show the trajectory of the thoracic duct, which appears from behind the trachea and describes a slight curve of superior convexity before opening in the right internal jugular vein (VYID). This variation is known as right thoracic duct. Reproduced with permission of the Editorial Board of Biomedical. Published in: Peña & Zuñiga (2009).

DISCUSSION

The lusoria artery develops when the fourth right aortic arch and the proximal part of the right dorsal aorta disappear. The anomalous origin and trajectory of the right subclavian artery constitutes, as well, the embryological basis for the non-recurrence of the right inferior laryngeal nerve.

According to Nathan & Gitlin, the embryological basis for variations in the course of the thoracic duct, such as a thoracic duct terminating on the right side of the neck

associated with aberrant retro-esophageal right subclavian artery and truncus bicaroticus, is well documented. In the early embryo there exist both, right and left thoracic ducts, with numerous anastomosing channels between them (Davis, 1915). The usual pattern of the adult channel develops in its lower part from the right duct and in its upper part from the left duct. Usually, the upper part of the right duct becomes the right lymph duct. In the case of a right thoracic duct, the upper part of the left duct disappears remaining the inferior part of this duct and the upper part of the right duct.

The authors of the present report postulate a possible theory for the development of the right thoracic duct, which is based in the physical barrier formed by the ARSA. Since in the embryo the blood vessels appear previous to the lymph vessels, in case that a lusoria or ARSA artery is formed, since the vessel crosses the superior mediastinum from left to right behind the esophagus, it becomes a physical barrier that will prevent the normal course of the thoracic duct towards the left side of the neck, forcing it to deviate towards the right side.

The presence of a non-recurrent inferior laryngeal nerve accompanying a lusoria artery has been reported (Casal *et al.*, 2010; Namking *et al.*, 2009), but in the literature extensively reviewed so far, only one report was found (Namking *et al.*) of the three simultaneous variations present in this Colombian individual. It is the case of an 80 year-old female cadaver of Thai nationality, dissected in the gross anatomy laboratory of the Khon Kaen University. The diameter of the left subclavian and of the anomalous right subclavian arteries were measured at their origin, being that of the lusoria artery almost twice that of the left vessel. In our case, the diameter of the lusoria artery at its origin (pre-esophageal part) was considerably bigger (41 mm) than that of the Thai female (15.4 mm).

The lack of reports of these three simultaneous anatomical variations could be the result of not having in mind the possibility that, whenever a lusoria artery develops, it can be accompanied by a non-recurrent inferior laryngeal nerve and by a right thoracic duct.

As noted by Nathan & Gitlin, a thoracic duct ending at the right venous angle may or may not be accompanied by anomalies of the large arteries. The extent to which anomalies in the origin and course of the large arteries is accompanied by anomalies of the thoracic duct is not known, since in these cases the thoracic duct is not considered. However, ignoring the possible existence of a right lymphatic duct may lead to its injury or section in the course of a neck surgery, with a subsequent lymph leakage or even a chylothorax (Kaul *et al.*, 1976).

Nathan & Gitlin, report the simultaneous occurrence of a thoracic duct terminating on the right side, at the junction of the internal jugular and subclavian veins, a right subclavian artery arising as the last branch of the aortic arch, beyond the left subclavian artery, and the right and left common carotid arteries arising by a common stem (truncus bicaroticus) from the aortic arch. They briefly describe the embryological basis for the development of these variations and suggest that special

attention should be directed to the course of the thoracic duct whenever an anomaly of the branches of the aortic arch is observed.

Another case of three simultaneous variations is the report of Chen *et al.* (2006), about bilateral thoracic ducts coexisting with a persistent left superior vena cava, being this last variation one of the most common developmental anomaly of the larger systemic veins.

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RESUMEN: En un cadáver de nacionalidad colombiana, disecado por un grupo de estudiantes de medicina durante un curso de anatomía macroscópica en la Universidad del Valle de Cali, Colombia, tres variaciones anatómicas fueron encontradas: una arteria subclavia derecha anómala o aberrante (ARSA), un nervio laríngeo inferior no recurrente y un conducto torácico derecho. Del arco o cayado aórtico emergían cuatro en lugar de tres arterias, las cuales de derecha a izquierda eran las arterias carótida común derecha, carótida común izquierda, subclavia izquierda y subclavia derecha. Esta variación anatómica de la subclavia se conoce también como arteria lusoria, en cuyo caso la arteria pasa por detrás del esófago y de la tráquea en su curso hacia el lado derecho del cuello. Los perímetros del arco aórtico y de la arteria lusoria fueron medidos en diferentes sitios; los de la arteria lusoria fueron disminuyendo gradualmente en el curso de la arteria hacia el lado derecho del cuello. El nervio laríngeo inferior no recurrente se originaba en un ángulo recto del nervio vago derecho, a la altura de la glándula tiroidea. El nervio siguió un curso horizontal en dirección a la laringe, pasando por detrás del lobo derecho de la glándula, en estrecha relación con las ramas de la arteria tiroidea inferior. De los tres tipos de variación posibles en el curso del nervio laríngeo inferior no recurrente, el encontrado corresponde a la del curso horizontal o tipo II. El curso del conducto torácico en el tórax fue normal, situado por detrás del esófago, entre la vena ácigos y la aorta torácica, pero gradualmente se fue desviando hacia el lado derecho del cuello para desembocar en la vena yugular interna. En las extensas bases de datos consultadas solo se encontró un reporte de estas tres variaciones simultáneas.

PALABRAS CLAVE: Arteria subclavia derecha aberrante; Nervio laríngeo recurrente; Conducto torácico; Variaciones genéticas.

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