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Variations in Anterior Jugular Venous Drainage and Their Clinical-Surgical Relevance: A Case Report

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ABSTRACT: The anterior jugular venous system is known for its marked anatomical variability, with descriptions of its variations dating back to early anatomical studies. A thorough understanding of these variations is essential for clinicians performing invasive procedures in the anterior cervical region. During a routine dissection at the Department of Anatomy, Faculty of Medicine, University of the Republic in Montevideo, Uruguay, an atypical anterior jugular venous configuration was encountered. This case was notable for the presence of numerous venous trunks, all ultimately draining into the right subclavian vein. The dissection focused on the anterior cervical region, with detailed examination of each component of the anterior jugular venous system and their respective terminations. The subject was an 80-year-old cadaver weighing approximately 45 kg, previously preserved in formaldehyde. Standard surgical instruments were used for the dissection, measurements were obtained with an electronic caliper, and photographic documentation was performed using a Nikon D500 camera. The dissection revealed multiple anterior jugular venous trunks: three on the right and two on the left. These vessels originated from various sources, including the external jugular vein, facial vein, thyrolinguofacial venous trunk, and submental veins. All ultimately converged to form a common trunk draining into the right subclavian vein. Anatomical variations of the anterior jugular system are frequent and can pose challenges during clinical and surgical procedures involving the cervical region. Awareness of such variants is critical to minimize the risk of iatrogenic injury, particularly during the placement of central or peripheral venous catheters or surgical approaches such as the presternocleidomastoid route. This case underscores the importance of detailed anatomical knowledge in ensuring safe and effective interventions in the neck.

KEY WORDS: Jugular veins, Neck dissection, Vein, Catheterization, Central venous, Anatomical variations.

INTRODUCTION

The anterior jugular venous system is part of the superficial venous drainage system of the neck. It consists of a series of superficial venous vessels, most often formed by two large venous trunks. These venous trunks usually originate at the level of the mental border, where they form through the union of different mental veins. From there, both venous trunks descend on each side in an almost vertical direction, then change course at the jugular arch and drain on each side into the terminal portion of the external jugular vein or the subclavian vein in most cases (Rouvière & Delmas, 1999; Latarjet & Ruiz Liard, 2019; Birch *et al*., 2021)

The existence of variations of the anterior jugular veins is widely recognized in the literature. Since the times of classical authors such as Testut, Sebileau, Demoulin, Paturet, and Gray (Gray, 1866; Paturet, 1964; Testut & Latarjet, 1982), more or less detailed descriptions of some of these variations have been documented. Variations have been reported in the origin, the number of anterior jugular vessels, as well as their termination. In addition to these cadaveric descriptions, the advent of different imaging techniques has enabled the description of many of these variations in living individuals (Schummer *et al*., 2004; Álvarez Cuenva *et al*., 2021). However, it is noteworthy that, to date, no unified classification system exists for variations of the anterior jugular venous system, which hinders the standardization of criteria when comparing findings among different studies.

The existence of variations in the anterior jugular venous system carries significant clinical and surgical relevance, which can only be properly appreciated through anatomical knowledge of such variations. It is known that the placement of central venous catheters in the jugular or subclavian veins, an everyday clinical practice, may be complicated by variations of the anterior jugular veins that alter the course of catheter placement (Schummer *et al*., 2004; Paraskevas *et al*., 2014). Likewise, anomalously positioned anterior jugular veins may present obstacles during anterior approaches to the neck (Nayak, 2006).

The aim of this work is to report an unusual case of variations of the anterior jugular system, as well as their clinical and surgical significance. In doing so, we seek to emphasize the importance of understanding the variations of this venous system, which is often overlooked by both anatomists and surgeons.

MATERIAL AND METHOD

During a routine dissection in the Department of Anatomy of the Faculty of Medicine, Universidad de la República, Montevideo, Uruguay, anomalies of the anterior jugular venous drainage were observed in a female cadaver, 80 years of age and weighing 45 kg. This cadaver, as well as all those used in the Department of Anatomy of the Faculty of Medicine, Universidad de la República, Montevideo, Uruguay, were obtained through voluntary donation for both research and teaching purposes.

For the dissection, dissecting forceps, iris, Adson, and curved forceps were used, as well as Metzenbaum scissors and straight scissors, a grooved director, and Farabeuf-type retractors. For the various measurements, an electronic caliper and micro-rulers were utilized. Photographic documentation was performed using a Nikon D500 camera. Microsoft Excel 2010 was used to compile the data.

For the dissection, an anterior cervical approach was performed through a midline longitudinal incision from the inferior border of the mandible to the jugular notch. Complementary transverse incisions were then made at the clavicular level and along the inferior border of the mandible, allowing both skin flaps to be reflected laterally. The anterior jugular veins were then dissected, noting their arrangement, termination, as well as anastomoses between them and with other venous systems. The length and caliber of the different venous trunks identified were also measured using an electronic caliper and micro-rulers.

A literature search on the subject was conducted on May 20, 2025. The following databases were used: PubMed, Scopus, Google Scholar, and SciELO. Searches were carried out using MeSH terms (“jugular veins,” “neck dissection,” “veins”) and non-MeSH terms (“anterior jugular veins,” “presternocleidomastoid approach,” “venous anomaly”).

RESULTS

Numerous vessels corresponding to the anterior jugular venous system were found, with variable origins, among which the origin of the thyrolinguofacial vein was noteworthy. The presence of 3 right anterior jugular trunks and 2 left anterior jugular trunks was determined.

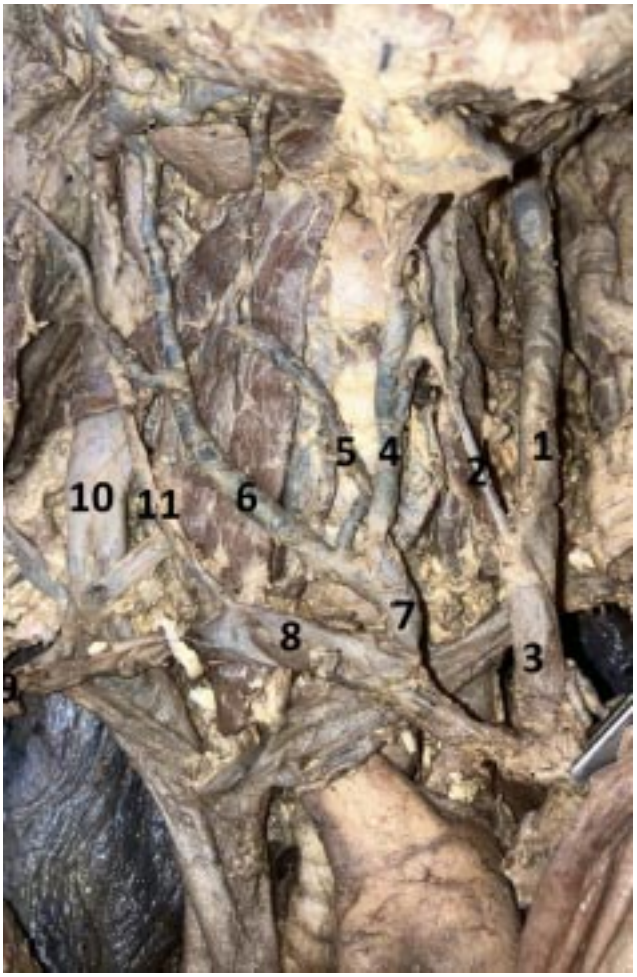

Fig. 1. Anterior view of the anterior jugular axis. 1: left lateral trunk; 2: left medial trunk; 3: left common trunk; 4: right medial trunk; 5: right middle trunk; 6: right lateral trunk; 7: right common trunk; 8: common anterior jugular trunk; 9: internal jugular vein; 10: anastomosis between the internal jugular vein and the common anterior jugular trunk.

In the right system, from lateral to medial, an anterior lateral jugular trunk was identified, formed by two venous roots: laterally, a branch originating from the right external jugular vein, and medially, a branch originating from the thyrolinguofacial trunk; a middle trunk originating from the facial vein; a medial trunk arising from the inferior border of the mandible; and finally, a right common trunk originating from the three previously described trunks.

Fig. 2. Origin of the left lateral anterior jugular trunk. 1: left lateral trunk; 2: left internal jugular vein; 3: thyrolinguofacial venous trunk; 4: facial vein.

In the left system, a lateral trunk was observed with its origin in the thyrolinguofacial vein, and medially a small vein originating from the inferior border of the mandible. These two left trunks join to form a left common trunk.

Both common trunks unite to form a common trunk that drains into the right subclavian vein in immediate relation to the formation of the right brachiocephalic venous trunk, and it also presents an anastomosis with the right internal jugular vein. The various measurements of the anterior jugular vessels are shown in Table 1.

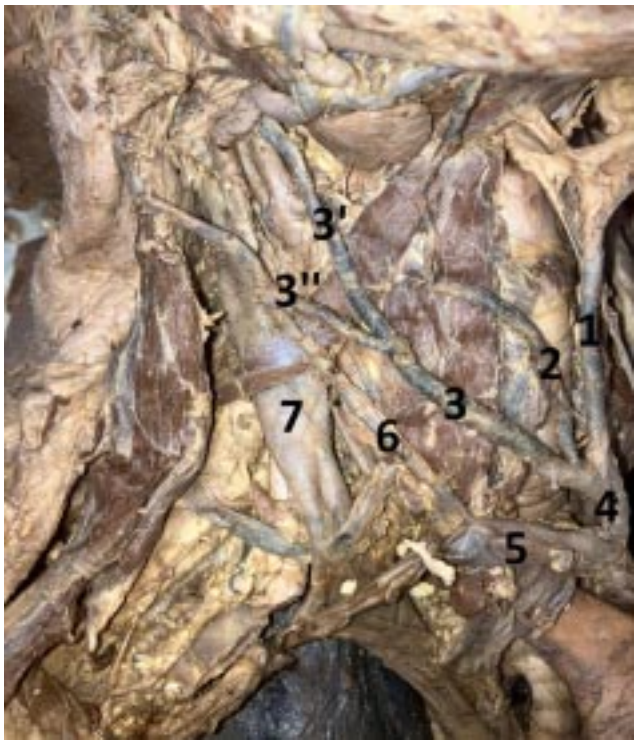

Fig. 3. View of the right anterior jugular trunks. 1: right medial jugular trunk; 2: right middle jugular trunk; 3: right lateral jugular trunk; 3': medial root of origin of the right lateral jugular trunk; 3'': lateral root of origin of the right lateral jugular trunk; 4: right common trunk; 5: common anterior jugular trunk; 6: anastomosis with the right internal jugular vein; 7: right internal jugular vein.

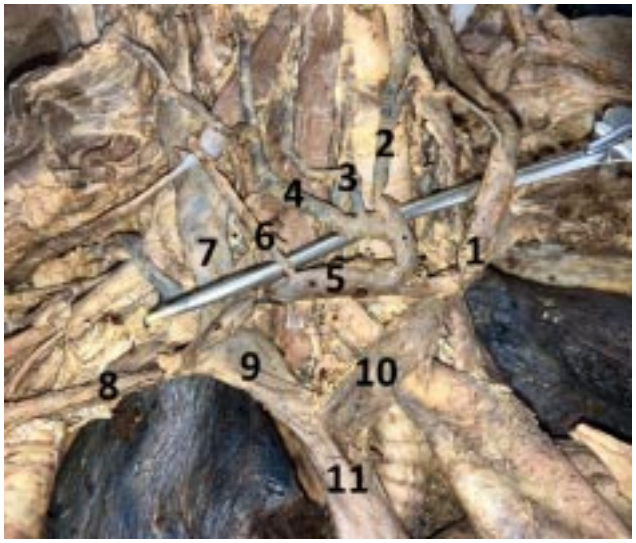

Fig. 4. View of the termination of the anterior jugular axis. 1: left common trunk; 2: right medial jugular trunk; 3: right middle jugular trunk; 4: right lateral jugular trunk; 5: common anterior jugular trunk; 6: anastomosis with the internal jugular vein; 7: internal jugular vein; 8: right subclavian vein; 9: right brachiocephalic vein; 10: left brachiocephalic vein; 11: superior vena cava.

Table 1. Number and measurements of the veins of the anterior jugular venous system. The results are presented according to the origin of the veins of the anterior jugular system, from right to left.

Variable	Length (mm)	Width (mm)
1– Right lateral anterior jugular	37	4
2– Right middle anterior jugular	58	2
3– Right medial anterior jugular	61	3
4– Right common trunk	9	6
5– Left lateral anterior jugular	67	5
6– Left medial anterior jugular	60	1
7– Left common trunk	46	6
8– Common trunk of both systems	44	9

DISCUSSION

The superficial venous anatomy of the neck is particularly variable (Álvarez Cuenca *et al*., 2021), and it is crucial to understand it both in surgery and in clinical practice. Despite this, few studies describe its anatomical variations (Hojaij *et al*., 2022); this considerable gap means that these veins may simulate pathological processes such as masses or lymph nodes in the cervical region (Álvarez Cuenca *et al*., 2021). It is necessary to delve deeper into this topic, as knowledge of these structures is essential both for radiologists (Paraskevas *et al*., 2014) and for emergency physicians, given that this is a common route for catheterization (Paraskevas *et al*., 2014).

As previously mentioned, it is common for the anterior jugular vein to form in the suprahyoid region through the confluence of the submandibular veins (Paraskevas *et al*., 2014) or a submental vein (Álvarez Cuenca *et al*., 2021). It is worth noting that a few reported cases describe the facial vein or its tributaries, normally expected to ultimately drain into the internal jugular vein via the thyrolinguofacial trunk, giving rise instead to the anterior jugular vein (Nayak, 2006). However, in our case it is clearly observed in Fig. 3 that the anterior jugular veins arise from the thyrolinguofacial venous trunk on both sides, as well as from the submental venous network. Therefore, we can affirm that we are dealing with an atypical variable origin, topographically located above the suprahyoid region, at the level of the facial mass.

It is important to highlight that Nayak (2006), has reported cases in which the facial vein continued as the anterior jugular vein, noting that this variation was accompanied by an anastomosis between the anterior jugular vein and the internal jugular vein (Nayak, 2006). In our case, a communicating vein links the anterior surface of the right internal jugular vein with the posterior surface of a right anterior jugular trunk, as shown in Fig. 1. Given the anterior and inferior direction of this communicating vein, we may infer that blood flow travels from the internal jugular vein toward the anterior jugular vein, likely due to gravitational force alone.

The termination of the anterior jugular vein most frequently occurs at the ipsilateral external jugular vein in 46% of cases, and in 54% at the ipsilateral subclavian vein, according to Deslaugiers *et al*., (1994). What is particular about our case is that the left anterior jugular veins did not contact the external jugular vein or the ipsilateral subclavian vein, draining entirely into the right anterior jugular system through a common trunk, which then emptied into the ipsilateral subclavian vein.

It is important to emphasize that our case is unusual, as a number of anterior jugular veins greater than expected was found: 4 on the right side and 3 on the left side of the midline, an extremely uncommon finding that, according to Hojaij, has not been frequently described (Hojaij *et al*., 2022).

Despite the above, it is essential to mention that, in 60% of cases, the most frequent diameter of these veins is less than 5 mm, making them the smallest of the jugular veins (Hojaij *et al*., 2022). Frequently, the size of the anterior jugular veins is inversely related (Schummer *et al*., 2004) to the size of the external jugular veins. Notably, authors such as Schummer *et al*., (2004) and Young *et al*. (2024), mention that this may be due to unilateral obstruction of the external jugular vein or the brachiocephalic venous trunk. In our study, it was not possible to determine the presence of venous thrombosis, as in the formalin-fixed cadaver the majority of vessels are obstructed by thrombi due to the preservation technique used. In our case, the anterior jugular veins had a diameter greater than 5 mm, with the common trunk reaching 9 mm in caliber, placing it within the 40% of cases where these veins measure more than 5 mm (Hojaij *et al*., 2022). Additionally, the inverse relationship in size with the external jugular vein was maintained, with the latter being smaller, an unusual finding, given that the caliber of the external jugular vein is generally larger than that of the anterior jugular vein even in cases of venous engorgement.

It is worth highlighting that these size variations, according to Schummer *et al*., (2004) and Young *et al*. (2024),

in cases of obstruction, could explain the development of tortuosity and elongation in the anterior jugular vessels, causing them to function as accessory pathways for blood drainage toward the contralateral side (Paraskevas *et al*., 2014); this may also relate to the thickened jugular arch described by Nayak (2006). On the other hand, it should be considered that, given their atypical origin, the blood flow through these veins may be greater, which could account for the increase in diameter, length, and tortuosity.

Regarding the clinical–surgical relevance of this variation, a precise understanding of venous variations is crucial to avoid complications such as pneumothorax, muscle injury, and damage to the internal carotid artery (Young *et al*., 2024). The use of ultrasound appears to be extremely helpful in cases of superficial venous variations (Paraskevas *et al*., 2014). According to Schummer *et al*. (2004), in the cases he described, the anterior jugular vein served as an alternative route for cannulation as well as an incorrect pathway leading to malposition of central venous catheters, given that the anterior jugular vein terminated directly in the brachiocephalic venous trunk and also due to the presence of contralateral venous obstruction. In our case, we find it particularly interesting to consider the anterior jugular axis for placement of a peripheral venous line, since it has a larger caliber than the external jugular axis, despite not being a usual site for peripheral venous catheterization.

In our case, the final common termination of the anterior jugular veins is aberrant, draining into the right subclavian vein, very close to the termination of both the external and internal jugular veins. This becomes relevant because it increases the risk of migration of a previously placed cannula in the right subclavian vein toward the anterior jugular axis. This would be facilitated by the large caliber of the common anterior jugular trunk at its termination, as well as the direction of this trunk, which is nearly identical to that of the right subclavian vein.

Malposition of the catheter into the anterior jugular vein increases the risk of complications, and because its diameter is often small, catheter placement in these cases may result in endothelial injury, thrombus formation, vascular stenosis, and perforation with extravasation of the infused substance through the peripheral venous route (Schummer *et al*., 2004).

Tamjidipoor & Ahmadi (2015), state that knowledge of anatomical variations should be considered essential for the surgeon, as they must avoid injury to the external and anterior jugular veins in order to prevent complications and subsequent hematomas (Paraskevas *et al*., 2014).

Currently, one of the most important approaches in this region for treating pathologies of the esophagotracheal complex is the presternocleidomastoid approach (Gagliardi *et al*., 2023). Because this approach involves an incision along the anterior border of the sternocleidomastoid muscle, the anterior jugular veins may be encountered; therefore, understanding their variations is fundamental.

It should be highlighted that the anterior jugular veins usually cross the midline of the neck, a site frequently used to perform tracheotomies and cricothyroidotomies (Hojaij *et al*., 2022). Keeping this in mind when performing a surgical dissection of the neck is essential to avoid injuring these veins (Hojaij *et al*., 2022). In fact, the anterior jugular arch is among the vessels commonly encountered during low tracheostomies (Schummer *et al*., 2004). In our case, this would be of great importance, as the large caliber of the anterior jugular arch could have represented a major obstacle, potentially causing significant bleeding.

CONCLUSION

Anatomical knowledge of the anterior jugular venous axis and its variations is essential for both general practitioners and surgeons who operate in the visceral compartment of the neck.

Atypical features were found in the origin, termination, caliber, and number of anterior jugular veins in this case.

This particular presentation is especially relevant. On the one hand, because these veins, given their increased number and large caliber, occupy a substantial portion of the anteromedial axis of the neck superficially; a fact that would place these vessels at risk in any cervical approach at this level, particularly emphasizing the widely used presternocleidomastoid approach. On the other hand, the atypical drainage territory, which emptied exclusively into the right subclavian vein, is of interest to any clinician placing a central venous access in this vessel, as the large caliber of the common anterior jugulartrunk could allow migration of a previously placed cannula in the right subclavian vein, thereby diverting its route when the intent is to administer drugs that must reach the systemic circulation rapidly.

It should also be noted that, given the large caliber of

the veins described in this report, evaluating their applicability as a potential site for peripheral venous access may be of interest.

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Joaquin Silva: conceptualization, data curation, investigation, methodology, visualization, writing–original draft

Lorenzo Martin: conceptualization, data curation, investigation, methodology, visualization, writing–original draft

Augusto Garrido: conceptualization, data curation, investigation, methodology, writing–review & editing, supervision

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Conflicts of Interest:

The authors declare no conflicts of interest.

Ethical Considerations:

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