Case Report

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A rare variation of the dural jugular septum: a cadaveric case report

Mert Nahir, Abdülkerim Kasap, Berna Doğan

Department of Anatomy, Faculty of Medicine, Tokat Gaziosmanpaşa University, Tokat, Türkiye

Abstract

The jugular foramen (JF) is a passage formed at the skull base between the petrosal part of the temporal bone and the occipital bone. This passage is important because it contains neurovascular structures such as cranial nerves IX, X, and XI, internal jugular vein and ascending pharyngeal artery. In this passage, the dura mater forms dural septums that surround, protect and separate the structures. Dural septa can separate structures individually as well as by grouping them with different variations. In this case, a dural septum separating the cranial nerve IX from the cranial nerves X and XI was found in the JF during routine head dissection of a 74-year-old male cadaver. In surgical procedures to be planned in this region, it will be useful for clinicians to know the variations of the septum due to its interaction with other anatomical structures.

Keywords: cadaver; cranial nerve; dural septum; jugular foramen

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Introduction

The jugular foramen (JF) is a canal located at the base of the skull between the lateral margin of the occipital bone and the anteromedial portion of the petrous pyramid. Due to its close anatomical relationship with the brainstem, cerebellum, tympanic cavity, and other critical neurovascular structures, the jugular foramen features distinct exocranial and endocranial surfaces with complex anatomical characteristics. On the endocranial surface, the jugular foramen is bordered superiorly by the cerebellum, medially by the hypoglossal canal, anteriorly by the petro-occipital fissure and the inferior petrosal sinus, and superolaterally by the internal auditory meatus.[1–3] This strategic gateway includes critical structures such as cranial nerves IX, X, and XI, the internal jugular vein, and the inferior petrosal sinus. The meningeal branches of the occipital artery and the ascending pharyngeal artery are also found in this area. The lateral part of the exocranial surface of the jugular foramen forms the jugular fossa, which lies directly beneath the thin bony floor of the middle ear. The stylomastoid foramen and the styloid process are located lateral to the jugular foramen, the occipital condyle lies medially, and the external opening of the carotid canal is situated just anterior to it. The anterolateral bony wall of the jugular foramen is formed by the temporal bone, whereas the posteromedial wall is formed by the occipital bone.[4–7] A detailed understanding of the neurovascular structures within the JF is essential for neurosurgical and neuroradiological applications, and it plays a crucial role in the treatment of pathologies such as paragangliomas, meningiomas, and schwannomas.[8]

The dura mater lining the interior of the JF contains specialized dural septa that protect and separate the important structures passing through this region.[2,9] Detailed knowledge of these anatomical structures and their variations is essential for specialists in neurosurgery, neurology, and radiology. A precise understanding of anatomical variations is a critical factor in the effective planning and execution of surgical and radiological procedures.[3,10,11]

This study was presented as an oral presentation at the International Congress on Information Technologies in Medicine, Pharmacy, Agriculture, Food, Forestry, Environment and Engineering (INFTEC) 2024, May 8–10, 2024, Tokat, Türkiye.

The primary focus of this study is to investigate the variation in dural septation, particularly between the cranial nerves IX, X and XI. During an educational cadaveric head dissection, a dural septum was identified separating cranial nerve IX from cranial nerves X and XI. The main objective is to describe this anatomical variation in detail and contribute to the existing literature to improve the understanding of JF and its related structures.

Case Report

A dural septum variation in the jugular foramen was identified in a 74-year-old male cadaver during a training dissection at Tokat Gaziosmanpaşa University Faculty of Medicine, Department of Anatomy. The dissection began with a coronal incision to the scalp between the zygomatic processes of the frontal bone, extending over the frontal eminence. From the midpoint of this incision, a sagittal cut was made, reaching the level of the external occipital protuberance. Finally, a horizontal incision was made from the sagittal cut to the level of the asterion on both sides, and the scalp was reflected anteriorly and laterally. The calvaria were carefully removed using an oscillating bone saw. After the removal of the dura mater together with the calvaria, the cranial nerves were dissected carefully one by one. The brain was removed by transecting the medulla spinalis at the level of the foramen magnum. Following these procedures, a variation in the dural septum was observed between cranial nerve IX and cranial nerves X and XI (**Figure 1**).

The width and length of the JF and the distance of the dural septum from the anterior and posterior walls of the JF were measured for both sides. All measurements were taken from the inner surface of the skull base. For anterior–posterior measurements, the distance from the most superficial part of the septum to the anterior and posterior margins of the JF was measured from the midpoint. Since the septum traverses the JF transversely, its midpoint was defined based on half the width of the JF. For the left JF, the length was 11 mm, the width was 3.3 mm, and the septum was located 5 mm anteriorly and 6 mm posteriorly. For the right JF, the length was 10.6 mm, the width was 4 mm, and the septum was located 5 mm anteriorly and 5.6 mm posteriorly.

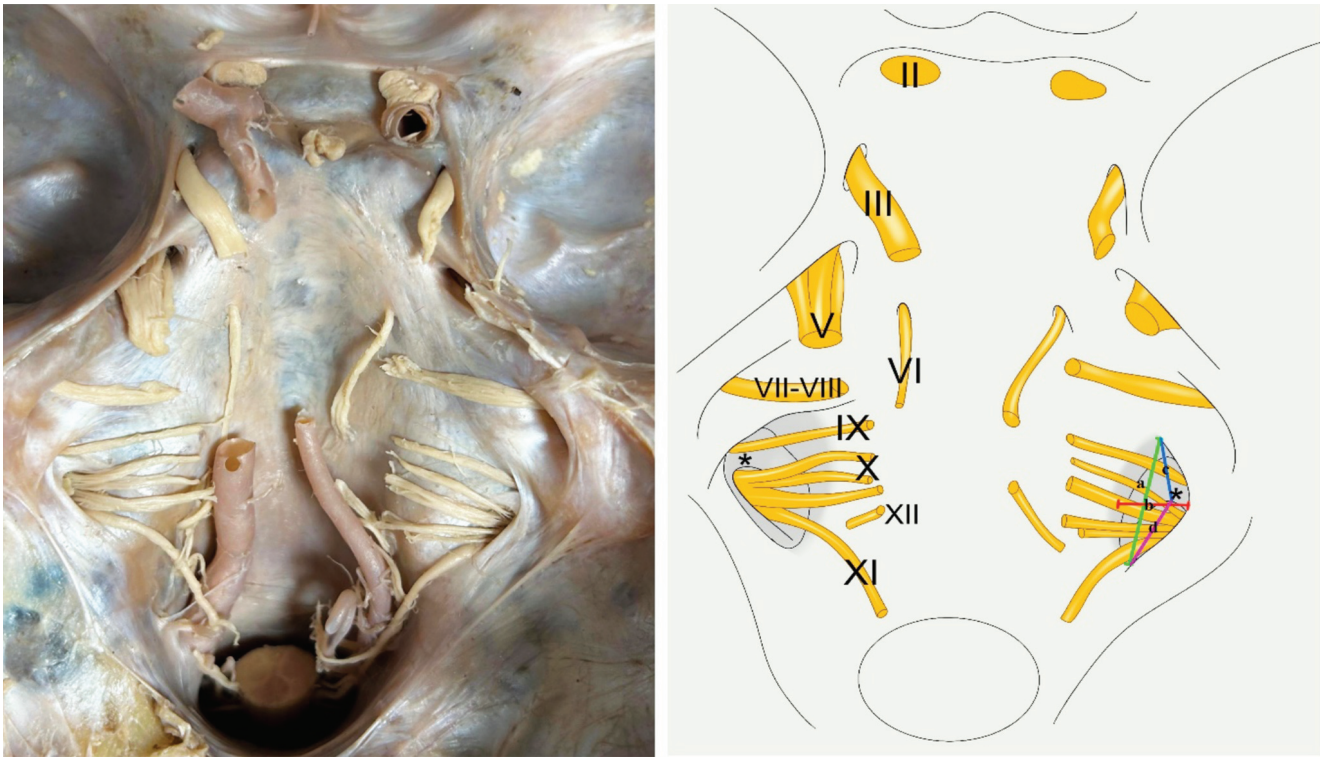


Figure 1. Cranial nerves within JF and dural jugular septum. **a** (green line): length of JF; **b** (red line): width of JF; **c** (blue line): distance of the septum from the anterior end; **d** (purple line): distance of the septum from the posterior end; *jugular septum.

Discussion

It is important to know the anatomy of the JF for clinicians such as radiologists, otolaryngologists and neurosurgeons because of the neurovascular structures it contains. In its presence, the septum is formed by the dura mater that divides the JF into compartments. In 1995, Silverstein et al. proposed the name jugular dural fold for this dura mater fold.[12] Tubbs et al.[8] classified dural septa in the jugular foramen (JF) into four types. Type I consists of a single septum separating cranial nerve IX from cranial nerves X and XI. Type II describes a JF without any septum. Type III is characterized by a single septum dividing cranial nerves IX and X from cranial nerve XI. Lastly, Type IV involves multiple septa, ranging from three to seven in number, creating an average of four segments. According to this classification, the variation observed in our case corresponds to Type I. In their study, Tubbs et al. identified Type I septa in 10 of 28 sides examined, with six occurrences on the left side and four on the right. They also reported septum lengths ranging between 0.5 mm and 1.1 mm. In their study involving 17 cadavers, Akdag et al. classified the specimens according to the four types proposed by Tubbs et al. Type I septation was identified in 62.5% of the right sides and 56.3% of the left sides.[1]

Aseta et al.[13] measured the anteroposterior and mediolateral diameters of the JF in a dry bone study conducted on a Kenyan population. In their findings, the mediolateral diameter was significantly larger compared to our results. This discrepancy may be attributed to ethnic differences, the use of dry bones instead of cadavers, and measurements taken from the outer surface rather than the inner surface. In contrast, the measurements reported by Naidoo et al.[14] were more consistent with our findings. However, unlike our case, they described a JF divided into three segments by two septa. The fact that their measurements were also taken from cadavers represents a common methodological point with our study.

Jugular foramen syndrome (JFS), also known as Vernet syndrome, is characterized by the paralysis of the ninth, tenth, and eleventh cranial nerves as they traverse the JF. Vernet first described this syndrome in the Paris Medical Journal in 1917. The etiology of JFS may be congenital, vascular, inflammatory, infectious, neoplastic, or traumatic in origin.[15] Metastatic disease is the most common cause of JFS; however, it is often misdiagnosed. Primary cancers most likely to metastasize to the JF include those of the breast, lung, kidney, and prostate. For benign tumors, safe surgical resection remains the treatment of choice. Safe resection refers to the surgical removal of a tumor with no residual mass left behind. In regions such as the jugular foramen, where microsurgical techniques are required, the success rate is directly proportional to the surgeon's familiarity with the regional anatomy and its variations.[15] These and similar cases highlight the critical importance of detailed knowledge of JF anatomy. The aim of this study is to provide clinicians with a better understanding of the anatomical features of the JF.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

NM: performed the cadaver dissection and prepared the visual documentation; KA: drafted the manuscript; DB: conducted the literature review (Decision date;. 2024/9, no: 83116987-390).

Ethics Approval

This study was conducted in accordance with the Declaration of Helsinki. According to the regulations of TÜBİTAK and Tokat Gaziosmanpaşa University, the study was exempt from ethical review.

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ORCID ID:
M. Nahir 0000-0002-8492-3704;
A. Kasap 0000-0003-1980-4562;
B. Doğan 0000-0002-9232-359X

Correspondence to: Mert Nahir PhD, Asst. Prof.
Department of Anatomy, Faculty of Medicine,
Tokat Gaziosmanpaşa University, Tokat, Türkiye
Phone: +90 356 214 94 44 / 7315
e-mail: mert.nahir@gop.edu.tr

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