

## CASE REPORT

# Bilateral Medially Duplicated Internal Jugular Veins in an 85-Year-Old Female Donor

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## Abstract

An 85-year-old female donor prosected during an advanced anatomy graduate nursing course in 2023 was found to have bilateral anomalous internal jugular veins. These were classified as duplications as opposed to fenestrations, as each vein entered the subclavian vein separately. These variations have been classified into types A, B, and C. Type A is classified as a high fenestration

joining to make a single entry into the subclavian vein. Type B is a duplication from just below the jugular foramen to the subclavian vein. Type C is a duplication starting commensurate to the hyoid bone with a laterally duplicated segment crossing the posterior triangle and making separate entry into the subclavian vein. This donor possesses a Type C bilateral medial variation with the duplicated limb descending medial to the carotid sheath and entering the subclavian vein lateral to the limb in standard position. Clinical ramifications and current literature are discussed.

**Key Words:** *Duplicated internal jugular vein; Neck venous anatomical variation; Bilateral anomalous internal jugular veins*

## Introduction

Knowledge of anatomy and clinical medicine are inextricably bound together; they depend upon each other [1]. Anatomical variations found in radiology and operating suites can have incidence confirmed in the anatomical laboratory, and findings in the laboratory can educate clinicians concerning variations that may affect morbidity and mortality in patient care [2-6].

Vascular complications associated with oncologic neck dissections are reported in the literature from 1-14%, ranging from minor hemorrhage to major vessel rupture. Overall, intraoperative bleeding may be as high as 14%, immediate post op hematoma 7%, and delayed (beyond 10 days) post op hematoma 2.7% [7]. Post operative carotid rupture is most feared and is associated with radiation therapy, pharyngeal

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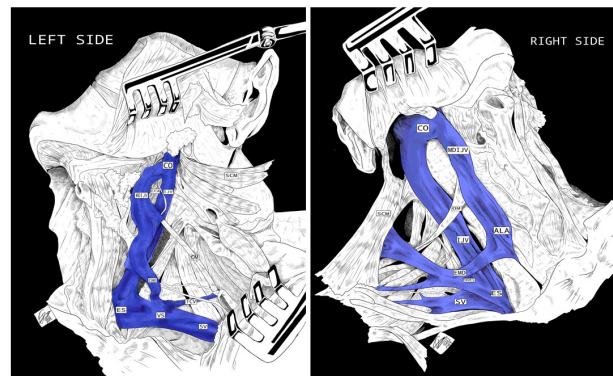
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cutaneous fistula, wound dehiscence, and wound infection. With the increasing incidence of modified/functional neck dissections, post operative internal jugular vein rupture has been described as well [8]. Unrecognized intraoperative injuries to vascular adventitia associated with thorough oncologic dissection or anomalous vascular anatomy can contribute to the likelihood of these complications.

Multiple reports of duplications and fenestrations of the internal jugular vein (IJV) exist, primarily from otolaryngologists and radiologists. Some reports are from donor dissections. Duplications refer to the individual limbs having separate entries into the subclavian vein (SV), while fenestrations have higher duplicated segments, which then join and enter the SV as a single entity [5]. Occurrences from these series range from 0.4 to 3.3% [6]. Positional anomalies overall are estimated at 5.5% [9]. Nayak et al. further classified duplications/fenestrations into types A, B, and C (6). Type A is classified as a high fenestration joining to make a single entry into the SV [2-4,10-12]. Type B is a duplication from just below the jugular foramen to SV [4,13]. Type C is a duplication starting commensurate to the hyoid bone with a laterally duplicated segment crossing the posterior triangle and making separate entry into the SV [10,14,15]. Type A is most prevalent (approximately 68%), while B (approximately 9%) and C (approximately 23%) are significantly less prevalent [6]. This article describes a case of type C with a medially duplicated limb in relation to the limb in standard position (Figures 1a and 1b).



**Figure 1a and 1b)** Schematic depiction of the left and right sides.

*ALA: Acute Lateral Angulation of the medial duplication of the internal jugular vein; CCA: Common Carotid Artery; CO: Communication between internal jugular vein and medial duplication of the internal jugular vein; EMD: Entrance of the Medial Duplication of the internal jugular vein into a common channel with the transverse cervical vein; EMDES: Entrance of the Medial Duplication of the internal jugular vein separately into the Subclavian vein; ES: Entrance into the Subclavian vein (for the internal jugular vein); ESMD: Entrance of the Medial Duplication of the internal jugular vein into the subclavian vein; IJV: Internal Jugular Vein; MDIJV: Medial Duplication of the Internal Jugular Vein; OM: Omohyoid Muscle; SCM: Sternocleidomastoid Muscle; SV: Subclavian Vein; TCV: Transverse Cervical Vein; VS: Venous Sinus allowing Medial Duplication of the Internal Jugular Vein and Transverse Cervical Vein entry into the Subclavian Vein.*

## Case Description

An 85-year-old female donor was dissected as part of an advanced anatomy graduate nursing course during the summer of 2023. The donor was found to have bilateral IJV duplications. The duplications began at or just below the hyoid bones, with the posterior segment in standard position within the carotid sheath anterolateral to the common carotid artery (CCA) and the duplicated portion anteromedial to the CCA. They were of similar size (Figures 2,3). The anteromedial portions were somewhat tortuous and angled acutely in a lateral direction in the distal third of the neck to enter the SVs in small sinuses together with the transverse cervical veins. The entries were separate and lateral to the standard limb entry (Figures 4,5). The anterior bellies of the omohyoid muscles



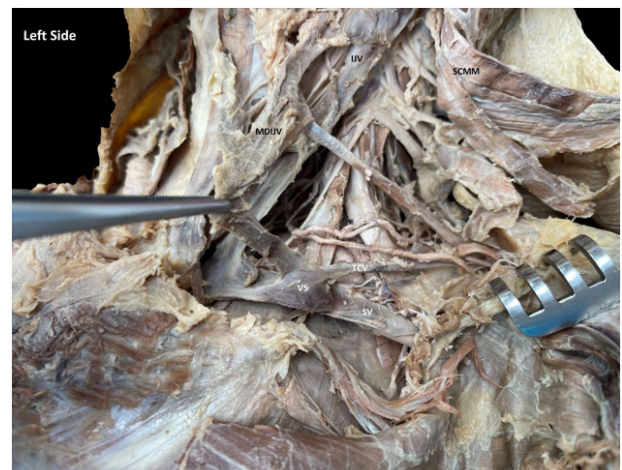
ran between the two limbs on both sides. The spinal accessory nerves ran posterior to the IJVs. On the left side, the superior laryngeal nerve ran between the two segments. Additionally, the most proximal portion of the left IJV above the duplication, had a branch that exited and reentered almost as a loop (Figure 6). Multiple smaller communicating veins drained into the proximal medial segments just below the bifurcations on both sides.



**Figure 2)** Dissection of the left side of the neck showing the bilateral internal jugular vein duplication. CCA: Common Carotid Artery; CO: Communication between internal jugular vein and medial duplication of the internal jugular vein; ES: Entrance into the Subclavian Vein (for the internal jugular vein); ESMD: Entrance of Medial Duplication of the internal jugular vein into the subclavian vein; IJV: Internal Jugular Vein; MDIJV: Medial Duplication of the Internal Jugular Vein; OM: Omohyoid Muscle; SCMM: Sternocleidomastoid Muscle; SV: Subclavian Vein; TCV: Transverse Cervical Vein; VS: Venous Sinus allowing the medial duplication of the internal jugular vein and the transverse cervical vein entry into the subclavian vein.



**Figure 3)** Dissection of the right side of the neck showing the bilateral internal jugular vein duplication. ALA: Acute Lateral Angulation of the medial duplication of the internal jugular vein; CCA: Common Carotid Artery; CO: Communication between internal jugular vein and medial duplication of the internal jugular vein; EMD: Entrance of the Medial Duplication of the internal jugular vein into a common channel with the transverse cervical vein; EMDES: Entrance of Medial Duplication of the internal jugular vein into the subclavian vein; ES: Entrance into the Subclavian vein (for the internal jugular vein); IJV: Internal Jugular Vein; MDIJV: Medial Duplication of the Internal Jugular Vein; OM: Omohyoid Muscle; SCMM: Sternocleidomastoid Muscle; SV: Subclavian Vein; TCV: Transverse Cervical Vein.



**Figure 4)** Dissection of the left side of the neck highlighting the venous sinus. IJV: Internal Jugular Vein; MDIJV: Medial Duplication of the Internal Jugular Vein; SCMM: Sternocleidomastoid Muscle; SV: Subclavian Vein; TCV: Transverse Cervical Vein; VS: Venous Sinus allowing the medial duplication of the internal jugular vein and the transverse cervical vein entry into the subclavian vein



## Discussion

Duplications are generally uncommon. Types B and C are much less prevalent than type A [6]. In type C the duplication is positioned lateral to the standard position of the IJV [10,14,15]. In this donor, the duplication was medial and then angulated abruptly laterally to enter the SV lateral to the standard anterolateral segment. This appears to be a previously undescribed variant.

The embryologic origin of IJV duplications is not definitively known [5,6]. Several hypotheses have been proposed: venous, bony, neuronal, and muscular. The venous theory suggests that some of the venous capillary plexuses that form in the first trimester do not regress in normal fashion [5,6,11,16]. The bony theory postulates abnormal osteophytes or bony bridges are responsible for divisions in the normal venous formation [5,6,16,17]. The neuronal theory puts forward the spinal accessory nerve as the culprit, in that if it is located within the capillary venous plexuses, it inhibits the usual formation of the IJV [5,6,11,18]. The muscular hypothesis points to the positioning of the posterior belly of the omohyoid within the capillary venous plexus as inhibitor of the most common IJV anatomy [5,19].

It is suspected that the anterior limbs of the duplications in this donor would have made successful catheter passage difficult due to the acute lateral angulation followed by additional medial angulation just proximal to the SV entry. According to Denys [9], there is an approximately 10% failure rate in IJV catheter placement even among very experienced medical personnel. In his series of 200 patients undergoing IJV catheter placement, the veins were examined with 2D ultrasound. 92% of the patients had the IJV in standard position lateral and anterior to the CCA, and the IJV did get larger with valsalva. 3% of the patients had a very small IJV, which did not respond



**Figure 5)** Dissection of the right side of the neck highlighted the major venous contributors to the subclavian vein. EJV: External Jugular Vein; ES: Entrance into the Subclavian vein (for the internal jugular vein); EVC: Entrance of the Venous Confluence into the subclavian vein; IJV: Internal Jugular Vein; MDIJV: Medial Duplication of the Internal Jugular Vein; SV: Subclavian Vein; VC: Venous Confluence of the external jugular vein, transverse cervical vein, and the medial duplication of the internal jugular vein.



**Figure 6)** Posterior view of the dissection of the left side of the neck highlighting the looping branch off of the internal jugular vein.

SCMM: Sternocleidomastoid Muscle; SAN: Spinal Accessory Nerve; IJV: Internal Jugular Vein; VN: Vagus Nerve; LBIJV: Looping Branch of the Internal Jugular Vein; SLN: Superior Laryngeal Nerve; MDIJV: Medial Duplication of the Internal Jugular Vein; CO: Communication between internal jugular vein and medial duplication internal jugular vein; CCA: Common Carotid Artery; HN: Hypoglossal Nerve.

to valsalva. 2.5% of the patients' IJVs could not be seen on imaging. In these cases, it was hypothesized that the IJV was clotted, as the IJV on the other side of the neck imaged normally. 2% of the patients had IJVs sitting on top of the CCA and 1% had the IJV displaced more than 1 cm lateral to the CCA. Overall, 5% of patients did not have an IJV that lined up with the standard external landmarks. Imaging would be required to cannulate these patients successfully. According to Bannon [20], central venous catheter placement complications can run as high as 15%, even when performed by experienced clinicians. Due to lesser angulation, the right IJV and the left SV are more successful as sites of catheter placement, especially for larger bore catheters needed for dialysis. These larger catheters need dilator placement, and if a thread is attempted into the vessel lumen, it will not thread successfully due to angulation. Dilators should be introduced only as far as the penetration of the finder needle.

Intraoperative and postoperative bleeding associated with neck dissection are real risks. Agrawal et al. [7] looked at 256 neck dissection patients over 9 years and found a 14% incidence of intraoperative hemorrhage, a 7% risk of hematoma in the first 10 days post op, and a 2.7% risk of hematoma after 10 days. Elteley et al. [8] evaluated 275 neck dissection patients over 5 years and reported 10 cases of post operative IJV rupture, with a mortality rate of 40%. These occurred within the first month post operatively and had a strong association with inflammatory conditions in the neck: pharyngeal cutaneous fistula, wound dehiscence, deep wound infection. Each case had sentinel bleeding prior to rupture. The IJV is the largest vein in the neck; duplication patients have two of these large high flow vessels in the operative field, with potential for lacerations leading to considerable intraoperative bleeding. Each also has adventitia which can inadvertently be denuded during dissection, with subsequent exposure, desiccation, and rupture if inflammatory complications ensue.

Additionally, if the IJV in standard position is unknowingly ligated below the takeoff of the unrecognized duplication and the duplication is damaged, significant bleeding can occur with confusion as to the source.

Chyle leak is not a common complication of neck dissection, approximately 0.3% [7]. Because duplication patients have two IJV entry sites into the SV, these patients may be at a higher risk of inadvertent injury due to uncertainty of the actual location of the thoracic duct.

## Conclusion

Bilateral type C medially duplicated internal jugular veins were found in an 85-year-old female donor. This is a previously undescribed variant of the type C duplication and could have seriously complicated internal jugular central venous access as well as neck dissection if indicated in this donor while alive. Although imaging before neck dissection is standard, usually the focus is on tumor location and adenopathy. Special attention should be paid to the appearance and location of the internal jugular venous system as well. Clinicians should be aware that duplications and variations of the IJV anatomy exist. Anomalies, although not frequent, have potential to significantly increase the morbidity associated with such surgery.

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