CASE REPORT

Multidetector CT findings of an extraordinary fenestration of the internal jugular vein

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ABSTRACT

Fenestration of the internal jugular vein is a rare malformation. Herein, the authors describe an extreme fenestration of the left internal jugular vein. This anomaly was found incidentally in a 47-year-old male patient undergoing multidetector computed tomography (MDCT) imaging and MDCT angiography evaluation for vertebral artery injury due to cervical trauma. MDCT angiography showed the presence of an extremely large fenestration in the left internal jugular vein.

Key words: • *internal jugular vein* • *fenestration* • *multidetector computed tomography*

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Published online 24 October 2011 DOI 10.4261/1305-3825.DIR.4474-11.1 he internal jugular vein (IJV) is the largest structure in the neck and drains the venous blood from the cranium, the facial region and the neck. It proceeds in the carotid sheath together with the common carotid artery before combining with the subclavian vein on the sternal side of the clavicle. The IJV is a significant landmark that is encountered during dissection of the cervical lymph nodes in oncological surgery, central venous catheter insertion, and interventional radiological procedures; familiarity with the probable anatomical variations of the IJV and those of its neighbouring structures is important (1–3). In this report, a male patient, in whom quite a large extraordinary fenestration was detected in the left IJV during multidetector computed tomography (MDCT), is presented in the light of MDCT findings and the literature.

Case report

A 47-year-old male patient was presented to the emergency room after he was involved in a motor vehicular accident. He did not have any other complaints except pain in the cervical region. The patient was referred to the radiology department. Because physical examination revealed significant tenderness, pain and restricted motion of the neck, cervical vertebral injury and accompanying vertebral artery injury was suspected; therefore, 16-slice MDCT (Brilliance, Philips Medical Systems, Amsterdam, The Netherlands) imaging was performed after the adminstration of intravenous contrast medium. The scan parameters were 120 kV, 340 mAs, and 420 ms rotation time with a slice thickness of 1 mm and increments of 0.5 mm, using a detector collimation of 16×0.75 mm (pitch, 0.2). A hundred milliliters of nonionic, iodinated, low-osmolar contrast medium (Iomeron 350 mgI/ mL, Bracco, Milan, Italy) was injected through the antecubital vein at a rate of 5 mL/s. An automatic bolus-tracking method was used to optimize visualization. Multiplanar reconstruction and three-dimensional (3D) volume-rendered (VR) images were obtained from CT images performed in the axial plane at a separate workstation to display osseous structures. On coronal multiplanar reformation MDCT and 3D VR MDCT angiography images, a large fenestration with tortuous appearance was detected in the left IJV (Fig.). Because there were connections between the two vessels at the proximal and distal ends, we diagnosed this as an extraordinary fenestration of the left IJV. The IJV was equal in diameter above and below the fenestration. No additional abnormality of the other cervical vessels was identified. As the patient was found not to have any other pathologies except IJV fenestration on the examinations, he was followed-up for 24 hours in the emergency room and discharged after being informed about the vascular anomaly.





Figure. a–c. The internal jugular vein (IJV) fenestration. Axial (**a**) and coronal-oblique (**b**) reformatted contrast-enhanced CT images demonstrate fenestration in the left IJV, with two channels converging *(arrows)*. A large fenestration with tortuous appearance in the left IJV is seen on a 3D volume-rendered MDCT angiography image (**c**, *arrows*); the right IJV is seen as normal.

Discussion

The IJV is an important vascular structure for oncologists, nephrologists and radiologists and is also a frequently used central venous route. Although fenestrations of many craniocervical arteries have been described in the literature, venous fenestrations are quite rare anatomical variations. A total of 11 cases have been described in the English literature, and of them, nine are duplications and two are fenestrations (partial duplication). The main difference between these two clinical conditions is that in duplication, the IJV that comes as a single vessel from the foramen jugulare bifurcates superiorly and communicates with the subclavian vein distally as two distinct

vessels; however, in fenestration, as in our case, these two veins communicate with each other just prior to joining the subclavian vein (2, 4).

The incidence of IJV fenestration has been found to be 0.4% in unilateral cervical dissections. Although fenestration usually affects the proximal 1/3 of the IJV, it may also be seen at different levels. IJV fenestrations usually have no clinical importance. However, exposure of the IJV and the accessory nerve in the course of cervical dissection is important in cases of head and neck tumors. The accessory nerve usually passes superficially to the IJV. The relationship between the accessory nerve and the IJV is necessary for protection of both of these anatomical structures during cervical dissection. Resection or injury of these structures can cause considerable morbidity (3-5). In a study by Prades et al. (4), IJV fenestrations were found in three out of 750 patients undergoing unilateral cervical dissection and the accessory nerve was found to pass through the IJV in all of these cases. In all reported cases of fenestration of the IJV, the spinal branch of the accessory nerve was always reported to pass deep to the anterior branch of the fenestrated IJV and superficial to the posterior branch (4). Because our patient did not need an operation, we were unable to find the anatomical relationship between the IJV and the spinal accessory nerve.

The embryologic basis of IJV fenestration is not fully clear. Although vascular, neural and osseous hypotheses have been suggested to explain this variation, they have not been supported. The fenestration has been proposed to develop during early embryological development (between 3-6 gestational weeks). Among vascular, neural or bony hypotheses, the vascular hypothesis is thought to be the most likely explanation and is usually accepted in the literature. During fetal life, the accessory nerve passes between two veins: the lateral and medial veins of the head. The lateral vein, which is superficial to the accessory nerve, usually disappears while leaving the nerve superficial to the vein. More rarely, the medial vein disappears, leaving the nerve to lie deep to the vein. Duplication is thought to result from the appearance of a secondary venous ring at a lower level surrounding the spinal accessory nerve. The persistence of this secondary ring in adult life may be important in the etiology of venous duplication (5–7).

Fenestrated IJVs frequently occur with phlebectasia (local fusiform venous dilatation), which appears as a non-pulsatile cervical swelling that enlarges during the Valsalva maneuver. While abnormalities such as aneurysms and arteriovenous malformations accompany arterial fenestrations, they are rare in venous fenestrations (1–5). Phlebectasia or aneurysm(s) accompanying fenestration was not observed in our case.

low-flow Supraclavicular venous malformations, arteriovenous malformations, and multiple recanalization veins accompanying chronic venous thrombosis should be considered among the differential diagnosis of IJV fenestration. Each of these factors presents in a different location and with different clinical features. In IIV thrombosis, CT findings include identification of a low-density intraluminal thrombus, a sharply defined bright vessel wall (because of contrast uptake by the vasa vasorum), soft-tissue swelling surrounding the IJV and a distended IJV proximal to the thrombus. In addition, venovenous or arteriovenous fistulas can mimic IIV fenestration in a trauma patient, as in ours (8, 9).

The development of noninvasive imaging techniques, such as CT, ultrasonography (US), Doppler US and magnetic resonance imaging, increased reporting of this entity. US and Doppler US allow for safe, quick, and noninvasive assessment of the cervical vascular structures, and several centers have reported that the sensitivity to posttraumatic findings is high. US, hovewer, also has significant limitations.

In the setting of neck trauma, accurate evaluation may be limited by subcutaneous air or an echogenic hematoma overlying the vessel of interest. In addition, US is highly operator dependent. Because the present patient was in a post-traumatic setting, Doppler US was not performed. Supra-aortic arterial and venous structures may be visualized with a high imaging quality using MDCT technology, which offers a rapid, minimally invasive assessment of the cervical vessels. MDCT images are used as a guide in the endovascular and surgical treatment planning by reformatting and reconstructing on different planes (10). Contrast timing is a key determinant of CT angiography (CTA) image quality. Peak contrast opacification should occur at the time of the scan for each region evaluated. For the neck and brain, the use of high-concentration contrast optimizes the visualization of small vessels and defines vessel boundaries for improved accuracy. It permits high iodine flux at an acceptable intravenous (IV) injection rate. Higher IV injection rates provide high iodine flux but at a greater risk of extravasation from the IV site. We typically use 5 mL/s in our patients. Bolus tracking and automatic triggering methods have improved with MDCT technology. For neck CTA, the aortic arch with a 500 Hounsfield unit (HU) trigger provides a good basis for beginning to scan (11, 12).

In conclusion, familiarity with this type of variation is important in terms of preventing neurovascular injury, especially prior to surgical and interventional procedures involving the cervical region. Multiplanar MDCT images and 3D-reconstructed MDCT angiography are currently the preferred imaging methods for the detection of these types of vascular variations, especially when imaging complex anatomical structures such as the neck.

Conflict of interest disclosure

The authors declared no conflict of interest.

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