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ANATOMIC VARIATIONS

Four cases of spinal accessory nerve passing through the fenestrated internal jugular vein

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Abstract
Purpose Neck dissection (ND) is an important technique for the treatment of cervical lymph node metastasis in patients with head and neck cancer. Since the introduction of functional ND (FND), various modifications have been made to reduce the adverse effects of radical ND. Recently, many investigators have documented cases of FND with preservation of the spinal accessory nerve (SAN) and/or the sternocleidomastoid muscle, which have contributed to improve the quality of life following ND. For this type of ND, special attention must be paid to identify the SAN and the internal jugular vein (IJV).
Methods We performed 123 NDs over 2 years at the Department of Otolaryngology, Head and Neck Surgery, Kobe University Hospital. We collected data of all patients who underwent NDs by retrospectively reviewing the relevant hospital medical records and operative notes.
Results In 4 out of 123 NDs (3.3%), an anomaly of the SAN passing through the fenestrated IJV was observed.
Conclusion Although this anomaly is rare, head and neck surgeons should be aware of this anomalous relationship between the SAN and the IJV in order to avoid accidental injury to these structures during ND.

Keywords Neck dissection · Accessory nerve · Internal jugular vein · Head and neck cancer

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Introduction

Efficacious neck management is the most important prognostic factor for head and neck cancers. Since radical neck dissection (RND) was first described by Crile [1], it has played an increasingly important role in the management of cervical metastasis of head and neck cancers. Because severe morbidity and postoperative complications, such as dropped shoulder and pain were identified as sequela of RND, Suarez [9] introduced functional neck dissection (FND) with preservation of the internal jugular vein (IJV) and/or the spinal accessory nerve (SAN) in 1963. Since then, various modifications to RND have been proposed and demonstrated by several studies to improve the quality of life (QOL) with oncologically acceptable outcomes following neck dissection (ND). Previously, we reported that patients with the SAN-sparing FNDs had better shoulder function since SAN provides the motor supply to the sternocleidomastoid muscle (SCM) and trapezius muscle [4]. The level II area of the neck is an important region in ND because of its site-specific lymph drainage pattern and is closely related to the SAN. With the increasing use of FND, better knowledge of anomalous relationships between the SAN and the IJV is needed. Recently, we encountered a rare anomaly of the SAN passing through the fenestrated IJV in four cases during ND. We present here our experience and review previous reports concerning this anomaly.

Case reports

We performed 192 NDs for 137 patients between 2008 and 2009 at the Department of Otolaryngology, Head and Neck Surgery of Kobe University Hospital. Data for all patients

Table 1 Clinical data of four patients with anomaly

Case	Age/ sex	Primary site	TNM stage	NDs	Side of anomaly
1	67 M	Larynx	T4aN1M0	Bilateral	Left
2	64 M	Tongue	T3N2cM0	Bilateral	Right
3	71 M	Hypopharynx	T4aN2bM0	Bilateral	Left
4	62 M	Tongue	T3N0M0	Bilateral	Left

who had undergone NDs were collected by retrospectively reviewing the hospital medical records and operative notes. The origin of tumor was classified according to the TNM classification based on the sixth UICC staging system.

Four patients showed the anomaly of the SAN passing through the fenestrated IJV. Clinical data of these cases, age, gender, primary site, TNM classification, type of ND, and the side of the anomaly are presented in Table 1. The SAN always passed medially to the anterior part and laterally to the posterior part of the fenestrated IJV. This anomaly was found in 4 (2.1%) of 192 NDs performed over 2 years at our department. One representative case (case 1) is presented here.

A 67-year-old male presented with laryngeal squamous cell carcinoma. Lymph node metastasis was observed in the left level II area. He was suffering from right hemiplegia as a result of brain infarction. Total laryngectomy with bilateral NDs was performed. Level II–IV on the right side and level II–V on the left side were dissected. During ND on the left side, a partial duplication, which was known as fenestration of the IJV was encountered at a point 15 mm above the bifurcation of the common carotid artery. The SAN passed medially to the anterior part and laterally to the posterior part through this fenestration (Fig. 1). The facial vein was seen to branch from the anterior part, but other branches of the IJV were normal. No anomalous vessels were found on the right side. Preoperative neck contrast enhanced CT imaging showed duplication of the IJV in the retrospective view. As shown in Fig. 2, 3D-CT showed fenestration of the IJV clearly suggesting that presence of this anomaly could be anticipated before the actual ND.

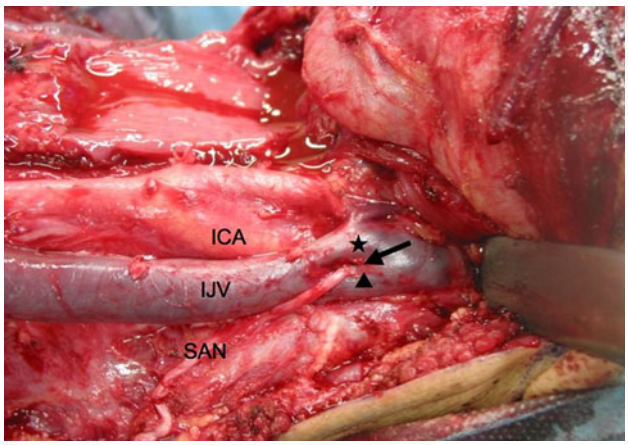

Fig. 1 SAN passes through medially to the anterior part (*star*) and laterally to the posterior part (*filled triangle*) of the fenestrated IJV (*arrowhead*)

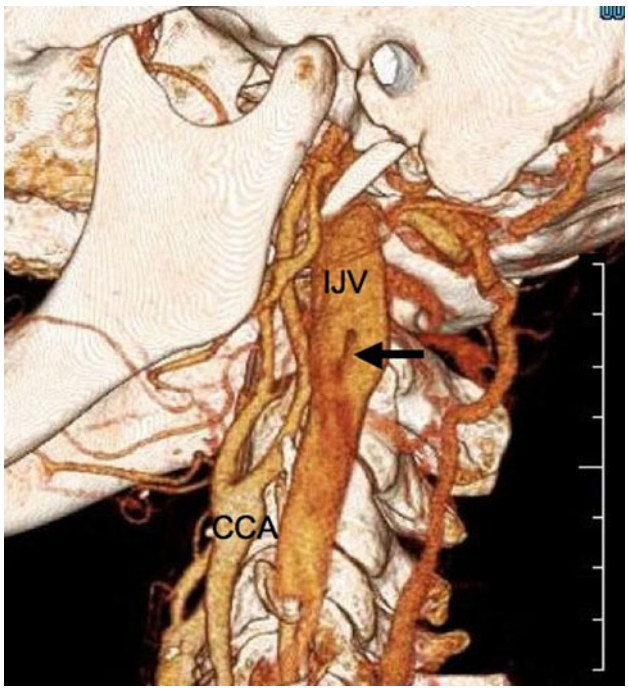

Fig. 2 3D-CT shows the fenestrated IJV (*arrowhead*) clearly

Discussion

Since Suarez [9] introduced FND with preservation of IJV and/or SAN in 1963, various modifications to RND have been proposed and demonstrated in several studies to improve the QOL with oncologically acceptable outcomes following ND. With the increasing use of modified NDs, head and neck surgeons are required to have better knowledge of anatomical variations in the relationship between SAN and IJV to avoid accidental intraoperative injury to these structures.

Downie et al. [2] classified the IJV duplication as a rare vascular anomaly consisting of two patterns. In one pattern, known as duplication, the IJV divides into two veins that separately enter the subclavian vein. In the other pattern, the IJV descends from the cranial base as a single vein and then branches into two veins over a certain distance. However, the branches rejoin proximally to the subclavian vein and the IJV terminates in the subclavian vein as a single vein. This type of architecture is classified as fenestration, since it features window-like openings.

According to this classification, 15 cases of fenestration of the IJV, similar to the present case, have been reported in the English literature [5–7]. Interestingly, the SAN passes through the duplicated IJV in almost all cases. Only a few previous studies have reported on the incidence of this anomaly. Hollinshead reported identifying 3.2% during cadaver dissection, and Prades et al. reported 4 (0.4%) instances of this anomaly per 1,000 unilateral NDs [3, 5]. In the most recent prospective study, Lee et al. [5] encountered this anomaly in 5 (2.8%) cases during 181 NDs. In our study, the clinical incidence was 4 (2.1%) per 192 unilateral NDs.

From the embryological point of view, three hypotheses (vascular, neural, and bony) have been proposed to explain the IJV duplication. Of these, the vascular hypothesis is generally accepted in the literature [7]. This hypothesis is based on the fact that the origin of the IJV develops from the precardinal veins that drain blood from the cranial aspect of the embryo, and the nerves generally emerge after the vessels. The venous duplication could result from inadequate condensation of the embryonic capillary plexus that develops posterior to the precardinal veins. Persistence of this capillary plexus may lead to duplication of the IJV in conjunction with the transvenous passage of the SAN [8].

Can we predict the presence of this anomaly before ND? Towbin and Kanal [10] reported two cases of the IJV fenestration as observed by means of CT angiography. We also detected partial duplication of the IJV on preoperative neck contrast enhanced CT imaging. Since the SAN always passes through the fenestration of the duplicated IJV in the reported cases, preoperative identification of this anomalous duplication or fenestration of the IJV obtained from CT or/and MRI imaging may help to avoid iatrogenic injury to the SAN and/or the IJV during a level II ND.

In conclusion, although the cases presented here are rare, surgeons should be aware of this anomalous relationship between SAN and IJV in order to avoid accidental injury to these structures during ND.

Conflict of interest None.

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