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Dual spinal accessory nerve: an anatomical anomaly during neck dissection

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SUMMARY

The spinal accessory nerve (SAN) is an important cranial nerve encountered during neck dissection. Preservation of this nerve from iatrogenic damage is crucial to avoid debilitating sequelae, which can be made challenging due to variation of its anatomical course. In this case report, we present a patient who underwent supraomohyoid neck dissection, where a rare variation of a dual SAN, traversing the internal jugular vein midway, was encountered. In this case report, we study this anatomical finding, which is undoubtedly a valuable addition to the existing knowledge of the SAN. Ultimately, allowing surgeons to develop further awareness of the variations of the SAN and contributing to favourable postoperative outcomes.

BACKGROUND

The XI cranial nerve, spinal accessory nerve (SAN), is an anatomical structure that is encountered during neck dissection. Preservation of this nerve from iatrogenic injury is an important consideration; this was widely recorded as a consequence of radical neck dissection (RND). Following the 1950s, the RND was revisited and modified approaches to neck dissection were employed, achieving reduction in overall morbidity, including improved function of the SAN postoperatively.¹

Iatrogenic damage (75%–90%) is known to be the most common aetiology of SAN injury, which is clinically encountered postoperatively in neck dissections and rarely in lymph node needle biopsies.^{2–3} A spectrum of clinical presentations arise from damage to the SAN, commonly known as SAN palsy, which may present as drooping of the shoulder secondary to trapezius paralysis, shoulder weakness (in abduction), winging of the scapula and trapezius muscle atrophy. Anatomical variations of the SAN towards the skull base and its course in the posterior triangle are recognised to be potential causes of increasing rates of iatrogenic damage.⁴

Identification of the SAN has been a challenge for surgeons as great anatomical variation has been described throughout the literature. Therefore, a thorough understanding of the topographical anatomy is of utmost importance in neck dissection in order to avoid debilitating postoperative consequences.⁵ Although selective and modified techniques of neck dissection are now common practice, it has been shown that the incidence of shoulder injury remains high.⁶

We present a case of a patient undergoing parotidectomy with selective neck dissection for a primary parotid squamous cell carcinoma (SCC). We aim to

discuss the surgical and clinical implications of a dual SAN and its rare relationship to the internal jugular vein (IJV).

CASE PRESENTATION

The male described in this case report, who was in his 80s, was referred to the otolaryngology department with an enlarging left parotid mass. Examination revealed a mobile parotid tumour, no evidence of facial nerve involvement and the remaining head and neck was unremarkable, including skin survey. The patient had a medical history of surgically resected right shin basal cell carcinoma (BCC), hiatus hernia, osteoarthritis and gastritis. There were no known drug allergies. He had good functional capacity and was fully independent with all activities of daily living.

Following clinical review, a neck ultrasound scan and subsequent CT revealed a 15 mm tumour of the superficial lobe of the parotid gland (figure 1). Initial fine-needle aspiration was suspicious of malignancy and subsequent core biopsy confirmed SCC. There was no evidence of cervical lymphadenopathy or metastatic disease on CT staging. Positron emission tomography (PET) CT was undertaken given the rarity of primary parotid SCC to exclude an alternative primary site; however, the PET CT showed no increased avidity elsewhere in the head and neck. Although the dual SAN was present and visible on the preoperative scans, it was not reported by the radiologists or noted by the parent team.

The patient subsequently consented for the undertaking of a left superficial parotidectomy and level Ib–III selective neck dissection. Intraoperatively, a dual SAN was encountered (figure 2). Moreover, the dominant of the dual nerves was traversing the IJV.

The dual accessory nerves we identified followed two different courses to their final position, supplying the sternocleidomastoid (SCM) and trapezius muscles. The nerve following the anomalous course was the dominant nerve and the nerve following the usual course was the non-dominant accessory nerve, in terms of size; these definitions will be subsequently used to refer to each nerve.

Following its exit at the jugular foramen, the non-dominant nerve travelled medial to the IJV and then coursed laterally over the vein to run obliquely, inferior and lateral, to reach the deep surface of the SCM. After supplying the muscle at this point, it ran 1–2 cm superior to Erb's point and crossed into the posterior triangle, embedded in loose connective tissue (the full nerve course was not dissected, as there was no clinical rationale to dissect level V).



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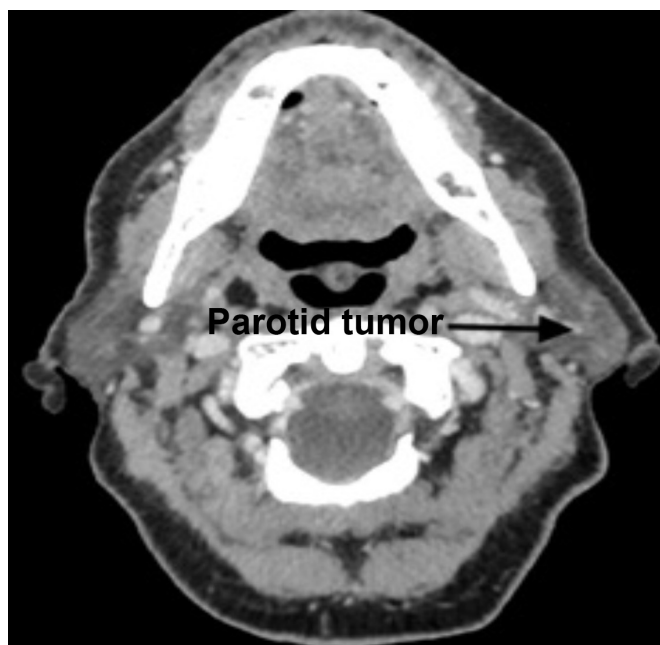


Figure 1 CT scan showing parotid tumour.

The dominant nerve descended on the posterior surface of the IJV traversing through the vein, dividing the IJV into two, to emerge anteriorly at the junction of upper and middle third of the vein (figure 3). The anomalous course continued inferiorly on the anterior surface of the IJV to level III of the neck, finally coursing inferiorly and laterally (figure 4) without supplying SCM, into level 5 towards the trapezius muscle; again complete nerve dissection was not justified clinically.

Postoperatively, the patient had mild signs of SAN dysfunction reporting left shoulder girdle pain in the immediate days following the operation. The patient required input from the physiotherapy team for rehabilitation and movement exercises. Subsequently, the patient made a complete recovery with regard to left shoulder function. On follow-up since the parotidectomy and neck dissection, the patient displayed no signs of local or regional recurrence of cancer.

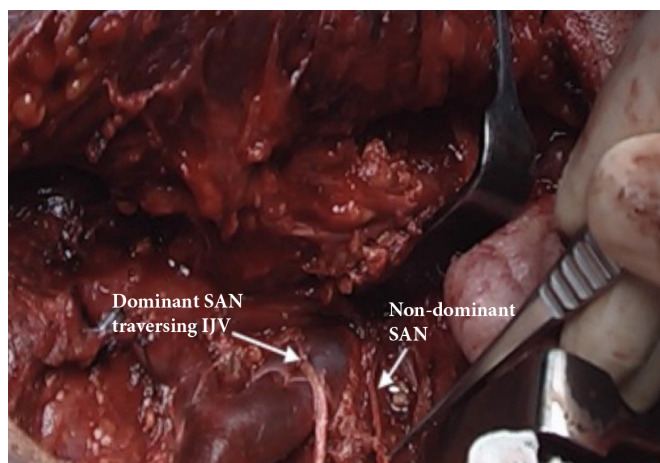


Figure 2 Intraoperative picture showing dominant SAN traversing IJV and non-dominant SAN running laterally to IJV. IJV, internal jugular vein; SAN, spinal accessory nerve.

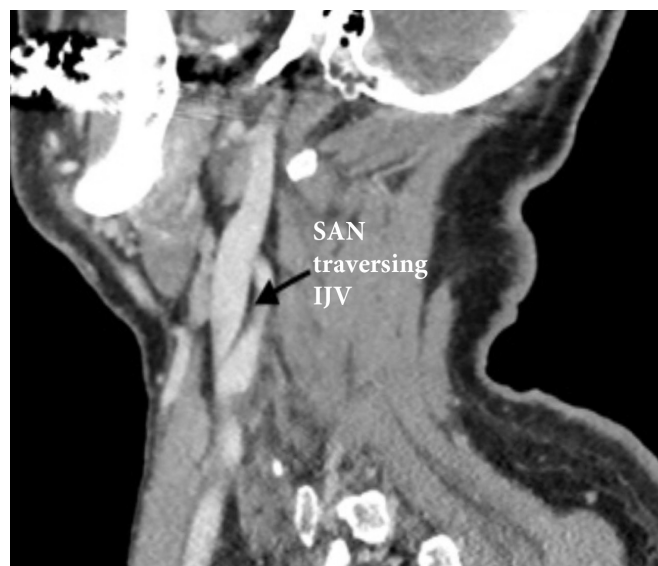


Figure 3 SAN traversing IJV. IJV, internal jugular vein; SAN, spinal accessory nerve.

DISCUSSION

The variations in the anatomy of CN XI have shown to present challenges in the avoidance of iatrogenic damage. Duplication of the SAN is a rare anatomical phenomenon, which has a reported incidence of 1.8%. Ajayi *et al*, in their study of 56 cadaveric cases, reported two cases in which the SAN was duplicated.⁷

Damage to the SAN is the most common complication of neck dissection and the second most iatrogenically damaged peripheral nerve.⁸ The accessory nerve is unique in that its nerve fibres originate from both the spinal cord and the medulla. In its normal course, the SAN along with the glossopharyngeal and vagus nerves emerges from the jugular foramen, passes deep to the posterior belly of the digastric muscle and courses through or deep to the SCM muscle to innervate the SCM, before traversing the posterior triangle of the neck and terminating at the trapezius muscle, which it also innervates.³

There are several anatomical variations of the SAN which have been documented to date. The variation may be in

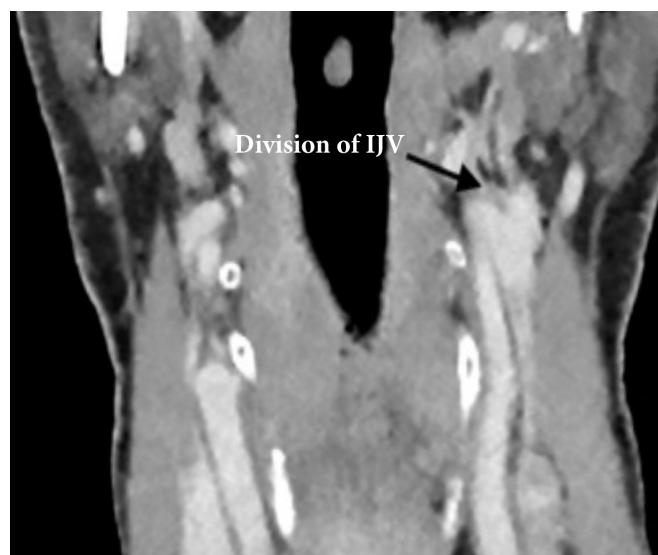


Figure 4 Division of IJV. IJV, internal jugular vein.

terms of anatomical structure or the course of the nerve in the upper neck. The SAN may be duplicated, it may transverse the IJV ventrally (39.8%), dorsally (57.4%) or through the IJV (2.8%), there may be varying number of branches originating from the SAN.⁹ In historical head and neck anatomy teaching, the SAN is usually described as crossing the IJV ventrally; however, as seen in our case, the SAN can also be seen to traverse the IJV or cross it dorsally. Saman *et al*, in their cadaveric study of the relationship between the SAN and IJV, showed that the SAN courses anteromedial to the IJV in 87% of cases and exits the jugular foramen laterally to IJV in 67% of cases. Due to the morbidity associated with IJV injury, it is vital that surgeons are aware of the anatomical variations which may be encountered regarding the relationship of the SAN to the IJV.¹⁰

As described in our case report, two rare variations were encountered in our patient, that is, a dual SAN, with the non-dominant nerve running ventrally to the IJV and the dominant nerve traversing the IJV. A number of variations in the nerve's relationship to the SCM muscle have also been described. The SAN does not penetrate the SCM in 45.9% of cases and penetrates via branches in 53.1% of cases.⁹ A plethora of literature on the anatomical variations of the SAN exists; however, to our knowledge, there has only been one other report of a duplex SAN, reported in Agha Khan University, Pakistan. Danish *et al* reported a case of a man in his late 40s with a left buccal SCC, managed with excision and selective neck dissection (SND). During SND, they also reported a duplicated SAN; their patient denied symptoms of shoulder dysfunction postoperatively.¹¹

In surgical operations concerning the posterior triangle of the neck, manipulation of the SAN causes postoperative functional morbidity, and this is known as 'shoulder syndrome', which describes the symptoms occurring as a result of SAN palsy. This may be in the form of shoulder pain, difficulty elevating the shoulder, scapular winging leading to trapezius muscle atrophy.¹² The occurrence of the symptoms of SAN palsy have been reported to vary with type of neck dissection being undertaken. The frequency of postoperative morbidity of the SAN in RNDs is 46.7%, 42.5% in selective neck dissections and 25% in modified neck dissections (MNDs). Therefore, although MNDs have significantly lower rates of postoperative morbidity, they have similar regional control rates as seen in the other more radical techniques.¹²

In order to prevent the sequelae of postoperative shoulder dysfunction and iatrogenic damage of the nerve, preservation of the SAN is of utmost importance. To ensure this, detailed knowledge of the anatomical variants of the SAN as well as the course of the nerve in the posterior triangle of the neck is vital. The MND aims to preserve the SAN, in an attempt to prevent the potential functional deformity associated with section or injury of the nerve. Intra-operatively, early identification of the position of the SAN as well as its relationship to the IJV is crucial, to avoid injury to these structures. Intraoperative nerve stimulation should be used frequently in an MND, to ensure the SAN is being stimulated throughout. Erb's point can often be used as a reliable landmark in identifying the SAN.¹²

In the management of SAN palsy, the most crucial step is recognition of this complication. Electromyography may be of benefit in the early diagnosis of iatrogenic nerve injury, allowing for prompt physiotherapy intervention, although accessibility is highly dependent on local resources.⁸ Simple interventions such as non-steroidal anti-inflammatory drugs may be used to aid in the relief of associated pain. In

severe cases, where pain is a debilitating issue, management options may include nerve transfer or nerve grafting, and these can give some potential improvement in postoperative disability.¹³

CONCLUSION

The preservation of the SAN or avoidance of damage is made technically challenging due to the variations in topographical and surgical anatomy, as well as factoring in the rare anatomical variations such as a duplex SAN and its relationship to the IJV. Damage to the SAN can lead to a number of debilitating postoperative consequences, which may require further management. Therefore, a sound appreciation of the common and rare anatomical variations of the SAN, as well as early identification of the nerve intraoperatively, is of fundamental importance for surgeons in approaching a neck dissection surgery/lymph node biopsy in order to reduce the risks of postoperative functional disability.

Learning points

- The identification of the spinal accessory nerve (SAN) in neck dissection is important to avoid iatrogenic damage.
- A dual SAN is an anatomical anomaly which has a reported incidence of 1.8%.
- Damage to the SAN during neck dissection surgery leads to debilitating sequelae.
- It is important to be aware of anatomical variations of the SAN which may be encountered in neck dissection.

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Contributors RC, SNQ and FS were present during the operation and finding of the dual spinal nerve in this patient. FS undertook the writing of the introduction, case report discussion and conclusion with assistance from Qamar. MJ was involved in obtaining the correct radiological and intraoperative images. The consultant, RC was in charge of overseeing the write up and for final corrections.

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Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

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