The Journal of Laryngology and Otology
October 1996, Vol. **110**, pp. 987–990

Jugular foramen involvement in nasopharyngeal carcinoma

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Abstract
Nasopharyngeal carcinoma (NPC) may spread posterolaterally with infiltration of the jugular foramen, jugular vein and the cranial nerves IX-XI. Cranial nerve palsies may be evident clinically but the extent of skull base infiltration is best assessed radiologically. Denervation atrophy is well demonstrated by both magnetic resonance imaging (MRI) and computed tomography (CT). Accurate delineation of the lesion is important in prognosis and radiotherapy planning.

Key words: Nasopharyngeal neoplasms; Carcinoma; Vagus nerve; Accessory nerve; Jugular veins

Introduction

Nasopharyngeal carcinoma (NPC) occurs in high frequencies in Southern China and Southeast Asia. The risk does not diminish among the Chinese migrants outside this region. Skull base erosion is common and may be seen in one-third of patients (Sham *et al.*, 1990). Posterolateral spread may involve the jugular foramen, the lower cranial nerves IX-XI and the carotid space.

The glossopharyngeal (cranial nerve IX), vagus (cranial nerve X) and spinal accessory (cranial nerve XI) nerves leave the posterior cranial fossa via the jugular foramen. These cranial nerves enter the nasopharyngeal carotid space as they exit the posterior cranial fossa. They leave the carotid space at the level of the soft palate except for the vagus nerve which remains within the entire length of the carotid space.

Patients with NPC may present with jugular foramen involvement at presentation or subsequently during the course of the disease. Radiological investigations are often required to confirm the clinical findings and to evaluate the disease extent.

Case reports

Case 1

The patient, a 55-year-old man, presented with a three-week history of epistaxis. Endoscopy showed a mass in the left nasopharynx. There was weakness in the ipsilateral trapezius and sternocleidomastoid muscles but no decrease in muscle bulk was evident. Biopsy revealed poorly differentiated carcinoma. MRI showed a large left NPC with infiltration of the left carotid space and the jugular foramen (Figure 1).

Case 2

The patient, a 56-year-old female, was a known case of NPC. She had undergone radiotherapy and was well for several years. She represented with epistaxis and mild hoarseness. CT showed destruction of the jugular foramen and intracranial extension (Figure 2). The left sternocleidomastoid and trapezius muscles showed atrophy indicating accessory nerve palsy. There was also evidence of vagus nerve palsy as indicated by atrophy of the ipsilateral pharyngeal muscles and the paramedian position of the vocal fold. Mucosal thickening could be seen in both maxillary sinuses. There were defects in the nasal and infratemporal walls of the right maxillary sinus. There was no history of surgery and these observations are most likely to be secondary to demineralisation as a result of the adjacent inflamed mucosa. The corresponding walls of the left maxillary sinus also showed similar but less severe changes. These changes do not appear related to NPC.

Discussion

The jugular foramen is formed by the petrous temporal bone anterolaterally and the occipital bone posteromedially. It is divided by a fibrous or bony septum into an anteromedial compartment (pars nervosa) and posterolateral compartment (pars vascularis). Not all the cranial nerves passes through the pars nervosa as the name suggests. Only the glossopharyngeal nerve passes through the pars nervosa together with the inferior petrosal sinus. The vagus and accessory nerves travel along with the jugular vein in the pars vascularis. The bony margins of the foramen are better appreciated on CT but MRI is superior in delineating the soft-tissue pathological anatomy especially in the presence of transcranial spread.

Malignant tumours of the head and neck are known to extend intracranially through perineural spread (Curtin *et al*, 1984). Perineural spread refers to tumour that follows the nerve pathway by using the perineural or endoneural spaces (Ballantyne *et al.*, 1963; Dodd *et al.*, 1970). The trigeminal nerve is most commonly involved in perineural spread. NPC with posterolateral extension may infiltrate the lower cranial nerves directly in the carotid space or

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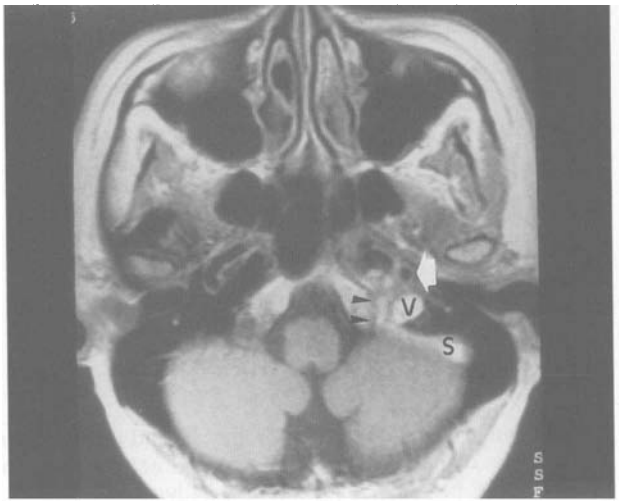
Accepted for publication: 26 July 1996.

(a)



(c)

(b)

(d)

(e)

FIG. 1

(a) Axial CT shows a large left NPC with invasion of the pterygoid process (P), the paranasopharynx (arrow), and posterolateral spread (asterisk). (b) Axial T1-weighted MRI shows an intermediate signal intensity lesion in the left jugular foramen (arrow). Note the normal signal void right jugular vein (star). (c) Axial contrast-enhanced MRI shows enhancement in the pars vascularis (V). There is also tumour enhancement in the pars nervosa (arrowheads) and the sigmoid sinus (S). Note the signal void carotid canal anterior to the jugular foramen (arrow). (d) Sagittal contrast-enhanced MRI showing tumour extension through the jugular foramen (asterisk). Note the enhanced sigmoid sinus (S) and the signal void carotid artery anteriorly (arrowheads). (e) Coronal contrast-enhanced MRI shows a large NPC (star) infiltrating the pars nervosa (arrows) and the pars vascularis (asterisks). Note the enlarged left cervical nodes (N).

https://doi.org/10.1017/S0022215100135534 Published online by Cambridge University Press

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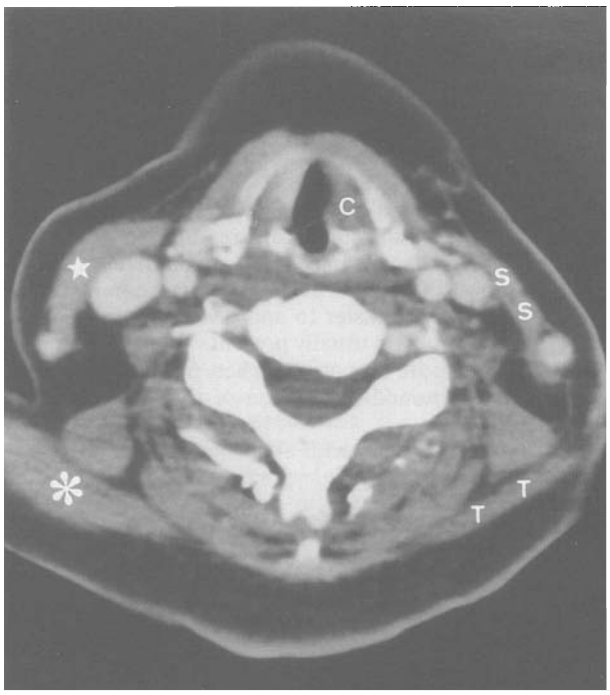

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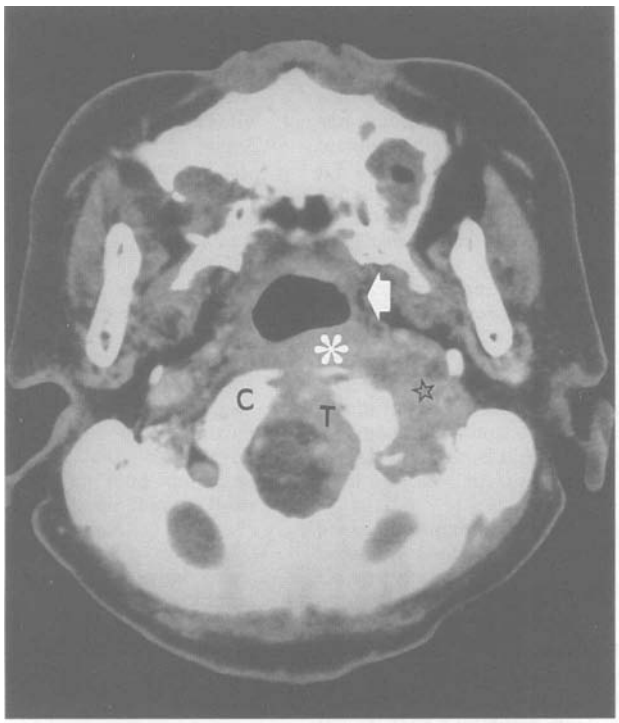

(b)

FIG. 2

(a) Axial CT shows a NPC (asterisk) with posterolateral spread. There is destruction of the left jugular foramen (J). Note the intracranial extension (arrows). There is slough in the nasopharynx (star) and inflammatory changes in both maxillary sinuses. (b) Axial CT shows tumour (asterisk) erosion of C1 (C). There is intraspinal extension (T). Tumour spread to the retrostyloid space and encasement of the carotid sheath is noted (star). Note the atrophy of the ipsilateral superior constrictor muscle (arrow) and inflammatory changes in both maxillary sinuses. (c) Axial CT shows atrophy of the left sternocleiodomastoid muscle (S) and the trapezius muscle (T). Comapre with the normal right sternocleidomastoid (star) and trapezius (asterisk) muscles. Note the paramedian position of the left vocal fold. (C).

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within the jugular foramen. However, perineural spread appears uncommon.

The stylopharyngeus muscle is the only muscle innervated by the glossopharyngeal nerve. As the muscle is radiologically inconspicuous, denervation atrophy secondary to tumour infiltration is difficult to document confidently. In contrast, established denervation atrophy of the sternocleidomastoid and trapezius muscles following accessory nerve infiltration can readily be identified. However, early changes may not be identifiable radiologically in spite of clinical evidence. Involvement of the vagus nerve appears easier to appreciate clinically. Some degree of hoarseness is usually present. Vagus nerve palsy, nevertheless, can be recognised when pharyngeal muscle atrophy or a paramedian position of the vocal cord are noted.

In summary, patients with skull base malignancy may have destruction of the jugular foramen. The lesion should be evaluated radiologically as possible surgery or radiotherapy planning depends on demonstrating the extent of the disease.

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