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Non-paraganglioma tumors of the jugular foramen – Growth patterns, radiological presentation, differential diagnosis

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ABSTRACT

Objective: Most common tumors of the jugular foramen are paragangliomas. However, other lesions, also malignant, may involve the jugular foramen and mimic radiographic presentation of paragangliomas. Therefore, a correct preoperative diagnosis is crucial for best treatment planning.

This study analyzes imaging characteristics of non-paraganglioma neoplasms involving the jugular foramen, with attention given to features helpful in differential diagnosis.

Study design: A retrospective chart search.

Setting: Teritary referral university centre.

Subjects and methods: During the years 1997–2010, 11 cases of jugular foramen tumors other than paragangliomas, with available imaging studies, were identified. Histopathology revealed: 3 schwannomas, 1 malignant schwannoma, 2 meningiomas, 1 hemangiopericytoma, 1 ependymoma, 1 endolymphatic sac carcinoma (ELST) and 2 nasopharyngeal carcinoma metastases. CT, MRI and angiography were assessed to determine tumor growth directions, bone involvement, tumor morphology and vascular composition.

Results: Schwannomas were characterized by parapharyngeal space involvement, jugular foramen expansion, preservation of cortical margins, irregular contrast enhancement. Meningiomas presented diffuse bone infiltration, sclerotic changes, erosion of the cortical bone. Ependymoma showed diffuse skull base infiltration, permeative erosion, heterogeneity, abundant vascularization. Hemangiopericytoma radiologically imitated paraganglioma. ELST showed permeative/geographic bony destruction, heterogeneity, intratumoral bony fragments. Metastases were lytic, solid lesions characterized by circumferential growth, internal carotid artery encasement and stenosis.

Conclusions: A combination of certain radiological features including tumor epicenter, growth vectors, skull base infiltration, bony changes and tumor morphology help

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establish correct preoperative diagnosis and differentiate less common jugular foramen tumors, from most common paragangliomas. Hemangiopericytoma may radiologically mimic paraganglioma.

1. Introduction

Jugular foramen is a complex region of the skull base containing important vascular and neural structures. The most common tumors of the jugular foramen are paragangliomas, arising from the chemoreceptor tissue of the paraganglia. These lesions constitute 60–80% of primary jugular foramen tumors and are histopathologically benign [1,2]. However, other lesions, sometimes of malignant course, may involve the jugular foramen primarily or secondarily and mimic radiographic presentation of most common tumors. Therefore, a correct preoperative diagnosis is crucial for best surgical planning and evaluation of postoperative morbidity and mortality. Radiological differential diagnosis is based on evaluation of tumor features demonstrated by computed tomography (CT), magnetic resonance imaging (MRI) and angiography.

This study analyzed imaging characteristics of non-paraganglioma neoplasms involving the jugular foramen. These findings were compared with radiological appearance of paragangliomas, which constitute a majority of jugular foramen tumors, with special attention given to characteristic features, that might be helpful in differential diagnosis. Usefulness of distinct imaging methods for depicting important differentiating features were discussed.

2. Materials and methods

A retrospective search of the files of the neuroradiology department and surgical database of our tertiary referral university center was performed for the years 1997–2010 and medical records of 51 cases of jugular foramen tumors with available imaging studies were obtained. Clinical and histopathological diagnosis was confirmed and 11 cases of jugular foramen tumors other then paragangliomas were identified.

Histopathologic diagnosis was obtained from surgery in 10 patients and revealed: 3 schwannomas, 1 malignant schwannoma, 2 meningiomas, and single cases of hemangiopericytoma, ependymoma and endolymphatic sac carcinoma. A pathology report was not available in 2 patients with skull base metastases in the region of the jugular foramen. They were included in the study, because metastatic disease was suspected on the basis of radiological findings and clinical evidence – the lesions occurred 3 months and 4 months after radiation therapy for the squamous cell carcinoma of the nasopharynx.

All patients underwent CT and 9 patients underwent MRI. Eight patients underwent digital subtraction angiography (DSA), with a standard technique including selective catheterization of both internal and external carotid arteries, as well as the vertebral artery on the side of the tumor.

Also 10 cases of jugular foramen paraganglioma randomly chosen from the radiology department files of the same time period were included in the study to facilitate highlighting radiological features useful in differential diagnosis. The study was approved by the institutional ethical committee.

All images were reviewed to determine tumor location and growth directions. CT scans were analyzed for types of bone involvement, such as pressure expansion, permeative growth, destructive or sclerotic changes. Special attention was given to bone margins of the jugular foramen. The presence of hyperostosis and calcifications was noted. On MRI tumor morphology was analyzed, including signal intensity, degree of contrast-enhancement, the presence of flow-void areas. On angiographic images the vascular composition of lesions was evaluated, with specific attention given to the presence of vascular blush.

3. Results

Clinical details and summary of radiologic features of jugular foramen tumors are listed in Table 1.

All *schwannomas* occupied the jugular foramen and the parapharyngeal space, with anteromedial displacement of the extracranial portion of the ICA. Involvement of the posterior fossa was observed in 1 patient. On CT scans tumors were characterized by enlargement and sharp contours of the jugular foramen (Fig. 1). Both *meningiomas* were primarily centered in the jugular foramen, extended to the CPA and encased the extracranial portion of the ICA. One ''dumbbell-shaped'' tumor had large extracranial component and abundant intra- and extracranial calcifications. On CT erosion of jugular foramen cortical margins, without its significant widening was a constant finding (Fig. 2). On MRI the intracranial component was a dural-based enhancing mass in one case and in another case had ''en plaque'' appearance (Fig. 3). *Ependymoma* occupied the jugular foramen, CPA and extended to the middle ear cavity, external auditory canal, carotid canal and mastoid. CT scans demonstrated extensive infiltration and permeative destruction of the skull base (Fig. 4). On MRI the tumor was markedly heterogeneous with multiple hyperintensive areas on non-contrast T1-weighted images consistent with subacute hemorrhage (Fig. 5). *Hemangiopericytoma* was a localized mass located in the jugular foramen with limited invasion of the medial mastoid (Fig. 6). *Endolymphatic sac carcinoma* occupied the jugular foramen and the retrolabirynthine portion of the petrous bone. Limited