Abstract:
This paper presents a case of paraganglioma involving the vagus nerve presenting as jugular foramen syndrome. These paragangliomas develop from paraganglia tissues which is distributed throughout the body. Commonly these tumors are found in the following areas:

- Carotid body
- Jugular bulb
- Vagus nerve

Vagal paraganglioma usually arise from the inferior vagal ganglion (nodose). These are slow growing tumors and the effects of involvement of vagus nerve takes sometime to develop. This case was managed surgically.

Case Report:
Our case, 35 years old female patient presented with hoarseness of voice and nasal regurgitation of 6 months duration. On examination, she had a swelling of 3x3cm over the right lateral pharyngeal wall, pushing the right tonsil medially. Gag reflex on right side was diminished, sensation over the right side tonsillar region, posterior 1/3 of tongue and posterior wall of pharynx was diminished. Other cranial nerves were clinically normal. MRI brain revealed a mixed signal intensity lesion of 5.28 x 3.07 x 2.26 cm in size, predominantly T1 hypo, T2/FLAIR hyper intense and brilliantly enhancing with contrast, in the region of right jugular foramen with significant extra cranial extension.
Right Internal jugular vein and internal carotid artery were anteriorly displaced by the tumour. Multiple intralesional flow voids were noted. Angiography showed highly vascular nature of the tumour and feeders from the right ascending pharyngeal artery. Provisionally, the pre operative diagnosis was Glomus Jugulare tumour.

Pre operative embolization was done 18 hrs prior to surgery. Retro auricular transcervical transmastoid infralabyrinthine approach was undertaken. Per operatively, Jugular bulb was found to be free and the tumour was found at the lower end of the right jugular foramen and arising from the right vagal nerve extending extracranially. Gross total excision of the tumour was done.

HPE report was consistent with Vagal paraganglioma. Post operatively, patient had transient 10th cranial nerve paresis which was recovered. Patient was discharged on 12th post operative day without any residual neurological deficit.
Discussion:

The paragangliomas make up a family of neoplasms that develop from paraganglia tissues (chemoreceptor organs) distributed throughout the body. The most common location in head and neck is the carotid body, followed by the jugular bulb and vagus nerve [2]. Vagal Paraganglioma (5% of paragangliomas) is a distant third in terms of prevalence [1]. In 1935, Stout identified the first paraganglioma of the vagus nerve and Birrell proposed the term vagal body tumour in 1953. Vagal Paraganglioma most commonly arises from glomus tissue rests within the inferior (nodose) ganglion. Other locations include the superior ganglion or elsewhere along the course of the vagus nerve. These are slow growing and often present as asymptomatic cervical masses [3]. Vagal nerve deficits are seen late in the clinical course of these lesions, as the fibers of the vagus nerve are usually splayed over the surface of the tumour.
Other lower cranial nerve palsies from hypoglossal, accessory or glossopharyngeal involvement commonly occur as late manifestations, typically 2 years after initial presentation (20-50%). Horner syndrome with infiltration into the cervical sympathetic chain occurs in 25% of patients. Rare manifestations include isolated hoarseness or vocal cord paralysis. Approximately 10% are bilateral. About 7-15% are malignant and may metastasise to regional lymph nodes or distant sites, commonly lungs and bones. The incidence of multifocal tumours in patients without a family history is around 10%, whereas the incidence of multiple paragangliomas rises to 30 to 40% in those with a positive family history[4]. Familial cases account for 40 to 50% of Vagal paragangliomas and the diagnosis of these tumours is made at a younger age.

Recent studies showed that the development of the disease has a genetic basis linked to a double mutation occurring in the alleles of chromosome 11, where the tumour suppressor PGL-1 gene is located. As the transmission of the mutation is an autosomal dominant function, the relatives of patients affected by multiple paragangliomas should be submitted to a screening protocol. This should be repeated every 5 years in those in whom tumours are not found. DNA analysis is possible in some, where the mutation is known and can be extremely reliable.

It offers the attractive possibility of a sensitive screen before clinical expression of the disease is evident. The natural history of Vagal paragangliomas is not entirely known. Morbidity associated with these tumours is unpredictable and is associated with loss of vagal function which might be bilateral.

Diagnostic work up includes CT/MRI and in selected situations, angiography [6]. MRI is superior to CT in assessing intracranial extension, as well as the relation of tumour to bone. The Vagal paraganglioma displaces both the External carotid artery (ECA) and Internal carotid artery (ICA) anteromedially, separating these vessels from the IJV. On arteriography, tumours located high on the nerve, tend to displace ICA anteriorly. Carotid body tumours, on the other hand cause splaying of ICA and ECA.

Staging system proposed by Browne and Fisch

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>I</td>
<td>Tumours that lie in the parapharyngeal space without invasion of the jugular foramen</td>
</tr>
<tr>
<td>II</td>
<td>Tumours that invade the jugular foramen without bone destruction</td>
</tr>
<tr>
<td>III</td>
<td>Tumours that deeply invade the jugular foramen and middle ear with bone destruction and variable involvement of the carotid canal</td>
</tr>
</tbody>
</table>

Subscript "i" for an isolated tumour without other tumours

Subscript "m" denoting multiple tumours
The necessity to prevent additional cranial nerve deficits influences the therapeutic approach. There is certainly mortality associated with disease progression and its treatment. Malignant paragangliomas are also a recognized cause of death from regional and distant metastases. [7] Surgical morbidity associated with vagal deficits is unavoidable. Literatures showed that vagal nerve function cannot be preserved even when the nerve is anatomically intact.

Differential Diagnoses:

The differential diagnostic considerations for a jugular foramen mass most commonly include nonneoplastic entities such as an asymmetrically enlarged jugular foramen, a high riding jugular bulb, and jugular vein thrombosis. Besides the paraganglioma, other neoplastic lesions include nerve sheath tumours, meningiomas, metastases, and miscellaneous primary bone lesions (eg, multiple myeloma, lymphoma, and Langerhans cell histiocytosis).

Nerve sheath tumours of the jugular foramen arise either from the lower cranial nerves or the spinal nerves. At CT, they appear with smooth enlargement of the foramen without associated destruction of the bony labyrinth. They may demonstrate a dumbbell shape with intracranial and extracranial components. Larger lesions are heterogeneous and contain areas of cystic degeneration. Calcification is not present.

At MRI, they are hypointense with short TE/TR sequences, are hyperintense with long TR/TE sequences, and undergo intense enhancement following contrast administration. They do not demonstrate a salt and pepper appearance. At angiography, they may manifest as either avascular or hypovascular.

Treatment:

Treatment planning for these patients can be fraught with problems and the major dilemma is the choice between surgery and observation. Radiotherapy as a realistic alternative lacks an evidence base [5]. The decision must be based on several factors that include the age of the patient, the preoperative status of the vagus, and the size and growth rate of the tumour. Multifocal disease may modify the management plan radically. In this respect, there are some basic facts that should be considered:

1. The natural morbidity of glossopharyngeal and vagal deficits is better tolerated than that caused by surgery.
2. The elderly do not compensate well for glossopharyngeal and vagal deficits.
3. Large tumours may inflict other cranial nerve deficits.
Small tumours, which are equal to or smaller than 2 cm in diameter, are usually easily removed with a predictable morbidity that is limited to the vagus nerve only; and there may well be a preoperative deficit in any case. A large tumour carries with it higher surgical risks with the possibility of additional cranial nerve palsies and damage to the internal carotid artery. Modern imaging techniques allow accurate monitoring of tumour growth that allows a change of management plan before the risk of collateral damage becomes too great. The age of the patient has to be weighed against the size of the tumour, predicted growth, and cranial nerve function. It may well be reasonable to adopt a watchful waiting policy in elderly patients who might not adapt well to an acute neural deficit. Multifocal paragangliomas present the surgeon and the patient with the greatest problem. The natural history of these tumours may result in a bilateral vagal palsy and make a pre-emptive surgical palsy unacceptable. In patients with bilateral paragangliomas it is only acceptable to operate on the side with a pre-existing vagal palsy. It should always be remembered that a young patient with multiple paragangliomas may develop even more. A unilateral vagal tumour may become one of a pair in time. The decision to resect a vagal paragangioma in this situation can never be taken lightly. The choice between surgery and watchful waiting is a balance between the natural actual or potential morbidity and the predictable surgical morbidity. The following Table contains the guidelines of treatment based on this concept.

<table>
<thead>
<tr>
<th>AGE &lt; 60 years</th>
<th>MONOFOCAL</th>
<th>PLURIFOCAL</th>
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<tr>
<td><strong>MONOFOCAL</strong></td>
<td>Tenth Nerve status</td>
<td>Treatment</td>
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<tr>
<td>Size&lt;2cm</td>
<td>10th CN loss</td>
<td>Surgery</td>
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<td>No 10th CN loss</td>
<td>Observation</td>
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<tr>
<td>Size&gt;2cm</td>
<td>10th CN loss</td>
<td>Surgery</td>
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<tr>
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<td>Observation (or Surgery*)</td>
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<tr>
<td>Size any</td>
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<tbody>
<tr>
<td></td>
<td>(surgical morbidity &gt; natural morbidity) Surgery*</td>
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*To prevent the natural morbidity of other cranial nerves
†In rare cases with oversized tumour
PREOPERATIVE EMBOLIZATION:

Preoperative embolization has been acclaimed by many investigators as a useful adjunctive tool in the surgical management of paragangliomas. Shrinkage in tumour vascularity and size, with a consequent decrease in intraoperative blood loss, is the goal. It is believed that a tumour larger than 3 cm is ideally suited for embolization.

A classification of the vascularization of paragangliomas into multicompartment and monocompartment tumours was proposed for the first time by Moret et al [8]. In a multicompartment tumour, each compartment is “hemodynamically independent” (ie, individual feeding vessels opacify only the compartments supplied by them). In contrast, one or more feeding vessels may supply a monocompartment paraganglioma, and each artery will supply the entire mass. Most paragangliomas (83%) have a multicompartment pattern of vascularity.

To completely embolize a paraganglioma, all the feeding vessels must be occluded. Most arteries can be embolized by using polyvinyl alcohol particles, typically varying from 140 to 250 mm in size. Alternative embolic materials include isobutyl-2-cyanoacrylate mixed with lipiodol, conjugated estrogen in absolute alcohol with polyvinyl alcohol, liquid embolic material (bucrylate and silicone), and absorbable embolic material (eg, sponge particles).

In monocompartment tumours, the entire tumour may be successfully embolized through a single feeding vessel by using a liquid embolization material under optimal conditions. Permanent occlusion of the ICA with detachable balloons may be performed following appropriate preoperative evaluation in patients whose tumours are extensively supplied from or infiltrate the ICA. The success rate for preoperative embolization (as defined by a decrease in tumour size) is estimated at about 80%.

RADIATION THERAPY:

In the middle part of the 1900s, radiation therapy was the primary method for treating paragangliomas. Largely because of significant improvements since that time, surgery has supplanted radiation therapy as the treatment method of choice in most instances. Although most cervical paragangliomas are considered radioresistant, their skull base counterparts are known to be radiosensitive. In patients with unresectable tumours, residual tumour following surgery or tumour involvement that occludes the ICA, radiation therapy may serve as an excellent palliative modality. Patients who refuse surgery or those who are not suitable surgical candidates can also be offered radiation therapy as a means of palliation. In bilateral vagal paragangliomas, bilateral resection is not an option because it usually entails bilateral vagal nerve paralysis with unacceptable morbidity and mortality. In these cases, adjunctive radiation therapy of at least one lesion with surgical extirpation of the other is recommended.
Recommended doses for radiation therapy range from 35 to 50 Gy. Complications associated with radiation therapy include radiation-induced demyelination, focal cerebral necrosis, progression of disease, and failure of radiation therapy to induce remission in functioning paragangliomas.

Conclusion:
Vagal paragangliomas are easily diagnosed by MRI and, in some cases, with the addition of angiography. Surgical excision remains the mainstay of treatment, sometimes requires preoperative embolization. Vagal paragangliomas are commonly misinterpreted as Glomus jugulare tumours as in this case. This case is being presented to highlight the fact that Vagal paraganglioma should be included in the differential diagnosis of tumours in the Jugular foramen region.

References: