Paragangliomas

Deborah P. Wilson, M.D.
Christopher Rassekh, M.D.
December 2, 1998
Paragangliomas

- benign, slow growing tumors
- distributed throughout the head and neck
- can also be found in the orbit, the larynx, and along the course of the vagus nerve
Paragangliomas

- various terminology used in past
- Glenner and Grimley divided the tumors into adrenal paragangliomas (or pheochromocytomas) and extra-adrenal paragangliomas
- terms used in past include: glomus tumors, chemodectomas, carotid body tumors
- the correct terminology is paraganglioma based on the anatomical location
History

- Carotid body first described in 1743
- The histologist Kohn first used the term paraganglion to describe the carotid body in early part of this century
- Guild first described vascularized tissue in the dome of the jugular bulb in 1941
- Rosenwasser reported a ‘carotid body tumor’ of middle ear in 1945.
Anatomy and Function of Paraganglia

- Carotid bodies are located in the adventitia of the posteromedial aspect of the common carotid artery.
- Have a chemoreceptor role by modulating respiratory and cardiovascular function in response to fluctuations in arterial pH, O2, and CO2.
- Blood supply is from the external carotid artery and sensory innervation is from the glossopharyngeal nerve.
Anatomy and Function of Paraganglia

- The paraganglia of the temporal bone are described as ovoid lobulated bodies.
- Approximately three bodies in each ear.
- Usually found accompanying Jacobson’s nerve or Arnold’s nerve or in the adventitia of the jugular bulb.
- Blood supply is ascending pharyngeal artery via inferior tympanic and neuromeningeal branches.
Anatomy and Function of Paraganglia

- Vagal paraganglia are small cell groups that rest within the perineurium of the vagus nerve.
- Their precise nerve supply has not been determined.
Pathology

- All paragangliomas are closely related to each other and to pheochromocytomas of the adrenal gland.
- Histologic appearance is similar to normal paraganglia.
- Paragangliomas consist of clusters of Type I or chief cells and Type II or sustentacular cells.
Pathology

- These clusters of cells make up the histologic structure termed Zellballen.
- Nuclear pleomorphism and cellular hyperchromatism is common in paragangliomas.
- Malignancy cannot be determined histologically but is reserved for presence of local, regional, or distant metastasis.
Paragangliomas of the Head and Neck

- Paragangliomas are most commonly found in the head and neck.
- The most common cervical paraganglioma is the carotid paraganglioma.
- Paragangliomas can also involve the vagus, the orbit, the larynx and the nose and paranasal sinuses.
- Temporal bone paragangliomas include the glomus tympanicum and glomus jugulare tumors.
Carotid Paragangliomas

- M.C. paraganglioma of the head and neck
- Are rare tumors
- More common in patients living at high altitudes
- Mean age at presentation is 45-50yrs
- Slight female preponderance
Carotid Paragangliomas

- present as painless neck mass just lateral to tip of hyoid bone
- may bulge into pharynx or extend into parapharyngeal space
- mass has typically been present for several years
- patients may c/o dysphagia or hoarseness
Carotid Paragangliomas

- multicentric paragangliomas in 10% overall
- approximately 20% of carotid paragangliomas are familial
- 50% of familial carotid paragangliomas are multicentric
- inheritance pattern is autosomal dominant modified by genomic imprinting
- the gene results in development of a carotid paraganglioma when it is paternally inherited
Carotid Paragangliomas

- On exam, the neck mass is mobile from side to side but not vertically b/c of it’s adherence to the carotid.
- Mass is frequently pulsatile and a bruit may be auscultated over the mass.
- The large majority of carotid paragangliomas are non-secreting but the pt must be questioned about any symptoms of excessive catecholamine secretion.
Carotid Paragangliomas

- Urinary screening may be unnecessary in asymptomatic patients.
- Screening should include 24 hr urinary vanillyl mandelic acid (VMA) and circulating catecholamines.
- If screening is positive, an abdominal CT should be done to rule out concomitant pheochromocytoma which is much more likely to cause elevated catecholamines.
- Patients with symptomatic secreting tumor should be treated with appropriate alpha and beta blocking agents.
Carotid Paragangliomas

- FNA not recommended
- initial imaging study can be CT or MRI
- characteristic finding is mass arising from carotid bifurcation which displaces the internal and external carotid arteries
- Arteriography confirms dx by revealing tumor blush at carotid bifurcation (lyre sign)
Carotid Paragangliomas

- arteriography also used to assess adequacy of carotid system
- both carotids should be studied to r/o multicentricity
- Balloon test occlusion coupled with cerebral blood flow testing can predict how pt would tolerate carotid occlusion
Carotid Paragangliomas

- most authors do not recommend preoperative embolization
- does not appear to decrease amount of blood lost
- may set up inflammatory response that makes surgery even more risky
Carotid Paragangliomas

- Therapeutic options include surgery, radiation therapy, and observation.
- Management should be individualized.
- Considerations should include age, medical condition of the patient, tumor size, and multicentricity of the tumor.
- Tumor size is a very important indicator of operative morbidity.
Carotid Paragangliomas

- Carotid paragangliomas >5cm carry a much higher operative complication rate (67%) than those <5 cm (14%)

- Shamblin’s classification scheme includes three groups: Group I are small & easy to dissect, Group II are medium and are more intimately attached to carotid, and Group III are large with transmural invasion of carotid requiring resection and grafting
Carotid Paragangliomas

- thoroughly discuss all risks with patient
- operative mortality of 2-10%
- stroke rate 20%
- cranial nerve injury rate 40-50%
- possible need for transfusion
- vascular surgeon should be available
Netterville published recent (1995) review on 30 pts with 46 carotid paragangliomas. Only 5/25 who elected to have surgery had permanent CN palsy (3 were SLN). A significant # of pts with baroreceptor failure (after bilateral resection) and “first-bite” pain. These conditions should be discussed with the patient preoperatively.
Carotid Paragangliomas

- surgical resection under GA

- important to identify and preserve marginal mandibular branch of CN VII

- submandibular gland removal may be necessary with large tumor

- must identify and trace hypoglossal and vagus nerves prior to resecting tumor

- important to gain distal and proximal control of carotid
Carotid Paragangliomas

- easiest to approach tumor inferiorly and posteriorly
- dissection is in subadventitial plane
- external carotid branches must be ligated as tumor is rolled off of carotid
- external carotid sometimes requires ligation
Carotid Paragangliomas

- are generally considered radioresistant
- XRT reserved for incompletely excised tumors (with intracranial extension), recurrent tumors, very large tumors and elderly patients or those who are poor surgical candidates
- mortality rate of untreated carotid paragangliomas is 8%/yr
- due to very slow growth rate, some authors recommended observation alone
Carotid Paragangliomas

- Malignancy rate of 2-10%
- Malignancy more common with familial paragangliomas
- Diagnosis of malignancy made by evidence of spread to regional lymph nodes or distant sites
Jugulotympanic Paragangliomas

- second most common temporal bone tumor (after acoustic neuroma)
- incidence of 1:1,300,000
- female:male ratio 4:1
- median age 50-60 yrs (range 6 mo - 88 yrs)
- no ethnic or racial predilection
Jugulotympanic Paragangliomas

- consist of sporadic and familial forms
- familial form has higher incidence of multicentricity
- incidence of secreting JTP is 1-3%
- no histologic distinction b/w benign and malignant
Jugulotympanic Paragangliomas

- very slow growing
- spread locally in multidirectional fashion along paths of least resistance
- air cell tracts are most important route
- can spread outside temporal bone via eustachian tube, vascular lumens, and neurovascular foramina including IAC
Jugulotympanic Paragangliomas

- bone erosion noted by crescentic lucencies
- hypotympanum and carotid crest (separating ICA from IJV) are susceptible
- clinical course is slow asymptomatic growth until lesion far advanced
- pt usually c/o pulsatile tinnitus. Other complaints may be aural fullness or HL
- cranial nerve deficits, especially IX and X, can be seen with large tumors
Jugulotympanic Paragangliomas

- Otoscopic exam can be normal, can reveal red mass behind TM, or show a vascular ear "polyp" which may bleed spontaneously.
- Brown’s sign = blanching of ME mass with positive pneumotoscopic pressure.
Jugulotympanic Paragangliomas

- just like carotid paragangliomas, a family hx should be sought
- question pt regarding symptoms of secreting tumor (labile B/P, tachycardia, vascular HA)
- any suspicion, obtain urine for VMA, circulating catecholamines
- if positive, get abdominal CT to r/o concomitant adrenal pheochromocytoma
Jugulotympanic Paragangliomas

- obtain audiogram
- imaging should include CT temporal bone and MRI
- on CT, JTPs show bone erosion around jugular bulb and carotid artery
- CT helps delineate tumor relationship to facial n., cochlea, and ICA
- MRI helps evaluate intracranial extension, flow in ipsi and contralateral sigmoid, and further defines tumor relationship to ICA
Jugulotympanic Paragangliomas

- arteriography is helpful if surgery is planned
- helps in detecting multicentric tumors, identifies feeding vessels, allows for embolization pre-op, identifies intrasinus and intravenous extension, provides further information on flow in contralateral sigmoid and internal jugular vein
- also allows for pre-op BTO if other images suggest extensive involvement of ICA
Jugulotympanic Paragangliomas

- no need for tissue biopsy
- two classification systems based on tumor size, petrous apex or carotid artery involvement and intracranial extension
- Fisch’s system has 4 categories ranging from Type A tumors isolated to ME cleft to Type D tumors with intracranial extension
- Glasscock and Jackson’s system divides JTPs into glomus tympanicum and glomus jugulare tumors. Each group is subdivided based on size and extension
Jugulotympanic Paragangliomas

- Decisions regarding management can only be made after extent is defined.
- Unlike carotid paragangliomas, JTPs are considered radiosensitive.
- Surgical goal is total or near-total removal.
- XRT goal is arrest of tumor growth.
- Much controversy over treatment of choice.
Jugulotympanic Paragangliomas

- Surgical risks include cranial nerve defects, vascular injury and bleeding and cerebrospinal fluid leak
- XRT risks include tumor regrowth, late-onset CN defects and ORN of T-bone
- Most authors agree that management of JTPs should be individualized
Jugulotympanic Paragangliomas

- In general, healthy younger pts (<65 yrs - sorry Dr. Quinn) should consider surgical resection.
- Pts with large tumors with pre-existing ipsilateral CN deficits should be offered surgery.
- Pts >65 with poor pulmonary fxn or other complicating medical conditions should consider primary XRT.
Jugulotympanic Paragangliomas

- pts with multicentric tumors require careful consideration as bilateral lower CN deficits can be devastating
- treat life-threatening lesion first, with palliation or observation of other lesions
- secreting tumors require surgery
Jugulotympanic Paragangliomas

- Thoroughly discuss all risks and alternatives
- Possible need for transfusion, consider autologous donation
- Preoperative embolization is controversial
- Many authors recommend embolization 24-48 hrs preop to decrease blood loss
- Others feel risks of embolization outweigh benefits
Jugulotympanic Paragangliomas

- Surgical techniques differ depending on size and extent of tumor.
- Glomus tympanicum tumors limited to ME without involvement of jugular bulb (Fisch Type A) may only require transcanal tympanotomy.
- Larger tumors that extend into mastoid (Fisch Type B) will require a mastoidectomy with extended facial recess approach.
Jugulotympanic Paragangliomas

- Glasscock and Jackson I and II and Fisch C1 and C2 tumors can usually be resected with extended facial recess approach.
- Dissection of upper neck allows for identification and preservation of CNs IX, X, XI and XII.
- An infratemporal fossa approach is preferred for larger tumors (G & J Class III and IV, Fisch C3 & C4).
Jugulotympanic Paragangliomas

- Tumors with intracranial extension (Fisch D1-3) may be resected with infratemporal fossa approach. Retrosigmoid and/or suboccipital approaches may be necessary for tumors that extend into posterior cranial fossa.

- Postoperative care is directed at treating cranial nerve deficits.
Jugulotympanic Paragangliomas

- Consider postoperative XRT or observation with serial MRIs for patients with residual tumor.
- Long term follow-up necessary. Glomus tympanicum tumors may be followed with serial otoscopic exams. Glomus jugulare tumors should be followed with serial MRIs.
- Management of post-surgical recurrences or XRT failures difficult and should be individualized.
Intravagal Paragangliomas

- arise most commonly at level of nodose ganglion
- mean age at presentation is 50 yrs old
- more common in females than males
- usually present as painless neck mass behind angle of mandible
- mass typically present for several years
Intravagal Paragangliomas

- pt may c/o dysphagia due to mass compressing pharynx
- pt may c/o tongue weakness, hoarseness or Horner’s syndrome
- imaging should include CT and MRI to help delineate tumor relationship to vital structures
- angiography typically shows tumor blush with mass displacing internal carotid artery anteriorly and medially
Intravagal Paragangliomas

- Only one secreting vagal paraganglioma has been reported.
- Even more rare than other paragangliomas.
- Historically not thought to be familial but recent study by Netterville revealed 20% incidence.
- Netterville also found multicentricity rate of 78% in familial vagal paragangliomas vs 23% in sporadic vagal paragangliomas.
Intravagal Paragangliomas

- estimated malignancy rate of 18% (higher than other head and neck paragangliomas)
- there is no consensus on management of choice
- surgery proponents say surgical resection allows chance of complete tumor removal
- non-surgical proponents say surgery has unacceptable morbidity with high rate of cranial nerve deficits
Intravagal Paragangliomas

- XRT has not been shown to be curative
- carries risk of ORN to temporal bone
- in general, younger pts are offered surgical resection
- conservative management (XRT or observation) is offered to elderly pts who have much more difficulty with swallowing rehab after sacrifice of multiple CNs
**Intravagal Paragangliomas**

- Surgical resection is via a transcervical approach often combined with lateral skull base approach depending on extent of tumor.

- Postoperative care is directed towards aggressive rehab of the CN deficits. Netterville’s group has performed primary medialization thyroplasty combined with arytenoid adduction. Facial nerve deficits are treated with eye precautions and gold weight implants &/or canthoplasty.
Other Paragangliomas of the Head and Neck

- Paragangliomas of the larynx, orbit, and nose and paranasal sinuses tend to be locally aggressive.
- Laryngeal paragangliomas require WLE and sometimes partial laryngectomy.
- Orbital paragangliomas have a high recurrence rate.
- Nasal paragangliomas require WLE.
- XRT has not been shown to be effective against these paragangliomas.