Dialogue with Residents: Approach to Skull Base Tumors

Classification of the lesions:

Where is the tumor?

- Is it intra-axial or extra axial (Outside the brain)
- Is it located at Cerebello-pontine angle, Jugular foramen or Petrous apex

Common lesions found at Petrous Apex:

- Cholesterol Granuloma
- Mucocoele
- Cholesteatoma (epidermoid)
- Chrondroma/Chondrosarcoma
- Trigeminal schwannoma
- Metastasis

Common lesions found at CPA:

- Vestibular Schwannoma
- Meningioma
- Epidermoid Cyst
- Arachnoid Cyst
- Lipoma

Common Lesions found at Jugular Formen

- Glomus tumors
- Vagal Schwannoma
- Metastasis

Cerebellopontine Angle

It is the area of the lateral cistern containing CSF, arachnoid tissue, cranial nerves and their associated vessels.

Its boundaries are:

- Medial – lateral surface of the brainstem
- Lateral – petrous bone
- Superior – middle cerebellar peduncle & cerebellum

- Inferior – arachnoid tissue of lower cranial nerves
- Posterior – cerebellar peduncle

CPA tumors include:

- Vestibular Schwannoma: 70-90%
- Meningioma: 5-10%
- Epidermoids: 2-5%
- Arachnoid Cysts: 1%
- Others: Facial and Trigeminal Schwannoma, Lipoma, aneurysm Anterior Inferior Cerebellar Artery.

The typical features of Acoustic Neuroma are as follows:

- It is centered on Porus Acousticus
- It forms an acute angle with petrous bone
- It often involves internal auditory canal
- There is an homogenous contrast enhancement
- It does not have a dural tail
- There is no calcification of the tumour

The typical features of the meningioma are as follows:

- It arises from the surface of petrous bone
- It forms an obtuse angle with petrous bone
- It uncommonly involves the internal auditory canal
- It frequently has a dural tail
- The calcification of the lesion is common

Treatment planning for Vestibular Schwannoma includes the following:

- Observation
- Surgery
  - Translabrynthine
  - Retrosigmoid
  - Middle Fossa
- Radiotherapy
  - Conventional radiation therapy
  - Stereotactic radiosurgery

Choice of surgery is determined by whether preservation of hearing is wanted or not:

If preservation of hearing is wanted then:

- Large Tumour: Suboccipital Approach
- Small lateral Tumour: Middle fossa approach

If preservation of hearing is not a priority then in any size tumour Translabyrynthine approach is followed.

Trans-labyrinthine Approach

Indications: Non-serviceable hearing

• Advantages:

There is little cerebellar retraction during the surgical procedure.

There is good exposure of facial nerve laterally

All size tumours can be handled with this approach.

• Disadvantages: There hearing is sacrificed and slightly higher CSF leak rate.

Middle Fossa Approach:

Indications

- Intracanallicular tumor (maybe 0.5cm into IAC)
- Residual Hearing

Contraindications

- Large tumors
- Older patients (> 60 yrs. may have higher rate of bleeding or stroke)

Advantages:

- The middle fossa approach perhaps has the highest hearing preservation rate
- There is good access to lateral fundus

Disadvantages:

- The Facial nerve is first in line of exposure in IAC
- There is limited medial exposure

- There is risk of Seizure during surgery

Retrosigmoid Approach:

Indications

- Patient is left with a serviceable hearing
- Any size tumor can be approached as long as it is not in lateral fundus

Contraindications

- Lateral IAC tumor (Through this approach the surgeon cannot get to fundus without risking hearing)

Advantages

- There is good exposure of the lesion superior-inferiorly
- Most neurosurgeons are familiar with this approach

Disadvantages

- There is extensive Cerebellar retraction during the procedure
- There is limited access to lateral fundus

Petrous Apex Masses

Characteristics of petrous apex lesions on MRI

Lesion	T1 Images	T2 Images	Gadolinium Enhancement
Cholesteatoma	Hypo	Hyper	No enhancement
Cholesterol Granuloma	Hyper	Markedly Hyper	No enhancement
Petrous apicitis	Hypo	Hyper	Rim enhancement
Effusion	Hypo	Hyper	Mucosal enhancement
Bone marrow asymmetry	Hyper	Hypo	No enhancement
Neoplasia	Hypo	Hyper	Enhancing

Approaches to Petrous Apex

- Translabyrinthine, Transcochlear/otic
- Infracochlear
- Infralabyrinthine , retrolabyrinthine and other perilabyrinthine approaches
- Transsphenoid
- Middle Fossa
- Partial labyrinthectomy

Jugulotympanic Paragangliomas

- These are 2nd most common temporal bone tumor after acoustic neuromas.
- 4:1 female to male ratio
- Median age of presentation 50-60 yrs
- No ethnic or racial predeliction
- Sporadic and familial forms (25 – 50% multicentricity)
- Functional secretion about 1-3%
- Malignancy rate < 5%
- They have a salt and pepper appearance on MRI

Jugulotympanic Paragangliomas Classification

Glasscock-Jackson Classification

I. Small tumor involving jugular bulb, middle ear, and mastoid

II. Tumor extending under internal auditory canal; may have intracranial extension (ICE)

III. Tumor extending into petrous apex; may have ICE

Tumor extending beyond petrous apex into clivus or infratemporal fossa; may have ICE

The Fisch classification describes four stages of tumour development:

- A - tumour limited to the middle-ear cleft (glomus tympanicum).
- B - tumour limited to the tympanomastoid area with no infra-labyrinthine compartment involvement.
- C - tumour involving the infra-labyrinthine compartment of the temporal bone and extending into the petrous apex.
    - C1 - tumour with limited involvement of the vertical portion of the carotid canal.
    - C2 - tumour invading the vertical portion of the carotid canal.
    - C3 - tumour invasion of the horizontal portion of the carotid canal.

D - tumour with intracranial extension.

- D1 - tumour with an intracranial extension less than 2 cm in diameter.
- D2 - tumour with an intracranial extension greater than 2 cm in diameter.

Anatomical principles of the lateral surgical approach to the skull base

Several different surgical approaches have been employed in order to reach lesions in the rather inaccessible region of the skull base. However, it is the lateral approach that has recently become established as the approach of choice for most surgeons who work in this area.

The main difficulty in creating adequate exposure has been the long, tortuous course of the facial nerve, which prevents direct access. However, the technique of anterior transposition of the nerve demonstrated by Fisch (1977) has provided the access necessary for control of the internal carotid artery and internal jugular vein, and so has permitted satisfactory exploration of the skull base from the lateral approach. Fisch has developed three variants of this lateral approach, which he loosely terms the 'infratemporal fossa approach'.

- The type A approach provides access to the temporal bone right up to the petrous apex.
- The type B involves a more anterior approach which allows dissection to proceed across the petrous apex to the basiocciput and clivus.
- The type C approach takes the exposure even further forward, allowing the surgeon to remove lesions in the nasopharynx and parasellar region.

Indications:

- ❖ Type A Approach: This technique is employed primarily for the removal of glomus jugulare tumours, and involves the now classic manoeuvre of anterior facial nerve transposition.
- ❖ Type B approach: For exposure of the clivus to remove a chordoma or petrous apex cholesteatoma, the type A approach is extended forward into the infratemporal fossa.
- ❖ Type C Approach: This approach can be employed for very anteriorly placed lesions in the nasopharyngeal, parasellar, retromaxillary and paratubal regions. A subtotal petrosectomy is carried out as for the type A and type B approaches, but anterior transposition of the facial nerve is not required.

Details of surgical procedure: Type A approach:

1. A long postaural incision is extended down into the neck
2. Greater auricular nerve identified & preserved for facial nerve grafting (if needed)
3. Spinal accessory N identified
4. Carotid sheath exposed.

5. Ascending pharyngeal and occipital art. Identified, these are usually the feeding vessels of the tumor.
6. The internal jugular vein is ligated and divided at the level of the carotid bifurcation
7. The sternomastoid is divided at its insertion into the mastoid tip.
8. The internal jugular vein can then be dissected right up to the skull base, where cranial nerves IX, X, XI and XII are identified at the jugular foramen, and the internal carotid artery is exposed as it enters the carotid canal.
9. A widely beveled cortical mastoidectomy with transection of the cartilaginous external auditory canal performed.
10. The vertical portion of the facial nerve is identified, and the posterior bony canal wall is taken down with removal of the mastoid tip.
11. The facial nerve is mobilized from the geniculate ganglion to its division in the parotid, and is then transposed anteriorly into a new fallopian canal created in the anterior attic.
12. The sigmoid sinus can then be exposed with the drill and is then either packed or ligated superiorly.
13. Eustachean tube obliterated
14. The superior and posterior tumour poles are then separated from the otic capsule and posterior fossa dura.
15. Separation from posterior fossa dura is achieved by opening the ligated sigmoid sinus and following its lumen down to the tumour.
16. Finally, the inferior pole of the tumour is approached at the jugular foramen and separated from cranial nerves IX, X, XII and XII. The whole jugular bulb can then be removed together with the tumour.
17. Large glomus jugulare tumours with intradural extension demand a neurosurgical approach to remove the intradural portion of the lesion once the extradural part has been excised