Metastatic Tumors to the Temporal Bone

Introduction
✓ Incidence of metastases: increasing
  ■ increasing incidence of cancer
  ■ increase in life expectancy
  ■ more effective radiochemotherapeutic methods
✓ Temporal bone affected by metastatic tumors in discrete histologic patterns and rather characteristic clinical presentations
✓ May mimic external auditory canal or middle ear inflammations
  ■ the importance of prompt diagnosis
✓ Metastatic tumors involving the petrous pyramid of the temporal bone
  ■ first report by Proctor and Lindsay in 1947

Patterns of involvement
✓ Hematogenous spread
  ■ leading to seeding of the marrow spaces of the petrous bone
✓ Meningeal carcinomatosis
  ■ gaining access to CSF and disseminating through the subarachnoid space into IAC
✓ Direct extension
✓ Leptomeningeal extension from an intracranial primary tumor
✓ Leukemic or lymphomatous infiltration

Hematogenous spread
✓ The commonest route of invasion
✓ Metastatic tumors occurred in the petrous region
  ■ bone marrow had the capacity to filter out circulating tumor cells
  ■ sluggish blood flow in the sinusoidal capillaries of the marrow $\rightarrow$ favors tumor cell deposition
  ■ proliferate rapidly, die out or dormant for months or year
✓ Metastatic involvement of the pneumatized portions: quite common
  ■ vascular permeation after invasion of the petrous bone
    ◆ submucosal vessels of the mastoid air cells occluded with tumor $\rightarrow$ producing edema $\rightarrow$ tumor grows out of the vessels to fill the air cells $\rightarrow$ in communication with the vessels of the middle ear cleft $\rightarrow$ tubotympanic cavity
    ◆ lymphatic plexus involved at this stage $\rightarrow$ dissemination occurs
    ◆ infiltration of the external ear canal in the presence of an intact tympanic membrane
    ◆ facial canal can be eroded by expanding tumor
- gross bone destruction, new bone formation, and hemorrhage
- ossicular involvement happens late in the process

**Meningeal carcinomatosis**
- Via perineural infiltration
- Routes of perineural spread
  - intraneural vessels, vasa nervorum and perineural lymphatics
  - gaining access to CSF and disseminating through the subarachnoid space into IAC
- Diffuse metastatic involvement of the cerebrospinal pia-arachnoid membranes
- Resemble the primary tumor in histological appearance, less well differentiated
- A predilection for invading the internal auditory canal, often bilaterally
  - invasion, demyelination or destruction of the VIIth and VIIIth cranial nerves

**Direct extension**
- Usually diagnosed earlier
- Occurs along potential clefs and planes of least resistance or along natural passages
  - Eustachian tube
  - carotid canal
  - foramen lacerum
  - foramen ovale
  - jugular foramen
  - internal auditory meatus
- Nelson & Hinojosa
  - 33 patients with tumors of H&N with direct extension to the temporal bone
    - most frequently involved the petrous apex and foramen lacerum
    - usually occurs late in the disease process and often asymptomatic

**Leptomeningeal extension from an intracranial primary tumor**
- Primary intracranial tumors may reach the temporal bone
  - via the meninges
  - invade the subarachnoid space
  - IAC: the first structure involved
- Meningoblastoma: the commonest intracranial neoplasm extending widely to the meninges and involving the temporal bone
- Glioblastoma multiforme, oligodendroglioma and ependymoma
- Differentiating this form of spread from meningeal carcinomatosis: quite difficult

**Leukemic or lymphomatous infiltration**
- In leukemias
  - infiltration of the middle ear cleft occurs in one-third of the cases
- tends to follow the mucosal folds to the ossicles and intratympanic muscles, and into the tympanic membrane
- IAC is also commonly involved
- S/S may be due to a hemorrhage into the middle ear or membranous labyrinth, not malignant infiltrate
- Shanbrom and Finch, a series of 100 patients
  - 32 had otologic signs or symptoms
  - 6 of these patients seeking medical attention due to otologic S/S

✓ Incidence of lymphoma: rather less well known
- routes of invasion by non-Hodgkin's lymphoma
  - along the nerve sheath through the foramina of the skull
  - along blood vessel adventitia
  - direct hematogenous or lymphatic spread
  - as the routes of central nervous system involvement

Prevalence
✓ True prevalence of temporal bone metastasis: hard to establish
- temporal bones not examined routinely during autopsies
- Gloria-Cruz
  - 212 patients (415 temporal bones) with primary nondisseminated malignant neoplasms
  - 47 had metastases to the temporal bone (76 temporal bones)
  - a prevalence of metastases of ≈ 22.2% (47/212)
  - from 2 to 87 years old
    - most (13 patients) being in the fifth decade
- Usually a female predominance
  - high occurrence of breast carcinoma

Site of metastasis
✓ Streitmann and Sismanis: 141 cases
- Gloria-Cruz, 47 patients

### TABLE 3. Site of metastasis

<table>
<thead>
<tr>
<th>Site of metastasis</th>
<th>No. (% of Patient)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrous</td>
<td>46 (3 bilateral)</td>
</tr>
<tr>
<td>Internal auditory canal</td>
<td>22 (12 bilateral)</td>
</tr>
<tr>
<td>Mastoid</td>
<td>12</td>
</tr>
<tr>
<td>External auditory canal</td>
<td>11</td>
</tr>
<tr>
<td>Middle ear</td>
<td>5</td>
</tr>
<tr>
<td>Squamous</td>
<td>1</td>
</tr>
<tr>
<td>Multiple sites</td>
<td>29 (4 bilateral)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>15</td>
</tr>
<tr>
<td>TOTAL</td>
<td>141</td>
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</tbody>
</table>
Primary malignancies metastasizing to the temporal bone

- Streitmann and Sismanis: 141 cases
  - Six commonest primary malignancies
    - 89 (63.1%) of all the secondary lesions
      - breast 35 (24.8%), lung 16 (11.3%), kidney 13 (9.2%), stomach 9 (6.4%), bronchus 8 (5.7%) and prostate 8 (5.7%)
  - unknown primary malignancies: 16 (11.3%)
  - cardiac myxomas, vaginal carcinoma, sigmoid colon carcinoma, rectum carcinoma, esophageal carcinoma, hypopharyngeal carcinoma, ameloblastoma, neuroendocrine tumor, seminoma, pancreas and bladder carcinoma

- The commonest metastatic tumors to the temporal bone
  - carcinomas of the breast, lung, kidney, prostate
    - a predilection for metastasizing to bone

Time of diagnosis

- Metastases resulting from hematogenous spread
  - have symptoms very late in the course of the disease
  - stays silent until it extends into areas that cause otologic dysfunction
  - usually diffuse metastases throughout the body by the time of diagnosis
  - temporal bone metastasis is generally overlooked
    - patient's poor general condition
    - symptoms in other systems overshadow the less-disabling otologic manifestations

Symptoms and signs

- Metastases to the temporal bone are often asymptomatic even in advanced cases
- A variety of otologic symptoms, including otalgia, otorrhea, hearing loss, facial nerve paralysis, tinnitus and aural mass
- The commonest symptom encountered: hearing loss
  - Conductive hearing losses
    - disruption of Eustachian tube function
    - secondary otitis media
    - invasion of the middle ear mucosa
    - destruction of the ossicles
    - infiltration of the tympanic membrane
  - Sensorineural hearing loss
    - destruction of the cochlear nerve fibers
    - compression in the internal auditory meatus
    - destruction of the bony otic capsule and invasion of the inner ear
Tumors spread to the meninges and enter the temporal bone via the IAC
- develop otologic manifestations earlier

Canal involvement
- associated with deficits of cranial nerves VII and VIII

Many of the audiological and vestibular symptoms found with leukemia
- changes in the biochemistry of these sensitive structures
  - an altered blood vessel permeability secondary to deficient platelets
  - alterations in the selective ion concentrations between the endolymph and the perilymph

Present with a polyp and chronic drainage
- more common for primary lesions
- the symptoms mimic mastoiditis → diagnosis may be delayed

Triad of symptoms
- otalgia, periauricular swelling, and facial nerve paresis
- highly suspect for malignant involvement of the temporal bone

Pain and VIIth nerve paralysis in a chronically draining ear
- a tissue suitable for biopsy

Diagnosis of metastatic carcinoma
- Based on knowledge of a primary site & histologic pattern (immunohistochemical studies)
- An audiogram
- Radiographic studies of the temporal bone
  - establish the presence of a destructive lesion
  - evaluate co-existing intracranial lesions
- HRCT of temporal bone
  - very useful in the diagnosis of secondary malignancies
  - excellent in delineating boney lesions
- MRI scan
  - if a metastasis to the IAC is suspected
- Single most important point in the diagnosis of temporal bone metastasis: suspicion
  - intractable chronic drainage
  - a combination of facial nerve paralysis with sudden sensorineural hearing loss and dizziness
  - Pain

Treatment
- Patients with a secondary malignant process involving the temporal bone
  - always present a complex clinical situation
- Conservative, but sufficiently radical to meet the patient's more urgent needs
Surgery, radiotherapy, and chemotherapy
- nature and behavior of the primary malignant neoplasm
- extent of the metastases in the temporal bone and other organs
- availability of effective therapy
- patient's well-being

Surgery
- Seldom indicated for metastatic lesions
- All granulation and polypoid tissue should be biopsied before planning the surgery
- Risk of operative mortality versus benefit of pain relief
- Unresectability
  - extension beyond the Eustachian tube
  - destruction of the sphenoid bone and clivus
- Indication of surgery
  - decompress the posterior cranial fossa
  - localized cerebellopontine angle tumors

Radiotherapy
- A poor alternative treatment
  - its effectiveness is limited at a site characterized by infection and bone invasion
- Brainstem damage starts at 5000 rads
- Disease remains uncontrolled after terminating radiotherapy → bone sequestration, infection, pain and probably also residual tumor

Systemic chemotherapy
- treatment of leukemic infiltrations

Prednisone or prednisolone
- hemorrhage into the temporal bone

Treatment of meningeal carcinomatosis
- radiotherapy directed to the neuraxis in combination with intrathecal chemotherapy to treat the entire subarachnoid space

Conclusion
Temporal bone metastases
- Being diagnosed more frequently
  - developments in imaging techniques
  - longer survival of cancer patients
- Mimic chronic inflammatory diseases of the ear
- Treatment
  - almost always palliative
- Main aim
  - improve the patient's quality of life
- Primary disease usually determines the prognosis
References: