NECROTIZING EXTERNAL OTITIS
Case report

- 73 y/o gentleman presents to PCP with left ear pain and left droopy face
- Diagnosed with otitis media and Bell’s palsy
- Treated with systemic and topical antibiotics for otitis media
- Antivirals and systemic steroids for Bell’s.

6 weeks later

- Pain worsening and extending to post-auricular area
- Transferred to tertiary care center
On presentation - history

- Decreased hearing on left
- No vision changes or facial numbness
- Continued pain in post-auricular area and neck
- Last A1c 9.4%
- 30 pack years, quit 30 years ago
On presentation- physical exam

- Afebrile, nontoxic
- WBC 14.4
- Moderate tenderness on manipulation of left ear and palpation of left mastoid
- HB VI on left
Coronal CT
OR

- Tympanomastoidectomy
- Drainage of mastoid tip abscess
- Decompression of facial nerve (no evidence of stimulation up to 2mA)
Operative findings

- Facial nerve atrophy
- Inflamed granulation tissue filling middle ear, facial recess and around the mastoid tip
Histopath

- Fragments of bone with extensive acute inflammation, fibrinous exudate and microabscess formation
Cultures

- Pseudomonas

History

- Formerly known as malignant external otitis
Toulmouche

- 1838
- Progressive osteomyelitis of the temporal bone
- First reported case
Melzer and Kelemen

- 1959
- Patient with ear pain
- Poorly controlled diabetes
- Multiple rounds of antibiotics
- Frequent finding of granulation tissue
- Frequent cultures of pseudomonas

PYOCYANEOUS OSTEOMYELITIS OF THE TEMPORAL BONE, MANDIBLE AND ZYGOMA.*†

Philip E. Meltzer, M.D.,
and
George Kelemen, M.D.,
Boston, Mass.
Continued...

- Multiple surgical debridements - mastoidectomies
- Many rounds of antibiotics
- Granulation tissue on dura
- Infratemporal fossa abscess - drained
- Jugular-foramen syndrome
  - Paralysis of right vocal cord, right palate and right paryngeal wall
- Ostemyelitis of zygomatic bone
Continued...

- Osteomyelitis of mandible
- Many cranial nerves out
- Internal jugular thrombosis
“Definitive” surgery

- Ligated external carotid
- Parotidectomy
- Removal of hemi-mandible, zygomatic arch and bone
- EAC walls removed
- Entered petrous apex- drained abscess
- Pain was relieved
One month later

- Wound looked great
- Carotid blow-out
- Death
Chandler

- 1968
- Advocated radical surgical debridement of the ear and adnexal structures
- External otitis thought to be “painful” and “annoying”
- Named malignant otitis externa
Chandler’s 13

- Average age 73
- 12 had diabetes
- All cultured pseudomonas
- All had surgical debridement
- 6 had facial nerve paralysis
  - 4/6 died
- 6 died
Quiz

- What is the single-most important medical advancement that has improved prognosis for NEO?

- Anti-\textit{Pseudomonal} antibiotics (fluoroquinolones)
Causative organisms

- **Pseudomonas**
  - *P. mirabilis*
  - *Aspergillus fumigatus*
  - *Proteus*
  - *Klebsiella*
  - *Staphylococcus*
  - Fungal species (HIV patients)

http://www.bioquell.com/technology/microbiology/multidrug-resistant-pseudomonas-aeruginosa/
Progression - pathways

- Begins in EAC
- Anteriorly through fissures of Santorini
  - Two horizontal fissures
  - Increase flexibility of EAC

- Posteroinferiorly through the stylomastoid foramen to the jugular bulb and skull base
- Through thrombosed veins
- Along the route of the facial nerve toward the petrous apex and skull base
Natural History

- Relentless progression to involve cranial nerves (involvement in 1979)
  - CN VII 75%
  - CN X 70%
  - CN XI 56%
- In 2003, CN VII reported to be involved in at least 25% with lesser involvement of X and XI


Continued progression

- Severe unremitting pain
- Extension of infection
  - mastoid
  - parotid
  - lower cranial nerves
  - Transverse and sigmoid sinuses
  - Skull base
    - Meningitis, brain abscess, death
### Staging

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>Infection of ear canal and contiguous soft tissue with deep pain with or without facial paralysis *some staging systems increase stage if facial paralysis</td>
</tr>
<tr>
<td>Stage II</td>
<td>Extension of the above infection to include osteitis of the skull base or multiple cranial neuropathy</td>
</tr>
<tr>
<td>Stage III</td>
<td>Further extension intracranially: meningitis, epidural empyema, subdural empyema, or brain abscess</td>
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</table>

Diagnosis- 4 historical features

- No pathognomonic criteria
- Persistent otalgia for >1 month
- Persistent purulent otorrhea with granulation tissue for several weeks
- Immunocompromise
- Cranial nerve involvement
Aural irrigation

- Possibly 60% of cases preceded by aural irrigation
- Pseudomonas often in tap water
- Can survive and grow even in distilled water
- Case report in literature of non-diabetic, non-immunocompromised man who underwent irrigation, developed NEO


Aural trauma

- Israel study regarding handedness and laterality of NEO
- May relate to vigorousness of scratching and cleansing the ear

<table>
<thead>
<tr>
<th></th>
<th>Right Ear</th>
<th>Left Ear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right-handed</td>
<td>24 (70.6%)</td>
<td>10 (29.4%)</td>
</tr>
<tr>
<td>Left-handed</td>
<td>0</td>
<td>4 (100%)</td>
</tr>
</tbody>
</table>

Physical Exam

- Granulation tissue inferior aspect of canal which may obscure TM
- Canal skin erythematous, indurated, sometimes macerated
- Purulent secretions
- Cranial nerve nerve neuropathy
Lab abnormalities

- Not significantly elevated WBC
- Usually elevated ESR, CRP
- ESR can be used to monitor treatment response
CT scan findings

- Erosion of anterior canal wall
- Involvement of TMJ
- Erosion of tympanic ring and base of skull
- Soft tissue thickening
- Mastoid clouding
- Effacement of tympanic ring
MRI with contrast

- Define the medial extent of soft tissue disease at the skull base
- Dural enhancement
- Involvement of medullary bone spaces
- Excellent visualization of cerebral involvement
- Assess patency of dural sinuses and great vessels of the neck
- Changes on MRI do NOT resolve with clinical improvement
Technetium-99m

- Scan 4-24 hours post-injection
- Very high sensitivity - most sensitive indicator for T-bone osteomyelitis
- Osteoblastic activity 10% above normal will yield a positive scan
- Positive in acute and chronic osteomyelitis and in trauma
- Remains positive for many months

Gallium-67

- Complementary to Tech-99 (order both)
- Ga-67 incorporated into proteins and PMN’s at sites of active infection
- Will highlight an acute infective focus
- Will not show full extent of osteomyelitis
- Scan will revert to normal as treatment progresses
Experience is key

- Pre-treatment, 3 weeks in, 4 months later (complete resolution)

Indium-111

- Labels leukocytes
- May replace Tech-99 and Ga-67
Aural toilet

- Frequent, regular debridement of ear with otomicroscopy
- Anti-pseudomonal otic drops
Cultures

- Essential to diagnosis
- Either swab or tissue cultures of EAC
- Must biopsy granulation tissue to r/o carcinoma
Antibiotic selection

- Pseudomonas
- 6 weeks
- Synergy of antipseudomonal and aminoglycoside - use 2 antibiotics
- Ciprofloxacin
- Ticarcillin or Piperacillin
- Gentamicin or tobramycin
- Consult infectious disease
Oral vs. IV

- Usually oral fluoroquinolones have high tissue levels
- Poor microvasculature have lower tissue concentrations with oral and may need IV
- Pt. should be admitted to hospital – use IV
Improvement of pain an early indicator of success in treatment

Regardless, antibiotics should be continued for 6 weeks at least

Diabetes must be brought under control
Adjunctive management

- Aggressive management of diabetes
  - Consider endocrine and nutrition consults
- HIV testing
- Consider further immune deficiency work-up if no obvious source of immunocompromise
Pediatrics

- Rare in peds
- More toxic, fever, leukocytosis, no mortality reported
- Facial nerve paralysis more frequent and rapid, often complete and permanent
- Cipro has some resistance
- Arthropathy in weight-bearing joints
- Cipro should be second-line
Surgical debridement

- Usually reserved if not responding to medical therapy
- Progression of pain
- Persistence of granulations
- Cranial nerve involvement
- Abscess
Surgical debridement

- Excise granulations
- +/- middle ear exploration
- +/- Mastoidectomy
- +/- Facial nerve decompression
- +/- Temporal bone resection if no response
Facial nerve involvement

- Often treated with early surgical removal of granulations
- Decompression of facial nerve
  - Some use ENOG and decompress when >90% electrical degeneration
Increase therapy

- If progression, involvement of more cranial nerves, meningitis, or brain abscess, must increase therapy
- Change antibiotic
- Increase level of aural toilet
- Consider surgery
Hyperbaric Oxygen - hypothesis

- Diabetic microangiopathy leads to local tissue hypoperfusion and hypoxia
- Infection causes wound hypoxia
- Increasing oxygen tension improves phagocyte function
- May cause capillary angiogenesis
Hyperbaric Oxygen Treatment

- Cochrane review 2013
- No randomized controlled trials
- No evidence to present
- Encouraged research

Cochrane-acknowledged studies

- Four case reports and five case series
- 73 patients
- Usually 20-40 doses, 90 minutes at 2.5 atmospheres absolute

http://animalemergency.net/hbot.php
Texas series- 1992

- 22 patients underwent HBO in addition to other treatments
  - Debridements
  - Mastoidectomy
  - Antibiotics
  - All different stages
  - Some previously treated
- All recovered with no recurrence
- Better results than historical controls

Prognosis

- Overall mortality 37% prior to treatment with carbenicillin and gentamicin, decreased to 23%
- 60% mortality if multiple cranial neuropathies
Singapore series

- Published June 2013 White Journal
- Most recent series
- Retrospective case series
- 19 cases 2006-2011
  - 16 men, 3 women
  - Mean age 69.1
- All admitted for IV antibiotics
- IV ceftazidime and oral fluoroquinolone

Resolution of disease

- 12 cases resolved after 6 weeks of abx
- 7 cases persistent after 6 weeks
  - 3 died of intracranial complications
  - 1 died of intracranial hemorrhage secondary to ceftazidime-induced thrombocytopenia
Comorbidities

- 18 had diabetes
- 1 on long-term steroids for RA
- 12 had ischemic heart disease
- 3 had PVD
- 5 ESRD
- 10 had HbA1c > 7.0%
Clinical presentation

- Otalgia and otorrhea (n=14)
- Parotid swelling (n=2)
- CN VII dysfunction (n=4)
- 6.79 weeks mean duration of symptoms (range 1-12 weeks)
Inflammatory markers

- Only 5 had elevated WBC
- 13 elevated CRP
- 16 elevated ESR
Table 1. Inflammatory marker level comparison between disease progression and disease resolution groups.

<table>
<thead>
<tr>
<th></th>
<th>Disease Resolved</th>
<th>Disease Progressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>At diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWC, mean, $\times 10^9$/L</td>
<td>8.81</td>
<td>12.02</td>
</tr>
<tr>
<td>CRP, mean, mg/L</td>
<td>41.60</td>
<td>34.00</td>
</tr>
<tr>
<td>ESR, mean, mm/h</td>
<td>58.11</td>
<td>75.00</td>
</tr>
<tr>
<td>2 weeks after antibiotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWC, mean, $\times 10^9$/L</td>
<td>7.68</td>
<td>9.14</td>
</tr>
<tr>
<td>CRP, mean, mg/L</td>
<td>13.80</td>
<td>29.57</td>
</tr>
<tr>
<td>ESR, mean, mm/h</td>
<td>51.20</td>
<td>58.71</td>
</tr>
<tr>
<td>6 weeks after antibiotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWC, mean, $\times 10^9$/L</td>
<td>7.09</td>
<td>10.72</td>
</tr>
<tr>
<td>CRP, mean, mg/L</td>
<td>17.89</td>
<td>27.00</td>
</tr>
<tr>
<td>ESR, mean, mm/h</td>
<td>49.00</td>
<td>74.67</td>
</tr>
</tbody>
</table>

Abbreviations: CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; TWC, total white cell count.
Positive culture (n=12)

- *Pseudomonas aeruginosa* (n=9)
  - Pan-sensitive 66.7%
  - Multi-drug resistant 33.3%

- *Klebsiella pneumoniae* (n=1)

- Contaminants (n=2)
<table>
<thead>
<tr>
<th>Findings</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor findings</td>
<td></td>
</tr>
<tr>
<td>EAC tissue swelling</td>
<td>16 (94.1)</td>
</tr>
<tr>
<td>EAC bony erosion</td>
<td>15 (88.2)</td>
</tr>
<tr>
<td>Mastoid involvement</td>
<td>16 (94.1)</td>
</tr>
<tr>
<td>Major findings</td>
<td></td>
</tr>
<tr>
<td>Infratemporal fossa</td>
<td>4 (23.5)</td>
</tr>
<tr>
<td>Temporomandibular joint</td>
<td>4 (23.5)</td>
</tr>
<tr>
<td>Parapharyngeal involvement</td>
<td>3 (17.6)</td>
</tr>
<tr>
<td>Nasopharyngeal involvement</td>
<td>1 (5.9)</td>
</tr>
</tbody>
</table>
Imaging findings

- CT imaging findings did not correlate with disease resolution
10 had MRI to delineate soft tissue involvement

- Masticator space - 5pts
- Condylar bone marrow - 3pts
- Parapharyngeal space – 4pts
- Nasopharynx - 6pts
- Clivus -5pts
- Dural enhancement – 4pts
Clival Involvement

- 5 pts
- All had persistent disease > 6 weeks
- 3/5 patients who died had Clival involvement
Selected References