CSF Leaks

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Grand Rounds Presentation
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CSF Leaks

- Abnormal communication between the subarachnoid space and the tympanomastoid space or nasal cavity.

- Presenting symptoms:
  - Middle ear effusion, hearing loss
  - Unilateral rhinorrhea

- Risk of meningitis is high
  - 2-88%
CSF Rhinorrhea

- Diverse etiology
  - Idiopathic
  - Trauma-Surgical
    - <1%
  - Trauma-Nonsurgical
    - 3% of all closed head injuries
    - 30% of skull base fractures
      - Frontal > Ethmoids > Sphenoids
  - Inflammatory
  - Congenital
  - Neoplasm
Testing of Nasal Secretions

- Beta-2-transferrin is highly sensitive and specific
  - 1/50th of a drop
- Electronic nose has shown early success
Imaging

- High resolution CT
- CT Cisternography
- MRI
  - Heavily weighted T2
  - Slow flow MRI
  - MRI cisternography
- Radionuclide cisternography
- Intrathecal flourescin
Imaging

- HRCT
  - Volume averaging
  - Congenital dehiscences of Spenoid/cribiform niche.
Imaging

- **CT cisternography**
  - Currently the optimal imaging modality (85% sensitive)
  - Intrathecal administration of iodine, prone 6hrs
  - 0% for inactive leaks
  - Substantial radiation exposure
  - ?neurotoxic potential
Imaging

- MRI cisternography
  - heavily weighted T2
- Intrathecal gadolinium
Imaging

- Slow flow MRI
- Diffusion weighted MRI
- Fluid motion down to 0.5mm/sec
- Ex. MRA/MRV
Imaging

- Radioisotope cisternography
  - Intrathecal administration of technitium 99m
  - Less spatial resolution and specificity
  - Largely abandoned due to false positive and false negative results
Intrathecal Flourescin

- 0.1ml of 10% flourescin solution mixed in 10cc of CSF
- Blue light may enhance the flourescin
- Complications are low
Treatment of CSF Rhinorrhea

- **Conservative measures**
  - Bed rest/Elev HOB>30
  - Stool softeners
  - No sneezing/coughing
  - +/- lumbar drains

- **Early failures**
  - Assoc with hydrocephalus
  - Recurrent or persistent leaks
Treatment of CSF Rhinorrhea

- Prophylactic antibiotics:
  - Two conflicting meta-analysis regarding basilar skull fractures.
  - Proponents argue less meningitis.
  - Opponents argue organism resistance.
Surgical Options

- Intracranial
  - Direct visualization
  - Success rates 50-73%
  - Significant morbidity
    - Anosmia
    - Cerebral edema
    - Seizures
Surgical Options

- Extracranial approach
  - Improved success rates (80%)
  - Significant morbidity
  - Frontal osteoplastic flap/infratemporal approach
Endoscopic repair

- Endoscopic intranasal repair
  - Overall success rates:
    - 90% 1st attempt
    - 52-67% for 2nd attempt
    - Overall 97%
  - Complications:
    - Meningitis (0.3%)
    - Brain abscess (0.9%)
    - Subdural hematoma (0.3%)
    - Headache (0.3%)
Endoscopic techniques

325-4B
Mucosa stripped from turbinate and defect

325-4C
Middle turbinate rotated to cover the defect

Complete ethmoidectomy

CSF leak
Overlay vs Underlay technique

- Meta-analysis showed that both techniques have similar success rates
- Onlay: adjacent structures at risk, or if the underlay is not possible
Surgical Techniques

- Use gelfoam and gelfilm (>90%)
- Use nasal packing (100%)
- Consider fibrin glue (>50%)
- Consider lumbar drain for idiopathic/posttraumatic assoc with increased ICP
  - 3-5 days
  - Not required
- BR, stool softeners, antibiotics
CSF Otorrhea

- **Acquired**
  - Postoperative (58%)
  - Trauma (32%)
  - Nontraumatic (11%)

- **Spontaneous**
  - Bony defect theory
  - Arachnoid granulation theory
Temporal bone fractures

- Longitudinal
  - 70%
  - Anterior to otic capsule
  - 15-20% facial nerve involvement
Temporal bone fractures

- Transverse
  - 20%
  - High rate of SNHL
  - 50% facial nerve involvement
Temporal bone fractures

- HRCT will demonstrate the fracture line and the likely site of CSF leak.
- Beta-2-transferrin

**Treatment**
- Bedrest
- Elev HOB
- Stool softeners
- +/- lumbar drain
Temporal bone fractures

- Brodie and Thompson et al.
- 820 T-bone fractures/122 CSF leaks
- Spontaneous resolution
  - 95/122: within 7 days
  - 21/122: between 7-14 days
  - 5/122: Persisted beyond 2 weeks
Temporal bone fractures

- Meningitis
  - 9/121 (7%) developed meningitis.

- A later meta-analysis by the same author did reveal a statistically significant reduction in the incidence of meningitis with the use of prophylactic antibiotics.
Pediatric temporal bone fractures

- Much lower incidence (10:1, adult:pedi)
  - Undeveloped sinuses, skull flexibility
- Otorrhea >> rhinorrhea
- Prophylactic antibiotics did not influence the development of meningitis.
Spontaneous CSF otorrhea

- **Congenital Defect Theory:**
  1) enlarged petrosal fallopian canal
  2) patent tympanomeningeal (Hyrtl’s) fissure
  3) Communicaiton of the IAC with the vestibule (Mondini’s dysplasia)-most common

- **Childhood presentation**
  82% SNHL
  93% Meningitis
  83% Mondini Dysplasia
Congenital bony defect
Spontaneous CSF otorrhea

Arachnoid granulation theory
- Enlargement of arachnoid villi due to congenital entrapments/pressure variations

Presentation
- Unilateral serous otitis media
- Meningitis (36%)
- No SNHL or Mondini dysplasia
- Sites are multiple, floor of the middle fossa most common
Arachnoid Granulation
Spontaneous CSF otorrhea

- Stone et al.

- HRCT vs. CT cisternography/radionuclide cisternography.
  - HRCT showed bony defects in 71%.
  - 100% intraoperative findings correlated with HRCT.
  - HRCT significantly identified more patients with CSF leak than radionuclide cisternography or CT cisternography.
Surgical approaches

- Transmastoid
  - Not ideal for large defects (>2cm), multiple defects, or defects that extend anteriorly

- Middle cranial fossa
  - Technically challenging
  - Best exposure

- Combined approach
Technique of closure

- Muscle, fascia, fat, bone wax, etc..

- The success rate is significantly higher for those patients who undergo primary closure with a multi-layer technique versus those patients who only get single-layer closure.

- Refractory cases may require closure of the EAC and obliteration.
Conclusions

- The clinical presentations of CSF leaks may be very subtle.
- The clinician must keep a low threshold for further testing with Beta-2-Transferrin.
- Imaging studies should be performed to anatomically localize the site.
- Success rates may be over 90% with proper patient and surgical selection.