Chronic Otorrhea and Otitis Media Isn’t Always What It Appears: Skull Base Defects

Department of Otolaryngology Head and Neck Surgery
Medical University of South Carolina
Ted Meyer, MD, PhD
Mary Ann Howerton, PAC

Learning Objectives
1. Describe the presentation of patients with skull base defects, with emphasis on temporal bone defects.
2. Discuss the etiologies of skull base defects.
3. Describe surgical repair of skull base defects.
4. Discuss nursing implications and post-op care of patients with skull base surgery.
5. Participate in an interactive discussion on the care of the patients with skull base defects.

CSF Otorrhea

- Definition
  - Presence of CSF within the confines of the temporal bone
- Causes
  - Trauma (most common)
  - Iatrogenic
  - Neoplastic
  - Infectious
  - Congenital
  - Spontaneous
- Spontaneous CSF otorrhea occurs in the absence of any inciting event

Anatomy

- External ear
  - Pinna
  - External auditory canal
- Middle ear
  - Ossicles
- Inner ear
  - Cochlea
  - Vestibule
  - Semicircular canals

Anatomy – Axial CT

From studyblue.com

From Frank Netter

From radiographics.rsna.org
Anatomy – Coronal CT

Pathophysiology

- Not well understood
- Theories
  1. Congenital bony dehiscence in the mastoid tegmen may predispose to dural herniation and CSF leakage
  2. Arachnoid granulations
     - Acts as reservoir for CSF
     - Site of pressure transmission to underlying bone
     - Erosion of bone

Pathophysiology

3. Central venous obstruction impairing normal pressure
   - High intracranial CSF pressures cause gradual skull base attenuation over time
   - Sigmoid or transverse sinus thromboses
   - Hypercompliant venous sinuses

4. Anatomical Predisposition involving thinning of cranial base
   - Congenital
   - Arachnoid Granulation
   - Chronic Idiopathic Intracranial Hypertension
   - Obesity

Pathophysiology - Obesity

- Obesity defined as BMI ≥ 30kg/m²
- Associated with other co-morbidities
  - Hypertension, diabetes, OSA, etc
  - Increased intra-abdominal pressure
  - Decreased venous return
  - Increased intracranial pressure

Pathophysiology - Obesity

- Levay, A., Kveton, J. Retrospective review looking at relationship between obesity, OSA, and spontaneous CSF otorrhea
  - 29 patients with CSF otorrhea
    - 14 spontaneous; 14 non-spontaneous
    - Avg BMI 35.3 spontaneous; 28.5 non-spontaneous
    - Patients with spontaneous otorrhea were more likely to be morbidly obese than non-spontaneous otorrhea patients
    - Diagnosis of OSA was more common in spontaneous (4) than non-spontaneous (0)

Pathophysiology - Obesity

- Scurry, W.C., et al. performed a retrospective review to determine location, nature, and etiology of encephaloceles
  - 8 patients were found to have spontaneous, idiopathic temporal bone encephaloceles, all of which BMI was > 30
  - Avg BMI 48.6 kg/m²
Pathophysiology - Obesity

Conclusion:
- Morbid obesity leads to Benign intracranial hypertension
- Correlation exists between morbid obesity and temporal bone encephaloceles/CSF otorrhea
- Explanation: High intracranial pressures secondary to morbid obesity lead to chronic trauma to skull base causing bony dehiscence → CSF otorrhea and encephalocele

Demographics

- Female
- Middle-aged
- Obese
- Idiopathic Intracranial Hypertension?

Literature Review

- Goddard J., Meyer T., Nguyen S., Lambert P.
- Retrospective review
- Patients with spontaneous CSF otorrhea that underwent primary surgical repair between 2000 and 2009
- Demographic information including age, sex, race, height, weight and BMI were recorded
- Hypothesis: Spontaneous CSF otorrhea is more common in middle aged, female patients with BMI > 30

Results
- 23 patients
  - 10 men, 13 women
  - 14 Caucasian, 9 AA
  - Mean age 60
  - Mean weight 103.7 kg
  - Mean BMI 36.3
- Males – mean BMI 36.0
- Females – mean BMI 36.5

Similar demographic profile to CSF rhinorrhea and Idiopathic Intracranial Hypertension
- This study and previous studies have demonstrated similar demographic features

Idiopathic Intracranial Hypertension

Benign IH (BIH)

- Impaired CSF absorption causing elevated intracranial pressure
- Obese, middle-aged females (most common)
- Headaches, pulsatile tinnitus, papilledema, visual disturbances
- Dandy Criteria is used to formally diagnose
- Radiographic imaging demonstrates empty or partially empty sella

Dandy Criteria

- Original criteria described by Dandy in 1937
- It was then modified by Smith in 1985

Modified Dandy Criteria
1) Signs and symptoms increased pressure
2) Increased ICP
3) Absence of localising findings on neurologic exam
4) Absence of neuroradiographic abnormality (exceptions small ventricles and empty sella)
5) Awake and alert
6) No other cause of ICP
IIH and Empty Sella

- Common radiographic finding in IIH and CSF leaks
- Empty sella = empty pituitary fossa
- Pituitary fossa which is largely empty of tissue and replaced by CSF

Idiopathic Intracranial Hypertension

- Research
  - Goddard, et al. – 12 of 15 with preoperative MRI demonstrated empty or partially empty sella
  - Former studies
    - Pritchard et al. – 5 of 7 patients with spontaneous CSF otorrhea demonstrated findings of an empty or partially empty sella
    - Schlosser and Bolger noted that nearly all patients with CSF rhinorrhea demonstrated empty sella on MRI and 72% met Dandy criteria for IIH
  - Previous studies and reports do seem to suggest the presence of empty/partially empty sella more common in patients with spontaneous CSF leak

Clinical Presentation CSF Otorrhea

- Unilateral hearing loss
- Unilateral chronic serous otitis media
- Aural fullness
- Persistent otorrhea with tube placement
- Meningitis

Physical Exam

- Otoscopy
- Tuning Forks suggesting conductive hearing loss
- Evaluate Nasopharynx for mass or reason for unilateral symptoms
- Myringotomy – yes or no?

Audiological Testing

- Audiometry
  - Unilateral conductive hearing loss
  - Flat tympanogram

From Pritchard, et al.

From Goddard, et al.

From Schlosser and Bolger

From sciencedirect.com
Laboratory Testing

- Beta-2 Transferrin
  - Most common laboratory test used to diagnose CSF leak in US
  - Only found in CSF, perilymph, and vitreous humor of the eye

Imaging

- High resolution CT is the initial radiographic test of choice
- MRI is a useful adjunct
  - Effective in identifying meningoencephalocele formation
  - Effective in recognizing empty sella
- CT/MRI cisternogram - Cisternography with injected contrast medium usually localizes the CSF leak

High Resolution Axial CT

- Tegmen – roof
- Should be solid bone
- Ratty, moth-eaten appearance ....
- Arachnoid granulations, CSF alone, meningocele, encephalocele, meningoencephalocele

High Resolution Coronal CT

- Normal
- CSF Otorrhea
Preop

- Most patients are obese, many with other co-morbidities – HTN, DM, aspirin, coumadin, ....
- Preop workup
  - Chest xray, EKG
  - CBC, BMP
  - PT/INR, PTT
- Often require medical clearance from PCP, cardiologist, etc

Treatment

- Treatment is surgical
  - Trans-mastoid approach
  - Middle cranial fossa approach
  - Combination
- The age of the patient, medical comorbidities, defect location, history of previous repair, and surgeon experience are all factors to consider
- Materials used to repair defect include temporalis fascia, calvarial bone, bone cement
Trans-mastoid Surgical Approach

- **Trans-mastoid**
  - Defects involving posterior fossa and tegmen mastoideum
  - **PRO**
    - Least invasive – ear surgery, not brain surgery
    - Advantage of visualization of middle fossa, posterior fossa, and middle ear
    - Fewer risks of bleeding, stroke, ...
  - **CON**
    - Get as good a seal?
    - Recurrence rate?
    - What if it bleeds – can it be controlled?

Middle Fossa Surgical Approach

- **Middle Fossa**
  - Defects involving tegmen mastoideum and tegmen tympani
  - **PRO**
    - Fixing leak from inside cranial vault – might see defect better
    - Maximum exposure
  - **CON**
    - More invasive - Brain surgery rather than ear surgery
    - Leave inflammation or other tissue behind
    - If brain is sitting on heads of ossicles – still have CHL
**Lumbar Drain??**
- Yes or no? – No for us
- PRO
  - Provides means to measure ICP
  - Provides ability to inject intrathecal fluorescein
  - Reduces CSF pressure post-operatively
- CON
  - Fluorescein is not FDA approved for intra-thecal injection
  - Risk of seizure and neurotoxicity with high concentration or rapid injection
  - Must remain bed rest until drain removed – longer hospital stay
  - Risks: bleeding, infection, nerve irritation, paralysis, post-spinal headaches, and pneumocephalus

**Acetazolamide?**
- Carbonic anhydrase inhibitor
- Decreases CSF production
- Diuretic often given in management of IIH
- May be important in patients with IIH who have undergone surgical repair for spontaneous CSF otorrhea

**Post-operative Course**
- Inpatient – billing purposes – might not collect anything if done outpatient
- Often NPO overnight
- Ambulate....tough with obese population
- Foley?
- Steroids?
- Mannitol?

**Post-operative Course**
- Expected phone calls – Questions to ask
- Severe headache?
- Spiking fevers?
- Altered mental status?
- Copious amounts of drainage?

**Complications – Short Term**
- Intracranial bleeding
- Cerebral Edema
- Hydrocephalus
- Meningitis
- Stroke
- Hearing loss
- Changes in taste
- Facial paralysis
- Wind, Water, Wound, Walk

**Complications – Long Term**
- Recurrence
- Meningitis
- Pulmonary Embolism
- Conductive hearing loss
Complications of Morbid Obesity

- Diabetes
- Hypertension
- Hypercholesterolemia
- Metabolic Syndrome
- Stroke
- Sleep apnea

Questions?

References