CSF Rhinorrhea: In Office and Radiologic Evaluation and Minimally Invasive Repair

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No Financial Relationships to Disclose
How to Find a Hole and Fix a Leak
CSF Basics

- 50-80%: choroid plexus
- ~30%: ependymal surface

Consistency:
- Ions - Na⁺, K⁺, Mg²⁺, Ca²⁺, Cl⁻, HCO₃⁻
- Glucose (60-80% of blood glucose)
- Water
- Amino acids and proteins

Normal pressure: 5-15 cmH₂O + varies
- ~90-150 mL of CSF at any one time
  - 20 mL/hr
  - 500 mL/day
Anterior Fossa

- Cribiform plate
- Lamella lateralis
- Ethmoid roof
- Frontal sinus
- Sphenoid
History/ Etiology

• Traumatic
  – Accidental
  – Surgical/iatrogenic

• Tumor

• Spontaneous
  – Elevated ICP (OSA)
  – Congenital defect
History

- Spontaneous
- Trauma
- Surgical History
- Weight Gain/Loss
- Sleep Apnea
History and Physical

• Symptoms
  – Headache
  – Post nasal drip with a salty/metallic taste
  – Anosmia
  – Nasal congestion

• Physical Exam
  – Head and neck exam
  – Obesity
  – Nasal endoscopy
  – Smell Identification Test
  – Stress Leak Test
Diagnostic Clues

- Halo sign
- Glucose testing
- CT
- MRI
- Radionuclide imaging
- Intrathecal dye
Halo Sign

- Not specific to bloody CSF
  - Blood mixed with water, saline, and other mucus will also produce a ring sign
  - Absence of a halo sign does not exclude a cerebrospinal fluid leak.
Glucose Testing

• may suspect CSF leak with a glucose concentration > 30mg/dL

• Negative glucose eliminates CSF fluid

• False findings
  ○ Presence of blood, lacrimal secretions or nasal mucus -> Increased glucose readings
  ○ Meningitis -> Lower concentration in CSF (false negative)
Beta 2 Transferrin

- Gold Standard
- csf, perilymph, and aqueous humor
- 88% specif.
- Test:
  - >0.5ml
  - Refrigeration
  - Electrophoresis (3h)

High Resolution CT

- Dehiscences
- Should have 1mm cuts with axial, sagittal and coronal views
- CT Navigation
- Most accurate when correlated to intra-op findings
MRI (Cisternography)

- Soft tissue abnormalities and pooling of CSF
  - (CSF has high signal intensity on T2 images)
- No need for contrast:
  - Can differentiate sinus inflammation from CSF fluid
- Sensitivity, Specificity, and Accuracy –
  - 0.87, 0.57, and 0.78,
CT Cisternography

• Accurate with active leaks
• Minimal side effects (headache, nausea)
• Neurotoxic potential
• Sensitivity for detecting leaks drops from nearly 100% with active leaks to 60% with intermittent leaks
CT Cisternography

• Intrathecal injection of radioactive tracers (technetium-99, I-131, Indium 111)
• Requires an active leak
  – With active leaks detection rate is 70%
  – Inactive leak - 30-40% detection rate Poor localization
• Radioactive isotope is absorbed into the circulation
CT Cisternogram
Intrathecal Fluorescein Dye

• Intra-operative: active CSF leaks
• 0.1ml of 10% fluorescein solution mixed in 10cc of CSF
• No FDA approval
• Side effects
Classification

• Etiology

• Location

• Size of defect
Management

• Conservative vs Surgical
• 80% of traumatic leaks will resolve with conservative management
• Spontaneous and iatrogenic leaks will require surgical treatment
Conservative Therapy

• Bed Rest x 7 days
• Diuretics:
  – Utilized with increased ICP
  – Acetazolamide
• Lumbar Drain
  – Consider after 5-7 days of conservative management
  – 10-15cc/hr to prevent side effects
Antibiotics

• Controversial
• Meningitis prevention
• Selection of more virulent bacteria
• Resistance
Surgical Indications

• Any confirmed leak
• Risk of meningitis
• Symptomatic relief
Endoscopic Reconstructive Ladder

- Free graft
  - Autograft/Allograft
- Pedicled Flap
- Microvascular
- Free Tissue Transfer
Endoscopic vs Open CSF Leak Repair

• Meta-analysis 2012
  – Open vs Endoscopic treatment
  – Equal success rates – approx 90%
    • Encephalocele, Meningocele
  – Lower complication Rate
    • Meningitis
    • Wound infection
    • Sepsis
    • Mortality
Endoscopic Repair

– Good visualization and exposure
– No incisions
– Cauterize encephalocele stalk prior to reduction - prevents intracranial hemorrhage
– 2-5mm of bone should be exposed around the defect
– Grafts - 30% larger than the defect to account for shrinkage
Factors in Endoscopic Reconstruction

• Location of Defect- i.e. ant fossa, sella, etc...
• Size of Defect
• CSF leak – High vs Low flow
• Radiation/Infection/ORN
• Exposed Neurovascular structures
• Pathology
Endoscopic Repair

• Small leak/low flow
  • < 2mm – Almost any grafting technique is successful
  • < 1cm - free graft –
    • 90% success rate 1°
    • 97% secondary
• Larger Defects/High Flow Leaks -
  • Multi-layered closure
  • Free Grafts vs. Pedicled Flaps
Image-Guidance
Free Graft Material

- Autograft/Allograft
  - Cartilage
  - Bone
  - Septal mucosa
  - Turbinate
  - Fascia
  - Abdominal fat
  - Alloderm
Endoscopic Repair
Pedicled Vascular Graft

• Advantages
  • Vascularized Tissue
  • Native tissue
  • Easily harvested and mobilized
  • Minimal donor site morbidity
  • Conform to irregular surfaces
  • High success rate
  • Able to revise and reuse
Nasoseptal Flap

• “Workhorse” of Endoscopic Reconstruction
• Pedicled on nasoseptal a. from SPA
• Large pliable surface area
• Used in conjunction with multilayered closure
• May harvest bilaterally
Nasoseptal Flap
Multilayered Repair
Postoperative Management

- Bed rest with HOB elevation
- Stool softeners
- Maintain low BP
- No straining
- Lumbar Drain
- ABX with packing
Conclusions

• CSF leaks overall a rare occurrence
• History and Physical exam
• Imaging is a clue to the leak
• Careful intra operative exploration
• Many techniques for repair
References

• Dula, DJ, MD and Fales, F, MD. The 'Ring Sign': Is It a Reliable Indicator for Cerebral Spinal Fluid? Annals of Emergency Medicine, 1993;22:718-720.