



# ACOI Board Review Course CNS Infections

MarkAlain Déry, DO, MPH, FACOI  
Chief Innovation Officer

Medical Director of HIV and Hepatitis Services

Access Health Louisiana; FQHC

Medical Director AIDS Educational Training Center (AETC)

Medical Director Southern Center for Health Equities

Executive Director;

102.3FM WHIV-LP

Human Rights and Social Justice Radio

[madery@whivfm.org](mailto:madery@whivfm.org)



# Disclosures



**NOTHING:  
THE SCIENCE OF EMPTINESS**



# Objectives

At the conclusion of this section, participants;

- 🚫 By the end of the presentation the attendee will be familiar that the major causes of community-acquired bacterial meningitis in adults in developed countries are *Streptococcus pneumoniae*, *Neisseria meningitidis*, and, primarily in patients over age 50 to 60 years or those who have deficiencies in cell-mediated immunity, *Listeria monocytogenes*.
- 🚫 By the end of the presentation the attendee will recognize that the diagnosis of a patient with aseptic meningitis may be difficult to make, because of the large variety of potential etiologic agents and the overlap between self-limited viral illnesses and potentially fatal bacterial infections.
- 🚫 By the end of the presentation the attendee will know that risk factors for spinal epidural abscesses include epidural catheters, diabetes mellitus, alcoholism, HIV infection, bacteremia, and intravenous drug use.



# CNS Infections; Bacterial Meningitis; Pathogens

## Bacterial Meningitis

### PATHOGENS;

- *S. pneumoniae*
- *N. meningitidis*
- *Listeria monocytogenes*
- For community-acquired bacterial meningitis, *Streptococcus pneumoniae* and *Neisseria meningitidis* are responsible for usually 80% of all adult cases.
- The overall species-specific infection rates (all ages, 1997-2008 data):
  - *Streptococcus pneumoniae* 58%
  - Group B streptococcus 18.1%
  - *Neisseria meningitidis* 13.9%
  - *Haemophilus influenzae* 6.7%
    - Note the incidence of *Haemophilus influenzae* type b meningitis in children has been dramatically reduced with the introduction of the vaccine in 1986; most cases of *H. influenzae* meningitis are secondary to non serotype b organisms or serotype b infections in non-vaccinated children and adults.
  - *Listeria monocytogenes* 3.4%



# CNS Infections; Bacterial Meningitis; Clinical

## CLINICAL;

- Early bacterial meningitis often considered difficult to recognize as symptoms may be non-specific.
- Classic signs of rash, fever, altered mental status, and headache are often later signs and less common in the very young or elderly.
  - Classic triad (fever, neck stiffness, and altered mental status) found in only 44%, but almost all present with at least two of four symptoms: headache, fever, neck stiffness and altered mental status (as defined by a score below 14 on the Glasgow Coma Scale).
- Other symptoms may include photophobia, n/v, irritable states.
- Focal neurological findings may develop: CN III, IV, VI or VII most commonly due to elevated intracranial pressures.



# CNS Infections; Bacterial Meningitis; Clinical

## CLINICAL;

- Pneumococcal or meningococcal infection may cause petechiae or purpura that can become extensive (purpura fulminans).
  - May occur over hours to 1-2 days.
- Signs: Kernig's or Brudzinski's sign (present  $\leq 5\%$ ), nuchal rigidity (30%), jolt accentuation of headache, cranial nerve palsies or other focal neurologic findings, rash (petechial, purpura fulminans), seizures.
  - Brudzinski's sign: patient supine, flex the neck; flexion of the hips and knees is positive Brudzinski's sign.
  - Kernig's sign: patient's leg flexed at knee and hip, straighten knee; discomfort behind the knee with full extension is a positive Kernig's sign.
- Usual sequence for severely ill patients with suspected meningitis: stat empiric antibiotics --> CT if needed ---> LP.
  - CSF normal values:
    - OP: 5 - 15 mm Hg or 65 - 195 mm H<sub>2</sub>O
    - WBC: < 5-10 monos, no polys
    - Protein: 15 - 45mg/dL, may be higher in elderly
    - Glucose: 40 - 80 mg/dL; CSF/blood ratio > 0.6 (with abruptly high serum glucose, usual ratio is 0.3).



# CNS Infections; Bacterial Meningitis; Diagnosis

## DIAGNOSIS

- LP: should perform if safe based on clinical exam or consider CT first if focal neurological findings, papilledema, or severely depressed sensorium or defer if bleeding risks high (coagulopathy, thrombocytopenia) to avoid brain herniation or bleeding risks.
- CSF: typical results OP  $>30\text{cm}$  (nl  $< 17\text{cm}$ ), WBC  $> 500\text{cells/ml}$  with  $> 80\%$  neutrophils, glucose  $< 40\text{mg/dL}$  (or  $< 2/3$  plasma), and protein  $>200\text{mg/dL}$ .
  - CSF: strong predictors of pyogenic meningitis: WBC  $> 2000$  or PMNs  $> 1200$ ; glucose  $< 34$ , protein  $> 220$ .
  - Gram stain and sensitivities of blood and CSF cultures direct later decisions.
  - Adjunctive laboratory studies: blood and CSF cultures, bacterial CSF antigen detection (rarely helpful for adults except partially treated meningitis), CSF PCR (viral causes, e.g., enterovirus, HSV).



# CNS Infections; Bacterial Meningitis; Treatment

## TREATMENT;

- Empiric Treatment: Children and Adults
  - Age 2-50 yrs likely etiologies = *S. pneumoniae* and *N. meningitidis*:
    - Vancomycin plus either ceftriaxone or cefotaxime.
  - Age >50 likely etiologies = *S. pneumoniae*, *L. monocytogenes*, and Gram-negative bacilli:
    - Ampicillin + vancomycin +/- rifampin PO or IV plus either cefotaxime or ceftriaxone.
- Dexamethasone (10mg IV q6h x 4d) recommended 15-20 min. prior to or simultaneously with first abx infusion for suspected pneumococcal meningitis.
  - Continue for 4d but discontinue if not bacterial meningitis (unclear benefit with other bacterial pathogens).





# CNS Infections; Bacterial Meningitis; Prevention

## Prevention:

- Vaccines and Chemoprophylaxis
  - Antibiotic prophylaxis not required for pneumococcal meningitis, but recommended for *N. meningitidis*.
  - Provide ONLY FOR CLOSE CONTACTS (individuals who frequently sleep and eat in the same dwelling with an index case, e.g., family, day care contacts, boyfriend/girlfriend).
    - *N. meningitidis*: prophylaxis for household, daycare and intimate contacts and HCWs with secretion contact (intubation etc):
      - Ciprofloxacin
      - Rifampin
- Vaccines:
  - *Haemophilus influenzae*: Hib conjugate vaccine recommended during infancy and has nearly eliminated this cause of meningitis in children.
  - *Neisseria meningitidis*
  - *Streptococcus pneumoniae*



# CNS Infections; Aseptic Meningitis; Clinical

## Aseptic Meningitis

### PATHOGENS

- Viral: enteroviruses (including Coxsackie, echo, Enterovirus 71), and HSV (primarily Type 2).

### CLINICAL

- Annually diagnosed as reason for >36,000 hospitalizations. Most common reason: viral infections w/ enteroviruses as leading cause (55-90%), seen mostly in summer and fall.
- Clinical: typically fever, headache (often more prominent than in bacterial meningitis), photophobia, nausea/vomiting, rash (depending on etiology), diarrhea, flu-like illness, meningeal signs, lethargy without obtundation, and mental status changes in HSV.
- Other etiologies: drug-induced meningitis (NSAIDs, co-trimoxazole), and malignancy (lymphoma, carcinoma).



# CNS Infections; Aseptic Meningitis; Clinical

## CLINICAL

- Physical Examination: meningismus, cranial nerve palsies, rash (depending on cause), hand-foot-mouth disease (multiple oral ulcers and papulovesicular rash of palms and soles commonly seen with enterovirus), acute flaccid paralysis (WNV, polio), genital herpes (>1/3 of primary genital HSV-2 infections in women are accompanied by meningitis; 11% in men).
- Lab:
  - CSF: 10 to < 1,000 WBC typical, mostly lymphocytes or monocytes (PMNs may be seen early in course)
    - Elevated protein
    - Glucose normal
    - Negative culture and gram stain
    - RBCs; suggestive of HSV.



# CNS Infections; Aseptic Meningitis; Diagnosis/Treatment

## DIAGNOSIS

- Typically CT or MRI should not show any acute brain pathology.
  - Temporal lobe abnormality; HSV.
- Dx studies should include: CSF - WBC, protein, glucose, VDRL, crypt Ag, standard cultures including C&S, PCRs for Enterovirus, HSV.
  - Enterovirus and HSV CSF PCR superior to viral culture.
    - Suspect w/ CSF WBC < 500/ml with lymphocyte pleocytosis, protein < 80.
    - Enteroviral and HSV PCR helpful, if (+) one can shorten abx administration, speed hospital discharge.

## TREATMENT

- Supportive care for most (hydration, electrolyte repletion, pain management).
  - Progressive downhill course argues against most purely viral meningitides (although viral meningoencephalitis can be severe).
- HSV-2 meningitis: may treat for neurologic sx such as urinary retention or weakness; treatment is not necessary if only meningitis presentation without complication.
  - Acyclovir x 10-14d, can likely switch to valacyclovir 1g PO three times a day w/ improvement (experience limited).
  - Recurrent HSV-2 meningitis (formerly called Mollaret's meningitis).



# CNS Infections; Epidural Abscess; Pathogens

## Epidural Abscess

### PATHOGENS;

- *S. aureus* (most common)
- Enterobacteriaceae
- Streptococcal species
- *Pseudomonas aeruginosa*
- *Mycobacterium tuberculosis*
- *Brucella* species
- Post-neurosurgical procedure: *S. aureus*, coagulase-negative staphylococci, Gram-negative bacilli (including *Pseudomonas*), fungi
- 2012-2013: contaminated compounding pharmacy corticosteroid spinal injection
  - Predominantly *Exserohilum* spp.
  - *Aspergillus*
- Immunocompromised host (AIDS, steroids, transplants): *Candida* species, *Cryptococcus neoformans*, *Nocardia* spp., *Mycobacterium tuberculosis* and other mycobacteria (non-tubercular)
- Foreign-born: *M. tuberculosis*



# CNS Infections; Epidural Abscess; Clinical

## CLINICAL

- Organisms causing spinal epidural abscess (SEA) are usually introduced by hematogenous seeding.
- Direct extension of infection from vertebral osteomyelitis/discitis or post-spinal surgical procedure also possible.
  - Risk factors: IDU (top in most series), diabetes, alcoholism, immunosuppression, renal/liver/ cardiac disease.
    - Males > females, age over 50 most common
- Sx: Back pain is most common complaint.
  - Fever (variable)
  - Weakness (up to half of initial presentations)
  - Focal vertebral pain (may be a heralding symptom)
  - Spinal/paraspinal tenderness to percussion
    - Radicular pain or paresthesia along involved nerve roots.
    - With advancing spinal cord compression:
      - Motor weakness
      - Bowel or bladder dysfunction
      - Sensory changes
      - Paralysis (possibly depressed respiratory function if cervical cord involved)
      - Cauda equina syndrome.



# CNS Infections; Epidural Abscess; Clinical

## CLINICAL

- Abrupt loss of motor function: may be due to cord ischemia, from infectious vasculitis or thrombosis of a spinal artery rather than compression.
  - Location: thoracic > lumbar > cervical.
  - Epidural abscesses may extend many levels up and down cord.
  - Extension into paravertebral tissue or into muscle producing iliopsoas abscess (with lumbar involvement) possible.
- Lab:
  - Obtain CBC with differential, ESR/CRP, blood cultures.
  - LP relatively contraindicated if epidural abscess suspected. If performed, may show CSF pleocytosis and elevated CSF protein.
- Differential diagnosis:
  - May be confused with routine back pain, Guillian-Barré, spinal cord tumor/infarction/hematoma, HIV-related vacuolar myelopathy, cervical spondylosis, HTLV-1.
  - Radicular pain may also mimic and cause misdirection: myocardial infarction, cholecystitis, abdominal pain, sciatica.
  - May occasionally be confused with Zoster sine herpeticum, *Borrelia burgdorferi* neuritis.



# CNS Infections; Epidural Abscess; Diagnosis

## DIAGNOSIS

- Suspect in patient complaining of severe back pain AND findings of fever, chills, leukocytosis, elevated ESR or CRP.
- Imaging: radiographic evidence of inflammation in the epidural space (frequently due to or accompanied by discitis or vertebral osteomyelitis). Obtain study as soon as possible if suspecting diagnosis.
  - MRI with contrast (IV gadolinium) test of choice.
    - Always image higher than the general location of pain, e.g., if lumbar pain always include thoracic study.
    - Non-contrast MRI may miss smaller epidural processes.
  - CT myelogram or conventional myelography: perform if patient cannot undergo MRI study.





# CNS Infections; Epidural Abscess; Diagnosis

## DIAGNOSIS

- CT with or without contrast is less sensitive and cannot be counted upon to exclude diagnosis.
- Microbiology: Obtain CT-guided aspiration if surgery not to be performed immediately, not a surgical candidate and/or blood culture information negative.
- In at-risk populations
  - TB: consider PPD or IGRA
  - Culture data:
    - Abscess/disc space: positive in up to 90%.
    - Blood: positive in 60-70%, especially *S. aureus*.
    - Culture for anaerobes, mycobacteria, and fungi when suspected.
    - If patient is stable, may hold empiric abx until cultures obtained.
    - Obtain neurosurgical opinion ASAP if diagnosis suspected.



# CNS Infections; Epidural Abscess; Treatment

## TREATMENT

- Antimicrobial therapy
  - Empiric therapy: cover MRSA and Gram-negative bacteria
    - Preferred:
      - Vancomycin
      - Ceftazidime or cefepime
    - Initial empiric therapy may be guided by concomitant or recent infection elsewhere (e.g., bacteremia/line sepsis, skin/soft tissue infection/decubitus, dental infection, UTI).
      - Adjust regimen based on culture results.
  - Epidural abscesses most commonly require both surgical and medical therapy.
    - Failure rates of medical treatment only ~40-45% in most series.
    - Duration of therapy typically 2-6+ wks IV or until clinical improvement/stability with normal CRP.
    - May be able to convert to oral therapy after 2-4 wks if using equivalent bioavailable agent.
- Surgery or drainage
  - Progressive neurological signs or clinical deterioration should prompt consideration of emergency neurosurgical decompression.
  - Urgent surgical or percutaneous drainage together with IV antibiotics remains the treatment of choice.
  - Drainage must be performed emergently for eligible patients with acute neurological (especially motor) deficit.
  - CT-guided aspiration and/or drainage has been used successfully in absence of neurologic deficits.