MENINGITIS

(Last updated 01/20/2020; Reviewers: Rajyabardhan Pattnaik, MBBS, DA; Bibek Karki, MBBS)

PRESENTING COMPLAINT: Fever, headache, nausea/vomiting, neck stiffness

FINDINGS

- **A** Check airway
- **B** Normal
- **C** Normal
- **D** Variable altered (V,P,U,D)*
- **E** Petechial rash, purpura, seizure, arthritis
- **L_{PC}** ↑WBC
- **U_{PC}** Normal

***V** (verbal), **P (**pain), **U** (unconsciousness), **D** (delirious)

U_{PC} (point of care ultrasound) **L_{PC}** (point of care labs)

OTHER HISTORY

Predisposing factors: recent meningitis exposure, infection (ear or respiratory, endocarditis), travel (endemic), injection drug use, head trauma (otorrhea/ rhinorrhea), HIV/ immunocompromising condition, neurosurgery (with hardware in place such as VP shunts)

Signs and Symptoms: Nuchal rigidity, photophobia, Kernig's sign (Painful extension of the knee when the thigh is flexed at the hip and knee), Brudzinski sign (Flexion of the hips and knees when the neck is flexed), jolt accentuation

DIFFERENTIAL DIAGNOSIS

Viral, fungal or tuberculous meningo-encephalitis, encephalitis, neurosyphilis, Lyme disease, subarachnoid hemorrhage, drug intoxication, non-convulsive seizures, toxin exposure or ingestion

OTHER INVESTIGATIONS

- Lumbar puncture:
    - Turbid, ↑ opening pressure, ↑ cell count (predominately neutrophils), ↑protein, ↓ glucose, positive gram stain, positive culture → Bacterial meningitis.
    - Clear, normal opening pressure, slightly ↑ cell count (Lymphocyte predominance), slightly ↑ protein, normal glucose, negative gram stain, negative culture → Viral meningitis → Viral PCR is done if HSV is of concern.

- Clear, normal to ↑ opening pressure, ↑ cell count, slightly ↑ protein, normal to ↓ glucose count, negative gram stain → Fungal meningitis → If HIV is prevalent then, do cryptococcal antigen testing.
- Clear, ↑ cell count (mononuclear pleocytosis), slightly ↑ protein, ↓ glucose count, positive AFB stain → Tubercular meningitis → Xpert MTB/RIF assay (not in US), CSF ADA (Adenosine deaminase); CSF ADA is the earliest diagnostic marker for tubercular meningitis

- **Imaging:** CT scan of the head: (indicated before lumbar puncture if suspicion for high intracranial pressure or any neurological deficits on exam)
- **Blood culture** (done prior to antibiotics therapy, but do not delay antibiotics for cultures)
- **Lab:** Coagulation profile (INR/PT), ABG, electrolytes, renal function test (BUN, Cr)
- **CSF culture:**

  Community-acquired: *Streptococcus pneumoniae* (gram + cocci), *Neisseria meningitides* (gram – diplococci), *Listeria monocytogenes* (gram + bacilli; immunodeficiency, >50 yr).
  Other: gram – bacilli (*E. Coli, Klebsiella spp, H. influenzae*)
  Healthcare-associated: *Staphylococcus aureus, c*oagulase-negative staphylococci, gram-negative bacilli including *Pseudomonas aeruginosa,* anaerobic agents, *Staphylococcus aureus* and *Pseudomonas aeruginosa* (for recent history of surgery/procedures)

THERAPEUTIC INTERVENTIONS

- **General:** Early empiric IV antibiotics or antiviral or antitubercular drugs. As soon as possible after cultures and before CT (but again, do not delay antibiotics for LP, CT or cultures)
  - Vancomycin + Ceftriaxone (+ Ampicillin if >50 yrs, diabetic or history of alcohol abuse)
  - Vancomycin + Cefepime or Carbapenem (Meropenem/Imipenem): If healthcare-associated/CSF shunt/recent neurosurgery/penetrating trauma
  - Empiric IV Acyclovir (If concern for HSV encephalitis (particularly altered sensorium, seizures))
  - Antitubercular therapy should be initiated without delay (if tubercular meningitis is suspected)
  - For pneumococcal meningitis: Adjunctive IV Dexamethasone 0.15 mg/kg every 6h, started shortly before or while giving first antibiotic dose should be given for 2-3 days only
- **Specific treatment:**

Seizures: Anticonvulsant

Septic shock: Fluid resuscitation, intubation, vasopressors

Coma and increased intracranial pressure: Maintain cerebral perfusion pressure: head of bed elevation, vasopressors, mannitol, and steroids; avoid hyperthermia, hypercapnia and hyperglycemia.

ONGOING TREATMENT

- **Follow up:** Result of CSF analysis → Adjust treatment to gram stain/culture findings.
- **Consult:** Neurology and infectious disease consultation
- **Treatment:** Adjust antibiotic dosing to renal/hepatic functions; Repeat CT/LP if no improvement after 48h of appropriate antimicrobial therapy; Consider ICP monitoring in severe brain edema; Standard ICU monitoring and prophylaxis
- **Prevention:**

  Droplet precautions as per hospital infection control policies

  Early antimicrobial chemoprophylaxis for close contacts for Neisseria (recent prolonged contact with probable oral secretions exposition): Ciprofloxacin or Ceftriaxone

  Consider Pneumococcal vaccines before hospital discharge, (Assess if the patient is asplenic or with functional asplenia)
- **Prognosis:** Inform the family regarding the risk of mortality and late neurologic sequelae

CAUTION:

- Lumbar puncture: Minimize LP delay as soon as possible if prior CT
- Brain herniation risk: CT scan prior to LP (If suspicious history or neurologic examination e.g., coma, new onset seizure, immunocompromised state, papilledema)
- False positive LP: CSF pleocytosis (traumatic LP, seizures), contamination during procedure
- Treatment: Time is of essence, consider beta-lactam allergy, and consider seizures in drug choices.

REFERENCES & ACKNOWLEDGMENT

Acknowledgement*: Benjamin Bonneton, M; Joseph C. Farmer, MD; Govind Pandompatam, MD; Prakhar Vijayvargiya, MBBS; Kelly A. Cawcutt, MD, MS*

- McGill F, Heyderman R, Michael B et al. The UK joint specialist societies guideline on the diagnosis and management of acute meningitis and meningococcal sepsis in immunocompetent adults.*Journal of Infection*. 2016;72(4):405-438. doi:10.1016/j.jinf.2016.01.007.

- Tunkel AR, Hartman BJ, Kaplan SL, et al. Practice guidelines for the management of bacterial meningitis. Clin Infect Dis 2004; 39:1267.
- Hasbun R, Abrahams J, Jekel J, Quagliarello VJ. Computed tomography of the head before lumbar puncture in adults with suspected meningitis. N Engl J Med 2001; 345:1727.
- De Gans J, van de Beek D, European Dexamethasone in Adulthood Bacterial Meningitis Study Investigators. Dexamethasone in adults with bacterial meningitis. N Engl J Med 2002; 347:1549.
- Van de Beek D, de Gans J, Spanjaard L, et al. Clinical features and prognostic factors in adults with bacterial meningitis. N Engl J Med 2004; 351:1849.
- Huy NT, Thao NT, Diep DT, et al. Cerebrospinal fluid lactate concentration to distinguish bacterial from aseptic meningitis: a systemic review and meta-analysis. Crit Care 2010; 14:R240.
- Fitch MT, van de Beek D. Emergency diagnosis and treatment of adult meningitis. Lancet Infect Dis 2007; 7:191.
- Auburtin M, Wolff M, Charpentier J, et al. Detrimental role of delayed antibiotic administration and penicillin-nonsusceptible strains in adult intensive care unit patients with pneumococcal meningitis: the PNEUMOREA prospective multicenter study. Crit Care Med 2006; 34:2758.