

AHD – Meningitis Learner Guide

EBM interleaving prework:

Please complete prior to starting AHD!

300 people got LPs (gold standard) for suspected bacterial meningitis. 100 patients were CSF culture positive for bacterial meningitis. Of these culture- positive patients, 56 did not have the classic triad of fever, neck stiffness, and altered mental status. What is the sensitivity of the classic triad for bacterial meningitis?

Case 1

A 28-year-old man presents with a 2-day history of severe headache localizing to the back of the head. He associates nausea, emesis, and light sensitivity. He recently had an episode of sinusitis. No recent travel as he follows COVID guidelines very closely. He has no past medical/surgical history. He takes ibuprofen PRN, and has been using regularly during the past 24 hours for headache. He has no allergies to medications. He is an industrial engineer. He is sexually active with women only and always uses barrier protection.

VS: 101.8 °F, BP 134/82, HR 95, RR 13, and 98% on RA.

General: Patient appears uncomfortable with headache.

HEENT: Reports photophobia with eye exam. PERRL. EOMI. No papilledema on non-dilated examination. There is mild, bilateral maxillary sinus tenderness.

Lungs: CTAB, normal effort

CV: RRR, normal S1 and S2, no m/r/g

Neuro: AOx4 without confusion. There are no focal findings.

Skin: He has no rashes, oral or genital ulcers.

1. What is on your differential diagnosis?

2. What diagnostics would you obtain? IDSA recommended studies:

3. Does this patient need a head CT before LP?

4. You perform a Lumbar Puncture. What CSF studies would you order for each tube?

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Case 1 continued:

Labs:

\ 14.2 /
8.2 ----- 335
/44 \

Differential shows left shift.

135|102|11 /
----- 110
4.0| 24 |0.8 \

Hepatic panel: normal

CRP: 55mg/L (N: 1-10 mg/L)

Serum glucose: 98 @ 12:00PM

CSF analysis @ 12:00PM

Opening pressure: 2200 mm H₂O (normal: 70-200 mm H₂O)

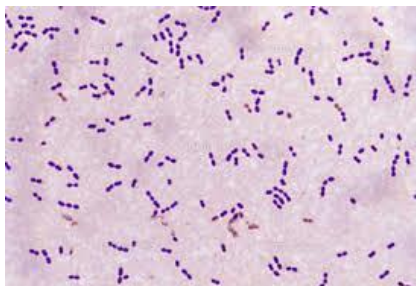
WBC: 1200/ μ L with 60% neutrophils, 40% lymphocytes (N:0-5/ μ L (0-5 \times 10⁶/L))

Glucose: 30 mg/dL (N: 40-80 mg/dL)

Protein: 350 mg/dL (N: 15-60 mg/dL)

Gram stain: see below

Culture: processing



5. What is your assessment of the above labs?

6. What is your initial management? Write the initial admission orders including doses of any medications.

Case 2

65-year-old female with PMHx of HTN and SLE complicated by nephritis presents to the ED with headache, fever, nausea and vomiting for 2 days. She associates lightheadedness, photophobia, and neck pain. She is in a monogamous relationship with a male partner. She is retired but babysits for two school-age grandkids, but neither has been sick. She does not smoke or drink alcohol. Medications include ASA, lisinopril, and cyclophosphamide. She has no allergies to medications.

1. **What is on your differential diagnosis? How would you use your physical exam to support/refute your concerns?**

Case 2 continued.

Physical exam:

Vitals: 100.8°F, BP 125/84, HR 64, RR 18, 99% RA

Gen: Ill appearing but in no acute distress

Neck: Neck stiffness, + Kernig, + Brudzinski (*see figure 2 in appendix*)

CV: RRR, no murmurs

Lungs: CTAB, normal effort

Abd: Scaphoid, soft, nontender

GU: No lesions/rashes

Neuro: CN intact, strength 5/5, sensation intact, DTRs 2+

Skin: Dry skin, no rashes

2. **Initial labs including CBC, BMP, INR, and CRP are all normal. You are concerned about meningitis, what is the next best diagnostic step for this patient?**

3. What therapy will you start?

- 4. The CT Head is negative for recent or remote stroke, hemorrhage, intracranial lesions, or herniation. After multiple attempts by several providers in the ED and on medicine, CSF is unable to be obtained. IR is unavailable currently. Discuss the course of therapy that you would prescribe for this patient.**

Case 3

An 80-year-old woman with history of HTN, DM2, early dementia, and hypothyroidism is hospitalized for a 1-day history of AMS and fever. Her family notes that yesterday she seemed confused and had trouble getting dressed. This morning, she was extremely somnolent, and she was transported to the hospital by ambulance. She takes Lisinopril, metformin, donepezil, and levothyroxine. She has no medication allergies. Per family, she is independent of ADL's but does not manage her finances any longer. She lives with her son and grandchildren but has no sick contacts. She does not drink alcohol, smoke or have risky behaviors.

Physical exam:

VS: 101.2 °F, 118/78, HR 110/min, RR 24/min, and 98% on RA.

Gen: Appears ill. She responds to deep stimulation with a grimace.

Neuro: Oriented to name only, speaking random words. Does not follow commands. She moves all extremities spontaneously, withdraws from pain. Face is symmetric without droop. Opens eyes to pain.

PERRL, no papilledema on non-dilated fundoscopic exam. Unable to flex neck, + Kernig, + Brudzinski (**see figure 2 in appendix**)

Cardiovascular: tachycardic

Pulmonary: CTAB, tachypnea

Abdominal: soft, non-tender, non-distended, BS normoactive

GU: No lesions or rashes

Skin: warm, dry, no rash.

Labs/Diagnostics:

Does she need a CT head? Yes – ask them why before you provide the results (GCS < 10)

CT Head: No intracranial hemorrhage or mass. No lesions identified. Normal ventricular size. Chronic small vessel ischemic changes noted.

CBC: \12.7/
 4.8 ----- 287 with normal differential
 / 37 \

CMP: normal

CRP: 8mg/L (N: 1-10 mg/L)

UA: no WBC, negative nitrite, no protein

Serum glucose: 98 @ 11:00AM

CSF analysis @ 11:00AM

Opening pressure: 80 mm H₂O (normal: 70-200 mm H₂O)

WBC: 11/μL with 60% lymphocytes, 40% neutrophils (N:0-5/μL (0-5× 10⁶/L))

Glucose: 66 mg/dL (N: 40-80 mg/dL)

Protein: 76 mg/dL (N: 15-60 mg/dL)

Gram stain: no organisms

Culture: processing

HSV PCR: negative

Blood cultures: processing

1. Discuss your differential diagnosis for this patient.

2. Appropriate empiric therapy is started. MRI Head is obtained. What is the diagnosis and management?



Case 4 - Bonus

A 68 yo male with a history of HIV (last CD4 count 190 ~1 year ago) nonadherent to HAART, DM2, HTN, and alcohol use disorder presents with altered mental status. He lives at home with his nephew who noticed that he had been “off” the past week and had been complaining of a headache and fatigue. His nephew thought it could be COVID, as these are two of the symptoms. The nephew has been isolating himself in the basement of their shared home for the past 4 days. This morning, the nephew went to check on him and found the patient unarousable in his bed. The patient is retired, widowed, and is not sexually active. His nephew admits the patient does go to the neighborhood bar nightly.

Physical exam:

VS: T 101, HR 102, BP 114/91, RR 22, SpO2 95% on RA

Gen: appears acutely ill, thin, and disheveled

HENT: normocephalic, atraumatic,

Neck: supple

Neuro: somnolent, intermittently opens eyes spontaneously. Withdraws from pain. Face symmetric, no droop. PERRL.

Cardiovascular: tachycardic

Pulmonary: CTAB, tachypnea

Abdominal: soft, non-tender, non-distended, BS normoactive

Skin: warm, no rash

1. **What is your differential for altered mental status in this patient?**
2. **You appropriately order blood cultures, begin empiric antibiotics, and then obtain a head CT in this patient prior to undergoing LP. Head CT shows mild hydrocephalus. You discuss with neurology and they agree that an LP is necessary for further diagnostic work up. When measuring the opening pressure, CSF shoots out the top of the manometer! What are you thinking next for this patient's management?**
3. **The lab calls you with an urgent result (see QR code for stain). What is your treatment approach?**
 - *If you haven't called them yet, call ID!*
 - *Amphotericin B + flucytosine for at least 2 weeks of induction therapy; then fluconazole for consolidation therapy*
 - *If increased ICP, serial LP vs lumbar drain – may be a good question for the expert!*



Appendix

Table 1: Most common organisms for meningitis

Organisms	
Bacterial	Viral
<i>Streptococcus pneumoniae</i> (~50%)	Enterovirus
<i>Neisseria meningitidis</i> (~25%)	HSV 1, 2
Gram-negative bacilli	HIV
Staph. Species	Arthropod-borne viruses (eg – WNV)
<i>Listeria monocytogenes</i> **	VZV, EBV
<i>Pseudomonas aeruginosa</i>	

**Risk factors for *Listeria meningitis*: age >50, pregnancy, immunocompromised, ETOH

Table 2: Bacterial vs Viral CSF analysis

Test	Bacterial	Viral
Opening pressure	High	Normal – high
WBC	Very high; Neutrophilic	High; Lymphocytic
Glucose	Low	Normal
Protein	High	Normal – High
GC / Culture	GS+ >60%; Cx+ >80%	Negative

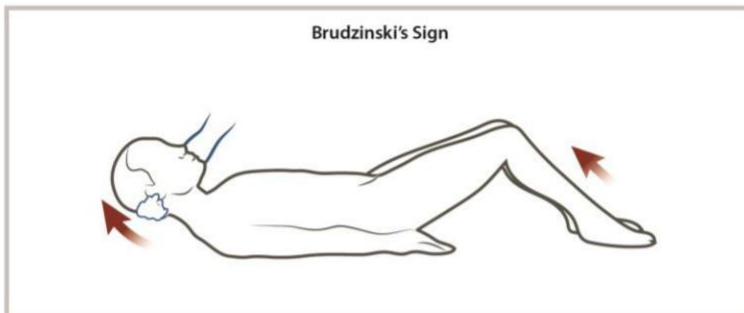
Table 3: CSF profiles

Cerebrospinal Fluid Profiles					
Investigation	Normal	Bacterial	Viral	Tuberculosis	Fungal
Opening pressure	10-20 cm (50-180 mm H ₂ O)	High	Normal/high	High	High/very high
Color	Clear	Cloudy	Clear/cloudy	Cloudy/yellow	Clear/cloudy
Cells	< 5 mm ³	1,000-50,000 mm ³	50-1,000 mm ³	50-500 mm ³	0-1,000 mm ³
Differential	Mononuclear	Neutrophilic	Lymphocytic	Mononuclear	Mononuclear
Glucose	> 45 mg/dL (2.5 mmol/L)	< 40 mg/dL (2.2 mmol/L)	> 45 mg/dL (2.5 mmol/L)	< 45 mg/dL (2.5 mmol/L)	> 45 mg/dL (2.5 mmol/L)
Protein	< 45 mg/dL	100-500mg/dL	< 200 mg/dL =	50-300 mg/dL	> 45 mg/dL

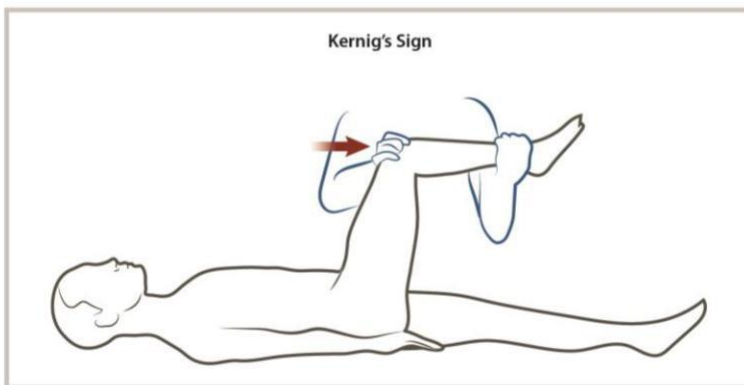
Figure 1: Sunrise Inpatient CSF labs order set

		Order Name
<input checked="" type="checkbox"/>		Cerebrospinal Fluid Cell Count-1
<input checked="" type="checkbox"/>		Glucose, CSF
<input checked="" type="checkbox"/>		Protein, CSF
<input type="checkbox"/>		Lactate Dehydrogenase, CSF
<input checked="" type="checkbox"/>		Culture - CSF with Gram Stain
<input type="checkbox"/>		Gram Stain
<input type="checkbox"/>		Gram Stain - RRL
<input type="checkbox"/>		Culture - Acid Fast - CSF
<input type="checkbox"/>		Cryptococcal Antigen - CSF
<input type="checkbox"/>		Culture - Fungal, CSF
<input type="checkbox"/>		NonGYN Cytopathology Order
<input type="checkbox"/>		Flow Cytometry
<input type="checkbox"/>		VDRL Titer, CSF
<input type="checkbox"/>		Herpes Simplex Virus 1/2 PCR, CSF
<input type="checkbox"/>		Borrelia burgdorferi DNA by PCR
<input type="checkbox"/>		Borrelia burgdorferi IgG, CSF
<input type="checkbox"/>		West Nile Virus by PCR, CSF (NYDOH)
<input checked="" type="checkbox"/>		CSF PCR Panel

Figure 2: Kernig and Brudzinski sign



1. Lift patient's neck toward his or her chest. Brudzinski's sign is positive when neck flexion causes patient to flex knees and hip.



1. Flex hip and knee 2. Extend knee while keeping hip flexed. Kernig's sign is positive when pain is elicited upon extension of the knee.

Table 4: Antibiotics and organisms

Antibiotic	Organism coverage
Vancomycin	Resistant <i>S. pneumoniae</i>
Ceftriaxone	<i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>Neisseria meningitidis</i>
Ampicillin	<i>Listeria monocytogenes</i>
Acyclovir	HSV, VZV

Table 5: Duration of treatment based on identified pathogen

Organism	Treatment duration
<i>H. influenzae</i>	7 days
<i>N. meningitidis</i>	7 days
<i>S. pneumoniae</i>	10-14 days
<i>S. agalactiae</i>	14-21 days
aerobic gram-negative bacilli	21 days
<i>L. monocytogenes</i>	at least 21 days

IDSA 2004 recommendations (IDSA Grade A-III)

Table 6: Common bacterial organisms based on patient population

Population	Organisms
2-50 years old	<i>S. pneumoniae</i> ; <i>N. meningitis</i>
>50 years old	<i>S. pneumoniae</i> ; <i>N. meningitis</i> ; Listeria , aerobic gram (-) bacilli
Post-NSGY; CSF shunt	CoNS, <i>S. aureus</i> , aerobic gram (-) bacilli
Skull fracture	<i>S. pneumoniae</i> , <i>H. influenzae</i> , group A strep
Penetrating trauma	CoNS, <i>S. aureus</i> , aerobic gram (-) bacilli
Asplenic	<i>S. pneumoniae</i> , <i>N. meningitis</i> , <i>H. influenzae</i>