

## AHD – Meningitis Learner Guide

**Agenda:**

- 1:00 – 1:15 Meningitis Theory Burst
- 1:15 – 2:00 Case 1
- 2:00 – 2:20 Questions for the expert & Break
- 2:20 – 3:10 Cases 2 & 3
- 3:10-3:30 Questions for the expert and Wrap Up

**EBM:**

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. 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: Endorses 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?

3. Does this patient need a head CT before LP? What are the indications for head CT prior to LP?

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

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**Case 1 continued.**

Labs:

<p>\ 14.2 / 8.2 ----- 335 / 44 \</p>	<p>Differential - left shift.</p>	<p>135   102   11 / ----- 110 4.0   24   0.8 \</p>
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Hepatic panel: normal

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

Serum glucose: 98 @ 12:00PM

CSF analysis @ 12:00PM

Opening pressure: 2200 mm H<sub>2</sub>O (normal: 70-200 mm H<sub>2</sub>O)

WBC: 1200/μL with 60% neutrophils, 40% lymphocytes (N:0-5/μL (0-5× 10<sup>6</sup>/L))

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

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

Gram stain: see QR code

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.

**Questions for the expert!**

**Break!**

**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

HEENT: PERRL, EOMI, no papilledema on non-dilated fundoscopic exam

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, 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, extremely somnolent, and she was transported to the hospital by ambulance. She takes Lisinopril, metformin, and levothyroxine. She has no medication allergies. Per family, she is independent of ADL's and manages her own finances well. 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. Does not follow commands. She moves all extremities spontaneously.

Face is symmetric without droop, speech is clear, PERRL, no papilledema on non-dilated fundoscopic exam. Unable to flex neck, + Kernig, + Brudzinski (*see figure 2 in appendix*)

GU: No lesions or rashes

Skin: warm, dry, no rash.

Cardiovascular, pulmonary, and abdominal exam are normal.

*Labs/Diagnostics:*

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

CBC: 4.8 > 12.7 / 37 < 287 with normal differential

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 H<sub>2</sub>O (normal: 70-200 mm H<sub>2</sub>O)

WBC: 11/μL with 60% lymphocytes, 40% neutrophils (N:0-5/μL (0-5× 10<sup>6</sup>/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?**



**Questions for the expert. End AHD.**

## 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**

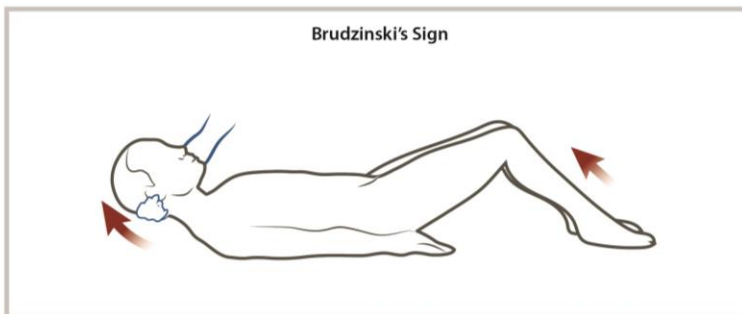
Cerebrospinal Fluid Profiles					
Investigation	Normal	Bacterial	Viral	Tuberculosis	Fungal
Opening pressure	10-20 cm (50-180 mm H <sub>2</sub> O)	High	Normal/high	High	High/very high
Color	Clear	Cloudy	Clear/cloudy	Cloudy/yellow	Clear/cloudy
Cells	< 5 mm <sup>3</sup>	1,000-50,000 mm <sup>3</sup>	50-1,000 mm <sup>3</sup>	50-500 mm <sup>3</sup>	0-1,000 mm <sup>3</sup>
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: EPIC Inpatient CSF labs order set**

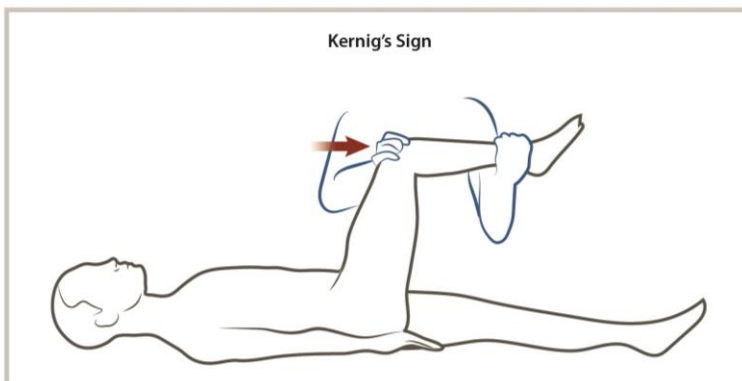
CSF Labs Panel		Accept
<input checked="" type="checkbox"/>	Tube 1: Cell Count, CSF STAT, Once First occurrence Today at 1429	P
<input checked="" type="checkbox"/>	Tube 2: Glucose, CSF STAT, Once First occurrence Today at 1429	P
<input checked="" type="checkbox"/>	Tube 2: Protein, CSF STAT, Once First occurrence Today at 1429	P
<input checked="" type="checkbox"/>	CSF Culture Plus Stain STAT, Once First occurrence Today at 1429	P
<input checked="" type="checkbox"/>	Tube 4: CSF Cell Count (Hold for additional studies) STAT, Once First occurrence Today at 1429	P
<input type="checkbox"/>	Cryptococcal Ag, CSF w/Fungal Cult STAT, Once	
<input checked="" type="checkbox"/>	Enterovirus RNA, Qualitative RT PCR, CSF STAT, Once First occurrence Today at 1430	P
<input type="checkbox"/>	Herpes Simplex 1 & 2, Real-time PCR, CSF STAT, Once	
<input checked="" type="checkbox"/>	West Nile Virus, CSF STAT, Once First occurrence Today at 1430	P
<input type="checkbox"/>	Acid Fast Culture Plus Stain STAT, Once	

Next Required      Accept

**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. meningitidis</i>
>50 years old	<i>S. pneumoniae</i> ; <i>N. meningitidis</i> ; <b>Listeria</b> , aerobic gram (-) bacilli
Post-neurosx; 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. meningitidis</i> , <i>H. influenzae</i>