Bacterial Meningitis Clinical Practice Guidelines

Inclusion criteria:
Children suspected of having bacterial meningitis

Exclusion Criteria:
Immunocompromised patients, recent head trauma, recent neurosurgery, patients with ventriculoperitoneal shunts or other neurologic hardware, NICU patients

Diagnosis	• Lumbar puncture with meningitis/encephalitis film array, culture (includes gram stain), glucose, protein, cell count and differential
	  ○ HSV PCR does not need to be ordered in addition to the meningitis/encephalitis film array
	  ○ CT scan may be indicated in patients to rule out obvious signs of mass lesion or brain shift (e.g. patients with altered mental status, focal neurologic findings, papilledema, focal seizure, and risk for brain abscess- immunocompromised or congenital heart disease with right to left shunt).
	  ○ see Appendix 1 for Contraindications to LP
	• BMP
	• CBC
	• Blood Culture
	  ○ A blood culture should be done prior to antibiotics administration

Treatment	• Clinical Prediction Rule for Identifying Children With Cerebrospinal Fluid Pleocytosis at Very Low Risk of Bacterial Meningitis http://jama.jamanetwork.com/article.aspx?articleid=204883
	Bacterial Meningitis Score --patients are classified as very low risk if none of these variables are present:
	  ○ Positive cerebrospinal fluid Gram stain
	  ○ Cerebrospinal fluid absolute neutrophil count ≥1000 cells/uL
	  ○ Cerebrospinal fluid protein ≥80 mg/dL
	  ○ Peripheral blood absolute neutrophil count ≥10,000 cells/uL
	  ○ History of seizures before or at the time of presentation
	• Antibiotics
	  ○ If LP delayed by more than 1 hour from presentation, a blood culture must be obtained and antibiotics administered prior to performing the LP.
	  ○ First line empiric therapy for suspected bacterial meningitis in patients greater than one month of age- ceftriaxone (or ceftazidime if ceftriaxone contraindicated) AND vancomycin
	  ○ First line empiric therapy for suspected bacterial meningitis in patients less than one month of age- ampicillin and a third or fourth generation cephalosporin (ceftazidime)

	○ Meningitis film array results are typically available within 90 minutes of collection. ○ Aminoglycosides be used in initial treatment of Group B Streptococcus for synergism along with a beta lactam until sensitivities are known. ○ Antibiotic therapy should be modified once identification and sensitivities are available ○ Standard vancomycin dosing should be started as first line empiric therapy for patients greater than one month of age as stated above. If CSF culture growing drug resistant strep pneumoniae or MRSA then vancomycin trough should be 10-15 with close monitoring of renal function. • Steroids- Dexamethasone 0.15mg/kg every 6hr for 2-4 days starting prior to or concomitant with the first antimicrobial dose ○ Does not apply to neonates ○ Re-evaluation prior to second dose to see if appropriate to continue ○ Shown to be beneficial for H. influenzae and S. pneumoniae • IVF- D5 **normal saline** with 20 mEq Kcl/L should be the IVF of choice for most patients with the goal to maintain euvolemia • ID consult for patients with bacterial meningitis
Placement/ Monitoring	• **Patients under the age of 1 year with presumed or suspected bacterial meningitis, based on gram stain, other CSF studies and clinical picture should be monitored in the pediatric intensive care setting for at least the first 12hr. Patients >1yo, placement should be determined by clinical picture and physician judgment.** • Sodium should be monitored regularly with serum Na monitored q6-12hr for 24hr, then q12hr for 24hr then daily for those with suspected bacterial meningitis (until SIADH is no longer a concern or has resolved), stat serum Na should be checked if acute change in urine output, mental status, or seizures develop. • Strict I/O's monitoring • Re-evaluation of patient by physician should take place q 4-6hr during the first 24hr to evaluate mental status, vitals, urine output • Vancomycin troughs and renal function to be evaluated in patients on vancomycin (see above for vancomycin trough recommendations) • Head circumference daily if <12mo • Cardiorespiratory monitors • Continuous pulse ox • Neuro checks

	• Droplet Isolation for first 24hr after initiation of effective antimicrobial therapy for patients with suspected bacterial meningitis or based upon identification of organism • Consider chemoprophylaxis as indicated for meningococcal infections or H. Influenza type b. Consult Infectious Disease and Infection Control for guidance with chemoprophylaxis of household contacts.
Follow-up	• Hearing screen prior to discharge • Rehab referral if needed for neurologic deficits • At risk for developmental delay and referral to Help Me Grow services if <3 years of age

References:

1. Nigrovic LE, et al. Clinical prediction rule for identifying children with cerebrospinal fluid pleocytosis at very low risk of bacterial meningitis. JAMA. 2007 Jan 3;297(1):52-60.
2. Tunkel AR, et al. Practice guidelines for the management of bacterial meningitis. Clin Infect Dis. 2004 Nov 1;39(9):1267-84. Epub 2004 Oct 6.

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Appendix 1.

CONTRAINDICATIONS TO LUMBAR PUNCTURE IN PATIENTS WITH SUSPECTED CNS INFECTION

Blood cultures and antibiotics should be started prior to obtaining a CT scan. Antibiotics should be given prior to a LP any time the LP is going to be delayed for greater than 1 hour.

Performing an LP in the presence of symptomatic intracranial hypertension may cause cerebral herniation. Lumbar puncture is contraindicated:

1. significant respiratory and/or hemodynamic compromise
2. bleeding diathesis (if LP considered essential, consult hematology regarding safe correction of coagulopathy prior to performing LP)
    a. patient is actively bleeding
    b. platelet count <50,000
    c. INR >1.4
3. soft tissue infection at the lumbar puncture site
4. rapidly deteriorating level of consciousness (decrease of more than 2 in GCS) or GCS <10(e.g. if patient requires noxious stimulation to assess GCS, the LP should be delayed)
5. altered pupillary response including dilated and/or fixed pupils, unilateral or bilateral, or any asymmetric response
6. fixed deviation of the eyes
7. decorticate or decerebrate posturing, or hemiparesis
8. respiratory abnormalities including Cheyne-Stokes respiration, hyperventilation, or apnea
9. papilledema
10. hypertension and bradycardia
11. recent(within 30 minutes) or prolonged (>30 minutes) convulsive seizure
12. focal or tonic seizures
13. other focal neurological signs

Clinical signs are the best indicators of who should not have an LP done in the setting of acute bacterial meningitis. A CT scan may be indicated in patients to rule out obvious signs of mass lesion or brain shift (e.g. patients with altered mental status, focal neurologic findings, papilledema, focal seizure, and risk for brain abscess-immunocompromised or congenital heart disease with right to left shunt). **However, even if the CT is normal in these high risk patients, a lumbar puncture should not be done because of the risk of cerebral herniation.**

References

1. Oliver WJ, et al. Fatal lumbar puncture: Fact versus fiction- an approach to a clinical dilemma. Pediatrics 2003;112: e174-6.
2. Kneen R, et al. The role of lumbar puncture in suspected CNS infection-a disappearing skill? Arch Dis Child 2002;87:181-3.
3. Joffe AR. Lumbar puncture and brain herniation in acute bacterial meningitis: A review. J Int Care Med 2007;22:194-207.
4. Nadel S. Infections of the Central Nervous System in Textbook of Pediatric Critical Care Medicine, Wong H, Wheeler D, eds. Springer Verlag, London, 2007;956-75.