Pharmacology of Encephalitis/Bacterial Meningitis Cheat Sheet

by Bailey_Rickett via cheatography.com/184326/cs/38818/

Pathophysiology

Meningitis	Inflection and inflammation of the meninges.
Enceph-alitis	Infection and inflammation of the brain or spinal cord parenchyma itself.
Common causes:	Viruses, Bacteria, Fungi, and Parasites
	Viral encephalitis is the most common type of encephalitis, but less severe than bacterial.

Encephalitis

Common Viruses	**Herpes Simplex** (most common, >42%)
	Varicella Zoster Virus
	Epstein Barr Virus
Diagno-stics	Lumbar puncture- CSF
	PCR for the identification of viruses (HSV, EBV, CMV, HHV6, and enteroviruses)
	*The same organisms respon-sible for viral meningitis usually are also responsible for encephalitis.
Diagnostic Criteria for Encephalitis	
Major Criterion	Required

Encephalitis (cont)

	Subacute onset of impairment in the domains of consciousness, memory, mental status, or new onset psychiatric changes without alternative cause.
Minor Criterion	(at least 2)
	Fever >/= 100.4 F within the 72 hours before or after presen-tation
	Seizures not attributed to a previous seizure disorder.
	Cerebrospinal fluid pleocytosis (WBC > 5/cubic mm)
	Evidence of brain parenchymal inflammation on neuroimaging (acute or subacute)

Symptoms of Meningitis

Early Symptoms	Headache
	Fever
	Nausea
	Vomiting
Later Symptoms	Drowsiness
	Confusion
	Stiff ness and pain on flexion of the neck (Nuchal Rigidity)
	Seizures
	Non-blanching purpuric rash (Meningococcal)

Symptoms of Meningitis (cont)

	Photophobia
	Rapid Breathing Rate
Triad	Headache
	Fever
	Nuchal Rigidity

Meningococcal Meningitis

Meningococcal meningitis is a bacterial form of meningitis, a serious infection of the thin lining that surrounds the brain and spinal cord.

This is the most important pathogen for meningitis (Neisseria Meningitides) because it has the potential to cause epidemics.

Characterized by non-blanching purpura.

You can easily tell it by pushing a glass against it and if it disappears it is not meningitis.

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Types of Antibiotics vs. Age

< 3 Months	IV Cefotaxime + Ampicillin
3 months – 50 y/o	IV Cefotaxime or Ceftriaxone + Vancomycin + Dexamethasone
> 50 y/o	IV Cefotaxime or Ceftriaxone + Ampicillin
Meningococcal	IV Penicillin + Cefotaxime
Pneumococcal	IV Cefotaxime
H. Influenza	IV Cefotaxime
Listeria	IV Ampicillin + Gentamicin

By **Bailey_Rickett**

cheatography.com/bailey-rickett/

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Is Meningitis Contagious?

Parasitic	non contagious
Fungal	non contagious
Viral	contagious
Bacterial	contagious

General Notes on CNS Infections

Acute infections such as bacterial and viral meningitis and encephalitis require quick distinguishing and treatment.

It is imperative to differentiate between them, identify the pathogen, and quickly initiate therapy.

Neisseria, Haemophilus, Hepes simplex 1, Varicella Zoster

Symptoms of Encephalitis

Deep cognitive functions disturbed.

Confusion or disorientation.

Seizures or fits.

Changes in personality and behavior.

Difficulty speaking.

Weakness or loss of movement in some parts of the body.

Loss of consciousness.

Diagnostics to Confirm Meningitis

CT- to rule out bleeds

Head Scans

Lumbar Puncture (Gold Standard) confirms diagnosis. This is CI in meningococcal septicemia, so you need to do blood cultures and PCR, instead. CI if there is bulging of the fontanells in an infant (this indicates increased ICP), CI in hydrocephalus.

PCR- determines viral etiology

Blood Culture

Empiric Treatment

Preterm to <1 Month old	Ampicillin+Cefotaxime
1-3 Months old	Ampicillin+ Cefotaxime or Ceftriaxone
>3 months to adults <50	Ceftriaxone or Cefotaxime+ Vancomycin+ Dexamethasone (steroid for ICP)
Adults with >55 or with alcoholism or disease	worried about listeria so + ampicillin (Ampicillin +Ceftriaxone or Cefotaxime + Vancomycin + Dexamethasone)
Alternatives for penicillin allergy	Can substitute TMP-SMP (Bactrim) or meropenem for Ampicillin if you need the possible listeria coverage in immunosuppressed or >50 yo
	Meropenem can also be substituted in for ceph if can't take ceph. Aztreonam is also an option.
Dexamethasone	Given 10-20 minutes before antibiotic therapy and continue for 2-4 days

Empiric Treatment (cont)

Shown to decrease morbidity and mortality by decrease inflammatory response secondary to bacterial lysis which usually causes detrimental physiologic effects- used for s. pneumo or haemophilus causes only, not shown to benefit with other pathogens.

No benefit if given after antibiotics are initiated.

Given IV 10mg (0.15 mg/kg ped) Q6hrs for up to 4 days

Bacterial Meningitis Treatment

If the lumbar puncture is delayed for any reason, including the need for additional diagnostic testing, such as a CT scan of the head- then empiric antibiotic therapy should be started as soon as possible, ideally after blood cultures have been performed.

It is important to start antibiotic therapy even if the evaluation for bacterial meningitis is ongoing, since as delay in treatment is associated with increased morbidity and mortality. Recommended empiric treatment of bacterial meningitis is based on a patient's age and comorbid conditions.

Vancomycin

MOA:	Inhibits peptidoglycan cross linking, leading to weaker cell membrane
Indications:	Primarily activity is against **gram positive** (too large to penetrate through gram negative cell membranes)
Formulations:	Administered via IV infusion (oral is only given for the treatment of colitis caused by cdiff)
ADRs	Fairly frequent. Irritating to tissues, chills, fever, **nephrotoxicity** is common, rare **ototoxicity** **red man syndrome** (infusion flushing caused by the release of histamine can prevent this by administering slowly, or pretreating with antihistamines)
Notes	Widely distributed into tissues, including adipose, but poorly absorbed from GI tract
	Therapeutic drug monitoring protocols of vancomycin are put in place to measure AUC levels in order to minimize occurrence of nephrotoxicity. Calculating AUC is used to check for therapeutic levels and to monitor for toxicity. Accumulates in renal therapy.

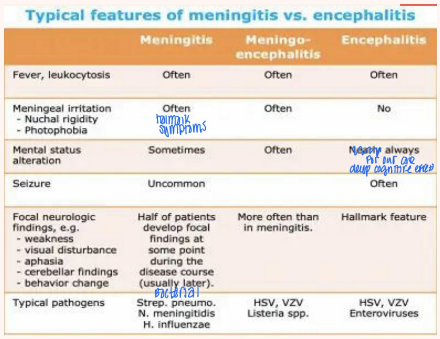
Vancomycin (cont)

Treats MRSA

Works synergistically with gentamicin and other aminoglycosides for treating enterococci.

VRE (vancomycin resistant enterococci) are becoming more prevalent.

Meningitis vs. Encephalitis



Treatment of Encephalitis

Start **IV Acyclovir** (for herpes simplex) while awaiting CSF results. This is the empiric therapy of choice.

Herpes Simplex is the **most common** cause of encephalitis so starting acyclovir will help to prevent death or serious outcomes.

Pediatrics and Adults: acyclovir 10mg/kg IV q8h

Acyclovir is used to prevent and treat herpes infection of the skin, mouth, and mucous membranes; herpes zoster (shingles); chicken pox; and genital herpes.

CFS Analysis

Bacterial	Viral
Cloudy	Clear (Usually)
Glucose is low (bacteria is using the glucose)	60-80% of normal plasma levels
Proteins are high	Normal protein levels
WBC- Neutrophils, PMNs	Lymphocytes

Bacterial Meningitis Causes

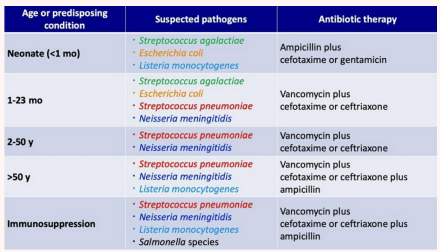
0-6mos	6mos-6yrs	6yrs-60yrs	60+
Group B Strep	S. Pneumoniae	S. Pneumoniae	S. Pene oniae
E. Coli	N. Meningitis	N. Meningitis	Gran Nega Rods
Listeria	Enterovirus	HSV-1	Liste
	H. Influenza	Enterovirus	

Causes Notes

Usually caused by strep pneumoniae and Neisseria meningitis in those 2-50 yo

Listeria monocytogenes should be considered in pregnancy, >50, alcoholics, and immunocompromised patients.

Bacteria Meningitis Causes and Treatments



Medications and the CSF

The CSF is hard for a lot of medications to penetrate due to the BBB. To overcome this you can increase the dose or depend on the inflammation to open up permeability.

Most medications do not penetrate into the uninflamed meninges, however in meningitis a lot of antibiotics are able to gain higher concentrations in the CSF because the inflammatory response allows the BBB to be more penetrable to hydrophilic substances (we already know lipophilic drugs have are more permeable)

Ex. Hydrophilic antibiotics are beta lactams and vancomycin.

Beta lactams have the most evidence behind them in meningitis prophylaxis due to their ability to eradicate the causative pathogens, BUT dosing has to be **increased** in order to gain appropriate concentrations in the CSF.

Of the cephalosporins cefotaxime and ceftriaxone are the most used.

Prophylaxis for Meningitis

Haemophilus Influenza B	Rifampin for 4 days for both peds and adults
	recommended for all household contacts with kids <4 that haven't been fully vaccinated, child care settings when 2 or more chases have occurred within 60 days.
Neisseria Meningitidis	Rifampin (2 days)
	Ciprofloxacin (adults only) (BS)
	Ceftriaxone (IM 1 dose)

Prophylaxis for Meningitis (cont)

start withing 24 hours after identified, should involve household members, child care contacts, direct exposure to oral secretions. After 14 days no prophylaxis is recommended.

Report all cases to the CDC

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