Meningitis and Encephalitis

Samantha Noll
June 11, 2015
Objectives & Goals

- Discuss the definition of meningitis and encephalitis and principles behind the pathophysiology of these conditions
- Provide a review of the more common pathogens in the United States
- Review common presentation and complications of meningitis and encephalitis
- Review diagnosis of each disorder and significance of lumbar punctures
- Discuss indications of CT in diagnostic workup
- Discuss treatment of each disorder
- Discuss utility of dexamethasone in treatment of bacterial meningitis
- Review common board/ABEM questions regarding these topics
- Review recent evidence based medicine related to these topics
Definitions

- Meningitis: inflammation of the membranes of the brain or spinal cord AKA arachnoiditis or leptomenigitis
  - CSF and meninges

- Encephalitis: inflammation of the brain itself
  - Parenchyma

- Presence OR absence of normal brain function is the important distinguishing feature between encephalitis and meningitis

- Meningoencephalitis: More diffuse inflammatory process
  - More overlap of symptoms
Bacterial Meningitis

- US: 4,100 cases/year 2003-2007, 500 deaths
  - 5-10 cases/100,000

- *S. pneumoniae* remains the predominant pathogen in adult patients (61%)
  2. *N. meningitidis*
  3. Group B *Streptococcus*
  4. *H. influenzae*
  5. *L. monocytogenes*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborns</td>
<td>Group B <em>Streptococcus</em>, <em>Escherichia coli</em>, <em>Listeria monocytogenes</em></td>
</tr>
<tr>
<td>Infants and Children</td>
<td><em>Streptococcus pneumoniae</em>, <em>Neisseria meningitidis</em>, <em>Haemophilus influenzae</em> type b</td>
</tr>
<tr>
<td>Adolescents and Young Adults</td>
<td><em>Neisseria meningitidis</em>, <em>Streptococcus pneumoniae</em></td>
</tr>
<tr>
<td>Older Adults</td>
<td><em>Streptococcus pneumoniae</em>, <em>Neisseria meningitidis</em>, <em>Listeria monocytogenes</em></td>
</tr>
</tbody>
</table>
Pathophysiology

- Upper airway invasion or seeding from TM, mastoid
  OR
- Dissemination through bloodstream
- Infiltration of subarachnoid space
  - Host defenses are weaker in CSF
- Inflammatory cascade
- Meningeal and brain edema
  - vasogenic, interstitial, cytotoxic
- Increased ICP, brain ischemia
Signs & Symptoms

- Classic: fever, neck stiffness, headache, & altered mental status
- The absence of fever, neck stiffness, and AMS DOES NOT EXCLUDE meningitis in adults
- 95% of cases 2/4; ~40% 4/4

- Nuchal rigidity: 30% / 68% sens/ spec
- Brudzinski’s sign: 5% / 95%
- Kernig’s sign: 5% / 95%
- Jolt accentuation: 64% / 43%
- Seizures have been reported in 25% of cases of bacterial meningitis
- Focal neurologic signs: cranial nerve palsies
- With AMS alone, the likelihood of bacterial meningitis is low
Diagnosis

ACEP Recommendation for order of work-up:

- “If a CT is deemed to be necessary on clinical grounds, the emergency physician should perform tasks in the following strict order: “
  1. Blood cultures
  2. Steroids
  3. Antibiotics
  4. CT
  5. LP
Diagnosis

**IDSA Recommendation** for use of head CT:

- Obtaining a head CT prior to LP for patients who meet any of these criteria:
  - immunocompromised state
  - history of CNS disease (mass lesion, stroke, or focal infection)
  - new-onset seizure within 1 week of presentation
  - papilledema
  - abnormal level of consciousness
  - focal neurologic deficit
Diagnostics

Contraindications to LP

- Deteriorating LOC (GCS <11), brainstem signs (including pupillary changes, posturing, or irregular respirations), very recent seizure

- CT findings
  - "lateral shift of midline structures"
  - Unequal supratentorial ICP
  - "loss of the suprachiasmatic and basilar cisterns"
  - Supratentorial >> infratentorial pressure
  - "obliteration of the fourth ventricle"
  - Increased posterior fossa pressure
  - "obliteration of the superior cerebellar and quadrigeminal plate cisterns with sparing of the ambient cisterns"
  - Upward cerebellar transtentorial herniation
Flash Quiz

- **Question:** You recognize a co-resident who has spent too much time in the dorms with coeds presenting to the ED with headache, neck stiffness, and fever. What would you expect to see on the gram stain from the LP?

- **Answer:** Gram negative diplococci (*N. meningitidis*)
Diagnosis

*With limited fluid, send off:

- Cell count w/ diff
- Gram stain
- Bacterial culture

Table 169-1 Contraindications to Lumbar Puncture

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin infection near the site of lumbar puncture</td>
</tr>
<tr>
<td>Central nervous system lesion causing increased intracranial pressure, or spinal mass</td>
</tr>
<tr>
<td>Platelet count &lt;20,000 mm³ is an absolute contraindication; platelet counts &gt;50,000 mm³ are safe for lumbar puncture*</td>
</tr>
<tr>
<td>International normalized ratio ≥1.5*</td>
</tr>
<tr>
<td>Administration of unfilttered heparin or low-molecular-weight heparin in past 24 h*</td>
</tr>
<tr>
<td>Hemophilia, von Willebrand disease, other coagulopathies*</td>
</tr>
<tr>
<td>Trauma to lumbar vertebrae</td>
</tr>
</tbody>
</table>
Pediatric Pearls

- AAP guidelines for when to LP w/ febrile seizure:
  - Clinical concern for meningitis (VS, PE) (Level B)
  - Immunizations not UTD (Hib/S. pneumo) (Level D)
- Perform LP at L4-L5 or L5-S1 in infants
- Bacterial Meningitis Score for Children:
Flash Quiz

- **Question**: How soon can CSF sterilization occur after initiation of IV antibiotics?

- **Answer**: 2 hours
Diagnosis

- Total cell count of >5 cells/mm$^3$ or >1 PMN should be considered evidence of CNS infection
  - Pretreatment with antibiotics should NOT affect cell counts
- Gram stain: 60-90% sensitive, >97% specific
  - 20-40% sensitive after antibiotics
- 90% of immunocompetent pts with culture-proven meningitis have characteristic CSF findings
- CSF lactate's high negative LR may make it useful for ruling out bacterial meningitis
  - CSF lactate >35 mg/dl or >6 mmol/l indicative of bacterial
  - Antibiotic pretreatment reduces clinical accuracy
  - Non-specific: elevated in CVA, malignancy, seizure
## Diagnosis

<table>
<thead>
<tr>
<th>TEST</th>
<th>NORMAL VALUE</th>
<th>SIGNIFICANCE OF ABNORMALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell count</td>
<td>≤5 WBC/mm³</td>
<td>Increased WBC counts are seen in all types of meningitis and encephalitis; increased PMN count suggests bacterial pathogen</td>
</tr>
<tr>
<td></td>
<td>≤1 PMN/mm³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤1 eosinophil/mm³</td>
<td></td>
</tr>
<tr>
<td>Gram's stain</td>
<td>No organism</td>
<td>Offending organism identified 80% of the time in bacterial meningitis, 60% if patient has been pretreated</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Clear</td>
<td>Increased turbidity with leukocytosis, blood, or high concentration of microorganisms</td>
</tr>
<tr>
<td>Xanthochromia</td>
<td>None</td>
<td>Presence of RBCs in spinal fluid for 4 hr before lumbar puncture; occasionally caused by traumatic tap (if protein ≥150 mg/dL) or hypercarotenemia</td>
</tr>
<tr>
<td>CSF-to-serum glucose ratio</td>
<td>0.6 : 1</td>
<td>Depressed in pyogenic meningitis or hyperglycemia; lag time if glucose given intravenously</td>
</tr>
<tr>
<td>Protein</td>
<td>15-45 mg/dL</td>
<td>Elevated with acute bacterial or fungal meningitis; also elevated with vasculitis, syphilis, encephalitis, neoplasms, and demyelination</td>
</tr>
<tr>
<td>India ink stain</td>
<td>Negative</td>
<td>Positive in one third of cases of cryptococcal meningitis</td>
</tr>
<tr>
<td>Cryptococcal antigen</td>
<td>Negative</td>
<td>90% accuracy for cryptococcal disease</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>≤35 mg/dL</td>
<td>Elevated in bacterial and tubercular meningitis</td>
</tr>
<tr>
<td>Bacterial antigen tests</td>
<td>Negative</td>
<td>≥95% specific for organism tested; up to 50% false-negative rate</td>
</tr>
<tr>
<td>Acid-fast stain</td>
<td>Negative</td>
<td>Positive in 80% of cases of tuberculous meningitis if ≥10 mL of fluid</td>
</tr>
</tbody>
</table>

### PATHOGEN TYPICAL CHARACTERISTICS

- **Staphylococci**
  - Gram-positive cocci: singles, doubles, tetrads, clusters

- **Streptococcus pneumoniae**
  - Gram-positive cocci: paired diplococci

- **Other streptococci**
  - Gram-positive cocci: pairs and chains

- **Listeria monocytogenes**
  - Gram-positive rods: single or chains

- **Neisseria meningitidis**
  - Gram-negative cocci: negative paired diplococci; kidney or coffee bean appearance

- **Haemophilus influenzae**
  - Gram-negative coccobacilli: “pleomorphic” bacilli

- **Enterobacteriaceae (including Escherichia coli)**
  - Gram-negative rods

- **Pseudomonas aeruginosa**
  - Gram-negative rods
Diagnostics

- WBC count can be as low as 100 in bacterial meningitis
- 10% of pts with bacterial meningitis will have lymphocyte predominance
- Early viral meningitis may have neutrophilic predominance (<24 h)
- Formula for true WBC in the setting of traumatic tap:
  - True CSF WBC = (Measured CSF WBC) - ((CSF RBC x blood WBC) / blood RBC)
  - Use 1 WBC for every 700 RBC
  - if peripheral cell counts normal
Flash Quiz

• **Question:** Another co-resident presents concerning for bacterial meningitis. In addition to vancomycin + ceftriaxone, what would you add based on the amount of his post-shift Honest John’s/Como’s encounters?

• **Answer:** Ampicillin
## Treatment

<table>
<thead>
<tr>
<th>Age</th>
<th>Common organisms</th>
<th>Antibiotic therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonates (&lt;1 month)</td>
<td><em>E. coli</em>, <em>Group B strep</em>, <em>Listeria monocytogenes</em>, Gram-neg bacilli</td>
<td>Cefotaxime + Ampicillin OR Gentamicin + Ampicillin</td>
</tr>
<tr>
<td>Infants (1-3 months)</td>
<td>Neonatal pathogens, <em>Strep pneumoniae</em>, <em>N. meningitidis</em>, <em>Group B strep</em>, <em>H. influenzae</em></td>
<td>Cefotaxime + Ampicillin + Vancomycin OR Ceftriaxone + Ampicillin + Vancomycin</td>
</tr>
<tr>
<td>Children (3 months-18 years)</td>
<td><em>S. pneumoniae</em>, <em>N. meningitidis</em>, <em>H. influenzae</em></td>
<td>Ceftriaxone + Vancomycin OR Cefotaxime + Vancomycin</td>
</tr>
<tr>
<td>Adults (18-50 years)</td>
<td><em>S. pneumoniae</em>, <em>N. meningitidis</em></td>
<td>Ceftriaxone + Vancomycin</td>
</tr>
<tr>
<td>Adults &gt;50 years and alcoholics</td>
<td><em>S. pneumoniae</em>, <em>N. meningitidis</em>, <em>Listeria monocytogenes</em>, Gram-neg bacilli</td>
<td>Ceftriaxone + Vancomycin + Ampicillin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Head trauma</th>
<th>Common organisms</th>
<th>Antibiotic therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basilar skull fracture</td>
<td><em>S. pneumoniae</em>, <em>H. influenzae</em>, group A β-hemolytic streptococci</td>
<td>Vancomycin plus a third-generation cephalosporin + †</td>
</tr>
<tr>
<td>Penetrating trauma</td>
<td><em>Staphylococcus aureus</em>, coagulase-negative staphylococci (especially <em>S. epidermidis</em>), aerobic gram-negative bacilli (including <em>Pseudomonas aeruginosa</em>)</td>
<td>Vancomycin plus cefepime, vancomycin plus ceftazidime, or vancomycin plus meropenem</td>
</tr>
<tr>
<td>Postneurosurgery</td>
<td>Aerobic gram-negative bacilli (including <em>P. aeruginosa</em>), <em>S. aureus</em>, coagulase-negative staphylococci (especially <em>S. epidermidis</em>)</td>
<td>Vancomycin plus cefepime, vancomycin plus ceftazidime, or vancomycin plus meropenem</td>
</tr>
<tr>
<td>CSF shunt</td>
<td>Coagulase-negative staphylococci (especially <em>S. epidermidis</em>), <em>S. aureus</em>, aerobic gram-negative bacilli (including <em>P. aeruginosa</em>), <em>Propionibacterium acnes</em></td>
<td>Vancomycin plus cefepime, ‡ vancomycin plus ceftazidime, ‡ or vancomycin plus meropenem ‡</td>
</tr>
</tbody>
</table>
Treatment

- HFH Antimicrobial Stewardship Guidelines

<table>
<thead>
<tr>
<th>Empiric Therapy for Meningitis in Children ≥ 3 Months of Age¹,²</th>
<th>Penicillin Allergy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preferred Therapy</strong></td>
<td>The American Academy of Pediatrics recommends ceftriaxone in patients with penicillin allergy due to lack of evidence for cross-sensitivity (ie, anaphylaxis reaction) with cephalosporins. Therefore, the patient should still receive the preferred therapy.</td>
</tr>
<tr>
<td>Ceftriaxone IV 100 mg/kg/day divided every 12-24 hours</td>
<td>If life threatening penicillin allergy, consider consulting infectious disease or allergy specialist.</td>
</tr>
<tr>
<td>Plus</td>
<td></td>
</tr>
<tr>
<td>Vancomycin IV 60 mg/kg/day divided every 6 hours</td>
<td></td>
</tr>
<tr>
<td>Plus or minus</td>
<td></td>
</tr>
<tr>
<td>Dexamethasone IV 0.6 mg/kg/day divided every 6 hours</td>
<td></td>
</tr>
<tr>
<td>(administer before or with first dose of antibiotics)</td>
<td></td>
</tr>
</tbody>
</table>

**Diagnosticality**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Suspected Pathogens</th>
<th>Empiric Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain abscess</td>
<td>Staphylococci, <em>Streptococci</em>,</td>
<td>Ceftriaxone + metronidazole + vancomycin</td>
</tr>
<tr>
<td></td>
<td><em>Enterobacteriaceae</em>, anaerobes</td>
<td></td>
</tr>
<tr>
<td>Brain abscess, post-neurosurgical</td>
<td>Staphylococci, <em>Streptococci</em>,</td>
<td>Piperacillin-tazobactam + vancomycin</td>
</tr>
<tr>
<td></td>
<td><em>Enterobacteriaceae</em>, <em>P. aeruginosa</em>, anaerobes</td>
<td>Celepine + metronidazole + vancomycin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aztreonam + metronidazole + vancomycin (severe β-lactam allergy)</td>
</tr>
<tr>
<td>Meningitis, community-acquired</td>
<td><em>S. pneumoniae</em>, <em>N. meningitides</em>,<em>Listeria monocytogenes (EtOH abuse, age &gt;50)</em></td>
<td>Ceftriaxone + vancomycin ± ampicillin (if risk factors for <em>Listeria</em> present)</td>
</tr>
<tr>
<td>Meningitis, post-neurosurgical</td>
<td>Staphylococci, Gram-negative</td>
<td>Celepine + vancomycin ± tobramycin</td>
</tr>
<tr>
<td>NOTE: Add tobramycin for patients with severe</td>
<td>bacteria</td>
<td>Aztreonam + vancomycin ± tobramycin (severe β-lactam allergy)</td>
</tr>
<tr>
<td>sepsis or septic shock. Stop after 3 days if a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>beta-lactam/monobactam resistant organism is not</td>
<td></td>
<td></td>
</tr>
<tr>
<td>isolated or if cultures were not obtained.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Flash Quiz

- **Question:** What antibiotics should be used in a patient with meningitis and a confirmed cephalosporin allergy?

- **Answer:** Meropenem or chloramphenicol can replace the 3rd generation cephalosporin
Treatment

Corticosteroid Use

- Steroids should be given in all suspected cases of bacterial meningitis regardless of pathogen

- Dexamethasone 10 mg IV q6h x 4 days in adults
  - .15 mg/kg for pediatric population

- Give 15 min before start of abx or concomitantly

- Likely attenuates inflammatory response
Treatment

Corticosteroid Use

- Steroids reduced hearing loss and neurological sequelae, **but did not** reduce overall mortality

- Reduced mortality in *S. pneumoniae* meningitis **but not** *H. influenzae* nor *N. meningitidis*

- Reduced severe hearing loss in children with *H. influenzae** but not** due to non-*Haemophilus* species
Treatment

Corticosteroid Use

- IDSA Recommendations: Do not give dexamethasone AFTER initiation of antibiotics
- Use of hydrocortisone at 50 mg IV is a reasonable approach
  - Although it has not been proved in RCTs of patients with both septic shock and meningitis
Treatment

- **ABCs**
- Adjunctive treatment:
  - IV fluid resuscitation (avoiding hypotonic fluids)
  - Seizures
  - Coagulopathy
  - Increased intracranial pressure
  - Hyponatremia
  - Hyperpyrexia
  - Thiamine depletion
Flash Quiz

- **Question**: An unfortunate resident is requesting chemoprophylaxis after a patient with N. meningitides meningitis sneezed in her mouth. She wears contacts and does not want to ruin them. What are second line antibiotics she could take?

- **Answer**: Ciprofloxacin 500 mg PO or Ceftriaxone 250 mg IM
Chemoprophylaxis

- Health care workers are not at increased risk unless they have had direct mucosal contact with secretions
  - ET intubation, NT suctioning, mouth-to-mouth resus

- **Rifampin**: 600 mg (adults); 10 mg/kg (children > 1 mo); 5 mg/kg c(<1 mo)
  - PO q12H for 4 doses

- Ciprofloxacin 500 mg by mouth (adults only) and ceftriaxone 250 mg IM (125 mg children <15 yrs) provide single-dose alternatives

- Only for *N. meningitides* and *H. influenzae*
Immunoprophylaxis

- **N. meningitides**: Elective vaccination to college freshmen
- **S. pneumoniae**: Too many serotypes
- **H. influenzae type b**: Great for kids
Morbidity & Mortality

Complications

- Focal paralysis
- Intellectual disorders
- Hearing loss
- Ataxia

Mortality

- Pneumococcal: 20-25%
- Meningococcal: 20%
  - Meningococcemia poor prognostic factor
- Listeria: as high as 40%
Putting It All Together

Suspicion for bacterial meningitis
Typical signs may be absent, prior antibiotics may mask severity of illness

Assess severity
Ventilation
Circulation
Neurologic examination

Start investigations
Blood cultures
Blood gases
Serum laboratory investigations
Chest x-ray
Rash: skin biopsy

Shock and/or coagulopathy?
Anticoagulant use
Disseminated intravascular coagulation

Yes
No

Shock: low dose steroids
No shock: DXM
Empiric antimicrobial therapy

Indications for imaging before lumbar puncture?

Yes
No

Lumbar puncture

Stabilization and/or correction coagulopathy

DXM and empiric antimicrobial therapy

Cloudy CSF or apparent progress of disease?

Yes
No

CT/MRI scan brain

CSF consistent with bacterial meningitis?

Yes
No

Bacterial meningitis: DXM and empiric therapy

Significant space-occupying lesion?

Yes
No

CSF consistent with bacterial meningitis?

Yes
No

Bacterial meningitis

No lumbar puncture

Reconsider diagnosis

Thanks, Rosen’s for simplifying the workup…
Viral Meningitis

- The most common type of meningitis
  - Most go unreported, approx 11 - 27 individuals/100,000

- Non-polio enteroviruses most common (85%)
  - Coxsackie virus A
  - Coxsackie virus B
  - Echoviruses
  - Enterovirus D68 and other Enteroviruses

- HIV
- Mumps Virus
- Herpesviruses: HSV-2, VZV, CMV, EBV; Mollaret’s
- Measles virus
- Influenza
- Arboviruses: West Nile Virus
- Lymphocytic choriomeningitis virus
Viral Meningitis

Most are short, benign, self-limited course followed by a complete recovery.

May discharge from ED w/ 24 hr follow up.
Fungal Meningitis

- Slowly progressing, subacute processes
- Cryptococcal
  - Immunocompromised (CD4 < 100)
  - Headache, ophtho issues, vomiting, seizures
  - High opening pressure, india ink stain, antigen
- Coccidioidal
  - SW USA, respiratory disease
- Histoplasma, Candida, Aspergillus
- Rx: Amphotericin B and flucytosine most common
Tuberculous Meningitis

- High clinical suspicion to treat
- RIPE (streptomycin)
- Corticosteroids
Aseptic Meningitis

- Other bacterial: **Syphilis**, leptospirosis, lyme disease, other tick-borne diseases, mycoplasma
  - CSF PCR, antigen testing, **VDRL**; serologies

- Parasitic: *T. gondii*, *T. solium*, *trichinella*, *N. fowleri*

- Drugs: NSAIDs, trimethoprim-sulfamethoxazole, azathioprine

- Autoimmune: Sarcoidosis, SLE, Behcet’s

- Malignancy: lymphoma, leukemia, metastatic

- Post-infectious and post-vaccine
CNS Abscess

- Subacute URI/sinusitis/IVDU/Nsg + focal neuro sx
- Head CT
- Ceftriaxone and metronidazole (+ vancomycin)
  - Previous neurosurgical patient get MRSA coverage
  - Steroids only if cerebral edema
- Neurosurgery consult for possible drainage
  - ID/Cards/CTS for possible endocarditis
Flash Quiz

- **Question**: You pick up the BT nursing home patient with “mental status changes.” With a clean UA, negative CXR, and mild fever, what is the treatment of choice for HSV encephalitis?

- **Answer**: Acyclovir 10 mg/kg IV every 8 hours
Encephalitis

- Viruses that cause encephalitis include the arboviruses, HSV-1, HZV, EBV, CMV, and rabies
  - Suspect 5-10% of ALL cases are due to HSV
- Most common arboviral encephalitides in the US: La Crosse, St. Louis equine, western, eastern equine, and West Nile virus
Signs and Symptoms

- Alteration of consciousness occurs in all patients

- Focal neurologic deficits and seizures occur much more commonly with encephalitis >> meningitis
  - May also have symptoms of meningeal irritation

- Fever, headache, and a change of personality
  - Hallucinations and bizarre behavior may precede motor, reflex, and other neurologic manifestations by several days

- HSV encephalitis results in a higher incidence of dysphasia and seizures

- WNV produces a myelitis resulting in a flaccid paralysis with a clear sensorium
Diagnosis

- Diagnosis rests on imaging studies using MRI; EEG and LP
  - **MRI/CT:** HSV encephalitis has medial temporal and inferior frontal grey matter involvement
    - “The diagnostic approach to patients with encephalitis must include neuroimaging—either MRI or CT. If neuroimaging is not used, the medical record should include documentation of the specific reasons” - IDSA
  - Asymmetric sharp waves on EEG

- **LP:** Usually similar to viral meningitis findings
  - HSV DNA PCR amplification and the identification early in the disease: Sens 95-100%, Spec 100%
  - **Elevated RBCs**, elevated protein, normal glucose
Treatment

- Acyclovir 10 mg/kg IV every 8 hours for HSV
  - Empiric treatment is recommended for any patient concerning for encephalitis pending results
  - We likely under treat in the ED

- Ganciclovir, foscarnet, and cidofovir are also effective in HHV infections
- Pleconaril has been effective in enteroviral disease
- Rabies treatment

- Admission to hospital; supportive care
Morbidity and Mortality

- Sequelae: Seizure disorders, motor deficits, and permanent changes in mentation/psyche

- Acyclovir treatment has reduced mortality of HSV encephalitis to 30%
  - Previously ~70%
Flash Quiz

**Question:** An HIV patient presents with a generalized tonic-clonic seizure. A CT scan is performed of the head as shown below. What treatment should be initiated?

**Answer:** Pyrimethamine and sulfadiazine

**Bonus Question:** Is serologic testing useful?

**Answer:** No - High prevalence of antibodies in the general population
Summary

- Ruling out meningitis/encephalitis is a big headache
- It is okay to “go out of order” for diagnostics and treatment of suspected bacterial meningitis
  - Steroids before or with antibiotics
- Pretend to know indications for when to CT a patient
- Aseptic/fungal meningitis in special populations
- Empirically treat encephalitis with acyclovir
  - More patients should be getting MRIs
- We have neurology, neurosurgery and ID always* available at this hospital
Questions?

References

- Are you still reading this? You really are…
- [http://www.cdc.gov/meningitis/viral.html](http://www.cdc.gov/meningitis/viral.html)
- Benson, PC and Swadron, SP. Empiric acyclovir is infrequently initiated in the emergency department to patients ultimately diagnosed with encephalitis. Annals of Emergency Medicine 2006; 47(1): 100-105.
Thank You

Sunset Cliffs, San Diego, CA May 15th, 2015