20.1.2 Post-neurosurgical procedure meningitis  
CSF fistula:  
- usually streptococci  
- for immunecompromised: usual organism + Cryptococcus neoformans, M. tuberculosis, HIV aseptic meningitis, L. monocytogenes  
 - empiric antifungal agents for cryptococcal meningitis:   
 - induction therapy: liposomal amphotericin B 3-4mg/kg IV QD + flucytosine 25mg/kg PO QID x 2 weeks  
 - consolidation therapy: fluconazole 400mg PO QD x 8 weeks  
 - chronic maintenance therapy: fluconazole 200mg PO QD

- if persistent post-traumatic CSF rhinorrhea:  
 - do not start antibiotics as this will super-select an organism  
 - watch for two weeks  
 - send 2-transferrin to confirm CSF  
 - place a lumbar drain for 4-5 days  
 - CT cisternogram to localize leak  
 - explore with ENT

20.1.3 Post craniospinal trauma meningitis  
- look for basal skull fracture and/or CSF rhinorrhea  
- abx chosen based on CSF penetration and organism sensitivity [vancomycin for gram (+) and imipenem and ciprofloxacin for gram (-)]  
- continue abx for 1 week after CSF is sterilized (if rhinorrhea persists, surgical repair is recommended)

20.1.4 Recurrent meningitis  
- evaluate these patients for abnormal communication (intraspinal/intracranial)  
- eg. Dermal sinus, CSF fistula, neurenteric cyst

20.1.5 Chronic meningitis  
- tuberculosis, fungal infections, cysticercosis, neurocysticercosis  
- diff dx: sarcoidosis, meningeal carcinomatosis

20.1.6 Antibiotics for specific organisms in meningitis  
- S. pneumoniae: PCN G, ceftriaxone, vancomycin  
- N. meningitides: PCN G, ceftriaxone, meropenem  
- H. influenza: aztreonam  
- Group B strep: ampicillin, vancomycin  
- L. monocytogenes: ampicillin + IV gentamicin, IV Bactrim  
- S. aureus: oxacillin or nafcillin, vancomycin  
 - if MRSA: vancomycin + rifampin, linezolid + rifampin  
- aerobic gram negative bacilli: ceftriaxone  
- P. aeruginosa: cefepime, meropenem, if ventriculitis: IT gentamicin or tobramycin  
- candida: liposomal amphotericin B 3-4 mg/kg IV QD

20.2 CEREBRAL ABSCESS  
20.2.1 General info  
- hematogenous, contiguous, direct trauma  
- symptoms progress rapidly  
- **Streptococcus** is most common organism  
- DWI with restricted diffusion  
- treatment: IV antibiotics, needle drainage for some, excision for fungal or resistant abscess

20.2.2 Epidemiology

20.2.3 Risk factors  
- dental procedures  
- pulmonary abscess or AV fistula  
- chronic sinusitis/otitis  
- congenital cyanotic heart disease (increased Hct and low PO2 provides a hypoxic environment)  
- immunecompromise (transplant, HIV)  
- bacterial endocarditis  
- penetrating head trauma

20.2.4 Vectors  
- hematogenous dissemination is the most common  
- abscesses following penetrating trauma require open debridement to remove foreign material and devitalized tissue

20.2.6 Presentation  
- seizures common  
- symptoms progress more rapidly than with neoplasms

20.2.7 Stages of cerebral abscess  
- takes two weeks to progress through maturation process  
- steroids prolong it  
1. Early cerebritis (days 1-3)  
2. Late cerebritis (days 4-9)  
3. Early capsule (days 10-13) – less developed along side facing ventricles  
4. Late capsule (> day 14) – collagen capsule, necrotic center, gliosis along capsule, firm resistance to aspirating needle (“pop” on entering)

20.2.8 Evaluation  
- CBC, ESR, CRP (may be normal)  
- LP may show organism, but can be dangerous and lead to herniation  
- due to associated risks and low yield, avoid LP  
- CT and MRI brain  
- Chest XR and chest CT to r/o pulmonary source  
- TEE with agitated saline (bubble study): look for patent foramen ovale or cardiac vegetations

20.2.9 Treatment  
- surgical: should be done if abscess is >/= 3cm in size  
- correction of primary source  
- IV antibiotics: 6-8 weeks with 4-8 weeks oral   
 - duration guided by clinical and radiographic response  
- medical treatment if duration of symptoms is < 2 weeks (suggests cerebritis stage), lesion < 3cm in size, patient shows clinical improvement within the first week of abx  
- medical treatment only if: poor surgical candidate (NB: local anesthesia and stereotactic biopsy can be done in almost any pt with normal clotting factors), multiple small abscesses, poorly accessible location, concomitant meningitis, ependymitis

Indications for surgical treatment:  
- mass effect  
- difficulty in diagnosis  
- proximity to ventricles  
- evidence of elevated ICP  
- poor neuro exam  
- traumatic abscess associated with foreign body  
- fungal abscess  
- multi-loculated abscess  
- f/u scans cannot be obtained every 1-2 weeks  
- failure of medical management: neuro change, progression towards ventricles, enlargement, if no decrease by 4 weeks

Management:   
- obtain blood cultures  
- initiate antibiotic therapy  
- prophylactic use of AED is optional  
- steroids controversial: reduces edema, but may impede therapy  
- avoid LP

Antibiotic selection:  
- MRSA unlikely if no h/o trauma or neurosurgical procedure  
- Start with: **Vancomycin** (15mg/kg IV Q8-12 hours to achieve a trough 15-20mg/dL + **ceftriaxone** + **metronidazole** (flagyl) 500mg Q6-8H  
- alternative to cefepime + metronidazole: meropenem 2g IV Q8H  
- Strep only: PCN G + ceftriaxone  
- MRSA: Vancomycin  
- MSSA: nafcillin 2g IV Q4H [peds: 25mg/kg IV Q6H]  
- Cryptococcus, aspergillus, candida: liposomal amphotericin B 3-4mg/kg IV QD + flucytosine 25mg/kg PO QID  
- AIDS patients: toxoplasma [sulfadiazine + pyrimethamine + leucovorin]  
- IV antibiotics for 6-8 weeks, followed by oral antibiotics  
- CT improvement may lag behind clinical improvement  
- duration of treatment may be decreased if abscess and capsule excised surgically

Glucocorticoids  
- reduce edema  
- decrease likelihood of fibrous encapsulation  
- reduce penetration of antibiotics into abscess  
- immunesuppression may be deleterious

Follow-up imaging:  
- decreased ring-enhancement, edema, mass effect  
- takes 1-4 weeks for lesion to improve  
- 95% of lesions will resolve with antibiotics alone (decrease in size by 1 month)

Cultures:   
- gram stain  
- acid-fast stain  
- modified acid-fast (looks for Nocardia)  
- aerobic and anaerobic cultures  
- fungal culture  
- TB culture  
- molecular testing (PCR) for viral infections

Excision of abscess:  
- can only be done in chronic phase  
- abx treatment can be shortened to ~3 days if total excision is performed  
- excision is recommended in abscesses assoc. with foreign bodies and most nocardia abscesses; may also be needed in fungal & multiloculated

20.3 SUBDURAL EMPYEMA

20.3.1 General information  
- SDE is more emergent than an abscess as it has not anatomic barrier (fibrin and collagen) to prevent spread  
- may be complicated by cerebral abscess and venous thrombosis

20.3.2 Epidemiology

20.3.3 Etiologies  
- direct extention of local infections

20.3.4 Organisms  
- most common organism: aerobic streptococcus

20.3.5 Presentation

20.3.6 Evaluation  
- LP can be dangerous

20.3.7 Treatment  
- emergent surgical evacuation  
- burr hole if early in the course and no loculations  
- craniotomy: debride and drain; do not try to remove material adherent to the cortex (may cause infarction)  
- antibiotics similar to cerebral abscess  
- prophylactic AED

20.3.8 Outcome

20.4 NEUROLOGIC INVOLVEMENT IN HIV/AIDS

20.4.1 Types of neurologic involvement  
Focal CNS lesions in AIDS:  
- toxoplasmosis  
- primary CNS lymphoma (PCNSL): associated with Epstein-Barr virus  
- progressive multifocal leukoencephalopathy (PML): caused by JC virus  
- cryptococcal abscess  
- TB (tuberculoma)

Neurosyphillis  
- caused by Treponema pallidum  
- CNS manifestations occur 10-20 years after infection with syphilis  
- four types: asymptomatic, general paresis, meningovascular, tabes dorsalis  
- serum VDRL or serum RPR (FTA-ABS to confirm diagnosis)  
- treatment: PCN G 3-4 million units IV Q4H 10-14 days; alternative: rocephin 2g IV QD for 10-14 days  
- f/u blood tests at 3, 6, 12, 24, and 36 months to make sure infection is gone  
- f/u LP for CSF fluid analysis Q6 months

20.4.2 Neuroradiologic findings in AIDS  
- MRI brain c/s contrast

20.4.3 Management of intracerebral lesions  
Toxoplasmosis: pyrimethamine + sulfadiazine + leucovorin  
PML: no proven effective treatment (antiretroviral therapy may help)  
CNS lymphoma: usually treated with RTX

Recommendations:   
- PML can usually be identified radiographically (usually multiple, non-enhancing, limited to white matter, no to minimal mass effect)  
- Toxoplasmosis and PCNSL cannot be differentiated on MRI alone  
- obtain toxoplasmosis serology (IgG)  
- if multiple enhancing basal ganglia lesions with positive toxo titer, high probability of being toxoplasmosis  
- if single enhancing lesion, PCNSL is more likely than toxoplasmosis  
- if no significant mass effect, send CSF for PCR of EBV and JCV (PCNSL and PML)

20.4.4 Prognosis

20.5 LYME DISEASE – NEUROLOGIC MANIFESTATIONS

20.5.1 General information  
- complex, multisystem disease  
- Borrelia spirochetes  
- transmitted by ticks

20.5.2 Clinical findings  
Three stages (can overlap or occur separately)  
1. Erythema migrans (“bulls-eye rash”) and flu-like illness  
2. Cardiac and neurologic  
- Classic neuro triad: cranial neuritis (mimics Bell’s palsy; can be bilateral), meningitis, radiculopathy  
3. Arthritis, encephalopathy, peripheral neuropathy, ataxia, dementia

20.5.3 Diagnosis  
- ELISA detects IgM or IgG; antibodies to B. burgdorferi  
- oligoclonal bands and elevated IgG may occur

20.5.4  
Antibiotic therapy is most effective in early stages of illness

20.6 NOCARDIA BRAIN ABSCESS  
- occurs primarily in patients with chronic debilitating illnesses  
- abx: Bactrim 15mg/kg IV QD in 2-4 doses + imipenem 500mg IV Q6H  
- duration of treatment: at least one year with CNS involvement and possibly indefinitely in immunecompromised hosts