Infectious Diseases of the Central Nervous System

Bacterial Meningitis

Most common form of CNS infection

Organisms reach the leptomeninges via hematogenous spread or direct extension

Spinal tap yields cloudy CSF with many neutrophils and bacteria may be seen

<table>
<thead>
<tr>
<th>Age group</th>
<th>Organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonates</td>
<td>Group B streptococci; <em>E. coli</em></td>
</tr>
<tr>
<td>Infants and children</td>
<td><em>Haemophilus influenzae</em> (now &lt;2 / 100,000)</td>
</tr>
<tr>
<td>Adolescents and young adults</td>
<td><em>Neisseria meningitidis</em></td>
</tr>
<tr>
<td>Elderly</td>
<td><em>Streptococcus pneumoniae</em></td>
</tr>
</tbody>
</table>
Pneumococcal meningitis
Brain abscess
Second most common infection of CNS following bacterial meningitis

Source of infection
Local contiguous spread (sinusitis, otitis, mastoiditis)
Hematogenous (Septic emboli from bacterial endocarditis, pulmonary infection, ect.)

Stages of cerebral abscess formation
Early cerebritis (1-3 days)
Late Cerebritis (4-9 days)
Early Capsule Formation (10-13 days)
Late Capsule Formation (14 days and later)
Early Cerebritis

Late Cerebritis

Early Capsule Formation
Late Capsule Formation
Cerebral Fungal Infections

Often seen as an opportunistic infection in immunocompromised patients

Typically reach CNS via hematogenous spread from other organs

May produce leptomenigitis, vasculitis, granulomas or cerebral abscess

Common Organisms

<table>
<thead>
<tr>
<th>Genus</th>
<th>Morphology</th>
<th>Patient status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspergillus</td>
<td>Septate hyphae</td>
<td>Opportunistic</td>
</tr>
<tr>
<td>Mucormycosis</td>
<td>Nonseptate hyphae</td>
<td>Opportunistic</td>
</tr>
<tr>
<td>Candida</td>
<td>Budding yeast, pseudohyphae</td>
<td>Opportunistic</td>
</tr>
<tr>
<td>Cryptococcus</td>
<td>Budding yeast, encapsulated</td>
<td>Opportunistic or previously healthy</td>
</tr>
</tbody>
</table>
Candida albicans
Candida albicans

Aspergillus sp.
Cryptococcus sp.
CNS viral infections

**Manifestations**
- 'Aseptic' meningitis
- Encephalitis
- Meningoencephalitis
- Myelitis

**Stereotypical tissue reactions**
- Inflammatory cell infiltrates
- Microgliosis
- Neuronophagia
- Microglial nodules
- Astrocytosis
- Intracellular inclusion bodies
- Neuronal cell degeneration
- Cellular and tissue necrosis
Herpes simplex virus encephalitis
Neuropathology of AIDS

Human immunodeficiency virus type 1 (HIV-1)

**Primary complications**
- HIV encephalitis or AIDS dementia complex
- HIV-associated myelopathy (vacuolar myelopathy)
- HIV-associated neuropathy (distal sensory neuropathy)
- HIV-associated myopathy

**Secondary complications**
- Opportunistic infections
  - Cryptococcosis
  - Toxoplasmosis
  - Progressive multifocal leukoencephalopathy
  - Cytomegalovirus infections
  - Primary CNS lymphoma

Microglial nodule with multinucleated giant cell
Toxoplasma

Progressive multifocal leukoencephalopathy
Cytomegalovirus encephalitis / ventriculitis
Transmissible spongiform encephalopathies - Prion diseases

**Creutzfeldt-Jakob Disease**
Worldwide incidence of approximately 1 per million
Peak incidence in seventh decade of life
Sporadic (85%), familial (15%) or iatrogenic transmission (very rare)
Rapid progressive dementia, myoclonus, ataxia, usually fatal < 1 year

**Other Human Prion Diseases**
Gerstmann-Straussler-Scheinker disease
Fatal familial insomnia
Kuru
New Variant CJD (Mad Cows Disease)

**Animal Prion Diseases**
Scrapie
Bovine spongiform encephalopathy
Others

Cytomegalovirus encephalitis
Prion Hypothesis

PrP is a 30-KD normal cellular protein present in neurons.
Disease occurs when PrP undergoes conformational to a protease resistant form.
This change occurs spontaneously at a very low rate, resulting in the sporadic cases.
Various mutations in PrP facilitate the conformational change in familial cases.
The infectious nature comes from ability of PrP<sub>sc</sub> to conformation of normal PrP.
How accumulation of PrP<sub>sc</sub> causes neuronal cell death is still not understood.
*New variant* CJD
Other infections of the CNS

Arbovirus infections (arthropod-borne)
Poliomyelitis
Neurosyphilis
Neuroborreliosis (Lyme Disease)
Tuberculosis
Cysticercosis