# 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; E. coli</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 embol from bacterial endocarditis, pulmonary infection, etc.)

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)
Cerebral Fungal Infections

- Often seen as an opportunistic infection in immunocompromised patients
- Typically reach CNS via hematogenous spread from other organs
- May produce leptomeningitis, 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 or previously healthy</td>
</tr>
<tr>
<td>Cryptococcus</td>
<td>Budding yeast, encapsulated</td>
<td></td>
</tr>
</tbody>
</table>
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
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

Large necrotic Toxoplasma lesion

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
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-familial cases.

The infectious nature comes from ability of PrP<sup>sc</sup> to conformation of normal PrP. How accumulation of PrP<sup>sc</sup> causes neuronal cell death is still not understood.

Other infections of the CNS

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

'New variant' CJD