Acute Viral Encephalitis and Brain abscess:

**Acute Viral Encephalitis:**

- Approximately 20,000 cases of encephalitis occur in the USA each year, almost all of which are caused by viruses.

**Causes of Acute viral Encephalitis:**

1- **Herpes simplex virus-1:**

- Common etiology of sporadic viral encephalitis.
- It is accounting for 10% of cases in USA.
- For these cases, it is associated with 70% mortality rate.
Virology: (Herpes simplex virus-1):

**Classification:**
**Family:** Herpesviridae.
**Subfamily:** - Alphaherpesvirinae;
    - (Rapid cytocidal growth cycle).

**General properties:**
- Icosahedral enveloped double stranded DNA virus.
- Latency in nerve ganglia.
Pathogenesis of HSV-1:
- Primary infection of upper respiratory tract epithelial cells; mild pharyngitis, or gingivostomatitis.
- Virus transported up peripheral nerve to sensory neuron in trigeminal ganglion.
- A latent infections are established in sensory neuron of trigeminal ganglion.
- Fibers emerging from the trigeminal ganglion innervate the Dura of the middle and anterior cranial fossa, and meningeal arteries.

- Infection of meninges to the contiguous cortex.

- Infection of CNS parenchyma of temporal and frontal lobes respectively.
- Destruction of neurons of temporal and frontal lobes; causes mononuclear infiltration from the perivascular sheaths (Virchow-Robin spaces).

- None-effective immune response; lymphocytic infiltration; severe destruction of brain tissue.

- Focal cerebral cortical encephalitis.

**CNS infectious diseases occur in two forms:**

1- Nondisseminated neuronal transmission: (limited to the CNS).

2- Hematogenous dissemination with multi-organ involvement.
2-Rabies Virus infection: Zoonosis:

Virology:

Classification:

Family: *Rhabdoviridae*.
Genera: *Lyssavirus*.
Species: Rabies.

General properties:

- Helical enveloped single-stranded RNA virus.
- Neurotropism: Entry into the neuron by receptor-mediated endocytosis.
- Surface glycoproteins are antigenic for production of neutralizing antibodies.
Pathogenesis of Rabies:

- Bite of an infected animal, or exposure of mucous membrane or non-intact skin to animal saliva.
- Incubation period (1 to 3 months).
- Local replication, neuromuscular junction, infection of peripheral nerves.
- The virus travels within the axoplasm of peripheral nerves to the spinal ganglia.
- Spinal cord infection, to brainstem, cerebellum, and other brain parenchymal tissue (diffuse encephalitis).
- From brain tissue, the virus travels along autonomic nerves to skin, cornea, and salivary glands.
Pathogenesis of Rabies:

1. Virus enters via animal bite
2. Virus replicates in muscle at site of bite
3. Virus infects nerve in peripheral nervous system
   Moves by retrograde transport
4. Virus replicates in dorsal root ganglion and travels up spinal cord to brain
5. Brain infected
6. Virus travels from brain via nerves to other tissues such as eye, kidneys, salivary glands
3-Arboviruses: (Arthropod-born Viruses):
- Transmitted by insects; usually Mosquitoes, or Ticks.

**A-Flaviviridae Family:**

**General properties:** Icosahedral enveloped single stranded RNA viruses.

**Examples:**

1. **West Nile virus:** Encephalitis in America, Africa, Middle East, and Europe.
2. **Japanese encephalitis virus:** Asia, India, Australia.
3. **Tickborne encephalitis virus:** Russia, Europe.

**B-Togaviridae and Bunyaviridae:** Mainly in USA.
Pathogenesis of Flaviviridae:

- Mosquito bite; skin inoculation; infection of endothelial cells of small blood capillaries and skin dendritic cells.

- Infection of blood phagocytes, **Primary viremia**;
  
  **Infection of Reticuloendothelial system.**

- **Secondary viremia**; the virus cross the blood-brain barriers through the choroid plexus to infect ependymal cells and periventricular brain tissues.

- **Subcortical white matter encephalitis**.
4-Enterovirus infection:

Classification: *Picornaviridae*.

Etiology: Coxsackievirus A and B, Poliovirus, and Echovirus.

General properties:
Icosahedral non-enveloped single-stranded RNA virus.

Pathogenesis:
- Viral replication in oropharynx and intestinal mucosa (epithelial cells and lymphoid cells).
- Intestinal mucosa lymphoid tissue infection; Viremia.
- Meninges infection; aseptic meningitis.
- **Poliovirus** could be transferred by retrograde axonal transport.

- Infection of the neurons of the gray matter of both the brain and spinal cord; then destroy them by its lytic replication cycle.

- **Acute encephalomyelitis** and **Poliomyelitis**.

- **Coxsackievirus A** and **B** encephalitis is established from meningitis.
Diagnosis of Viral Encephalitis:

- CSF abnormalities are similar to those found in viral meningitis.

- **Leukocytes count** in CSF: 10-500 cell/mm$^3$.

- **%Neutrophils**: May predominate in first 24 hours, then decreased. **Lymphocytes increased**.

- **Red blood cells** per mm$^3$: 10-500 cells (HSV infection). RBCs are not present in other CNS infections.

- **Glucose Concentration** mg/dL: 40-80 (normal).

- **Protein Concentration**: mg/dL: 50-100 (Elevated).  
  normal protein: 20-50mg/dl.

- **Molecular detection of virus genes by PCR**.
Brain Abscess:

- **Brain abscess** is a focal infection of the brain parenchyma, which may be caused by bacteria, fungi, or parasites.

- Microorganisms that cause brain abscess reach the brain by:

  1- **Direct extension from a contiguous focus of infection** (Otitis media, and Mastoiditis).

  2- **Hematogenous dissemination**: (acute bacterial endocarditis).

  3- **Direct penetration**: (Skull fractures or surgical procedures).
In the case of infections of middle ear, or mastoid;

The veins that bridge the surrounding bony structures and cerebral cortex can become infected (Septic thrombophlebitis); Decreased local blood supply and acts as a reservoir of bacteria.

Causes of Brain Abscess:

1-Acute Brain Abscess.

2-Chronic Brain Abscess.
Acute Brain Abscess:

- *Staphylococci*, Mixed anaerobic and aerobic bacteria, and Group A and D *Streptococci*.

-The mixture of aerobic and anaerobic bacteria is similar to the combination of bacteria found in the external ear canal or a parameningeal focus such as otitis media.

Treatment:

-Broad-spectrum antibiotics: (Example: Vancomycin, metronidazole, and ceftriaxone).
Chronic Brain Abscess:
(located in either meninges or brain tissues).

- The most common causative agents are:
  1- Bacteria: *Mycobacterium tuberculosis*.
  2- Fungi: *Cryptococcus neoformans*, or other fungi.

Other causes of Brain Abscess:

3- Parasites:
   A- *Taenia solium* (Cysticercosis).
   B- *Toxoplasma* species.
   C- *Entamoeba histolytica*.
      (Extraintestinal Amoebiasis: Rare).