Neuroscience II

Lecture 3

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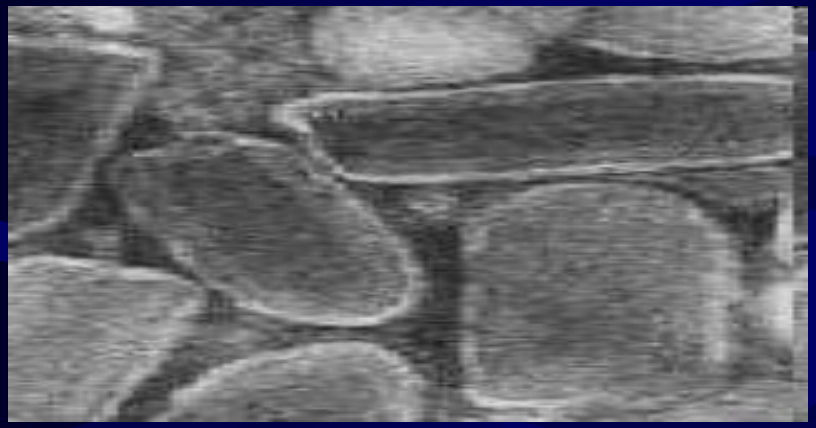
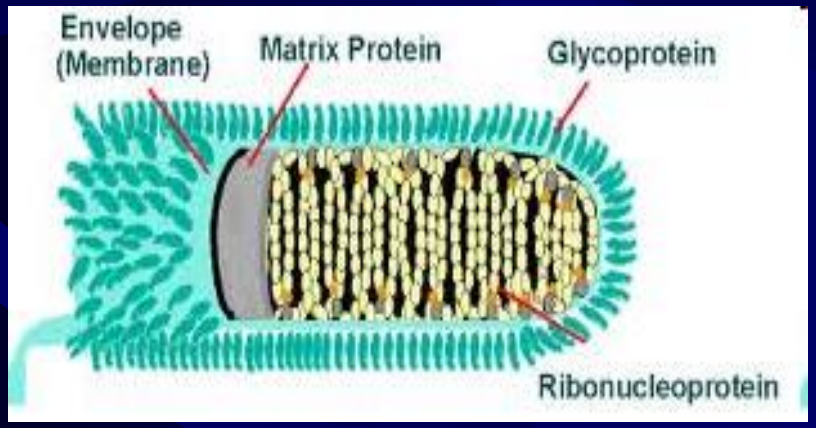
Rabies

Main properties:

- Belongs to Rhabodo viruses family
- Single stranded negative sense RNA
- Has its own RNA-dependent RNA transcriptase
- Surrounded by a bullet shaped capsid and a lipoprotein envelop
- Single antigenic type
- It has a broad range of hosts, all mammals basically but also birds, reptiles.

Rabies Virus





Rabies

Life cycle:

- Virus enters the muscular cell following the bite and replicate there > The viral RNA needs to be converted into a positive sense RNA > by the viral RNA transcriptase

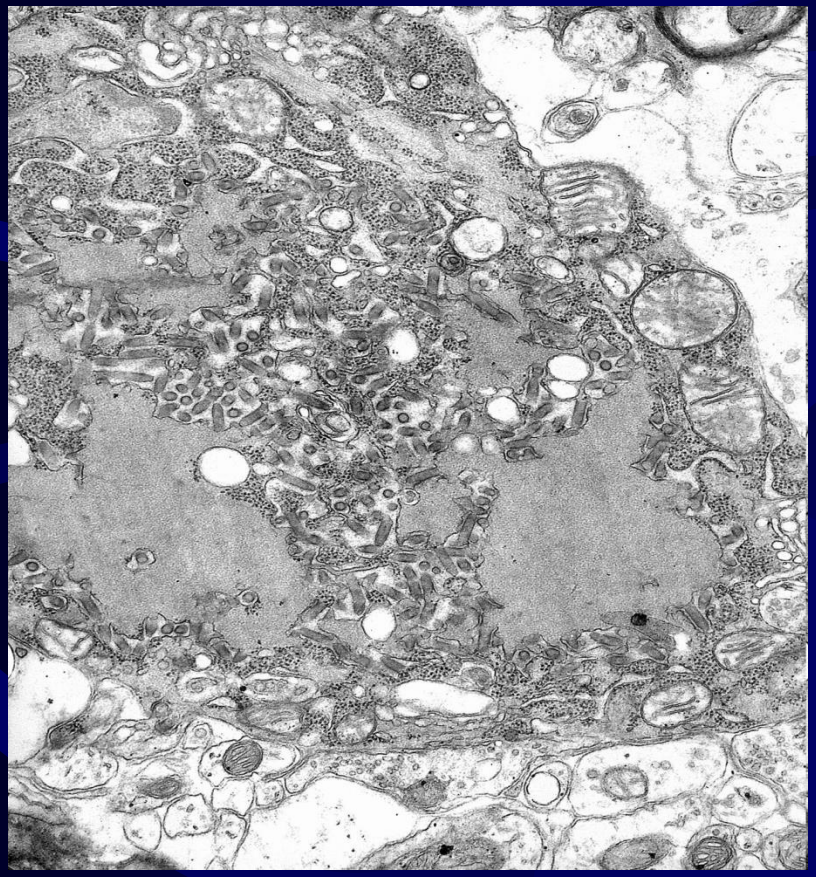
- Viral RNA replication and protein synthesis > budding through the cell membrane
- Enters the neuron via acetylcholine receptors (could be wider) > Transported from the neurons to the CNS where it replicates in the brain (grey matter and brain stem, medulla)
- The virus migrates peripherally via autonomic nerves to salivary glands, conjunctiva, lactating glands, kidneys, hair..

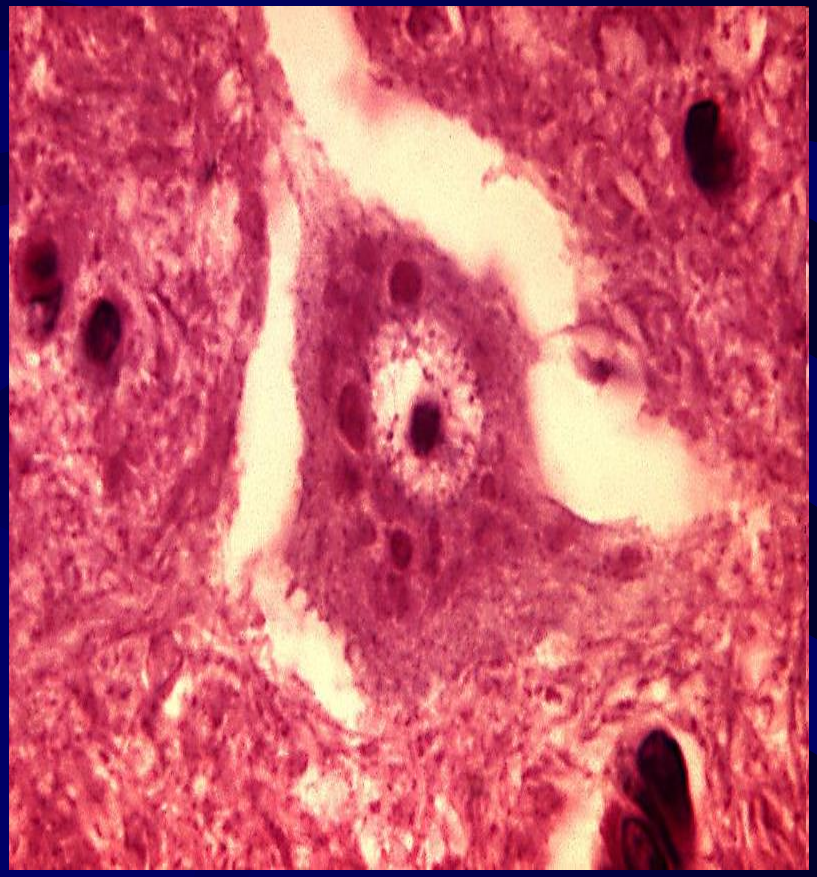
Rabies

Pathology:

- Nerve cell degeneration
- Eosinophilic Intracytoplasmic inclusion bodies (Negri's bodies)

Negri's bodies





Rabies

Transmission:

Through non intact skin

- Bites of rabid animals (bats, cats, dogs, racoons, foxes, skunks)
- Abrasion or scratches on skin

Also

- Mucous membrane exposed to saliva from licks
- Inhalation of bats secretions

Rabies transmission

Rabies

- Incubation period:

1 week – 5 year (1 week – 3 months on average)

- Risk of developing rabies after a bite: 5-80%.
  - Depends upon….
    - Severity of exposure
    - Location of the bite
    - The biting animal

    - **Bites on head and neck have shorter incubation time (as short as 15 days) because of rich peripheral nerve supply

Rabies

Two clinical patterns:

Dumb (paralytic) and Furious (encephalitis)

- Non-specific symptoms:

Bite site pain numbness, Fever, headache, dry throat, cough, insomnia

1. Dumb:

- symmetrical ascending paralysis
- 1/3 of cases
- May develops into encephalitis in 2-3 weeks > coma and death

Rabies

3. Furious:

- Encephalitis (delirium, convulsions, coma and death)
- Hydro and aerophobia
- In 2/3 cases
- Death usually in 1 week

- **Prognosis:**

✓ Once symptoms occur: fatal in 3-10 days

Rabies

Diagnosis:

Samples:

- Hair follicle
- Brain and salivary glands
- Serum, CSF

Tools:

- Serology: ELISA detection of antibodies detection
- Histology (post mortem)
- Reverse transcription – PCR

- Also animal observation for 10-14 days

Rabies / treatment

- No effective treatment exists.
- Post exposure Prophylaxis

1. **Wound care**:
   - immediate thorough washing with soap and water and povidine-iodine
   - Doxycycline to caver for anaerobic bacteria

Rabies

2. Passive immunity:

- Anti rabies immunoglobulin
- 20 IU/kg
- Half at wound area and half I.M (gluteal muscle)
- As soon s possible

3. Active immunisation:

- Killed virus
- I.M in deltoid muscle
- 5 doses at 0, 3, 7, 14 and 30 days

Prevention:

- Vaccination of animals and those who work with animals
- Inhibit animals smuggling

RABIES BE CAREFUL

Arboviral Encephalitis

- Arboviruses are *ar*thropod-*bo*rne *viruses*
  - Viruses are transmitted between hosts by blood-sucking arthropods (ex. mosquitoes)
- Mosquito-borne arboviruses cause various types of arboviral encephalitis
- As zoonotic diseases they rarely affect humans
- Signs/Symptoms
  - Arboviruses usually cause mild, coldlike symptoms
  - Arboviruses that cross the blood-brain barrier can cause encephalitis with symptoms similar to meningitis

Transmission of Encephalitis Arboviruses

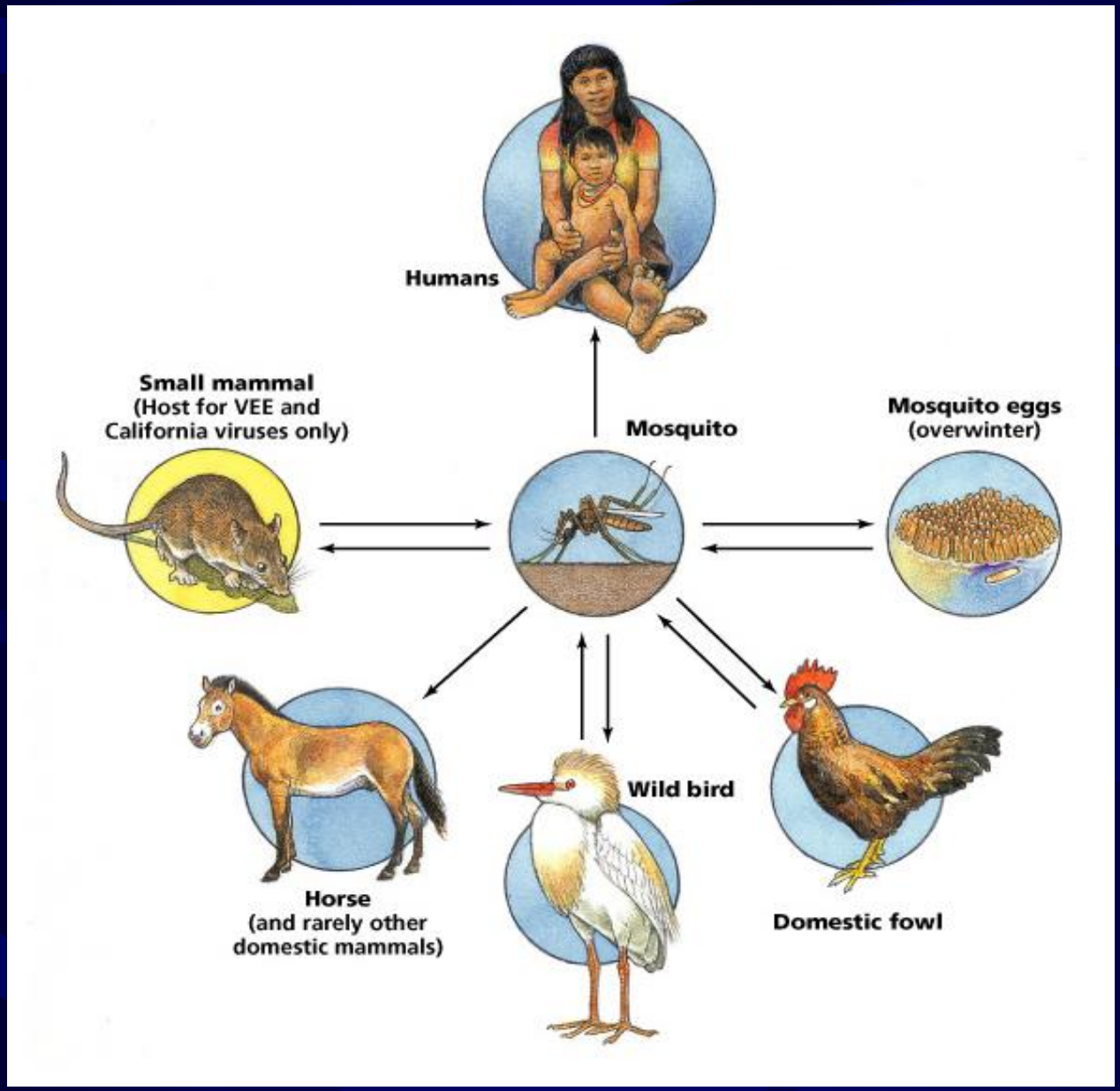


Figure 20.15

Arboviruses

- Arboviruses that can affect the nervous system :

- Alphaviruses (Togaviruses):

1. Eastern equine encephalitis (EEE)

2. Western equine encephalitis (WEE)

3. Venezuelan equine encephalitis (VEE)

Arboviruses

- Flaviviruses:

1. Japanese encephalitis
2. St Louis encephalitis
3. West Nile virus
4. Dengue virus
5. Tick-borne encephalitis

- Bunyaviruses:
- Rift valley virus

- Reoviruses:
- Colorado tick fever

Arboviruses / Japanese encephalitis

- In clinical cases, a life-threatening encephalitis can occur with complication
- Fatality rate : 30%; flaccid Paralysis (Parkinsonian syndrome) as a complication: 30%
- Vaccine: Yes (live attenuated and killed)

Prions

Main properties:

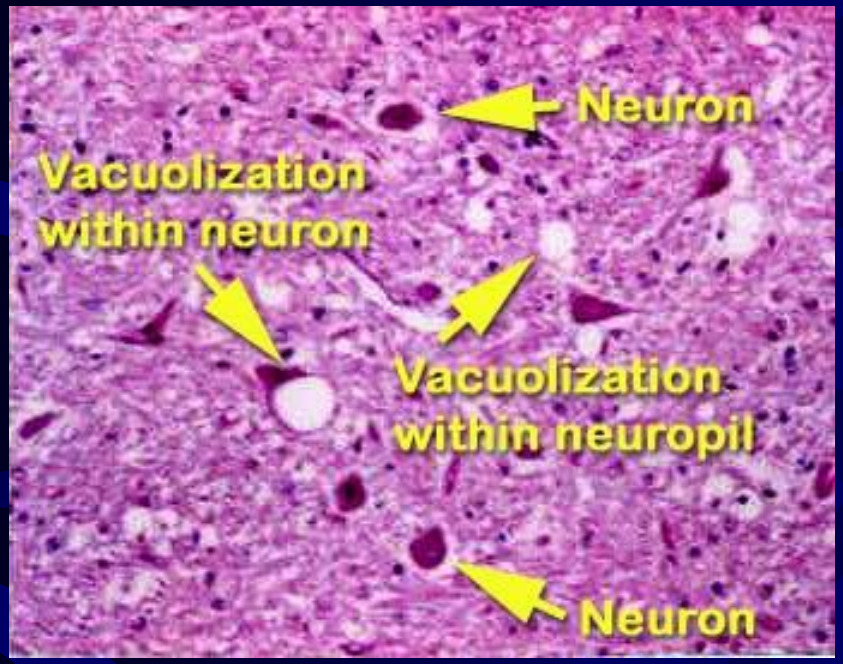
- Occurs in humans and animals causing transmissible spongiform encephalopathies
- These proteins have no nucleic acid
- Highly resistant to heat and disinfectants
- Sensitive to hypochlorite, sodium hydroxide, and phenols
- No immune response is generated to these proteins
- No specific treatment

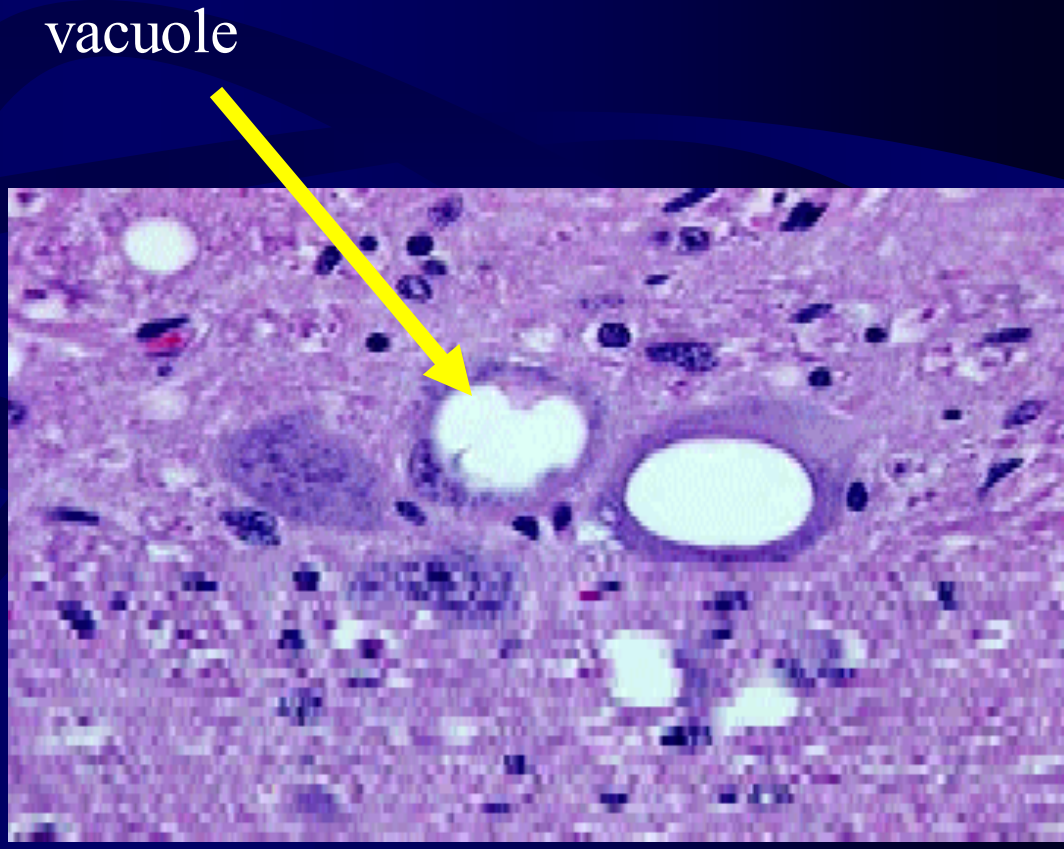
- Caused by a mutant normal human protein $PrP^{c} > PrP^{sc}$

Prions

- First identified with “Spongiform encephalopathies”
- Characteristics of infection:
  - Loss of motor control
  - Dementia
  - Paralysis
  - Encephalitis
  - Widespread neuronal loss
- Ways of infection:
  - Infectious, Iatrogenic (including diet, after surgical procedures, corneal transplants etc.)
  - Hereditary (autosomal and dominant)

Brain Damage from Spongiform Encephalopathy





Source: UC Davis School of Veterinary Medicine

Transmissible spongiform encephalopathies

- Animals
  - Bovine spongiform encephalopathy (BSE)
  - Scrapie in sheep and goats
  - Chronic wasting disease of deer, elk
- Humans
  - Kuru
  - Creutzfeldt-Jacob disease (CJD)
  - Fatal familial insomnia (FFI)
  - Gerstmann-Straussler syndrome (GSS)
- TSEs are always fatal

Papua New Guinea