Pathogenesis, Diagnosis and Prevention of Rabies in dogs, livestock and wildlife

Prof. Panduka Gunawardena

Rabies Diagnostic Unit

Faculty of Veterinary Medicine and Animal Science

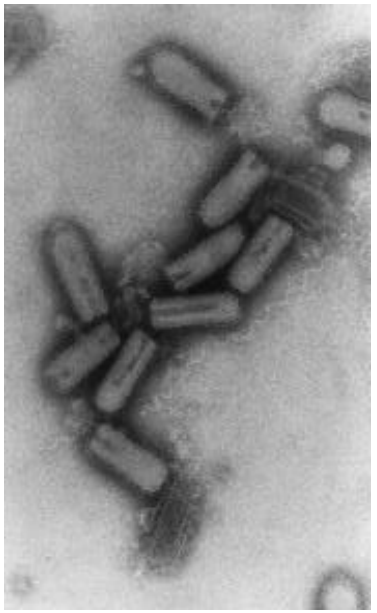
University of Peradeniya

What is rabies?

- A viral disease
  - Caused by Lyssaviruses
- A zoonotic disease
  - All mammals including humans are susceptible
  - Primarily a disease of mammalian carnivores and bats
- An invariably fatal disease
  - 100% fatality rate
- A disease with high economic and social impact

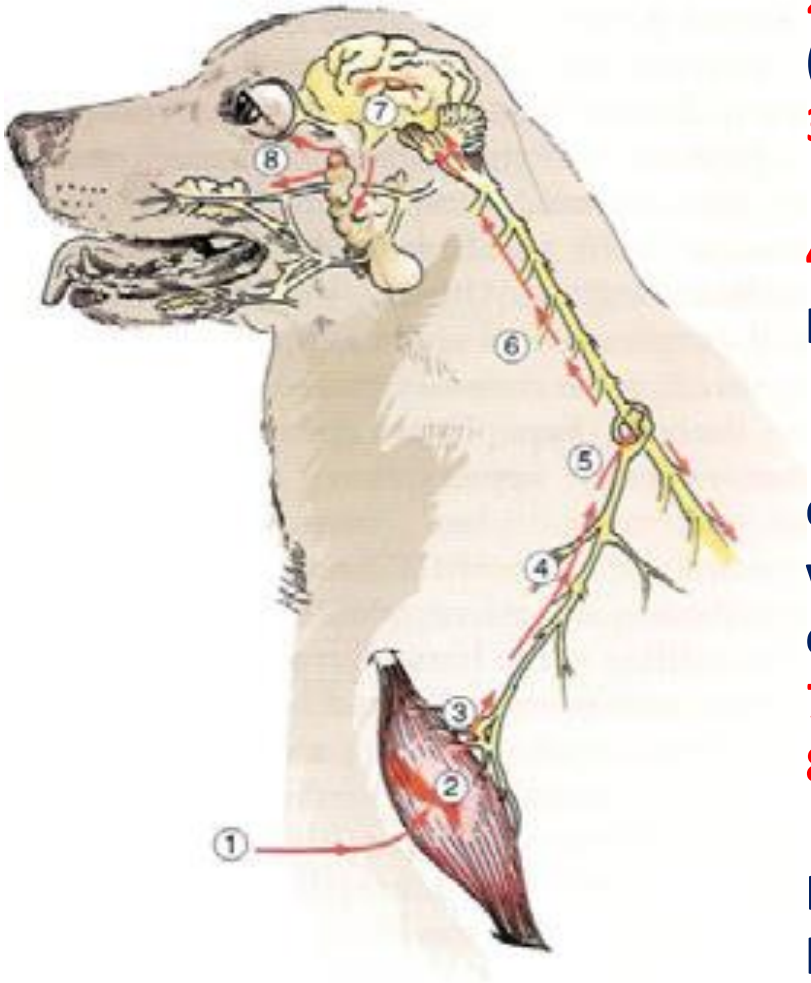
Rabies - Aetiology

- Genus – Lyssavirus
  - All lyssaviruses are pathogenic and neurotrophic
- Species - more than 20 species world-wide
  - Rabies virus (RABV) is the most common
- Phylogroups
  - Phylogroups I, II, III
- Lyssavirus species in Sri Lanka
  - Rabies virus (RABV) is the most common
    - A few variants, e.g. civet, bat
  - Gannoruwa Bat Lyssavirus (GBLV)
    - Found in bats
- Natural infection cycles of lyssaviruses in Sri Lanka
  - Urban (street) Cycle: mainly dogs and cats
  - Sylvatic cycle: wild carnivores and bats



Rabies – Pathogenesis…

Development of Lesions/Disease



1. Bite wound

2. Initial viral replication cycles in muscle (eclipse phase – several days to months))

3. Direct entry to the peripheral nerves is also possible

4. Retrograde axonal transportation via the peripheral nerves to

5. dorsal root ganglion

6. spinal cord – ascending and descending nerve fiber tracts carry the virus to the brain & other regions of spinal cord.

7. Infection of brain cells

8. Centrifugal spread of the virus to other tissues such as salivary glands.

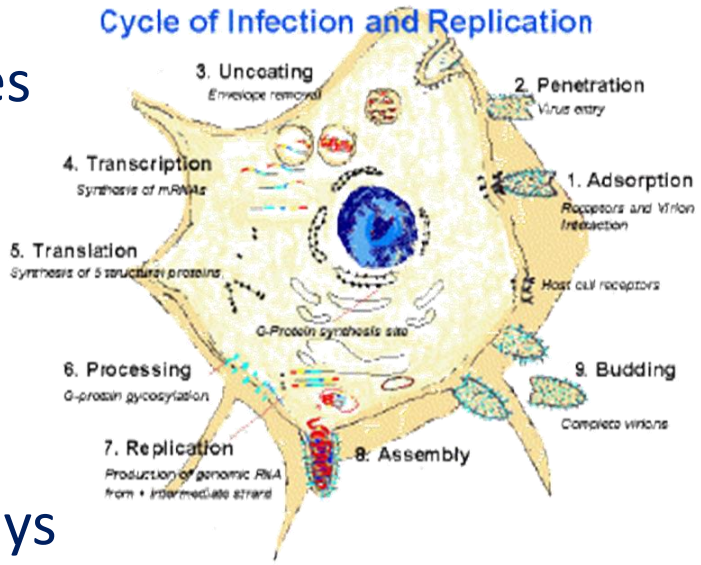
Inflammatory and necrotic changes in the brain lead to development of neurological signs

Rabies – Pathogenesis…

- Dissemination of virus includes early involvement of limbic system neurons in the brain.
- Limbic system (thalamus, hypothalamus, hippocampus, amygdala) concerns with emotion, behaviour, motivation, long-term memory, olfaction.
- By attacking the limbic system, the virus very effectively changes the behaviour of its victim. That's how this fragile, tiny, virus changes the **man's best friend** into the **man's worst enemy** by brain washing its host.
- An interesting characteristic of the rabies virus is that it infects the brain, triggering the animal to become aggressive and develop an urge to bite to ensure transmission to its next host.

Rabies – Incubation Period

- Incubation period in animals
  - Unknown in most animal species
  - Depends on the site and size of inoculation and the animal species involved.
- Dogs and cats
  - Usually less than 6 months.
  - Commonly between 2 weeks to 3 months.
  - Virus may be shed for up to 10 days prior to onset of clinical signs in animals.
  - Presence and number of viral particles in body secretions may vary from time to time.



Rabies – Clinical Diagnosis
Clinical manifestations in Carnivores

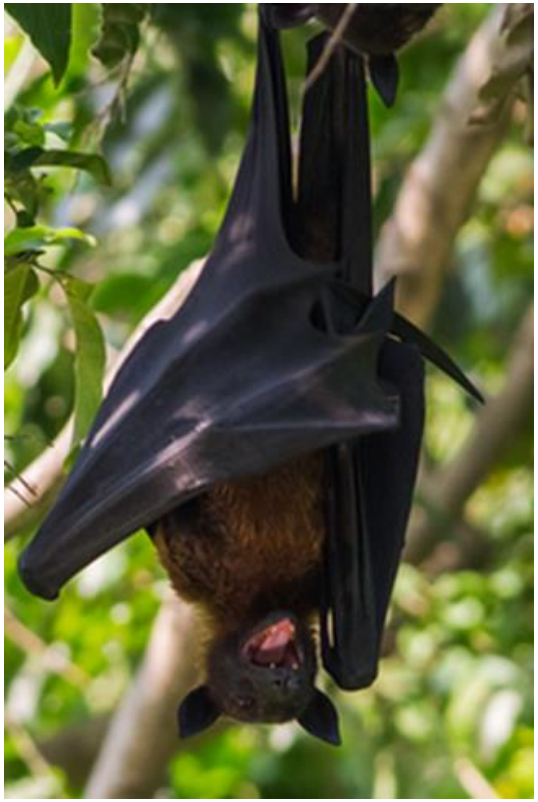
- Initially non specific signs
  - Anorexia, lethargy, fever, dysphagia, excessive salivation, vomiting, diarrhoea, straining to urinate and defecate
- Furious
  - Behavioural changes – increased aggressiveness, abnormal vocalization, restlessness, fearfulness, wandering, biting anything encountered, self-mutilation, convulsions
  - Cranial and peripheral nerve deficits may occur
- Dumb
  - Depression, progressive paralysis, pharyngeal & hypoglossal paralysis, respiratory paralysis
- Death usually occurs within 3-8 days of the onset of clinical signs.

Rabies – Clinical manifestations in Herbivores

- Anorexia
- Dysphagia
- Excessive salivation (foaming at the mouth)
- Head pressing
- Aggressiveness
- Bellowing (rabid cattle often exhibit a unique vocalization)
- Continually trying to defecate/ unproductive defecation
- Unexplained hind-limb lameness
- Paresis/paralysis
- Coma/death

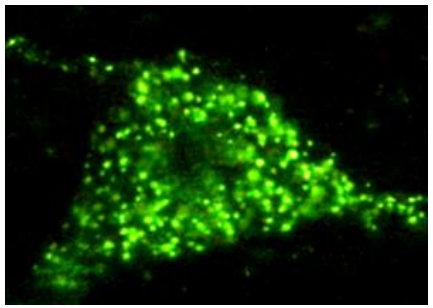
Rabies – Clinical manifestations in Bats

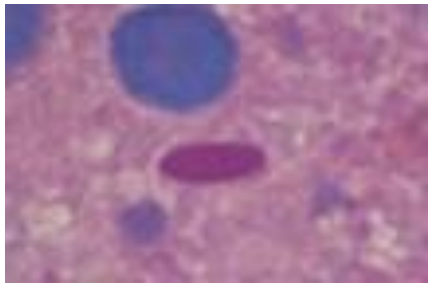
- Anorexia
- wandering in daytime
- Aggressiveness/biting
- Paresis/unable to fly
- Nystagmus
- Spontaneous vocalization
- Intermittent seizures (≠10 seconds)
- Death within a few days after onset of clinical signs

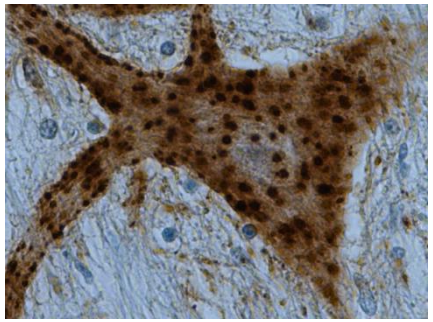


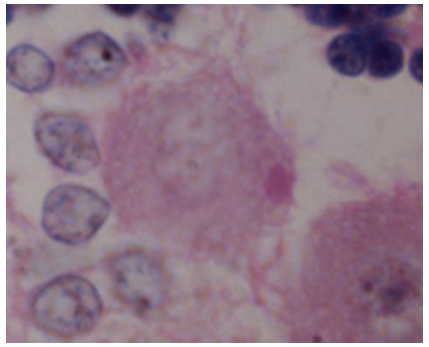
Rabies - Laboratory Diagnosis

- Fluorescent antibody test (FAT)
  - Gold standard test
- Other tests
  - Negri body test using Seller's stain
  - Immunohistochemistry (IHC)
  - Histopathology
  - Electron microscopy (EM)
  - Polymerase chain reaction (PCR)
  - Mouse inoculation test (MIT)
- Ancillary tests
  - DRIT
  - Rapid kits









Case definition of animal rabies

- Clinical case definition
  - rabies cannot be confirmed clinically.
  - However, clinical signs can be useful in identification of rabies in suspected animals.

1. **Suspected case of rabies**

   A case that is compatible with a clinical case definition of animal rabies.

2. **Probable case of rabies**

   A suspected case with a reliable history of ;

   contact with a suspected, probable or confirmed rabid animal and/or

   contact with an animal with suspected, probable or confirmed rabies that is killed, died or disappeared within 5 days of illness being observed.

3. **Confirmed case of rabies**

   A suspected or probable case that is confirmed in a laboratory.

4. **Not a case of rabies**

   A suspected or probable case that is ruled out by laboratory tests or epidemiological investigation (i.e. after subjected to appropriate quarantine period of eligible animals).

Rabies – Animal Vaccination Facts

- Serum antibody titres do not directly correlate with protection because other immunological factors also play a role in preventing rabies.
- However, the ability to measure and interpret those other factors are not well developed.
- Rabies vaccine is effective in healthy dogs, cats, cattle, sheep, goats, horses, ferrets, foxes and in principle all healthy mammals against the disease.
- An animal can be considered immunized within 28 days after initial vaccination, when a peak rabies virus antibody titre is reached.
- Rabies vaccine induces excellent antibody responses in previously vaccinated dogs 14 days after administration.
- Level of **maternal antibodies** acquired through colostrum begins to decline **two days** after birth in dogs.
- **Over-vaccination** may result in **hypersensitivity, autoimmune** and **neoplastic diseases**.
- Recent research suggests that high quality non-adjuvanted recombinant rabies vaccines may only be needed every 5 years.
- Vaccination schedules vary with the manufacturers, local authorities and animal species.
- Many animal rabies vaccine brands are available and used in Sri Lanka.

Rabies – Animal Vaccination Schedules

- Vaccination is the main method of rabies prophylaxis in animals
- There are two types of prophylaxis
  - pre-exposure
  - post- exposure
- It is always advisable to follow the manufacturer's directions
- Since there are many brands of animal rabies vaccines with different schedules used in our country, it is not sensible to decide on one vaccination schedule
- However, the manufacturer's schedule is suitable and applicable in animals which are managed properly
- Therefore, it is better to have two types of pre-exposure vaccination schedules
  - Manufacturer's schedule for the properly managed animals
  - Adjusted schedule for other animals
- In this way we can also encourage responsible animal ownership

Rabies – Pre-exposure prophylaxis (vaccination)

- **1. Manufacturer's pre-exposure vaccination schedule**
  - recommended for well-kept animals in low-risk environments and properly vaccinated using high quality vaccines
- Dogs, cats, livestock and domesticated mammals
  - 1st (primary) vaccination: given at age according to product label directions
  - 2nd vaccination: given at age according to product label directions
  - Revaccination: frequency according to product label directions
- Zoo & captive animals
  - Most zoos vaccinate their animal handlers against rabies, not their animals. But some vaccinate the animals depending on the situation and necessity
- Wildlife
  - No parenteral vaccines are recommended, only oral vaccines are used

Rabies – Pre-exposure prophylaxis (vaccination)…

- **2. Adjusted pre-exposure vaccination schedule**
  - recommended for the animals to which the manufacturer's pre-exposure vaccination schedule is not appropriate
- Dogs, cats & livestock
  - 1st (primary) vaccination: at **earlier** than 1st vaccination of the product label directions
  - 2nd vaccination: at 1st vaccination of the product label directions
  - Revaccination: **every year** after 2nd vaccination

Rabies – Post-exposure prophylaxis (vaccination)

For all animal species

Dose number	Timing
1st	Day 0 (as soon as possible following bite/exposure)
2nd	Day 3
3rd	Day 7
4th	Day 14
5th	Day 28

Pathogenesis, Diagnosis and Prevention of Rabies in dogs, livestock and wildlife

- Rabies is the number one zoonotic disease in our country in terms of its fatality and socioeconomic impact.
- Rabies is primarily an animal disease maintained naturally in urban and sylvatic cycles affecting mainly dogs, cats, and wildlife.
- Control of animal rabies is the key to control the disease in humans.
- Understanding of its aetiology, pathogenesis, clinical manifestations, diagnosis, and pre and post exposure prophylaxis are very useful in rabies prevention and control.


Thank You