
بسم الله الرحمن الرحيم

Special Virology 355

Lecture Series VIII

Family: Rhabdoviridae

Dr. Haitham M. Amer, DVM, Ph.D.

Virology Department, Faculty of Veterinary Medicine, Cairo University, Giza, 12211, Egypt

Introduction

- The family Rhabdoviridae contains 144 viruses of vertebrates, invertebrates (arthropods), and plants.
- Important animal viruses:
  - Rabies virus
  - Vesicular stomatitis virus
  - Bovine ephemeral fever virus
  - Several fish rhabdoviruses (SVC)
- Rhabdo = Rod (bullet) shape

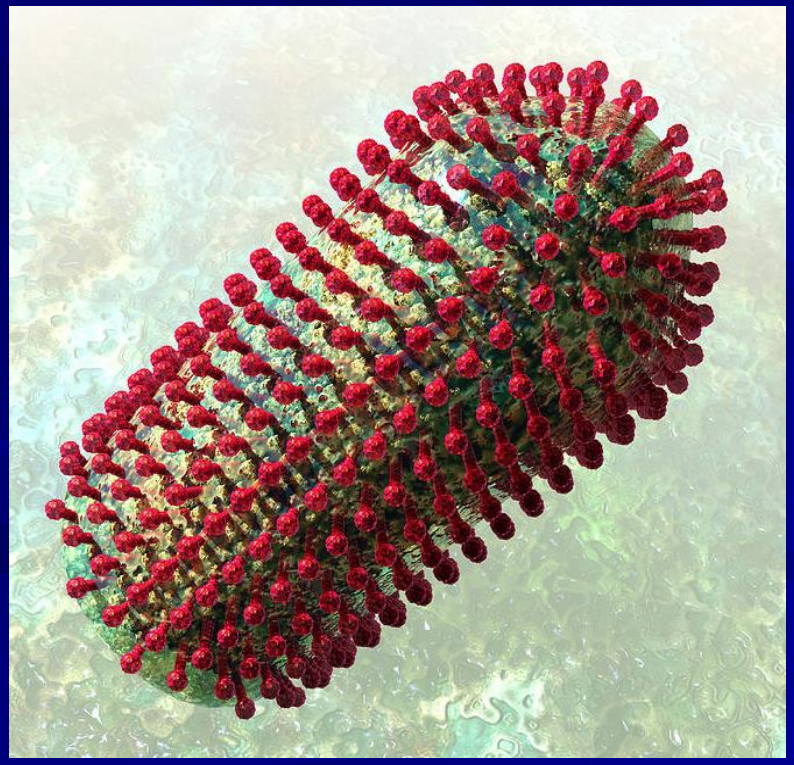
Taxonomy

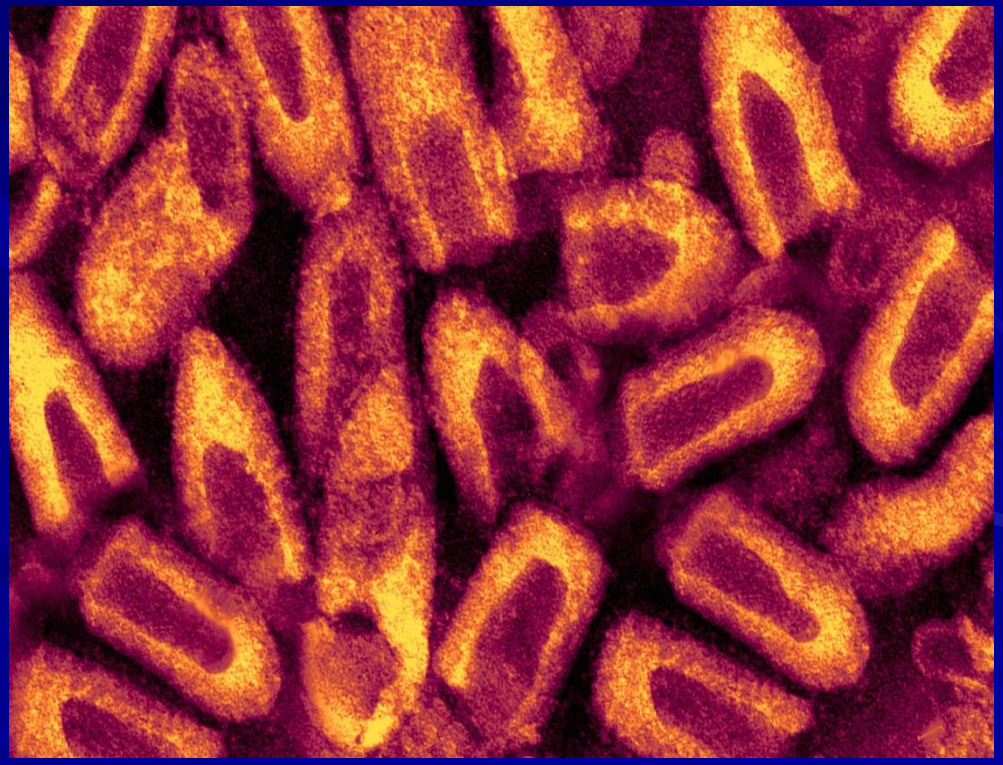
- **Class: Monjiviricetes …. 2 orders**
- **Order: Mononegavirales (Single –ve RNA) …. 11 families**
- **Family: Rhabdoviridae …. 20 genera**
  - **Genus: Lyssavirus (Rabies lyssavirus)**
  - **Genus: Vesiculovirus (Indiana vesiculovirus)**
  - **Genus: Ephemerovirus (Bovine fever ephermerovirus)**
  - **Genus: Novirhabdovirus (Fish viruses)**
  - **Genus: Perhabdovirus (Fish viruses)**
  - **Genus: Sprivivirus (Fish viruses)**

Virus Morphology and Characteristics

Bullet shape

Medium sized (70 nm width X 170 nm length)





Virus Morphology and Characteristics

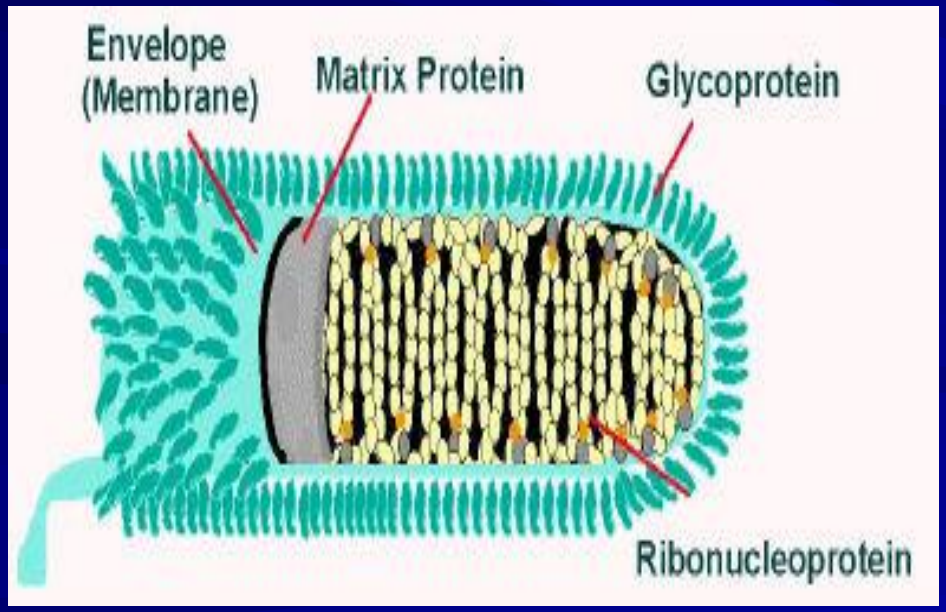
Genome: RNA – single stranded – negative sense – Linear – non-segmented – haploid – 11-15 kb long

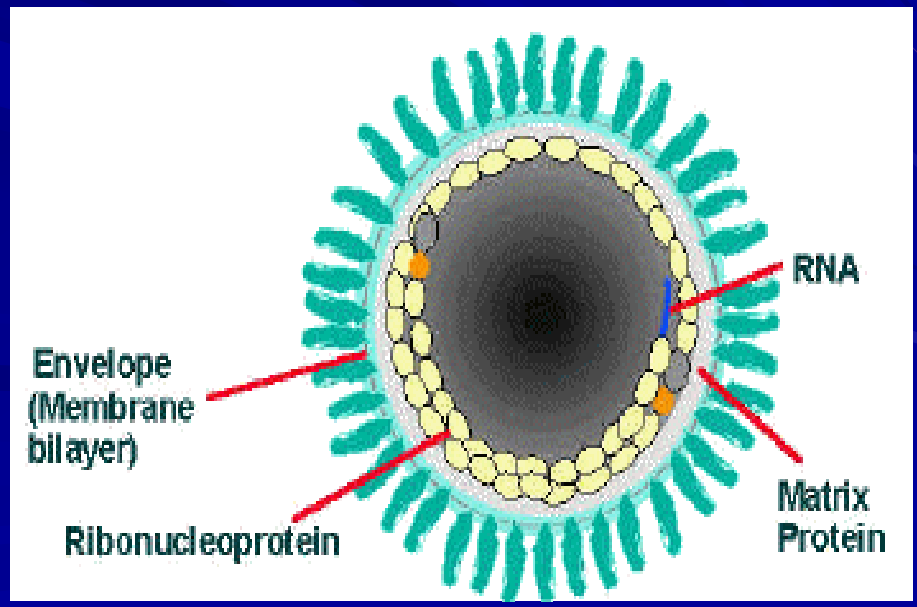
Capsid: helical (NP)

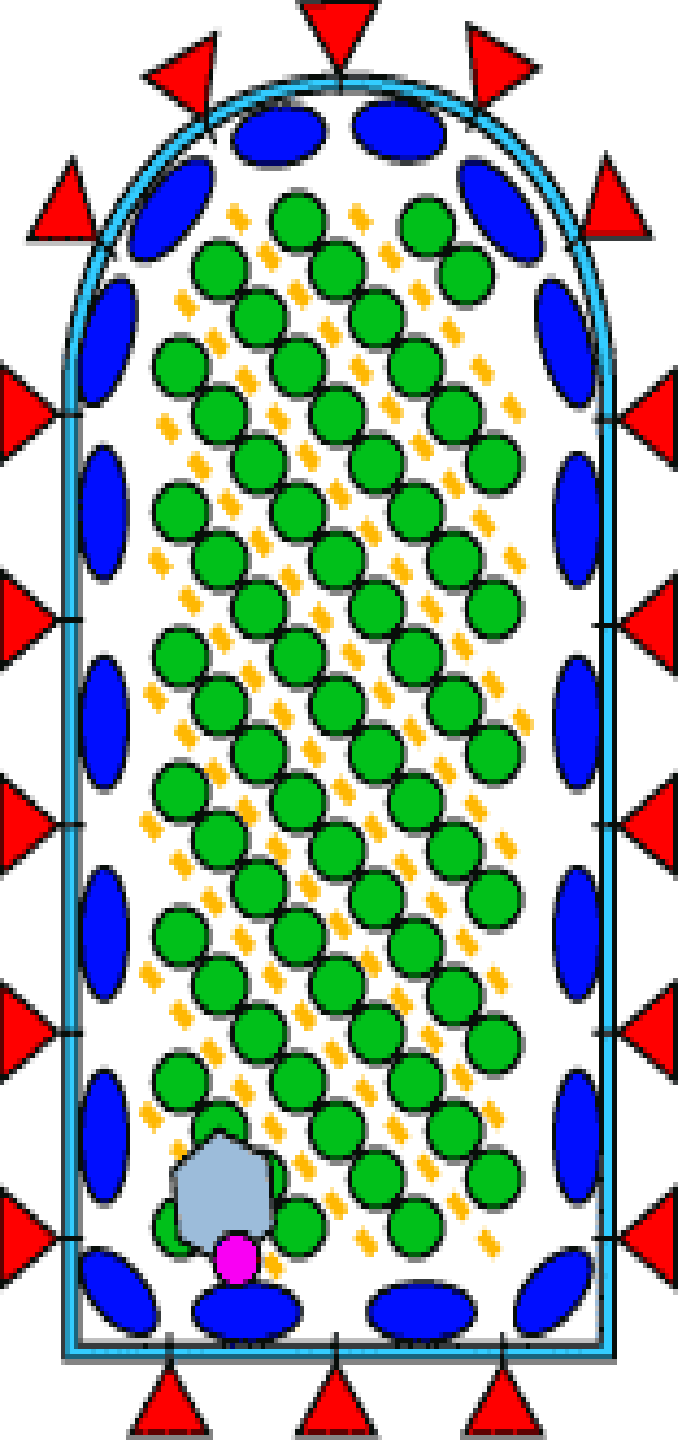
Envelope: Present - carry 400 peplomere of G protein

Matrix protein present internally to protect envelope

Viral enzymes: L and P proteins (polymerases)







Lipid bilayer

Membrane-spanning glycoprotein (G)

Matrix protein (M)

Negative-sense, single-strand RNA genome

Nucleocapsid protein (N)

Large protein (L)

Phosphoprotein (P)

Replication

Cytoplasmic

1- Attachment:

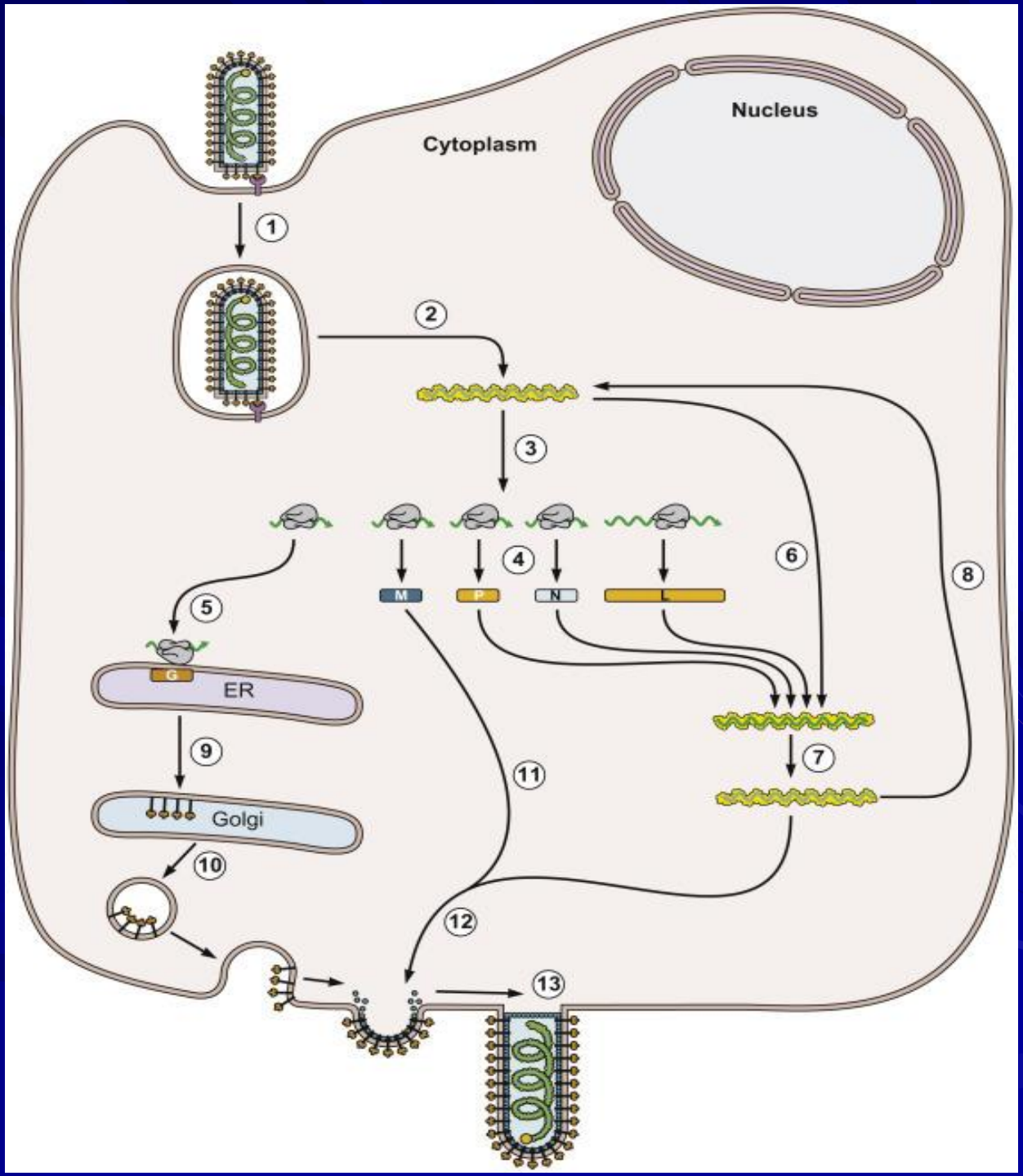
- G-protein
- Cell receptors

2- Entry:

Endocytosis (receptor-mediated)

3- Uncoating:

- Complete
- Release of RNP in cytoplasm



Replication

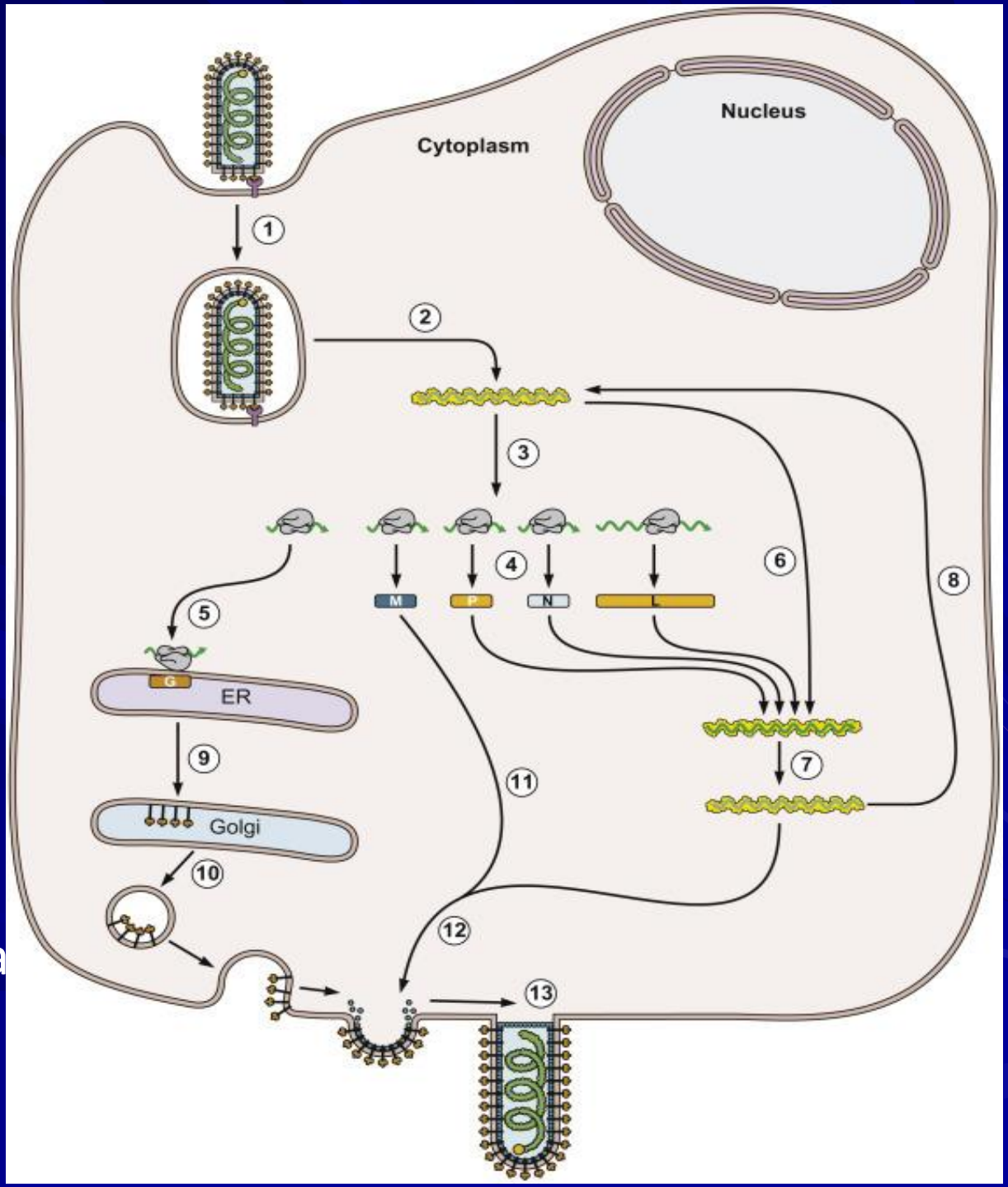
Cytoplasmic

4- Gene Expression:

- L protein attach to the leader.
- Transcription of 5 separate mRNAs.
- Translation.

5- Replication:

L prot. generates full length +ve strand that acts as a template for replication of the viral genome (-ve).



Replication

Cytoplasmic

6- Maturation:

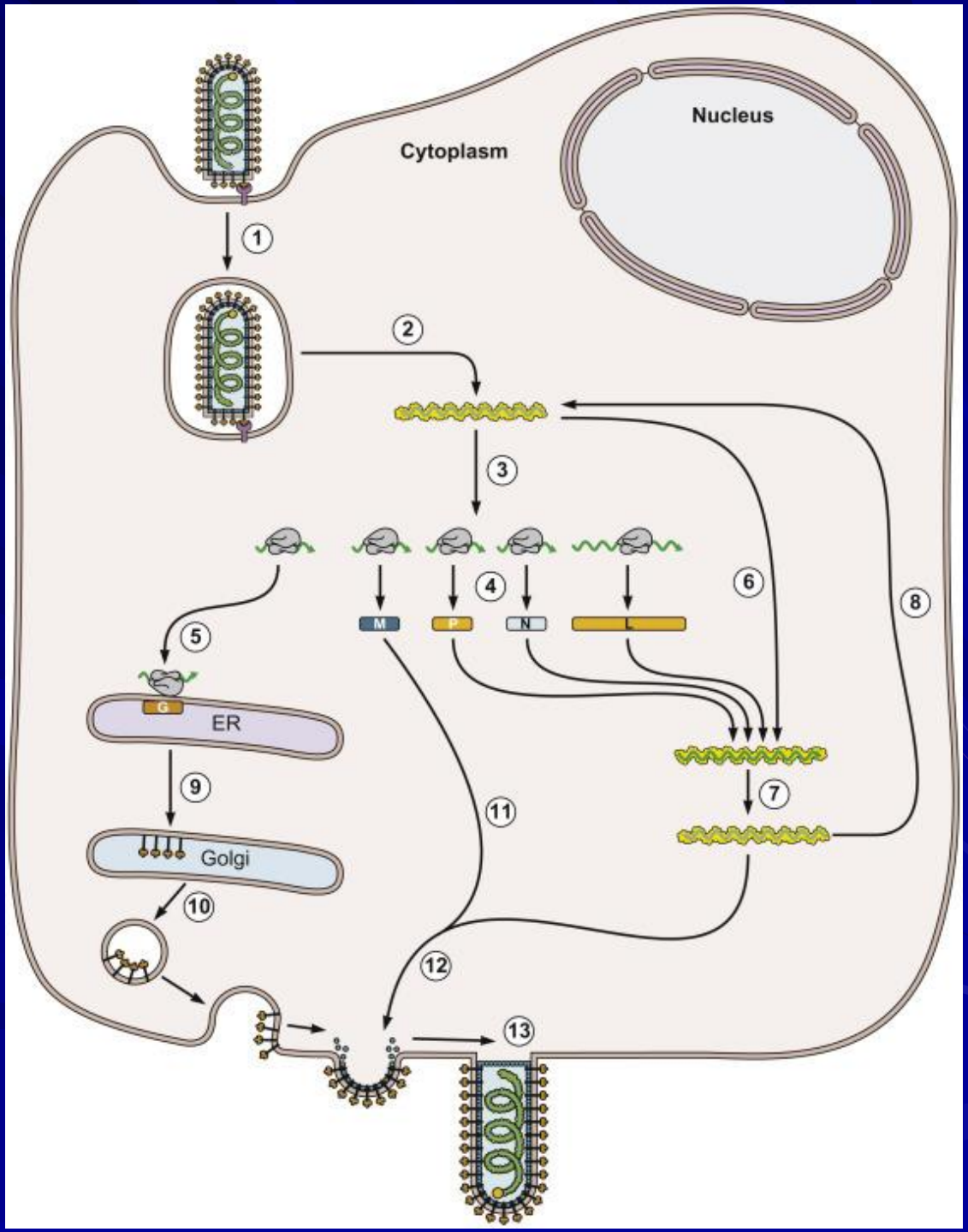
- Glycosylation (G)
- Phosphorylation (P)
- In ER and GA

7- Assembly:

- N, L, P (with RNA)
- M, G (at cell Memb.)

8- Release:

Budding



Rabies Virus

ORDER: Mononegavirales

FAMILY: Rhabdoviridae

GENUS: Lyssavirus

Contain 16 species:

Rabies Virus

Rabies-like viruses

European bat lyssa 1, 2 – West Caucasian bat
Australian Bat – Lagos bat – Shimoni Bat
Bokeloh bat – Gannoruwa bat - Lleida bat –
Ikoma – Irkut – Khujand – Mokola – Aravan –
Duvenhage

Host Affected and Distribution

Animals affected: "All worm-blood animals"

Mostly: Dogs, cats, foxes, wolves, bats and raccoons

Less common: Human, horses, cattle

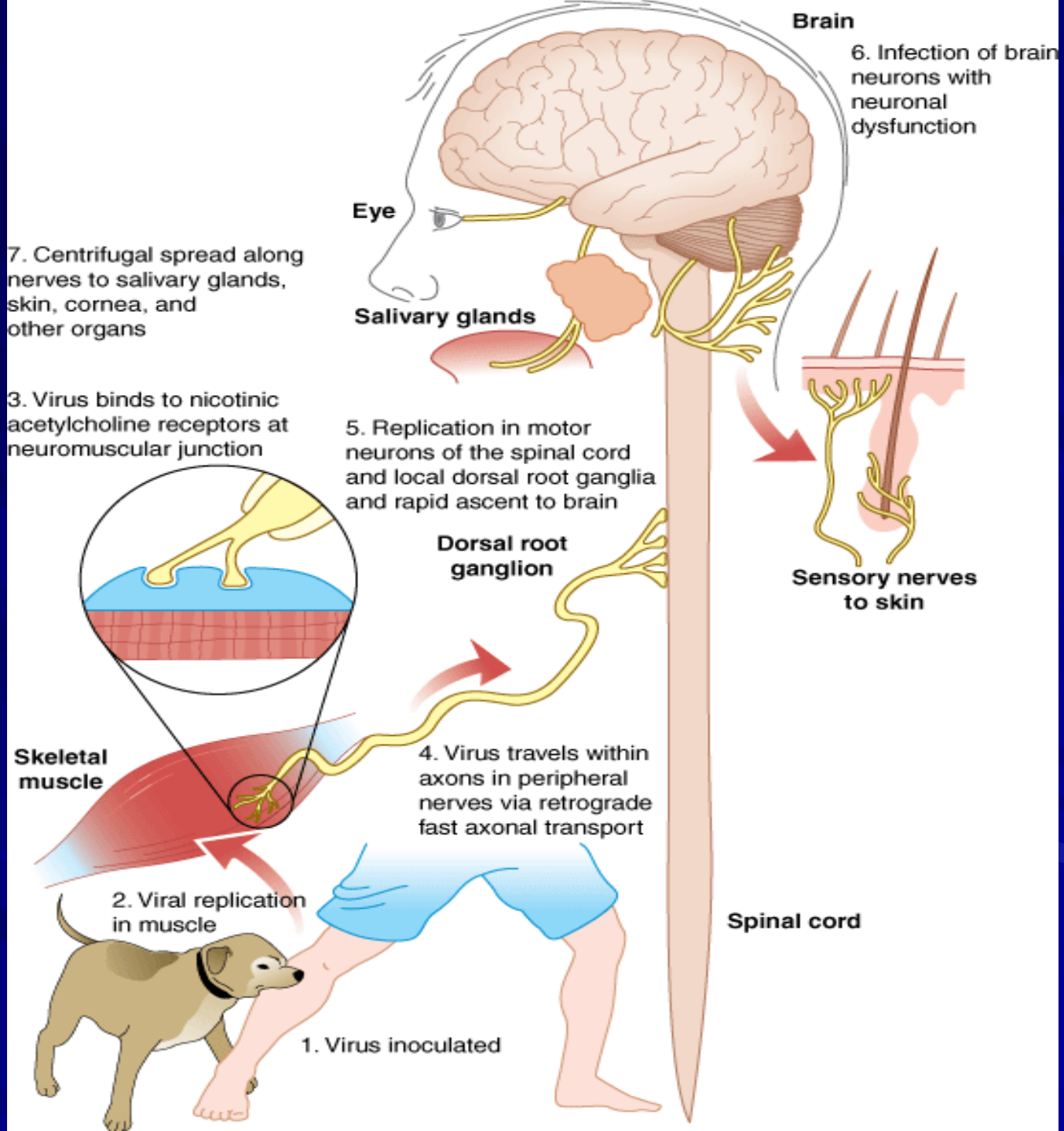
Mode of transmission:

- Bite of Rabid animal (Saliva carries > 1 million virus particles)
- Contamination of wounds or scratches with saliva.
- Inhalation of aerosols in bat caves (where air is full of aerosols contaminated with rabies virus).
- Corneal transplantation from undiagnosed rabid patient.

Pathogenesis

- Virus enters the body through a deep animal bite.
- Initial multiplication in muscle fibers.
- Entrance to the peripheral nerves through nerve endings.
- Centripetal travel along the neuron to CNS.
- Multiplication and spread in the brain.
- Centrifugal travel through the cranial nerves to:

  Adrenal cortex - Pancreas - Salivary gland.
- Excretion in saliva and lacrimal secretions.


Brain
6. Infection of brain neurons with neuronal dysfunction
Eye
Salivary glands
7. Centrifugal spread along nerves to salivary glands, skin, cornea, and other organs
3. Virus binds to nicotinic acetylcholine receptors at neuromuscular junction
5. Replication in motor neurons of the spinal cord and local dorsal root ganglia and rapid ascent to brain
Dorsal root ganglion
Sensory nerves to skin
Skeletal muscle
4. Virus travels within axons in peripheral nerves via retrograde fast axonal transport
2. Viral replication in muscle
Spinal cord
1. Virus inoculated

Diagnosis

Clinical Diagnosis:

- Incubation period: 14-90 days (up to 7 years)
  Depends on depth and site of bite.
- Furious form: (Dogs, cats and equine)
  - Animal appears restless, nervous and aggressive.
  - Bites at anything that gains its attention.
  - Bites and scratches himself (hyperesthesia).
  - Inability to swallow water (Hydrophobia).
  - Excessive salivation.
  - Exaggerated response to light and sound.
  - At end, same clinical picture of dump form.
- Dump form: (Ruminants, rodents and human)
  - Convulsions, paralysis, coma and respiratory distress.
  - Death after 2-14 days from beginning of signs.

Diagnosis

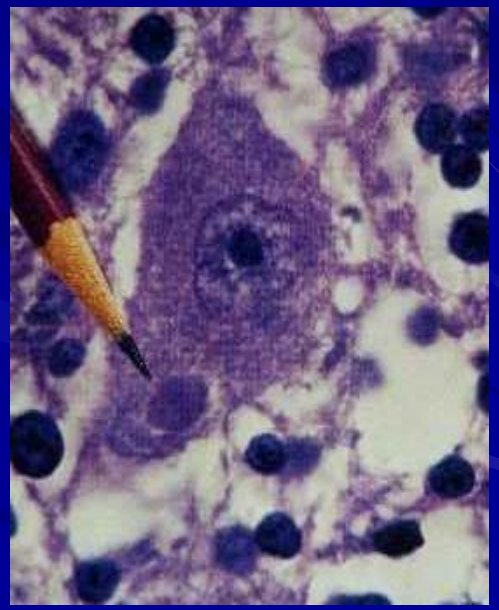
Laboratory Diagnosis:

Sample: Saliva – Cerebrospinal fluid – skin biopsy at hair follicles (at neck) – serum

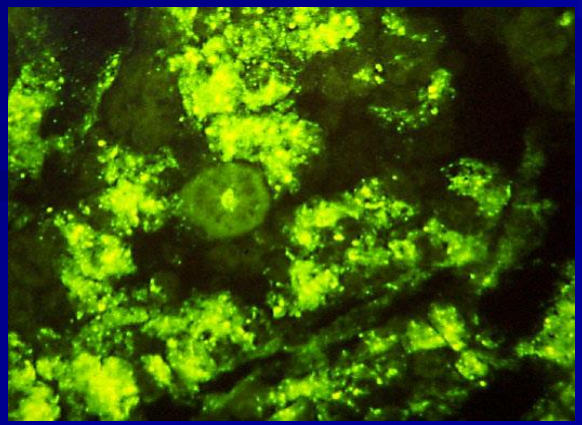
Biting animals (if caught): brain – spinal cord - cornea

Direct detection of the virus:

Histopathology: staining of tissues with Niessler stain for detection of Negri bodies.



Immunofluorescence



Diagnosis

Laboratory Diagnosis:

Virus isolation:

Tissue culture (WI-38 and BHK cells)

Serology (Antibody detection):

Using serum and cerebrospinal fluid

ELISA – Immunofluorecence – virus neutralization test

Prevention and Control

1- Prevent exposure to Rabies

- Eradication or removal of stray animals (dogs and cats).
- Control the movement of pet animals.
- Avoid entering bat caves without mask.
- Animal vaccination (vaccination programs in pets – bait vaccine for wild animals).
- People at high risk (vets – lab workers – animal handlers) should be vaccinated with inactivated tissue culture vaccine (repeated each 2-3 years).

Prevention and Control

2- Post-exposure treatment

- Cleaning the wound with water and soap, following by deep application of disinfectants.
- Immunization of the bitten animal with:

a) Anti-rabies immune serum:

1/2 dose I/M - 1/2 dose around the wound.

b) Inactivated vaccine:

Intra-muscular injection.

Five doses at 0, 3,7,14 and 28 days post-exposure.

Bovine Ephemeral Fever

Host affected and distribution

- Cattle is the main species affected.
- Water buffalos and deer may also show signs of infection.
- Widespread disease in tropical and subtropical areas in Africa, Asia and Australia.
- Not reported in the Americas and Europe.
- Transmitted by biting midges and mosquitoes.

Diagnosis

Clinical Diagnosis:

- Sudden appearance of symptoms.
- Clinical signs:
  - *Biphasic or polyphasic fever.*
  - *Immediate drop in milk production.*
  - Depression, cessation of rumination.
  - Stiffness, lameness and occasionally paresis.
  - Nasal and ocular discharges.
  - Constipation and occasionally diarrhea.
  - Usually recovery after 3 days [3-day sickness].
  - Morbidity rate reaches 100%.
  - Mortality very low (1-2%), may reach 10-20%.

Diagnosis

Laboratory Diagnosis

- Samples: Buffy coat - Serum
- Virus detection: Immunofluorescence – Antigen capture ELISA
- Detection of viral RNA: RT-PCR – Sequencing
- Virus isolation:

  Tissue culture: mosquito (*Aedes albopictus*) cells

  Laboratory animals: Intracerebral in suckling mice.
- Sero-diagnosis: for antibody detection using ELISA, IFA or VNT.

Prevention and Control

1- Eradication of the vectors.

2- Vaccination before the onset of insect season using inactivated or attenuated virus vaccines:

Duration of immunity does not exceed 6 months.

Problems of vaccines:

1- Inactivated vaccines: Require more antigenic mass than could be achieved economically.

2- Attenuated vaccines: Loss of immunogenicity with attenuation process.

3- Recombinant vaccines: derived from G protein has promising results.


Thank You