1 Rabies

1.1 Timeline

1. First written record of rabies causing death in dogs and humans: 2300 B.C.
2. Pliny the Elder makes a list of rabies cures: 79 A.D.
3. Richard Mead publishes the opinion that rabies outbreaks are controlled by the moon: 1702
4. First documented case in the US: 1753
5. Rabies recognized as an infectious disease: 1804
6. First rabies vaccines by Pasteur: 1885

1.2 Other Facts

Lyssa: Derived from the greek word for 'rage' and 'fury'

Rabies kills about 60,000 people yearly

Transmitted by rabid animals such as:

1. Dogs
2. Bats
3. Raccoons
4. Foxes

1.3 Rabies Virus

Rabies is caused by the rabies virus

→ Type species for the Lyssavirus genus in the Rhabdoviridae family

→ Enveloped RNA virus with a helical capsid

Other Lyssaviruses are also usually transmitted via a bite from an infected (rabid) animal

→ Cause a similar illness known as rabies

All mammals can get rabies

Non-mammal carnivores are less often associated with rabies cases

Small rodents are rarely transmitters because they die by bites from larger mammals

Non-mammals never transmit rabies

1.4 Transmission

Virus cannot enter intact skin

→ Transmission is almost always a bite

Occasionally saliva may come into contact with mucous membranes or fresh skin lesions

Rarely, there may be aerosolized rabies or human-to-human through transplantation

40-60% of animal bite cases are reported in children

1. More susceptible to bites on face / scalp because of height
2. More susceptible to play outside
3. Cannot ward off animals easily
4. More likely to provoke an animal

1.4.1 Control of Animal Vectors

Primary strategy for the prevention of rabies in humans

Typically targets dogs through vaccination, management of stray populations, and castration

Rabies thought to be controlled in 70% of dogs are vaccinated using inactivated virus vaccine

→ Immunity lasts around 3 years

1.5 Rabies Deaths by Country

Extremely high in Africa and (Southeast) Asia

$> 55,000$ deaths worldwide

98% of cases caused by dog bites

1.5.1 Delhi Vulture Crisis

Widespread use of drugs such as diclofenac (nonsteroidal anti-inflammatory drug (NSAID)) in livestock

→ Resulted in a substantial increase in the population of feral dogs

→ Led to 38 million dog bites, 47,000 deaths, and $34 billion in costs

1.6 Rabies in the US

In 1938, most cases of rabid animals were domestic (9,321) with some wild (44)

→ The numbers have since reversed

Human rabies deaths are relatively rare

1. 1-3 cases reported anually

   25 cases (2009-2018) with several acquired outside of the US
2. Over 90% of animal rabies cases occur in wildlife (6,690 cases in 2009)
3. Annual prevention costs $300 million

Most rabies exposure in the US are from infected bats (0.1% of bats have rabies)

Bite wound only the size of a hypodermic needle

→ Therefore don't seek medical attention or PEP

1.7 Rabies Control in Wildlife

Trap / Vaccinate / Release (TVR)

→ Effective in Canada raccoons (often combined with oral baits)

Oral baits with antivirus

→ Has been effective in Europe and Canada

→ Slowed outbreak in Ohio raccoons

→ used in Texas for coyotes and foxes

1.8 Pathogenesis

1.8.1 Course of Disease

Incubation period for rabies is typically 2-3 months but may vary from 1 week to several years

Depends on factors such as location of virus entry and viral load

Initial symptoms are not very specific

1. Fever with pain
2. Tingling
3. Pricking
4. Burning sensation (paraethesia)

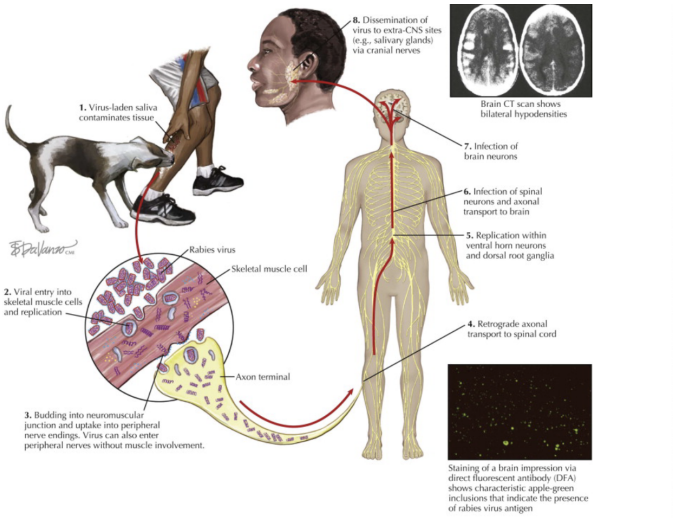

Figure 1: Rabies Pathogenesis

2 forms in humans:

1. Furious Rabies: Hyperactivity and hydrophobia

   Death after a few days due to cardio-respiratory arrest

2. Paralytic rabies accounts for around 20% of human cases

   Coma slowly develops and eventually dies

   Often misdiagnosed, due to under-reporting

1.8.2 Furious Rabies

Rabies increases saliva production because virus is spread through saliva

Painful spasms develop in the muscles that control breathing and swallowing

Feels like drowning → Hydrophobia

Other Symptoms:

1. Delirium
2. Aggression
3. Drooling
4. Muscle Spasms
5. Dizziness
6. Hallucinations

1.9 Preventive Immunizations

Any person who could be exposed to the live rabies virus

1. Lab staff
2. Veterinarians
3. Animal / bat handlers
4. Wildlife officials

Children travelling to / living in a rabies-endemic area

Travellers who may be more than 24 hours from a medical center with a post-exposure vaccine

1.10 Post-Exposure Prophylaxis (PEP)

Immediate treatment of a bite victim after rabies exposure

Prevents virus entry into the central nervous system

Consists of:

1. Extensive washing and local treatment of wound
2. Course of potent and effective rabies vaccine
3. Administration of rabies immunoglobulin (RIG)

Why are there so many deaths by RABV when treatment is available and effective?

1. Majority of victims can / do not receive rabies vaccination or do not complete the full course
2. Use of rabies immunoglobulins (RIG) is very low
3. Lack of awareness about the potential severity of animal bites
4. Some victims cannot afford the cost of PEP or may resort to indigenous treatment practices