Global Perspective of Rabies

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Topics

• general review of global situation of rabies
• general problems and basic epidemiology of rabies
• why do we need to focus on fighting rabies at the animal source - in particular at dog level
• neglected zoonotic disease, complexity of one health approach
• output and progress since past two OIE regional rabies conferences (2005 Kiev, 2007 Paris)
• current activities of the veterinary profession in rabies control
The Global Situation of Rabies

- Different variants of rabies viruses and/or rabies-related Lyssaviruses occur on all continents, except Antarctica.
- Each variant is generally associated with a principal host species whose use of space and social interactions allow the virus to persist in its populations.
- These principal hosts are all members of the orders chiroptera (bats) or carnivora.
Epidemiology:
The European Fox Rabies Example (a)

- Front-wave moved 25 to 60 km/year
- 1st cases almost always in foxes
- Hardly any individuals with antibodies → high case fatality rate
- Epizootic reduced fox population densities
Epidemiology:
The European Fox Rabies Example (b)

- Number of rabid specimens submitted for diagnosis fluctuating
- Prevalence of rabies in diagnostic submissions cycling
  CAVE AT (observation/sampling window)
- true prevalence and incidence unknown
- Models explain periodicity, but have mostly little predictive power
Spill-over (a)

All principal hosts transmit the disease to other species, which are sometimes highly susceptible, but whose population biology and behaviour are not conducive to maintaining an epizootic.
## Spill-over (b)

<table>
<thead>
<tr>
<th>Animal</th>
<th>LD&lt;sub&gt;50&lt;/sub&gt; in MICLD&lt;sub&gt;50&lt;/sub&gt;</th>
<th>% of pos submissions (Switzerland)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fox</td>
<td>10^{-0.5}</td>
<td>83</td>
</tr>
<tr>
<td>Hare</td>
<td>10^{1.6}</td>
<td>0</td>
</tr>
<tr>
<td>Cattle</td>
<td>10^{3.5}</td>
<td>1.6</td>
</tr>
<tr>
<td>Ferret</td>
<td>10^{4.7}</td>
<td>&lt;&lt; 0.1</td>
</tr>
<tr>
<td>Cat</td>
<td>10^{5}</td>
<td>&lt;&lt; 0.1</td>
</tr>
<tr>
<td>Sheep</td>
<td>10^{5.7}</td>
<td>0.7</td>
</tr>
<tr>
<td>Dog</td>
<td>10^{6}</td>
<td>0.4</td>
</tr>
<tr>
<td>Badger</td>
<td>?</td>
<td>4</td>
</tr>
<tr>
<td>Stone marten</td>
<td>?</td>
<td>2.5</td>
</tr>
<tr>
<td>Roe deer</td>
<td>?</td>
<td>5</td>
</tr>
</tbody>
</table>

after J. Blancou 1988

after Wandeler et al. 1974
What permits virus persistence in host populations?

• Triad:
  - high pathogenicity / high susceptibility
  - high susceptibility / high excretion
  - low immunogenicity / low survival

→ Blancou’s “biotypes”
Triad does not cover all virus adaptations necessary for the survival of a virus in a species
- with a habitat dependent population density
- population turnover and structure
- specific patterns of behaviour and social interactions (social use of space)

→Molecular mechanisms determining incubation, duration and amount of excretion, etc. are poorly understood
Habitat, Resources, and Social Organization

Social use of space is flexible

Example: The red fox Vulpes vulpes

rural North America and Europe:
monogamous pairs in exclusive family territories
(→ Spread of rabies mostly from territory to territory)

urban/suburban Europe (UK):
non-exclusive, overlapping home ranges
or group territories with dominance hierarchies
Interrelationships between habitat (resource distribution and density), social organisation, mortality and dispersal

Higher resource densities permit higher population densities, resulting in smaller home ranges and shorter dispersal distances

→ consequences for transmission dynamics
Wildlife Rabies – Dog Rabies

- Areas of the world in which dogs are the principal hosts and those where rabies is maintained in wild animals
- In wildlife rabies areas of North America and Europe only 0.1–5.0% of cases reported are in dogs.
- In large parts of Asia, Africa and Latin America, rabies in dogs is much more common, making up 95% or more of all diagnosed cases. Rabid dogs are the major source of human infection.
Dog Rabies - Human Rabies

50,000 (?) human rabies cases worldwide

more than 99% result from bites by rabid dogs

up to 1 case per 100,000 inhabitants in some areas (South and Southeast Asia, Africa?)

incidence of human rabies decreasing in areas with successful dog rabies control (Latin America)
Occurrence of Rabies in Countries
Rabies endemicity status, worldwide, 2000

- **Asia**: 31,000 deaths, >8,000,000 PEP
- **Middle and Near East**: <100, <100,000 PEP
- **North America and Europe**: <50 deaths, <100,000 PEP
- **Latin America**: <40 deaths, <500,000 PEP
- **Africa**: 24,000 deaths, <500,000 PEP
The cost of a post-bite treatment in humans is about twenty to one hundred times more costly than the vaccination of a dog. This is why it is cost effective that Ministries of Health provide financial resources to Veterinary Services to control the disease at its animal source.
Considerations

• Elimination of enzootic rabies in dogs is feasible – large efforts necessary – international support possibly required

• Modern Postexposure Prophylaxis (PEP) is highly effective
  ➔ human rabies is preventable
# Dog Rabies Control

<table>
<thead>
<tr>
<th>Dog Population</th>
<th>Medical Systems</th>
<th>Western Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunization</td>
<td>Western Medicine vs. competing traditional/culturally acceptable practices</td>
<td>Pre Exposure Prophylaxis (PreP)</td>
</tr>
<tr>
<td>Population Control</td>
<td>Education</td>
<td>Post Exposure Prophylaxis (PEP)</td>
</tr>
</tbody>
</table>

“One Health”
Surveillance and Human Rabies

- poor surveillance
- poor submission rate
- low level of awareness
- increased number of untreated human exposures
The Veterinary Profession in Rabies Control

• Immunization of dogs (and wildlife) to establish herd immunities that stop the spread of rabies

• Promotion of responsible dog ownership (→ reduction of infectious contacts)

• Health education

• Support rabies diagnostics and surveillance