Zoonotic tissue parasites of Australian wildlife

Increasing use of bushlands for recreational, commercial and scientific activities fosters movement across the urban-bushland interface. This may facilitate the transmission of parasitic diseases from wildlife to humans (zoonoses). The fashionable trend to consumption of game meats such as feral pig and crocodile, and raw fish such as sushi, sashimi and pickled herring has exacerbated the zoonotic potential of parasites of wildlife.

**Transmission from wildlife to humans**

**Angiostrongyliasis**

*Angiostrongylus cantonensis* is a nematode parasite of the pulmonary arteries and right ventricle of *Rattus rattus* and *R. norvegicus* in Australia. It is the causative agent of eosinophilic meningoencephalitis, a zoonotic infection of humans. The life cycle includes an obligatory period of larval development in terrestrial or aquatic snails and slugs, and also may involve a range of paratenic or transport hosts (freshwater prawns, land crabs, planarians, frogs, lizards), which feed on gastropods. Rats become infected by ingesting intermediate or paratenic hosts. In the rat, the nematode undergoes an obligatory migration through the spinal column and brain en route to the final site in the pulmonary arteries of the lungs. Humans become infected by accidentally or deliberately eating infected gastropods or paratenic hosts, or unwashed salad greens containing these. The parasite has been reported from domestic and zoo animals, mammalian and avian wildlife and humans in Brisbane and Sydney. The clinical signs of headache, vomiting, paralysis and sometimes death are induced as a consequence of the obligatory period of development of the parasite in the central nervous system. This occurs in young children who deliberately or accidentally ingest snails or slugs containing infective larvae, or foolish young adults who do so for a bet.

**Muspiceoidosis**

*Haycocknema perplexum* is a minute muspiceoid nematode living as adults inside individual skeletal muscle cells of humans in Australia. Eight to twelve eggs hatch inside the uterus of the female, develop to third-stage infective larvae and burst from the head region killing the adult, an efficient mechanism for auto-re-infection. Escaped larvae invade uninfected muscle cells. The occurrence of *H. perplexum* in intramyofibres results in eosinophilic polymyositis but no reaction within the invaded cell itself. Progressive myopathy occurs and infection becomes life threatening. Early human diagnosis by muscle biopsy is imperative in cases of progressive myopathy associated with blood eosinophilia and elevated creatine kinase levels. Steroid...
treatment of patients exacerbates their infections to a life-threatening illness and may delay diagnosis by masking key diagnostic features. Treatment with albendazole, 400 mg twice daily for 8–9 weeks, is recommended\textsuperscript{12}. *Haycocknema perplexum* is considered a zoonosis although the source of infection of humans—water, soil, plants or animals—remains unknown.

**Halicephalobus gingivalis**

*Halicephalobus gingivalis* formerly known as *Micronema deletrix*, is a free-living nematode of soil, manure and decaying humus known to cause opportunistic infections, primarily in horses but also in humans\textsuperscript{14}. The majority of cases in horses have been fatal and usually not diagnosed before necropsy. All human cases have involved fatal meningoencephalitis including the first human case in Australia, a 74-year-old woman from Eyre Peninsula, South Australia\textsuperscript{15}. In tissues, only ova, larvae and adult females are seen, reproduction in the parasitic phase presumed to be by parthenogenesis\textsuperscript{16}. It is not known how *H. gingivalis* infects humans or horses although exposure through an oromaxillary route may explain common neurological involvement\textsuperscript{15}.

**Transmission from domestic animals to humans and wildlife**

**Toxoplasmosis**

Felids, domestic cats in particular, are the only definitive host of the obligate intracellular protozoan parasite, *Toxoplasma gondii*\textsuperscript{17}. Most species of mammals and birds are susceptible to infection and may act as intermediate hosts. Infection is usually systemic resulting in a short period of rapid multiplication in various tissues followed by the establishment of tissue cysts in the muscles and brain. These are transmitted only if ingested by predation or scavenging or if passed vertically across the placenta from mother to foetus.

The localisation of *T. gondii* cysts in the forebrain of rats and mice together with the immune reaction to the cysts is related to altered behaviour, in particular the attenuation of predator odour aversion and anxiety. This facilitates ingestion of the intermediate host by the cat definitive host and perpetuation of the life cycle\textsuperscript{17}.

Humans become infected with *T. gondii* mainly by ingesting uncooked meat containing viable tissue cysts or by ingesting food or water contaminated with oocysts from the faeces of infected cats. Transplacental transmission may occur in women during their first trimester of pregnancy and this infection is then passed to the developing embryo via the placenta. This frequently results in severe brain and eye lesions in the newborn or death of the developing embryo. Research results from the past 15 years have shown that *T. gondii* infection is associated with several neuropsychiatric diseases and behavioural changes in humans as well animals\textsuperscript{18}. Although the mechanisms are unknown a growing body of data indicates that they are complex, comprising humoral, immune, neurotransmitter, epigenetic, genetic, and structural effects\textsuperscript{19}.

**Echinococcosis (hydatid disease)**

Australia has, on average, >80 new cases of human hydatidosis per annum caused by the larval stage of the cestode, *Echinococcus granulosus*\textsuperscript{20}. The parasite was introduced into Australia with domestic livestock and dogs. However, a cycle in wildlife is maintained through a predator/prey interaction between dingoes, wild dogs and less importantly foxes and wallabies, less importantly feral pigs (*Sus scrofa*)\textsuperscript{21,22}. The establishment of a dingo/wild dog-macropod cycle, which effectively maintains parasite transmission, acts as a spill-back reservoir of infection for sheep and cattle\textsuperscript{23}. This is a major problem for control strategies focussed on human education and husbandry practices to break the domestic ‘dog-sheep’ cycle. In contrast to the situation in livestock, hydatid cysts occur primarily in the lungs rather than the liver of marsupials. Infection occurs predominantly in the eastern States but the parasite has established recently in wildlife in water catchment and forestry areas outside Perth\textsuperscript{21}. Western grey kangaroos and feral pigs act as intermediate hosts. This focus of transmission may have been initiated through *E. granulosus*-infected domestic pig hunting dogs.

<table>
<thead>
<tr>
<th>Disease name</th>
<th>Organism</th>
<th>Type</th>
<th>Source</th>
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<tr>
<td>Leishmaniasis</td>
<td>Leishmania sp.</td>
<td>Trypanosomatid</td>
<td><em>Forcipomyia</em> spp.</td>
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<tr>
<td>Sparganosis</td>
<td>Spirometra erinaceieuropaei</td>
<td>Cestode (larval, plerocercoid)</td>
<td>Eating raw/undercooked meat</td>
<td>28</td>
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<tr>
<td>Pentastomiasis</td>
<td>Armillifer spp.</td>
<td>Modified brachiuran</td>
<td>Eating undercooked snake/mammal flesh, drinking contaminated water</td>
<td>29,30,31</td>
</tr>
<tr>
<td></td>
<td>Linguatula spp.</td>
<td>Crustacean</td>
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from the eastern states. Transmission appears to be perpetuated by dogs of local pig hunters infected through being fed the offal of locally shot kangaroos. Hydatid disease is also an important conservation issue, especially for small endangered species and populations of Macropodidae by severely reducing effective lung volume. Such reductions impact the fitness of the animals enhancing susceptibility to predation, thus ensuring perpetuation of the cycle.

Several potential zoonotic tissue parasite infections in Australia are listed in Table 1.

References


Bioography

Dave Spratt is an Honorary Fellow at the Australian National Wildlife Collection, National Research Collections Australia, CSIRO, in Canberra. The major themes of Dr Spratt’s research are the study and understanding of the diseases of wildlife including disease ecology, parasite taxonomy, helminth biodiversity and zoonoses. Research topics of interest include metastrongyloid, filarioid, trichineloid and muspcicoid nematodes, pentastomiasis, and small mammal succession and recolonisation of their helminth communities following wildfire.