Men, Mice and Maltese Crosses

Implications of the Discovery of Zoonotic Babesiosis in Australia

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Introduction
Protozoa of the genus Babesia (Piroplasmida, Apicomplexa) are the second most common blood-borne parasites of mammals after the trypanosomates. Over 100 species have been identified, infecting many mammalian and some avian species. Babesias are the aetiological agents of babesiosis, a tick-transmitted disease causing substantial losses of livestock and companion animals worldwide. Human babesiosis is a globally emerging zoonosis. Its clinical symptoms include: fever, fatigue, headache, chills, neck stiffness, accompanied by erythrocyte lysis, and possibly organ failure. Without exceptions, human babesiosis, is caused predominantly by B. microti (USA) and B. divergens (Europe). Babesia microti has a Holarctic (N. Hemisphere) distribution and has never before been identified in Australia.

Babesia Life Cycle
Babesia spp. utilise 3-host ixodid tick species; larvae and nymphs feed on small mammals (e.g. rodents, voles and shrews in Northern Hemisphere), and adults feed on larger vertebrates (e.g. deer). Humans become infected inadvertently when they encroach into these sylvatic life cycles, or as a consequence of infected blood transfusion (Fig.1). Babesia microti is the most frequently reported transfusion-transmitted microbial pathogen in the USA (FDA, 2008).

Zoonotic Babesiosis in Australia

In March 2012 we reported the discovery of Babesia microti in a 56 year old man from NSW (Senanayake et al., 2012). Intra-erythrocytic inclusions, including tetrad (“Maltese cross”) formations (Fig. 2) were observed in peripheral blood films and the diagnosis was confirmed by complete and partial sequencing of the 18S ribosomal RNA gene (18S rDNA) and β tubulin gene, respectively (Paparini et al., 2012). Phylogenetic analysis revealed 100% homology of the Australian piroplasm genotype obtained, with North American B. microti isolates. The person died of complications associated with comorbidities and babesiosis. In the absence of previous blood transfusion history, overseas travel and intravenous drug use, we hypothesise this infection was locally acquired (autochthonous) via the bite of an infected tick...

...What was the Origin of the Infection?
Option 1 - Imported Northern Hemisphere tick (e.g. in luggage from overseas)?
Option 2 - Native tick infected by an introduced rodent host?
Option 3 - Native tick infected by a native mammal host?
Option 4 - Introduced tick infected by a native or introduced mammal host?

Potential Invertebrate (Tick) Hosts
Native or Introduced:

- Ixodes holocyclus (paralysis tick) is one of approximately five Ixodes spp. ticks native to Australia known to bite humans. Other species include Amblyomma stipulaceum, native Haemaphysalis spp and occasionally Ornithodorus spp.
- Rhipicephalus sanguineus and Haemaphysalis longicornis are two introduced species of tick that occasionally bite humans.

Potential Vertebrate (Mammal) Hosts
Native or Introduced (Alien):

- Such as: Bush rats (Rattus fuscoperi), Antechinus (Antechinus spp.), Bandicoots (Form. Perameles).
- Such as: Ship rats (Rattus rattus), Norway rats (Rattus norvegicus), or mice.

Babesiosis is often Co-transmitted – Which other Tick-borne Pathogens might reside in Australia?

Anaplasmosis and Ehrlichiosis?
Anaplasma phagocytophilum (the cause of human granulocytic anaplasmosis), and Ehrlichia ewingii and E. chaffeensis (human granulocytic and monocyte ehrlichiosis) are transmitted by Ixodes ticks in the Northern Hemisphere. Infection usually produces mild to moderately severe illness, with high fever and headache, but may occasionally be life-threatening or even fatal.

Borreliosis and TBE?
Human borreliosis (or Lyme disease) is the most common tick-borne disease in the Northern Hemisphere. At least three species of Borrelia are responsible for Lyme disease; Borrelia burgdorferi sensu stricto is the main cause of Lyme disease in the US, whereas Borrelia afzelii and B. garinii cause most European cases. To date there has been no definitive evidence of borreliosis acquired by humans in Australia; the putative cause of Lyme-like illness remains controversial and requires further research. The tick-borne viral encephalitides (TBE) are transmitted by ixodid ticks and are an emerging disease problem in Europe and other parts of the world.

Bartonellosis?
Several Bartonella spp. with worldwide distribution are described in Australia including the causative organisms of cat scratch disease (Bartonella henselae and B. clarridgeiae) and occasionally more serious febrile illnesses in humans. This genus of bacteria is usually associated with flea transmission; however in recent studies novel marsupial-associated Bartonella DNA was detected in Australian Ixodes spp. ticks (Vilcins et al., 2009; Kaewmongkol et al., 2011). Bartonella spp. are rapidly emerging zoonotic pathogens around the world.

References

Fig. 1
Fig. 2