Diagnosis, investigation and management of tuberculosis at an Australian zoo

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Human disease

Tuberculosis (*Mycobacterium tuberculosis*) is the greatest killer in human history, and it continues to be a significant problem today: it is estimated that one in three people in the world are infected with tuberculosis (TB).[1] Although more than 95% of infections occur in developing countries, in an increasingly globalised world with high levels of travel and migration it is important that countries such as Australia (with a relatively low incidence: 6 cases per 100 000 population in 2009) remain vigilant about this disease.[2]

Zoonotic disease

M. tuberculosis infections have been reported in a wide range of animal species.[3] This occurs by *reverse zoonosis*; that is, a human pathogen transmitted to animals. *M. tuberculosis* is emerging as an important disease of elephants. In parts of Asia, where there are high rates of human infection, many elephants are used in religious and cultural ceremonies, for transport, entertainment and tourism and live in close association with humans. Once infected by humans, animal-to-animal transmission can occur.[4]

Tuberculosis at an Australian zoo

In November 2010 a post-partum, clinically healthy Asian elephant cow tested positive on trunk wash culture for *M. tuberculosis* and subsequently underwent a 12-month course of treatment. In September 2011, on a routine health check, a male chimpanzee that had been unwell was found to have advanced active TB and was euthanased. In October 2011, genotyping confirmed the chimpanzee's isolate as identical to that of the elephant.

The animal investigation and management

The frequency of screening of elephants was increased and the remaining 17 chimpanzees were screened. Six chimpanzees had one or more positive TB tests but no evidence of active disease. These chimpanzees were treated prophylactically. Enhanced infection control and biosecurity measures were implemented and all outgoing mammal transactions were suspended. A program of screening and monitoring for the Zoo's entire mammal population commenced. No cases of TB have since been diagnosed in any Zoo mammal or wildlife from within the Zoo grounds.

The NSW Health investigation

After diagnosis of the elephant NSW Health screened, by tuberculin skin test (TST), more than 50 Zoo staff who had been in contact with the elephant. After the elephant and chimpanzee were linked in October 2011, the investigation was extended: an expert panel was convened and the screening population was widened. A total of 138 staff were screened by questionnaire and TST. Management included enhanced infection control measures and communication and education for Zoo staff.

No cases of active disease were found in Zoo staff. There was a paired TST conversion in four of 47 cases who had both pre- and post-exposure TSTs, and close contact with the elephant appeared to be the most likely risk factor in these conversions.

Transmission pathway investigation

There were several hypotheses as to how *M. tuberculosis* may have been transmitted from the elephant to the chimpanzee: aerosol, vector (e.g. bird, rodent, possum), elephant faeces or fomite (any object or substance capable of carrying infectious organisms, for example, soft vegetation such as leaves and branches used as animal food, equipment, clothing, waste disposal bins). The investigation included literature reviews, international consultation, on-site inspections, analysis of prevailing winds, analysis of staff and volunteer screening results and questionnaires. The study was unable to determine a plausible pathway of transmission that was consistent with the known transmission dynamics of *M. tuberculosis*.

This study highlights the value of systematic risk assessment in the management of TB in captive animals.

References

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