

Cross-species transmission of *Mycobacterium bovis* in the same household

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No conflict of interest or funding



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Abstract

Mycobacterium bovis infection was confirmed at post-mortem examination in a dog and a cat from the same household within a period of 6 months. Whole-genome sequencing confirmed that the two affected pets shared an identical strain of *M. bovis*, which was closely linked to a strain found in local cattle, badgers, and deer. Four family members that had been in direct contact with the animals tested positive for latent TB. Potential for cross-species contamination and zoonotic risk must be considered when tuberculosis is identified in cats or dogs.

Introduction

Tuberculosis (TB) caused by *M. bovis* is an important emerging disease affecting both livestock and wildlife. Cats and dogs can also be infected, resulting in clinical illness and posing a zoonotic risk to owners¹. The disease typically affects the respiratory tract, with the formation of granulomas known as 'tubercles', but it can also lead to non-specific gastrointestinal, cutaneous, and respiratory clinical signs². Cross-species transmission between a dog and a cat has not been previously reported.

Case histories

Case 1: a 2-year-old neutered female Labrador was presented with a skin laceration on the right lower abdomen after jumping a fence. The dog was receiving long-term prednisolone and cyclosporine treatment for chronic enteropathy. The wound failed to heal with conservative treatment. The dog was euthanised following lack of response to treatment, spread to local lymph nodes and diagnosis of mycobacteriosis on wound cytology.

Case 2: a 16-year-old male neutered Burmese (Cat 1) from the same household was presented 6 months later with a 2-week history of weight loss, lethargy and respiratory effort. Ultrasonography revealed the presence of multiple pulmonary and hepatic nodules, most likely consistent with mycobacteriosis, and the cat was euthanised.

Case 3: a 16-year-old male neutered Burmese (Cat 2) from the same household presented one week later for tuberculosis screening. Cat 2 was euthanised after thoracic radiographs showed a suspected pulmonary nodule. Further investigations were declined by the owner given the zoonotic potential.

Physical examination

Dog

- Wound on right lower abdomen
- Subcutaneous mass and firm nodules near the right inguinal area
- Right inguinal lymphadenomegaly

Cat 1

- Poor BCS (3/9)
- Mild dehydration (5%)
- Mild expiratory effort
- Bilateral popliteal lymphadenomegaly

Cat 2

- No abnormalities detected

Diagnostic tests

Dog

- Initial cytology of subcutaneous mass:** neutrophilic inflammation with cell necrosis
- Culture of subcutaneous mass:** negative
- Abdominal CT:** large contrast-enhancing inguinal mass with severe local and sublumbar lymphadenopathy
- Ultrasound of right inguinal area:** marked right superficial inguinal lymphadenopathy with severe peripheral steatitis
- Repeat cytology of subcutaneous mass:** mixed pyogranulomatous inflammation with cell necrosis, and positive Ziehl-Neelsen (ZN) staining, consistent with mycobacteriosis (Fig 1 and 2)
- Post-mortem examination:** inguinal tuberculous panniculitis and multiple pulmonary granulomas
- Histology, ZN stain, and culture** of PM samples confirmed *M. bovis* infection

Cat 1

- Haematology:** leukocytosis ($29.74 \times 10^9/L$; reference interval (RI) $6-18 \times 10^9/L$) with moderate neutrophilia ($26.7 \times 10^9/L$; RI $2.5-12.5 \times 10^9/L$)
- Serum biochemistry and electrolytes:** azotaemia (urea 25.0 mmol/L (RI 6.6-10); crea 222.8 $\mu\text{mol/L}$ (RI 40-170)), increased AST activity (122 U/L (RI 0-70)), moderate hypokalaemia (3.29 mmol/L (RI 4-4.5))
- T4:** $<6.44 \text{ nmol/L}$ (RI 15-60), consistent with non-thyroidal illness
- Urinalysis:** cloudy, inappropriately dilute urine (USG 1.014), pyuria, bacteriuria and haematuria
- Urine culture:** pure growth of *Enterococcus faecalis*
- Thoracic and abdominal ultrasound:** pulmonary and hepatic nodules, bilateral pyelectasia, urinary sediment, mild abdominal effusion
- Post-mortem examination:** severe, diffuse granulomatous pneumonia (Fig 3), chronic renal disease, parathyroid hyperplasia, query chronic pancreatic fibrosis

Diagnostic tests

- Histology, ZN stain, and culture** of PM samples confirmed *M. bovis* infection

Cat 2

- Thoracic radiographs:** suspected mineralized pulmonary nodule in the right caudal lung lobe
- Post-mortem examination:** no evidence of mycobacterial infection

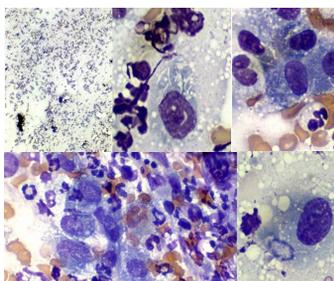


Fig. 1: Subcutaneous mass cytology consistent with mycobacteriosis

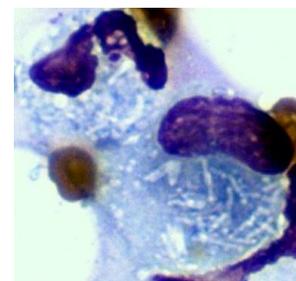


Fig. 2: Neutrophil and mononuclear cell containing numerous negatively-stained or clear silhouettes of long, rod-shaped structures, suspicious of mycobacteria



Fig. 3: Nodular pulmonary lesions consistent with severe, diffuse granulomatous pneumonia

Further investigations

- Whole-genome sequencing** revealed the strain isolated in the dog and Cat 1 to be identical and linked to a local strain reported in cattle, badgers and deer in Wicklow, Ireland, where the dog had been injured (Fig 3)
- Four human family members tested positive for latent TB on the Mantoux tuberculin skin test (TST) and the Interferon-Gamma Release Assay (IGRA), and received treatment for latent TB

Diagnosis

- Dog:** systemic tuberculosis due to *M. bovis* infection
- Cat 1:** pulmonary tuberculosis due to *M. bovis* infection
- Cat 2:** open for suspected pulmonary nodule; negative for *M. bovis* infection.

Discussion and conclusions

- To the authors' knowledge, this is the first documented case of suspected cross-species transmission of *M. bovis* between a dog and a cat in the same household, with suspected zoonotic spread to owners
- This case series highlights the importance of wildlife and contaminated environment as source of infection for pets and owners
- Although treatment can be successful for tuberculous mycobacterial infection in animals, the risk of transmission to in-contact animals and humans must also be considered

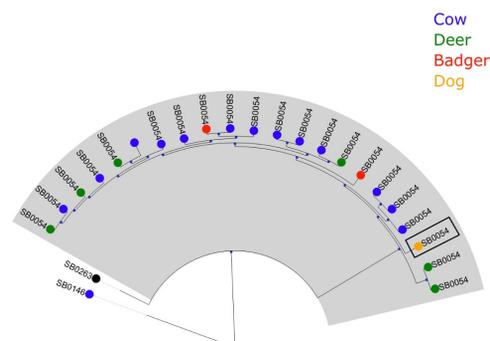


Fig. 3: Maximum likelihood phylogenetic tree displaying the relationship between the *M. bovis* strain identified in the current study and strains identified in local cattle, deer, and badgers in Wicklow. The canine sample is coloured orange. Total distance between the most distant strains was approximately 400 single nucleotide polymorphisms (SNPs), indicating all samples share the same strain type (SB004)

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