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Systemic *Mycobacterium caprae* infection in a domestic cat in the United Kingdom: a case report

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Abstract

This report describes the first documented case of *Mycobacterium caprae* (*M. caprae*) infection in a domestic cat (Felis catus) in the United Kingdom. The affected cat was a male-castrated Bengal breed that presented with respiratory symptoms and progressive weight loss. Clinical signs were unresponsive to antibiotics and anti-inflammatory therapy. Postmortem examination and histopathology revealed severe chronic pyogranulomatous bronchopneumonia with necrosis and acid-fast bacilli, which were identified as *M. caprae via* PCR and culture. While primarily a pathogen of goats, *M. caprae* poses zoonotic risks and requires specialized diagnostics. This case emphasizes the need for interdisciplinary collaboration to address emerging zoonotic threats.

Keywords *Mycobacterium caprae*, Domestic cat, Pathology, Pulmonary

Introduction

In veterinary medicine, *Mycobacterium* spp. represent a significant concern because of their impact on animal health, associated economic losses, potential threat to the conservation of endangered wildlife species, and risk of zoonotic transmission (Reheman et al. 2023). *Tuberculosis* (TB) in humans and other animal species is caused by members of the *Mycobacterium tuberculosis* complex (MTBC), which are obligate intracellular bacteria with specific host predilections (Ghielmetti et al., 2020). Among these, *Mycobacterium caprae* (*M. caprae*) is known primarily to affect goats, although sporadic cases have been reported in other domestic (rabbit, cattle, pig, bison and camel), wild (fox, wild boar, and deer), and captive species (Borneo elephants), as well as in humans (Bayraktar et al. 2011; Amato et al. 2017; Ghielmetti et al. 2017; Krajewska-Wędzina et al. 2017; Malone & Gordon 2017; Ahmad et al. 2018; Infantes-Lorenzo et al. 2020; Sevilla et al. 2020). Infection may result in respiratory disease, lymphadenitis, and disseminated disease, although it is associated primarily with tuberculous lesions (Pate et al. 2006; Vidal et al. 2018). Diagnosis can be challenging, and specialized laboratory tests, including bacterial culture and molecular techniques, are often needed.

The epidemiological role of companion animals in TB transmission remains debated. Domestic cats appear to be susceptible to mycobacterial infections (Broughan et al. 2013, Gunn-Moore et al., 2014). Nevertheless, these infections are often overlooked in veterinary practice (Mitchell et al. 2022), which raises concerns for human health. Infections of companion animals with zoonotic agents such as TB emphasize the importance of veterinarians in performing appropriate testing, reaching a proper diagnosis, ensuring appropriate case management, and engaging in adequate preventative measures (Global Tuberculosis Report, 2023).

This report presents the first documented case of *M. caprae* infection in a domestic cat in the United

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Kingdom, expanding the literature on mycobacterial infections in domestic species.

Clinical case information

The case involves a 1-year and 2-month-old, male-castrated, domestic Bengal cat with a 2.5-month history of retching, sneezing, coughing, respiratory distress, and progressive weight loss (4.3–2.8 kg). The respiratory signs were unresponsive to various antibiotics (amoxicillin and clavulanic acid at 12.5 mg/kg/12 h for 5 d, marbofloxacin at 3 mg/kg/d, and clindamycin hydrochloride at 11 mg/kg/d), anti-inflammatory drugs (prednisolone at an initial dose of 0.5 mg/kg/d for 3 d then lowered to 0.25 mg/kg for an additional 5 d) and antiparasitic drugs (fenbendazole at 1 g/d). Initial hematology tests revealed monocytosis. Despite initial improvement, symptoms persisted, leading to further investigations consisting of a Feline Upper Respiratory Disease Real PCR Panel and SNAP FIV/FeLV Combo test (IDEXX Laboratories) bronchoalveolar lavage with cytology. Cytologic evaluation revealed a mixture of uniform cuboidal respiratory epithelial cells, nondegenerative neutrophils, and occasional large round mononuclear cells/macrophages. No clear evidence of microorganisms was detected, and no respiratory viruses were identified *via* PCR. Heparinized blood samples were analyzed *via* an interferon-gamma release assay (IGRA; Biobest, Penicuik, UK), which yielded negative results. Despite the absence of a confirmed diagnosis, antibiotic (clindamycin hydrochloride) and antiparasitic (fenbendazole) treatments were continued to address potential underlying causes. The owner reported transient clinical improvement, with resolution of respiratory distress. Suspension of further examination and thorough monitoring of the cat's weight and progression of clinical signs by the owner were agreed upon. Approximately one month later, after progressive deterioration, the animal died, and a postmortem examination was requested.

Macroscopic findings

Gross postmortem evaluation confirmed a poor body condition with low adipose stores and mild symmetrical reduction of the appendicular musculature (BCS 1.5–2/5). The lungs contained multifocal to coalescing, 1–5 cm in diameter, pale tan, mildly raised, soft nodules on the pleural surface, prominently within the dorsal aspect of the caudal lobes (Fig. 1). These nodules produced small amounts of pale tan and creamy material on the cut sections, which was consistent with caseous necrosis. Similarly, larger nodules were cavitated and contained a small amount of central pale tan to brown liquid material, indicative of liquefactive necrosis. Similar findings were observed in the corticomedullary junction of the right kidney on cut sections.

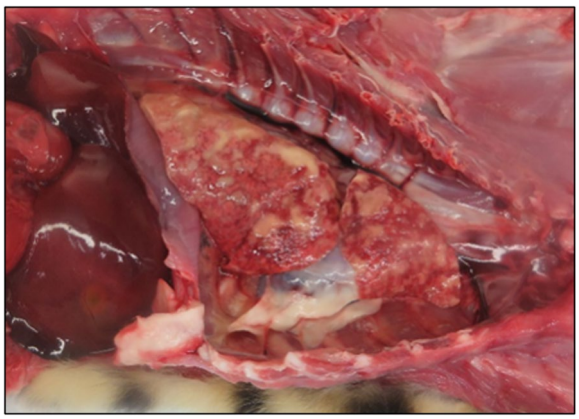

Fig. 1 Right lateral view of the thoracic cavity and liver. The right lung lobes are multifocal in that they coalesce pale tan to yellow, mildly raised foci, prominently affecting the dorsal aspect of the caudal lobes. A small amount of visceral adipose tissue is present in the thoracic cavity

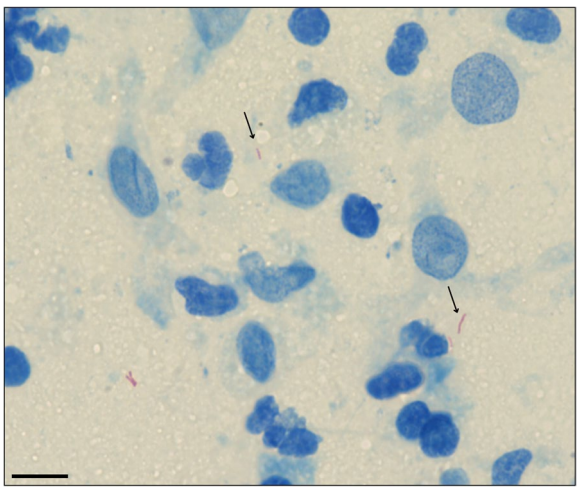

Fig. 2 Lung touch imprint. A mixture of cuboidal respiratory epithelial cells, nondegenerate and degenerate neutrophils, and large macrophages. Scattered, approximately 3-5 µm long, ZN-positive bacilli are present within the cytoplasm of macrophages (arrows; ZN 60x; scale bar: 20 µm)

Cytologic and histologic findings

Owing to concerns about tuberculosis, touch imprints of the pulmonary nodules were generated during necropsy by staining with Ziehl–Neelsen (ZN). This revealed small numbers of widely dispersed, ZN-positive bacilli approximately 3 to 5 µm long within the cytoplasm of the macrophages (Fig. 2).

Selected tissues were collected and fixed in 10% buffered formalin or stored at −20°C. Samples of the brain, heart, trachea, lungs, liver, kidneys, urinary bladder, testes, spleen, stomach, small intestine, large

intestine, pancreas, thyroid and parathyroid glands, skeletal muscle, and sciatic nerve were saved in 10% neutral buffered formalin; additional samples of the kidneys, liver, brain, lungs (including charcoal swabs of the affected areas), spleen, blood and small intestine were frozen. Selected fixed tissues (lung, kidney, liver, stomach, small and large intestine, heart, and brain [cerebral cortex, pons, cerebellum, thalamus, hippocampus]) were processed via standard methods for histologic evaluation with hematoxylin and eosin (H&E) staining and ZN staining of the lungs, kidney, and mesenteric lymph nodes.

Histologically, the pulmonary parenchyma and airways were effaced and replaced by multifocuses to coalesce with foci of pyogranulomatous inflammation and necrosis. The necrotic areas were surrounded by epithelioid macrophages, fewer foamy macrophages, and a low number of multinucleated giant cells with haphazardly arranged nuclei (foreign body type). ZN staining revealed scattered, intramacrophagic and extracellular 1 × 3–4 µm, acid-fast bacilli within the necrotic areas (Fig. 3). In addition, the pulmonary parenchyma was multifocally expanded with fibrous bands. The alveoli of the remaining lung parenchyma were filled with abundant edema, foamy macrophages, and fewer neutrophils. Chronic fibrosing pleuritis with multifocal mesothelial hyperplasia was also present.

Within the right kidney, pyogranulomatous interstitial nephritis with necrosis and intralesional intramacrophagic and extracellular acid-fast bacilli were identified. Interestingly, no gross morphological alteration of the mesenteric lymph node was detected; however, microscopically, the architecture was affected by randomly distributed granulomas (0.5–2 mm in diameter) with necrotic centers and large numbers of intracellular acid-fast bacilli (Fig. 4). Reactive lymphoid hyperplasia was observed in the spleen. No significant pathological changes were detected in the remaining organs.

On the basis of these findings, a suspicion of mycobacteriosis was reported to the Animal and Plant Health Agency (APHA), and samples of frozen lung were sent to the APHA for PCR. Mycobacterial PCR of the lung was positive for the *M. tuberculosis* complex but tested negative for *M. bovis* and *M. microti*. Further culture was performed to identify *M. caprae* as the infectious agent involved.

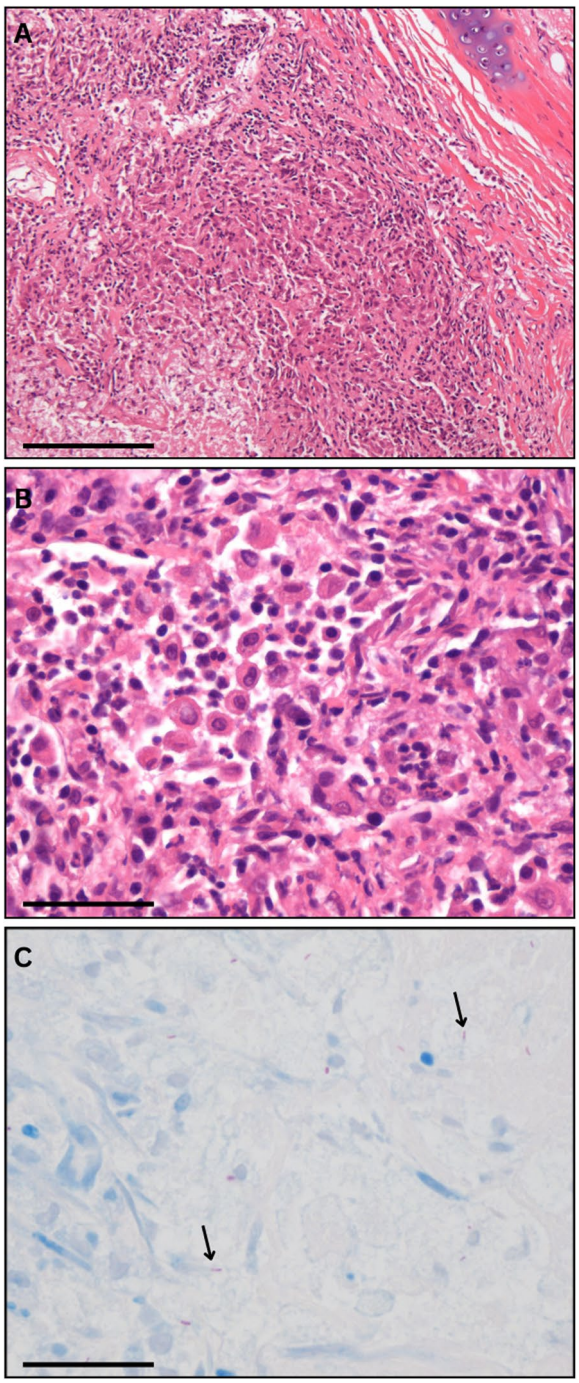

Fig. 3 Lung. **A** and **B** The pulmonary parenchyma is effaced and replaced by multiple layers to coalesce, with foci of pyogranulomatous bronchopneumonia consisting of abundant epithelioid macrophages and fewer foamy macrophages containing cytoplasmic, negatively stained bacteria (inset – HE, 60x), and a low number of multinucleated giant cells. Multifocal fibrous bands dissected from the area (**A:**HE, 10x; scale bar: 200 µm; **B:**HE, 20x; scale bar: 100 µm). **C** : Scattered, intramacrophagic and extracellular 1 × 3–4 µm ZN-positive bacilli are present within the granulomas (arrows; ZN, 40x; scale bar: 50 µm)

Discussion

The gross pulmonary and renal lesions in this case consisted of pyogranulomatous bronchopneumonia and nephritis, for which there are a number of differences in addition to mycobacteriosis. Owing to the rarity of

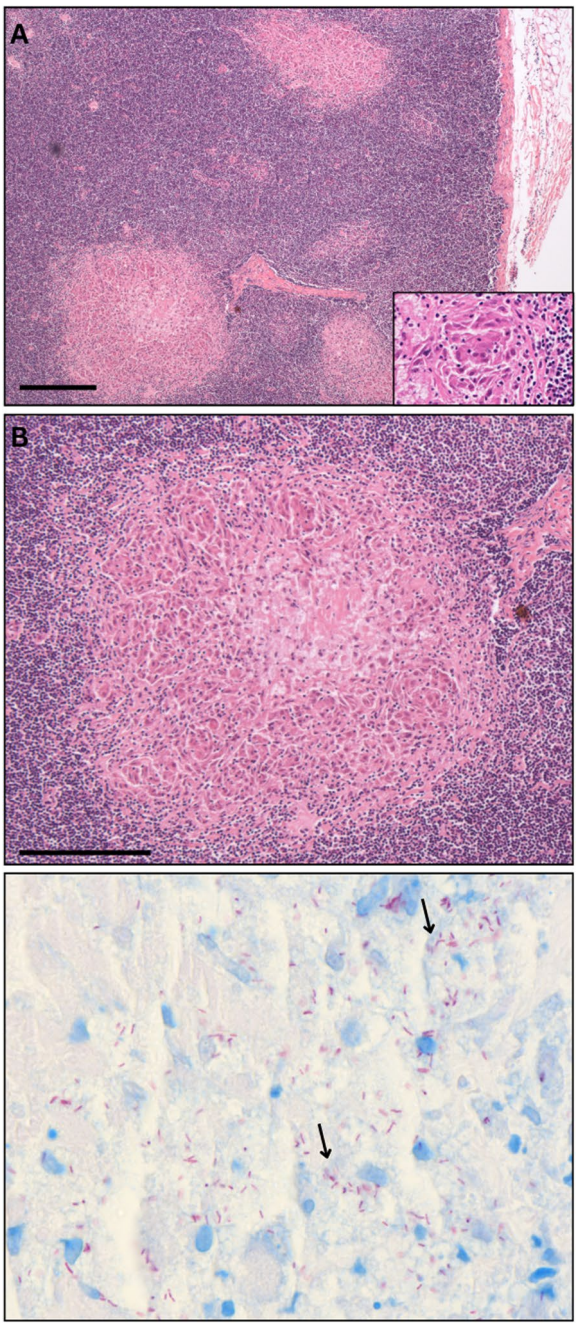

Fig. 4 Mesenteric lymph node. **A** and **B** The architecture is multifocally effaced by randomly distributed, variably sized granulomas (**A:** HE, 4x, scale bar: 300 µm; **B:** HE, 10x, scale bar: 200 µm). Inset **A**: multinucleated giant cells with haphazardly arranged nuclei (foreign body type) (HE; 40x). **C** Abundant intramacrophagic and extracellular 1 × 3–4 µm ZN-positive bacilli are present within the granulomas (arrows; ZN 40x; scale bar: 50 µm)

M. caprae infections in domestic animals, especially in cats, this etiology was not initially considered. The clinically negative IGRA additionally decreased suspicion for mycobacterial infection. Importantly, while IGRAs have been shown to have higher diagnostic sensitivities than tuberculin skin tests do, they do not have a reliable sensitivity for use as a rule-out test for active TB infections in humans. In addition, given that the recorded sensitivity of the test in cases of feline mycobacteriosis is similar, it should not be used as a rule-out test in feline cases (Mitchell et al. 2021; Sester et al. 2011). This case provides a clear example of the potential pitfalls of using the IGRA results as a rule-out test for active tuberculosis in cats. In line with the gross findings, primary differentials initially included several bacteria (*e.g., Nocardia* spp., *Actinomyces* spp., *Pasteurella* spp., *Bordetella bronchiseptica, Rhodococcus equi, Mycoplasma* spp.), fungi (*e.g., Cryptococcus* spp., *Aspergillus* spp.) and parasitic entities (*e.g., Capillaria aerophila*), as well as atypical mycobacteria (nontuberculosis group), which are known to cause suppurative to pyogranulomatous pulmonary lesions in domestic and wildlife species, as well as in humans (Caswell & Williams 2016; Couto & Artacho 2007; Díaz-Santana et al. 2022; Fernandez et al. 2018; Husain N. A., 2021; Lehmann et al. 2024; Sting et al. 2022). ZN staining of the bacilli and histopathology, however, were highly indicative of mycobacterial infection.

This animal shows systemic mycobacteriosis, and the most common presentation in this species is cutaneous (Mitchell et al. 2022). The young age of the cat and the severity of its condition, which progressed approximately 3 months from the first reported clinical signs, raised concerns about the contribution of an unidentified underlying immunosuppressive condition (*e.g.*, chronic stress, viral infections) (Slaviero et al. 2021).

A primary aerogenous route of entry is suspected due to prominent lesions within the respiratory tract. This case, like many reported cases of feline mycobacteriosis, has proven to be paucibacillary, particularly in the lungs (Gunn-Moore et al., 2014). Conversely, a moderate number of acid-fast bacilli were observed in the mesenteric lymph node. This may reflect some aspects of simultaneous oro-intestinal transmission, although no signs of inflammation or acid-fast bacteria were observed within the gastrointestinal tract (O'Halloran et al. 2021). However, the moderate degree of autolysis of the gastrointestinal specimens hampered detailed histologic evaluation. The size and distribution of the renal lesions were consistent with hematogenous embolic spread.

The most common causes of TB in domestic cats are *M. bovis* and *M. microti* (Mitchell et al. 2022). Despite the increasing recognition of *M. caprae* as a pathogen in domestic animals, with importance concerning its zoonotic potential (Riopel et al. 2024), few studies exist on its specific impact on feline health. Further research is needed to elucidate the epidemiology, diagnostic

methods, and treatment strategies of these infections in domestic animals.

Given that *M. caprae* is a member of the MTBC, its potential transmission to humans warrants particular attention. Zoonotic transmission of MTBC is well documented, particularly with *Mycobacterium bovis*, which frequently affects cattle and poses a significant threat to both livestock industries and public health (O-Reilly et al., 1995).

M. caprae accounts for a relatively small epidemiologic burden; however, this burden may be underestimated, as in some labs, diagnostic samples are not routinely identified at the species level. Differentiating *M. caprae* from *M. bovis* requires molecular analysis, which is not always pursued in cases of TB. Consequently, *M. caprae* infections in both animals and humans are likely underdiagnosed (Martinez-Lirola et al., 2023). *M. caprae* is phylogenetically distinct and, as such, warrants separate consideration in veterinary diagnostic investigations and public health contexts (De la Fuente et al. 2015). This case underscores the necessity of interdisciplinary collaboration between the veterinary and public health sectors to address zoonotic risks.

Conclusion

As the first reported case of *M. caprae* infection in a UK domestic cat, this study highlights a detailed description of the clinical case, including history, in vivo diagnostic investigations, and macroscopic and histologic pathologic findings, as well as the diagnostic complexities associated with *M. caprae* infection. Through this case report, we seek to raise awareness among veterinary practitioners, public health officials, and researchers to consider *M. caprae* as a differential diagnosis when similar clinical signs and pathologic lesions are observed. This case also serves as an important reminder of the limitations of IGRA testing in the diagnosis of mycobacteriosis. By contributing to the growing body of literature on mycobacterial infections in domestic animal populations, we can prevent or mitigate the risks of zoonotic transmission and safeguard the health and welfare of both animals and humans.

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Authors' contributions
C. Gola and P. Diaz-Santana contributed to the conception and drafting of the article. P. Diaz-Santana, J. Déniz-Marrero, and S. Fingerhood acquired the image data. C. Gola, P. Díaz-Santana, S. Fingerhood, J. Déniz Marrero, and M. Hernández Pérez edited and reviewed the manuscript critically for important intellectual content. All the authors contributed to the article and approved the submitted version to be published.

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Data availability
All the data analyzed in the current case report are included in this published article.

Declarations

Competing interests
The authors declare that they have no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

Ahmad, I., C.A. Kudi, A.I. Abdulkadir, S.N.A. Saidu, U.M. Chafe, and Z. Abdulmalik. 2018. Survey of bovine tuberculosis in Nigerian beef cattle. *Open Vet J.* 8 (4): 463–470. https://doi.org/10.4314/ovj.v8i4.18.

Amato, B., T.M. Capucchio, E. Biasibetti, E. Mangano, B.M. Boniotti, L.M. Pacciarini, S. Migliore, M. Vitale, M. Fiasconaro, Di Marco Lo. Presti, et al. 2017. Pathology and genetic findings in a rare case of *Mycobacterium caprae* infection in a sow. *Veterinary Microbiology* 205: 71–74. https://doi.org/10.1016/j.vetmic.2017.05.010.

Bayraktar, B., A. Togay, H. Gencer, T. Kockaya, N. Dalgic, A.B. Baris, and E. Bulut. 2011. *Mycobacterium caprae* causing lymphadenitis in a child. *The Pediatric Infectious Disease Journal* 30 (11): 1012–1013. https://doi.org/10.1097/INF.0b013e3182276f7c.

Broughan JM, Downs SH, Crawshaw TR, Upton PA, Brewer J, Clifton-Hadley RS. 2013. *Mycobacterium bovis* infections in domesticated nonbovine mammalian species. Part 1: Review of epidemiology and laboratory submissions in Great Britain 2004–2010. *Vet J.* 198 (2): 339–45. https://doi.org/10.1016/j.tvjl.2013.09.006.

Caswell, JL, & Williams, KJ. 2016. Respiratory system (Vol. 2). In *Jubb, Kennedy, and Palmer's Pathology of domestic animals.* Elsevier.

Couto, S.S., and C.A. Artacho. 2007. *Mycobacterium f*ortuitum pneumonia in a cat and the role of lipid in the pathogenesis of atypical mycobacterial infections. *Veterinary Pathology* 44 (4): 543–546. https://doi.org/10.1354/vp.44-4-543.

Díaz-Santana, P., A. Fernández, J. Díaz-Delgado, A.I. Vela, L. Domínguez, C. Suárez-Santana, R. Puig-Lozano, C. Fernández-Maldonado, E. Sierra, and M. Arbelo. 2022. Nocardiosis in free-ranging cetaceans from the central-Eastern Atlantic Ocean and Contiguous Mediterranean sea. *Animals (Basel).* 12 (4): 434. https://doi.org/10.3390/ani12040434.

Fernandez, J.A., M.N. Hidalgo, E. Hodzic, S.S. Diab, and F.A. Uzal. 2018. Pathology of coccidioidomycosis in llamas and alpacas. *Journal of Veterinary Diagnostic Investigation* 30 (4): 560–564. https://doi.org/10.1177/1040638718777282.

de la Fuente J, Díez-Delgado I, Contreras M, Vicente J, Cabezas-Cruz A, Tobes R, Manrique M, López V, Romero B, Bezos J, et al. 2015. Comparative genomics of field isolates of *Mycobacterium bovis* and *M. caprae* provides evidence for possible correlations with bacterial viability and virulence. *PLoS Negl Trop Dis.* 9 (11): e0004232. https://doi.org/10.1371/journal.pntd.0004232.

Ghielmetti, G., and U. Giger. 2020. *Mycobacterium avium*: An emerging pathogen for dog breeds with hereditary immunodeficiencies. *Curr Clin Microbiol Rep.* 7 (3): 67–80. https://doi.org/10.1007/s40588-020-00145-5.

Ghielmetti, G., S. Scherrer, U. Friedel, D. Frei, D. Suter, L. Perler, and M.M. Wittenbrink. 2017. Epidemiological tracing of bovine tuberculosis in Switzerland, multilocus variable number of tandem repeat analysis of *Mycobacterium bovis* and *Mycobacterium caprae*. *PLoS ONE* 12 (2): e0172474. https://doi.org/10.1371/journal.pone.0172474.

Gunn-Moore, D.A. 2014. Feline mycobacterial infections. *The Veterinary Journal* 201 (2): 230–238. https://doi.org/10.1016/j.tvjl.2014.02.014.

Husain, N.A. 2021. *The Lung*. In Robbins & Cotran Pathologic Basis of Disease: Elsevier.

Infantes-Lorenzo, J.A., B. Romero, A. Rodríguez-Bertos, A. Roy, J. Ortega, L. de Juan, I. Moreno, M. Domínguez, L. Domínguez, and J. Bezos. 2020. Tuberculosis caused by *Mycobacterium caprae* in a camel (*Camelus dromedarius*). *BMC Veterinary Research* 16 (1): 435. https://doi.org/10.1186/s12917-020-02665-0.

Krajewska-Wędzina, M., W. Olech, M. Kozińska, E. Augustynowicz-Kopeć, M. Weiner, and K. Szulowski. 2017. Bovine tuberculosis outbreak in farmed American bison (*Bison bison*) in Poland. *Polish Journal of Veterinary Sciences* 20 (4): 819–821. https://doi.org/10.1515/pjvs-2017-0103.

Lehmann, S., E. Dervas, A. Ruiz Subira, U. Eulenberger, A. Gimmel, F. Grimm, U. Hetzel, and A. Kipar. 2024. Verminous pneumonia in European hedgehogs (*Erinaceus europaeus*). *Veterinary Pathology* 61 (2): 256–268. https://doi.org/10.1177/03009858231193103.

Malone, K.M., and S.V. Gordon. 2017. *Mycobacterium tuberculosis* complex members adapted to wild and domestic animals. *Advances in Experimental Medicine and Biology* 1019: 135–154. https://doi.org/10.1007/978-3-319-64371-7_7.

Martínez-Lirola, M., M. Herranz, S. Buenestado Serrano, C. Rodríguez-Grande, E. Dominguez Inarra, J.A. Garrido-Cárdenas, A.M. Correa Ruiz, M.P. Bermúdez, M. Causse Del Río, et al. 2023. One health approach revealed the long-term role of Mycobacterium caprae as the hidden cause of human tuberculosis in a region of Spain from 2003–2022. *Eurosurveillance Weekly* 28 (12): 2200852. https://doi.org/10.2807/1560-7917.ES.2023.28.12.2200852.

Mitchell, J.L., P. Stanley, K. McDonald, P. Burr, S.G. Rhodes, D.A. Gunn-Moore, and J.C. Hope. 2021. Diagnostic accuracy of the interferon-gamma release assay (IGRA) for cases of feline mycobacteriosis. *Preventive Veterinary Medicine* 193: 105409. https://doi.org/10.1016/j.prevetmed.2021.105409.

Mitchell, J.L., J. Del Pozo, C.S.C. Woolley, R. Dheendsa, J.C. Hope, and D.A. Gunn-Moore. 2022. Histological and immunohistochemical features suggest etiological differences in lymph node and (muco)cutaneous feline tuberculosis lesions. *Journal of Small Animal Practice* 63 (3): 174–187. https://doi.org/10.1111/jsap.13386.

O'Halloran, C., C. Tørnqvist-Johnsen, G. Woods, J. Mitchell, N. Reed, P. Burr, D. Gascoyne-Binzi, M. Wegg, S. Beardall, J. Hope, et al. 2021. Feline tuberculosis caused by *Mycobacterium bovis* infection of domestic UK cats associated with feeding a commercial raw food diet. *Transboundary and Emerging Diseases* 68 (4): 2308–2320. https://doi.org/10.1111/tbed.13889.

O'Reilly, L.M., and C.J. Daborn. 1995. The epidemiology of *Mycobacterium bovis* infections in animals and man: A review. *Tubercle and Lung Disease* 76 (Suppl 1): 1–46. https://doi.org/10.1016/0962-8479(95)90591-x.

Pate, M., T. Svara, M. Gombac, T. Paller, M. Zolnir-Dovc, I. Emersic, W.M. Prodinger, M. Bartos, I. Zdovc, B. Krt, et al. 2006. Outbreak of tuberculosis caused by *Mycobacterium caprae* in a zoological garden. *Journal of Veterinary Medicine. b, Infectious Diseases and Veterinary Public Health* 53 (8): 387–392. https://doi.org/10.1111/j.1439-0450.2006.01000.x.

Reheman, A., Cao, X.J., Wang, Y.F., Nie, X., Cao, G., Zhou, W., Yang, B., Lei, Y.Y., Zhang, W.P., Naeem, M.A., Chen, X., 2023. Involvement of 2′-5′ oligoadenylate synthetase-like protein in the survival of Mycobacterium tuberculosis avirulent strain in macrophages. *Animal Diseases* 3: 5. https://doi.org/10.1186/s44149-023-00068-w.

Riopel ND, Long R, Heffernan C, Tyrrell GJ, Shandro C, Li V, Islam MR, Stobart M, Sharma MK, Soualhine H, Cooper R. 2024. Characterization of *Mycobacterium orygis*, *Mycobacterium bovis*, and *Mycobacterium caprae* infections in humans in Western Canada. *J Infect Dis*. E 124. https://doi.org/10.1093/infdis/jiae124.

Sester, M., G. Sotgiu, C. Lange, C. Giehl, E. Girardi, G.B. Migliori, A. Bossink, K. Dheda, R. Diel, J. Dominguez, et al. 2011. Interferon-γ release assays for the diagnosis of active tuberculosis: A systematic review and meta-analysis. *European Respiratory Journal* 37 (1): 100–111. https://doi.org/10.1183/09031936.00114810.

Sevilla, I.A., M.C. Arnal, M. Fuertes, E. Martín, J. Comenge, N. Elguezabal, D. Fernández de Luco, and J.M. Garrido. 2020. Tuberculosis outbreak caused by *Mycobacterium caprae* on a rabbit farm in Spain. *Transboundary and Emerging Diseases* 67 (1): 431–441. https://doi.org/10.1111/tbed.13366.

Slaviero, M., L.P. Ehlers, F.F. Argenta, C. Savi, B.C. Lopes, S.P. Pavarini, D. Driemeier, and L. Sonne. 2021. Causes and lesions of fatal pneumonia in domestic cats. *Journal of Comparative Pathology* 189 (5): 9–71. https://doi.org/10.1016/j.jcpa.2021.09.005.

Sting, R., I. Schwabe, M. Kieferle, M. Münch, and J. Rau. 2022. Fatal Infection in an Alpaca (*Vicugna pacos*) Caused by Pathogenic *Rhodococcus equi*. *Animals (Basel).* 12 (10): 1303. https://doi.org/10.3390/ani12101303.

Vidal, E., M. Grasa, T. Perálvarez, M. Martín, I. Mercader, and B. Pérez de Val. 2018. Transmission of tuberculosis caused by *Mycobacterium capra*e between dairy sheep and goats. *Small Ruminant Research.* 158: 22–25. https://doi.org/10.1016/j.smallrumres.2017.11.010.

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