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Case report

*Streptomyces cyaneus* dermatitis in a dog

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**Background** A 3-year, 10-month-old neutered male Australian terrier was referred for a nodular pyogranulomatous mass of the right axilla. It had been poorly responsive to antibiotic therapy.

**Results** Based on filamentous Gram-positive organisms identified in earlier biopsy material, infection by *Actinomyces* sp. was suspected and the dog showed clinical improvement on a trial of potentiated sulphonamides. Recurrence 5 months later prompted euthanasia, with *Streptomyces cyaneus* being cultured and confirmed by genetic sequencing of part of the 16s ribosomal RNA gene.

**Conclusion** Invasive *Streptomyces* sp. infections are uncommon in humans and animals, and isolations are sometimes considered to be contaminants, but the demonstration of the organism within the lesion in this instance indicates that the
isolation of *Streptomyces* sp. from veterinary cases should not always be considered a contamination, since this genus is clearly pathogenic.

**Keywords**  *Streptomyces cyaneus*; pyogranulomatous dermatitis; canine

**Introduction**

*Streptomyces* are a Gram-positive filamentous organism of the family Streptomycetaceae, within the order Actinomycetales. Other bacteria within this order are *Nocardia, Mycobacteria*, and *Actinomyces*. *Streptomyces* are aerobic (unlike *Actinomyces*) and non acid-fast organisms (unlike *Nocardia* and *Mycobacteria*) comprising several hundred species. Most are found in the soil and most produce pigments. Many antibiotics, such as the aminoglycosides, tetracyclines and macrolides, are derived from these species.

Most lesions due to Actinomycetales show chronic progression, abscessation and sometimes fistula formation. Diagnosis is often delayed and treatment can be prolonged\(^1\). *Streptomyces* spp. are often isolated as contaminants on laboratory agar cultures, or as agents of unknown significance in mixed infections. True infections are reported only rarely in the human literature,\(^2, 3,4\) usually as opportunistic infections of penetrating wounds, or from surgical contamination, although *Streptomyces* sp. pneumonia has been reported in both immunocompromised\(^5\) and immunocompetent humans,\(^6\) or those with other complicating conditions.\(^7\) One human case occurred following a needle-stick injury whilst vaccinating sheep\(^8\) and multiple cases associated
with catheter infections have been documented.\textsuperscript{9} Streptomyces sp. infections are less common than those caused by other actinomycetes such as Actinomyces sp. and Nocardia sp. Bacteraemia is only rarely found in Streptomyces sp. infections.\textsuperscript{10} A recent study\textsuperscript{11} in a neonatal pig model of necrotizing enterocolitis found Streptomyces as one of several types of bacteria associated with ileal dysbiosis accompanying the disease. Streptomyces sp. infections in animals are rare.\textsuperscript{12}

This report is a case of pyogranulomatous dermatitis in a dog, in which infection with Streptomyces cyaneus was confirmed by biopsy with histopathology, culture and partial DNA sequencing, confirming the pathogenic potential of Streptomyces sp. in dogs.

**Case report**

A 3 year 10 month, neutered male, Australian terrier presented with a history of a mass in the right axilla occurring approximately one year prior to presentation. The mass had recurred after drainage and biopsy. Antibiotics including clavulanic acid/amoxicillin, chloramphenicol and doxycycline had been prescribed over several months, without significant response. Physical examination indicated extensive pyogranulomatous skin disease extending cranial, ventral and caudal to the right axilla, with involvement of the prescapular lymph node. The owners were unable to afford the biopsy and culture procedures suggested for diagnosis and, based on previous histopathology results showing a pyogranulomatous deep dermatitis, with filamentous Gram-positive organisms, the dog was placed on a trial of potentiated sulphonamides for suspected Actinomyces infection. After 1 month, the lesions showed significant improvement, but 5
months later there had been recurrence and the owners asked for the animal to be euthanased. Post mortem examination was undertaken to establish the aetiology.

At post-mortem examination there was focally extensive alopecia and ulcerated multinodular swelling of the right axillary region, extending over the right forelimb (Fig. 1). Subcutaneous dissection revealed multinodular to coalescing, focally extensive accumulations of light brown semifluid purulent material with black flecks throughout (Fig. 1 inset). This extended 10-15 mm deep into the subcutis, passing over the lateral aspect of the thorax, medial to the scapula almost to its dorsal limit, and cranially to the level of the thoracic inlet, plus distally to the level of the right elbow. The right retropharyngeal lymph node was enlarged to 2 cm in length and appeared soft and oedematous. The right prescapular and axillary nodes were unable to be located amongst the purulent pockets. There were no other significant findings.

Histopathology from the right lateral thoracic wall revealed focally parakeratotic, focally ulcerated, and acanthotic epidermis, overlying a severe, focally extensive infiltrate of neutrophils, plasma cells and macrophages, the latter often containing light brown pigment, with numerous intralesional club colonies. The colonies had an eosinophilic centre and a black pigmented periphery (Fig. 2). Filamentous organisms were seen within the colonies. The infiltrate extended through deep dermis and hypodermis, down to underlying fascia and muscle. The organisms were negative for Ziehl-Neelson staining, positive with Gram staining, and negative for the periodic acid-Schiff reaction. Steiner’s silver stain demonstrated the organisms clearly (Fig. 2 inset). The organism’s
long filamentous morphology and Gram-positive reaction were well-demonstrated on smears made from the isolated colonies (Fig. 3). The morphological diagnosis was a focally extensive, severe, chronic pyogranulomatous dermatitis and cellulitis, with numerous intralesional filamentous pigmented bacteria.

Bacterial culture of both fresh tissue and a deep tissue swab from the affected area yielded a scanty to light growth of a Gram-positive filamentous bacterium. The isolate formed pearl-coloured, shiny, waxy, adherent colonies, with Gram stain showing Gram-positive long filaments. There was pure growth on the agar and a molar tooth appearance to the colonies on ageing. Partial DNA sequencing of the isolate was undertaken. A total of 404 bases were sequenced and there was a 100% match with the *Streptomyces cyaneus* (syn: *Streptomyces curacoï*) 16s ribosomal RNA gene (partial sequence-Locus AY232254) held on the NCBI NUCLEOTIDE database (http://www.ncbi.nlm.nih.gov/entrez).

**Discussion**

As noted above, *Streptomyces* sp. infections in animals are rare, with previously reported infections in animals including skin infections in cats,\(^{13,14}\) in donkeys with fistulous withers\(^{15}\) and as a pathogen from ostrich eggs.\(^{16}\) The *Streptomyces salmonicida* originally reported as a pathogen in fish\(^{17}\) has now been reclassified as *Nocardia salmonicida*.\(^{18}\) *Streptomyces* sp. has been isolated from ocular swabs of clinically normal horses, but not as a pathogen.\(^{19}\) Experimentally, *Streptomyces griseus* has caused mycetomas in laboratory mice.\(^{20}\) *Streptomyces* sp. was also cultured from a
nasal biopsy in a cat with neutrophilic, ulcerative rhinitis, but different bacteria were recovered in a nasal flush sample, and the animal was positive for feline herpesvirus-1 by PCR, making the pathogenic significance of the isolate unclear. Streptomyces have been detected by culture from faeces of a panther, but this is distinct from an infection.

To the authors’ knowledge, there is no documented case of Streptomyces sp. infection in dogs. In the case reported here, the isolation of this organism on two separate occasions, each time from two different sites plated onto different plates, makes contamination most unlikely. The bacteriology samples collected at necropsy were taken through shaved and ethanol scrubbed skin with sterile instruments, to minimise contamination. Additionally, the presence of filamentous bacteria on the histology section clearly demonstrates a genuine intralesional organism. The original source of the infection is not clear in this case, although at this site a perforating and contaminated traumatic injury is a possible inciting cause. These organisms are associated with lesions that are reported to have a low cure rate, often requiring protacted antibiotic treatment (Moss et al., 2003).

Differentiation from other filamentous bacteria in histological sections is based on the strong positive staining (and negative Gram stain) of opportunistic Mycobacteria with routine Ziehl-Neelson staining, and the positive staining of many, but not all, Nocardia species with modified acid-fast stains only (Fite-Faraco method). Culture or molecular techniques are often required to differentiate non acid-fast Nocardia from Actinomyces sp., since both are Gram-positive, although Nocardia only weakly so. Clinical
differentiation between the infections caused by *Actinomyces* sp., *Nocardia* sp., *Streptomyces* sp. and *Actinomadura* sp. is difficult, as noted in this case, since the lesions (actinomycotic mycetomas characterized by tissue grains or ‘sulphur granules’) are similar morphologically. Black-grained infections, as seen with the *Streptomyces cyaneus* infection reported here, are seen also in infections by *Curvularia geniculata*, *Madurella grisea* and *Phaeococcus* sp.

The case reported here indicates that the isolation of *Streptomyces* sp. from veterinary cases should not necessarily be considered a contamination, and that this genus is clearly pathogenic in domestic species. There may well be zoonotic potential from such infections.

**Acknowledgements**

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**References**


Figure legends

For all figures, authors suggest single column, approx. 90 mm would suffice.

Figure 1. Clipped skin over right elbow and thorax showing multinodular, ulcerated lesions. Inset shows appearance of subcutaneous tissues from the area indicated, with brown purulent material having multiple black flecks.

Figure 2. Routine light microscopy shows an example of a bacterial colony, extending from top left, having a pigmented periphery, amongst a mixed infiltrate of neutrophils, macrophages and plasma cells. Bar = 20 µm. H&E stain. Inset shows organisms positive with Steiner’s silver stain. Bar = 10 µm.

Figure 3. Smear cytology by oil immersion microscopy shows abundant, Gram-positive, filamentous bacteria. Bar = 10 µm. Inset shows the pearl-coloured, shiny, waxy colonies with a molar tooth appearance from which the smear was made.
Figure 1.

Clipped skin over the right elbow and thorax of a nearly 4-year-old neutered male Australian Terrier showing multinodular, ulcerated lesions. Inset: subcutaneous tissues from the area indicated, with brown purulent material and multiple black flecks.
Figure 2.
Routine light microscopy shows an example of a bacterial colony (from top left) with a pigmented periphery, among a mixed infiltrate of neutrophils, macrophages and plasma cells (H&E, bar = 20 μm). Inset: organisms staining positive with Steiner's silver stain (bar = 10 μm).
Figure 3.
Smear cytology by oil immersion microscopy shows abundant, Gram-positive, filamentous bacteria (bar = 10 μm). Inset: pearl-coloured, shiny, waxy colonies with a 'molar tooth’ appearance from which the smear was made.