

EVIDENCE OF *NOCARDIA SP.* IN A CAPTIVE-BORN BELUGA WHALE

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Introduction

Nocardia species belong to a group of microorganisms classified as aerobic actinomycetes. The vast majority of aerobic actinomycetes of clinical importance are currently assigned to one of three genera: *Streptomyces*, *Nocardia*, or *Mycobacterium*. When one considers that over 30 genera of actinomycetes have been described and that the medical microbiologist encounters only a limited number of species within the three principal genera that interests him, it becomes clear that he sees only a small sector of the whole actinomycetic spectrum. Properly speaking, actinomycetic genera are form-genera; that is they may, for the most part, be distinguished on the basis of morphological criteria. Most strains isolated from sources such as soil may be characterized this way. Unfortunately, this is frequently not possible for clinical isolates, because such strains have often lost the capacity to form characteristic morphological structures. In addition, the genus *Nocardia*, which harbours many of these, is not a form genus, and further, there is considerable disagreement about morphological criteria for the assignment of strains to the genus *Mycobacterium*. The classical acid-fast mycobacteria with no, or rare, filamentation and branching, are easily identifiable. Some believe genus *Nocardia* should be limited to strains which form filamentous colonies with aerial hyphae visible, at least, microscopically. The clinical microbiologist stands an excellent chance of correctly assigning most of the strains he encounters, either to *Mycobacterium* or to the *Nocardia-Streptomyces* group on the basis of morphology alone. Differentiating *Nocardia* from *Streptomyces* may be done on the basis of the isomer of 2,6-diaminopimelic acid (DAP), present in major amounts in whole cell hydrolysates. In *Nocardia*, the mesa form is present, in *Streptomyces*, it is the L-form (Lechevalier, 1968).

The genus *Nocardia* is difficult to classify into species because of cultural and biologic variability, and a number of species have been described, some of which are possibly synonymous (Jubb and Kennedy, 1963).

Case history

Tuaq, a male Beluga whale, born at the Vancouver Aquarium on July 13, 1977, was presented at 4 months of age. About 2-4 weeks prior to its death it was noted to have aberrant swimming patterns and developed a list to the right. It became progressively weaker, developed anorexia,

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was treated with numerous intramuscular injections of antibiotics, was tube fed on two occasions and blood samples taken. At death, November 1, 1977, the weight was 73.6 kg and length 160 cm. There was a thick slough of epidermis over the anterior half of the body. Blubber thickness varied from 3.5 cm on the dorsal surface to 2.0 cm on the ventral. Thoracic and abdominal viscera, as well as rib fracture sites and deep body wall, were riddled with multiple abscesses up to 10 cm in diameter. *Nocardia* sp. was cultured. Adhesions of the gut to the abdominal wall in the area of the umbilicus indicate a possible entry site and a restricted passage for ingesta. Analysis of mother's milk did not show the bacterium. A water-born infection at or near birth is suspect.

Considerations

Aerobic actinomycetes can cause a variety of clinical diseases in man and animals. The most common of these are actinomycotic mycetomas, cutaneous and subcutaneous abscesses and acute and chronic pulmonary infections which may later spread to other parts of the body via the blood stream. In spite of a wide distribution of aerobic actinomycetes in nature, only a few species are known to be infectious for mammals (Causey, 1974).

Nocardiosis can be described as a chronic suppurative granulomatous process which may be localized to the skin and subcutis, or be generalized from a primary focus which can be pulmonary or abdominal via the intestine. There is a tendency for organisms to invade blood vessels and generalization can occur from a primary subcutaneous focus. There is often a regional lymphadenitis which is not suppurative. The pulmonary lesions take the form of bronchopneumonia, multiple abscesses or multiple granulomatous nodules. From the lungs, dissemination is often wide and any organ may develop metastatic lesions (Jubb and Kennedy, 1963).

Nocardia asteroides is one of the opportunistic pathogens which are being encountered with increasing frequency in infections of human patients under prolonged treatment with corticosteroids and immunosuppression agents (Bach c.s., 1973).

It is possible that *Nocardia brasiliensis* infection produces a depression of cellular immunity that modifies the local host response to the organism, i.e. related to inactivation of normal T-lymphocyte function. This is not true in the case of *Nocardia asteroides*. Definitive work on other species of *Nocardia* has not been done to date (Folb c.s., 1976).

In vitro testing for antibiotic sensitivity leaves much to be desired. A marked variation in susceptibility among individual strains of *Nocardia asteroides* due to variations of inoculum, pH, and composition of agar assay media has been documented (Lerner and Baum, 1973).

It has been shown that *Nocardia* organisms can remain viable in the drugs used in antibiotic drug sensitivity tests even though showing a sensitivity to a particular drug. This suggests limitations of antinocardial therapy. The sensitivity of pathogenic *Nocardias* varies with

different isolates and hence therapeutic response of infection may vary from case to case. Clearcut therapeutic response to a particular drug or combinations of drugs cannot be assumed in alle cases. Tetracyclines should be included in the therapeutic armamentarium (Desai and Nair, 1973).

Diagnosis of nocardiosis is a difficult one. A good number of cases are discovered only at autopsy. The difficulties arise from a lack of characteristic symptomology (Kurup c.s. 1970).

In the case of Tuaq, bacteriological isolation procedures carried out on blow-hole samples, external lesions, genital slit, blood samples, water samples and tank filters, all failed to show the presence of the *Nocardia* species, even though the animal at the time was suffering from a fulminating suppurative pneumonia, and widespread systemic infection. While not all will agree, we feel those that are fortunate enough to isolate a *Nocardia* even without other supporting evidence have grounds to arrive at a presumptive diagnosis of nocardiosis. In humans, opportunistic infections with *Nocardia*, have become increasingly frequent throughout the United States. The mechanism of host resistance to invasion still remains unknown (Krick and Remington, 1975).

Nocardia infection in the past has not been high on the list of suspected organisms to look for in many clinical laboratories, and when the postmortem picture suggests *Nocardia* infection, only then bacteriological procedures are followed which may result in its discovery. Time is often at a premium in many busy diagnostic laboratories, and if nothing characteristic shows in 48 hours or so, the search is often abandoned. Whereas another 48 hours or so of culture would possibly bring the organism to the fore. Pulmonary nocardiosis is often incorrectly diagnosed in the gross, as actinomycosis, and in the case of fish, as tuberculosis. Without adequate cultural studies, a misdiagnosis is not unusual. The source of the *Nocardia* infection in the case of Tuaq remains a mystery. The role of fish as a source of the organism must be considered. Nocardial organisms have been found in a variety of fish species (Kusuda c.s., 1974; Ribelin c.s., 1975; Wolke c.s., 1974).

Summary

Nocardia infection has been documented in marine mammals. The infection has been reported in 2 Pacific Bottle-nosed Dolphins, a Pilot Whale, the Harbour Porpoise and a Pigmy Sperm Whale as well as *Tursiops truncatus* (Jasmin c.s., 1972; Pier c.s., 1970).

The diagnosis of Nocardial infection in the Beluga from the Vancouver Aquarium, was based on postmortem lesions, and cultural studies. The species of *Nocardia* isolated, has not, as yet, been characterized due to technical problems encountered at the laboratory where the isolate was sent for more sophisticated definitive studies.

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