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Authors: CORNELL, LANNY H., OSBORN, KENT G., and ANTRIM, JAMES E.

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COCCIDIOIDOMYCOSIS IN A CALIFORNIA SEA OTTER

(*Enhydra lutris*) □

LANNY H. CORNELL, KENT G. OSBORN and JAMES E. ANTRIM, Jr., Sea World, Incorporated, San Diego, California 92109, USA

JOHN G. SIMPSON, Newberry Park, California 91320, USA.

Abstract: A weak and emaciated California sea otter (*Enhydra lutris*) was found stranded on Atascadero Beach in Morro Bay, California. It died three weeks after capture. A diagnosis of coccidioidomycosis was confirmed by histology, serology and culture. This is believed to be the first reported case of this disease from the Morro Bay area of San Luis Obispo County, California as well as the first reported case in a free-ranging marine mammal.

INTRODUCTION

Coccidioides immitis is the most infectious of the systemic mycoses. *C. immitis* occurs naturally as a free-living, soil-dwelling saprophytic fungus, but readily assumes a parasitic form when the dust-borne spores are inhaled by warmblooded hosts. Maddy^{1,3} provides an excellent summary of this disease.

Areas of the United States considered enzootic for coccidioidomycosis include parts of Arizona, California, Nevada, New Mexico, Texas and Utah where the climate is arid or semi-arid with hot, dry summers followed by some rain and mild winters with no frosts. The conditions favoring growth and dissemination of this fungus are limited to areas where the soil is alkaline, vegetation is sparse, and dusty winds are not uncommon.

In California, the disease is enzootic in the San Joaquin Valley, and the adjacent slopes over the crest of the Coast Range mountains, the San Fernando Valley of Los Angeles County, as well as portions of Riverside, San Bernardino and San Diego counties. The disease has not been reported in the Morro Bay area, which includes the southern edge of the range of the California sea otter.

Coccidioidomycosis is primarily a respiratory disease that can be described as primary or progressive. Primary coccidioidomycosis is an acute but benign, self-limiting respiratory disease² varying considerably in severity. Approximately 40% of infected humans develop acute bronchitis or pneumonia, while the remaining 60% are symptomless. About 0.5% of infected humans develop progressive coccidioidomycosis, a chronic, malignant and disseminated disease that can involve cutaneous, subcutaneous, visceral and osseous tissues. Disseminated cases are fatal about 50% of the time.¹⁰

In addition to humans, a variety of animals are known to be susceptible to coccidioidomycosis. The disease has been found in domestic animals including horses, burros, swine, sheep, dogs and cats.¹³ Captive animals including a llama (*Lama sp.*, Jones, E.E., unpubl.), a gorilla (*Gorilla beringeri*),¹⁴ a tapir (*Tapirus sp.*),¹⁷ a chinchilla (*Chinchilla laniger*),⁹ two bengal tigers (*Panthera tigris*),⁸ and a California sea lion (*Zalophus californianus*).¹⁶ Each of these occurrences were in known enzootic areas. Reports of *C. immitis* isolation from free-ranging wild animals

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include coyotes (*Canis latrans*),^{1*} pocket mice (*Perognathes baileyi*, *P. pennicilatus* and *P. intermedius*),⁶ the kangaroo rat (*Dipodomys merriami*),⁶ and the grasshopper mouse (*Onychomys torridis*).⁶

CASE HISTORY

An adult male California sea otter was observed frequently leaving and entering the water at Atascadero Beach, California for a period of two days. The otter stayed out of the water most of the day on 25 October 1976. Suspecting that the weak and emaciated animal was ill, representatives of the California Department of Fish and Game brought the otter to Sea World, San Diego the same day.

The animal was quite thin, weighing only 19 kg, ataxic, and apathetic toward food. A deep laceration on both sides of the distal end of the tail extended 7 cm from the tip, exposing the caudal vertebrae. Clinical examination revealed depression, mild dehydration, decreased ability to use the hind limbs and anterior muscular tremors.

The animal's behavior appeared depressed. When in the water, the otter groomed with apparently normal vigor; yet, when it tried to leave the pool, was unable to do so without assistance. Once out of the water, the animal did not move about the enclosure.

Based on the clinical examination and the observations of behavior, we suspected: (1) a neurological disorder, (2) respiratory disease of unknown etiology, and (3) parasitic enteritis.

Treatment included twice-daily injections of a broad spectrum antibiotic (cephalothin sodium B.I.D. 20 mg/kg), an initial injection of flumethasone (0.1 mg/kg) followed orally (2.0 mg daily) and diphenylhydantoin (200 mg daily).

After the initial flumethasone injection, the otter took some food. Following the first few oral doses of the drug, the animal again showed some appetite. The otter remained inappetent after the first

week of treatment. Initially diphenylhydantoin relieved the tremor; however, after 10 days of treatment, the tremor became more pronounced and the diphenylhydantoin had no apparent effect.

The sea otter died on 17 November 1976.

NECROSPY RESULTS

Gross: The mucosa of the trachea, bronchi and bronchioles were inflamed. Both lungs had marked interstitial emphysema, but no significant consolidation. The upper lobe of the left lung proximal to the trachea contained a large (4.5 cm long × 2.2 cm maximum width) irregularly shaped, granular lesion fused to the normal lung. The lesion consisted of an off-white capsule about 3 mm thick surrounding a reddish hardened granular center (Fig. 1).

The apical and mesenteric lymph nodes were inflamed and edematous. Numerous white foci, about 1 mm in diameter were found on the surface and within the parenchyma of the spleen (Fig. 2). The liver was friable and the central lobe was grayish-tinged.

Examination revealed a severe enteritis and a heavy acanthocephalan (*Corynosoma sp.*) infestation and, in the brain, a 3 × 1.2 cm area of hemorrhage and fibrous plaquing on the ventral surface of the medulla. All other organs appeared normal.

Histopathology: Histologic examination revealed a disseminated infection by a spherical-shaped fungus ranging in size from 25 to 50 μm and characterized by a double contoured capsule and endospore. Host response consisted of granulomatous reaction comprised primarily of epithelioid cells. Also present were plasma cells, some small round cells, and occasional neutrophils associated with areas of marked necrosis. Lesions and fungi were found in lymph nodes, liver, lung and spleen. The brain lesion seen grossly

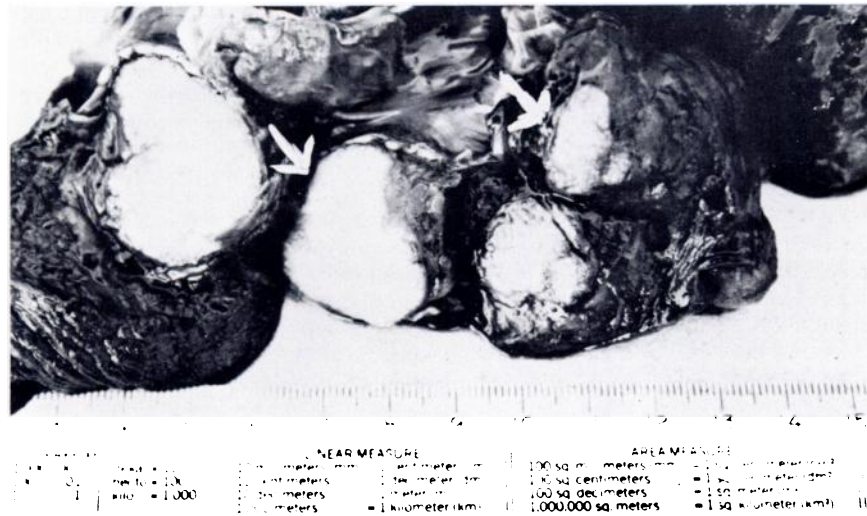


FIGURE 1. Granular lesions in sea otter lung (arrows).



FIGURE 2. Spleen with numerous white foci on both surface and cut section (arrows).

could not be confirmed on histologic examination.

Diagnosis: Coccidioidomycosis was diagnosed initially by morphology of the

spherules seen in tissue sections (Fig. 3). This diagnosis was strengthened with a positive immunodiffusion test (Pers. commun., Dr. D. Pappagianis) and confirmed by the isolation of *C. immitis* (Fig.

4). from frozen lung and pulmonary lymphatic tissue (Pers. commun., Dr. H. Walch) followed by establishing an infection in mice with these organisms.

DISCUSSION

Expansion of the reported enzootic area of coccidioidomycosis with this case poses a question as to the source of the spores. The greatest distance the spores of *C. immitis* can be dispersed effectively is unknown, but Maddy¹³ feels they do not disperse for more than a few kilometers beyond the source.

The closest reported enzootic area to the Pacific Ocean is in Pacific Beach, California.¹⁹ This site is on a hillside overlooking Mission Bay in San Diego County, about 130 m above sea level and 2.4 km north of the bay and 4 km from the ocean. The weather in this area is mild throughout the year and lacks the extremely hot periods usually associated with enzootic areas. In addition, the area has a moist environment because of its

proximity to the ocean and periodic fog cover; thus, supposedly is not favorable for *C. immitis*.

Weather conditions in the Morro Bay area, while averaging several degrees cooler, are not significantly different from the remainder of the southern California coast. According to records of the U.S. Weather Service, however, occasional hot, dry days, accompanied by strong east winds blowing from known enzootic areas of the San Joaquin Valley are not unusual. Moreover, the last two winters have been nearly devoid of the usual rainfall, producing drought conditions considered favorable to the spread of *C. immitis* spores.

Dabrowa, *et. al* surveyed tide-washed coastal areas of southern California for fungi potentially pathogenic to humans. They found a number of pathogens, but no *C. immitis*. Despite this, they recommended further consideration of the possibility that it occurs in the intertidal zone. This report provides support for the speculation¹ that certain fungus infections may be acquired at sites along



FIGURE 3. Sea otter lung tissue with endospore containing spherules.

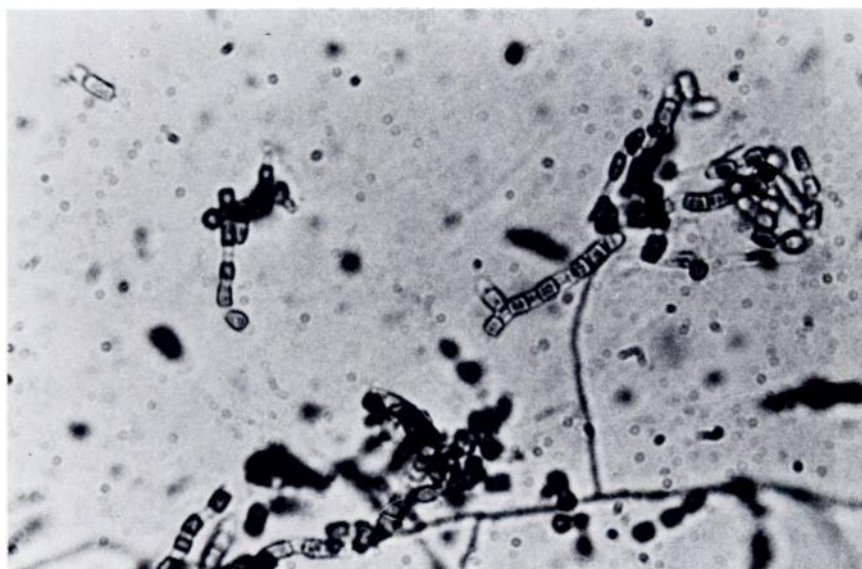


FIGURE 4. Arthrospores of *Coccidioides immitis* culture from sea otter lymph nodes.

the southern and central California coastline. It is apparent that further attempts to isolate *C. immitis* from southern and central California coastal areas are warranted.

In laboratory conditions, *C. immitis* will survive in sea water, in saturated sodium chloride,^{4,7} and in a variety of soils from different regions.¹² Egeberg³ suggested an association between high levels of soluble salts in soils, particular-

ly sodium and chloride, and the presence of *C. immitis*. Soils containing *C. immitis* have 8 to 75 times higher levels of sodium and 10 to 240 times higher levels of chloride than soils not yielding *C. immitis*.

The California sea otter, is the first free-ranging marine mammal reported to be infected with systemic coccidioidomycosis, thus expanding the host range for this fungus.

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