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## SALMONELLA MENINGOENCEPHALOMYELITIS IN A NORTHERN FUR SEAL (*Callorhinus ursinus*)<sup>1,2</sup>

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**Abstract:** *Salmonella enteritidis* was isolated from the brain of a neonatal northern fur seal (*Callorhinus ursinus*) with gross and microscopic lesions of meningoencephalomyelitis. Microscopic lesions in the liver and lung suggested septicemia.

### INTRODUCTION

Salmonellosis was first reported from northern fur seals (*Callorhinus ursinus*) on St. Paul Island, Alaska, in 1951. *Salmonella enteritidis* was isolated from the blood and tissues of 5 of 12 neonatal seal pups examined and from seal lice (*Antarctophthirius callorhini* and *Proechinophthirius fluctus*).<sup>3</sup> In another study of neonatal fur seal mortality, *S. enteritidis* was isolated from the enlarged mesenteric lymph nodes of only 1 of 58 animals examined bacteriologically (Unpubl. report-L. P. Doyle, 1957, Investigation of death losses in fur seal pups on St. Paul Island, Alaska, June 28 to August 15, 1957).

Other species of *Salmonella* have been reported from pinnipeds. On San Miguel Island off the Southern California coast, 30 of 90 rectal swabs from apparently healthy northern fur seal pups and 20 of 50 rectal swabs from California sea lion pups were positive for one or more serotypes of *Salmonella*.<sup>2</sup> These serotypes included *S. newport*, *S. oranienburg* and *S. heidelberg*. *Salmonella* sp. has been isolated from sick and injured California sea lions

stranded along the beaches of California.<sup>2,7,9</sup>

The present report describes the lesions of meningoencephalomyelitis attributed to *S. enteritidis* in a northern fur seal pup.

### CASE HISTORY

A male fur seal pup, approximately four weeks old, was found dead on Staraya Artil rookery, St. George Island, Alaska, on 25 July 1977. Significant macroscopic lesions included pronounced cerebellar coning, submeningeal accumulation of cloudy exudate and subdural and submeningeal hemorrhage in the left occipital region. The submeningeal exudate was most pronounced in the sulci of the dorsal cerebrum and surrounding the nerve roots of the cervical spinal cord. The oral mucus membranes, skeletal musculature, liver, and intestinal serosa were pale. Hookworms (*Uncinaria lucasi*) were present in the ileum. The mesenteric lymph nodes were enlarged and the lungs slightly edematous.

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Samples from the brain and cervical spinal cord were cultured on 5% seal blood agar and MacConkeys agar at 37 C. On seal blood agar, the bacteria grew in mucoid grey colonies and were  $\beta$  hemolytic. However, on sheep blood agar, the colonies were non-hemolytic. The organism was tentatively identified as *S. enteritidis* by standard biochemical reactions. Specific identity was confirmed by the serotyping of cultures submitted to the National Animal Disease Laboratory, Ames, Iowa.

Tissues were fixed in 10% buffered formalin, embedded in paraffin, sectioned at 6  $\mu$ m, stained with hematoxylin and eosin and examined by light microscopy.

Microscopic lesions included infiltration of the pia-arachnoid space of the cerebrum by large mononuclear cells and neutrophils. Prominent perivascular cuffs were present in both the grey and white matter of the cerebrum. Veins were more severely affected than arteries. Fibrin thrombi were present in some vessels and perivascular spaces were markedly increased due to the accumulation of edema fluid. Focal malacia and areas of neutrophil infiltration into the grey matter were observed in the cerebrum.

Similar microscopic changes were present in the cerebellum and cervical spinal cord. However, an intense neutrophilic infiltrate, especially around the spinal nerve roots, was observed in the spinal cord, and was more intense than in either the cerebellum or cerebrum. The central canal of the spinal cord was filled with neutrophils.

Moderate numbers of macrophages and neutrophils were present in the alveolae and small bronchioles of the lung. Alveolar septae were thickened by accumulations of fibrin and inflammatory cells. The bronchi contained amorphous cellular debris, sloughed epithelium and mucus. A cross section of an arthropod parasite presumed to be the

lung mite (*Orthohalarachne diminuta*) was present in one bronchiole. Microabscesses were present in the liver and accumulations of inflammatory cells were associated primarily with the vessels of the hepatic triads.

## DISCUSSION

The macroscopic and microscopic lesions observed in the seal pup are similar to meningoencephalomyelitis associated with septicemic salmonellosis described in swine.<sup>1</sup> In domestic animals and humans, *S. enteritidis* is often associated with an initial infection of the intestinal tract which becomes septicemic via the lymphatics. Microabscesses in the liver and pneumonia suggest systemic involvement. Enterocolitis, although frequently diagnosed in fur seal pups,<sup>5</sup> was not observed in this case. The enlarged lymph nodes were associated with the severe hookworm infection. Hyperplasia of the mesenteric lymph nodes is a consistent finding in fur seal pups with heavy infestations of hookworms.<sup>1</sup>

In domestic animals, systemic salmonellosis is more prevalent in young animals especially if stressed by irregular or inadequate feeding, crowded unsanitary conditions, and environmental extremes.<sup>1</sup> Seal pups frequently are lost or abandoned by their mothers and subsequently starve. Typically, the rookery is crowded and fecal contamination and decomposing carcasses of pups and adults add to the unsanitary conditions.

In the original report of *S. enteritidis* isolation from fur seals, the organism was isolated from the heart blood, tissue obtained at necropsy, and seal lice of 5 of 12 sick pups collected in late August, 1951.<sup>3</sup> Although we examined 175 dead and dying pups at necropsy and cultured samples from 58 of these from 1 July to 15 August 1977, only two isolates of *Salmonella* were obtained; one from the case of meningoencephalomyelitis and

the other from a mesenteric lymph node of a pup with peritonitis, enteritis, and suppurative lymphadenitis. Our results are similar to the results of Doyle who reported only a single *Salmonella* isolation in 58 animals examined bacteriologically from 28 June to 15 August 1977 (Unpubl. report - L. P. Doyle, 1957, Investigation of death losses in fur seal pups on St. Paul Island, Alaska, 28 June to 15 August 1957).

Several potential sources of *S. enteritidis* are present on the Pribilof Islands. Fecal contamination of rookery areas by adult seals is the most likely potential source. However, *Salmonella* sp. were not identified from intestinal cultures in a survey of apparently healthy subadult male seals on St. Paul Island. (pers. comm., Dr. A. Smith, Berkeley, California 94720, USA).

Arctic fox (*Alopex lagopus*) inhabit the island and are seen in the rookeries feeding on placentae and dead pups. Foxes can serve as reservoir host for *Salmonella*.<sup>6</sup> Fecal samples from five foxes were negative for the organism (M. E. Roelke, Unpubl.).

Several species of *Salmonella* have been isolated from birds.<sup>7</sup> The study area from which the pup was obtained is directly under a flyway used daily by large numbers of nesting sea birds. However, *Salmonella* sp. was not isolated from over 500 cloacal swabs of sea birds from the Pribilof Islands during the summer of 1978. (M. E. Roelke, Unpubl.).

The occurrence of this pathogen in a harvested population of wild animals, such as the northern fur seal, may suggest some important considerations for human or domestic animal health.

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