

Prokaryotic Intracytoplasmic Inclusions

I. Causative Agent and Disease

Prokaryotic intracytoplasmic inclusion bodies in marine molluscs are ubiquitous having been reported globally in the epithelial cells and connective tissues of many different species. These inclusion bodies contain organisms that are mostly rickettsia-like with less reports of chlamydia-like organisms and fewer still of mollicute-like organisms or mycoplasma. In most cases these organisms are incidental infections that do not cause significant disease except most notably the rickettsial agents causing mortality of sea scallops (*Pecten maximus* and *Placopecten magellanicus*), California black and red abalones with Withering Syndrome (caused by *Candidatus Xenohaliotis californiensis*) and an intranuclear rickettsia-like organism (NIX) causing mass mortality of razor clams in Washington and possibly Oregon (discussed in other section).

II. Host Species

Numerous species of marine and some freshwater bivalve molluscs in all parts of the world have been reported with intracytoplasmic inclusion bodies caused by these intracellular bacteria. Likewise in Alaska, similar cytoplasmic inclusion bodies of rickettsia-like organisms (RLO) have been detected in: Pacific oysters; littleneck clams; razor clams; geoduck clams; butter clams; blue mussels; basket cockles; pink, rock and weathervane scallops.

III. Clinical Signs

There are no gross clinical signs of infection nor is there apparent disease. During routine histological examination round, basophilic to purple intracytoplasmic inclusion bodies are detected in

the cells of various tissues (gill, mantle, digestive gland and kidney epithelium, connective tissue, muscle and gametocytes) depending on the host species.

IV. Transmission

The mode of transmission has not been determined but could be horizontal via ambient seawater but an alternate reservoir host or vector as part of the life cycle cannot be ruled out.

V. Diagnosis

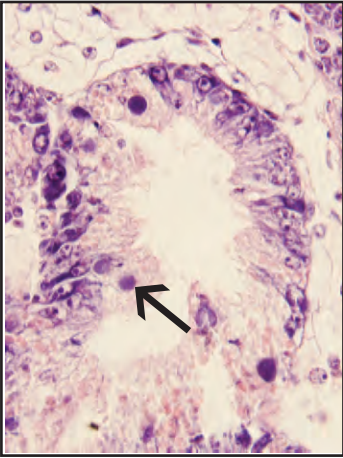
Diagnosis is by histological examination to detect the typical intracytoplasmic inclusion bodies within the cells of host tissues. Specific identification of the type of prokaryote within the inclusion bodies is based on the morphological features specific for rickettsia, chlamydia or mycoplasma as observed by transmission electron microscopy (TEM). Fluorescent antibody tests are available for some of these agents, although none have been isolated in culture using conventional methods. Only rickettsia-like organisms have been observed by TEM in the inclusion bodies found in Alaskan bivalve molluscs.

VI. Prognosis for Host

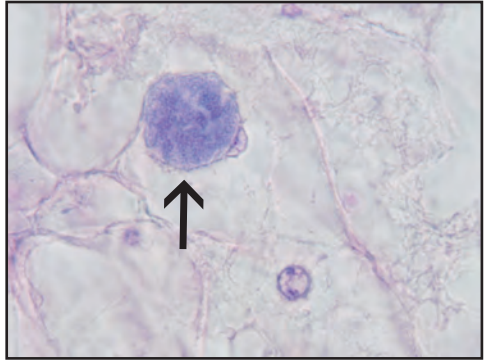
These organisms appear to be well tolerated with no harm to the host, despite sometimes heavy infections.

VII. Human Health Significance

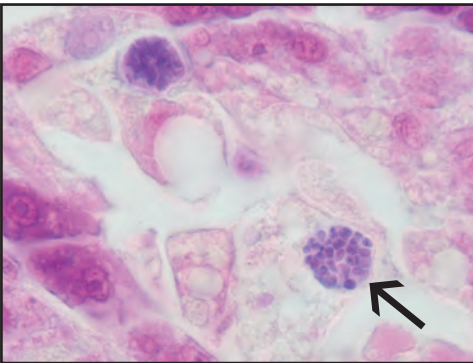
There are no known zoonotic human health concerns regarding infection of marine bivalve molluscs by these poikilothermic organisms which are different from similar organisms causing diseases in higher animals.



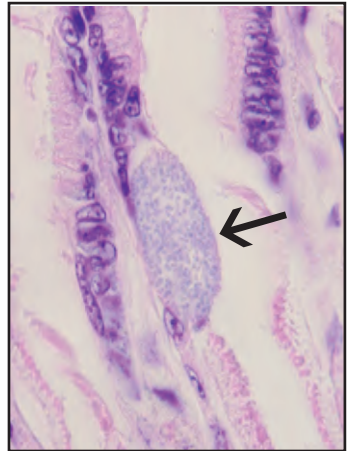
Histological section of RLO cytoplasmic inclusions (arrow) in digestive tubule epithelium of Pacific oyster



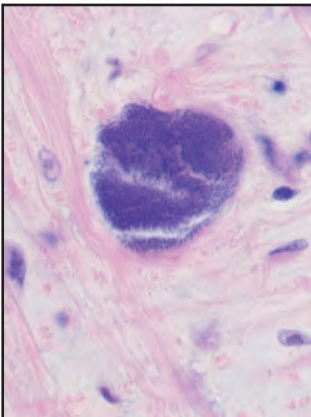
Histological section of RLO cytoplasmic inclusion (arrow) in a cell of the vesicular connective tissue of Pacific oyster



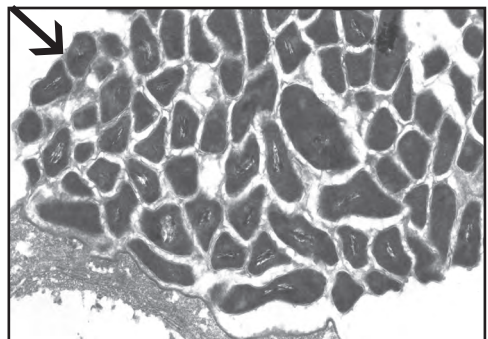
Histological sections of RLO cytoplasmic inclusions (arrow) in digestive tubule epithelium of basket cockle



Histological section of RLO cytoplasmic inclusion (arrow) in gill epithelium of basket cockle



RLO cytoplasmic inclusion in mantle muscle of littleneck clam



TEM of similar littleneck clam muscle inclusion showing rickettsia-like organisms (arrow)