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Pneumocystis

(*P. murina, P. carinii, P. wakefieldae, P. oryctolagi*)

Classification
Fungus (*Ascomycota*)

Family
Pneumocystidaceae

Affected species
All mammals may have host species-specific *Pneumocystis*. Among laboratory rodents and rabbits, *P. murina* has been described in mice, *P. carinii* and *P. wakefieldiae* in rats, and *P. oryctolagi* in rabbits.

In immunodeficient animals of all species, *Pneumocystis* infection causes chronic progressive pneumonia. In immunocompetent rats, *P. carinii* has recently been found to cause infectious interstitial pneumonia (IIP), the condition previously informally attributed to Rat Respiratory Virus. Immunocompetent mice become infected with the fungus *P. murina*, but clear the infection without developing lesions. In rabbits, *P. oryctolagi* infection causes transient pneumonitis near weaning. There is no cross-species transmission, even among immunodeficient individuals (the human organism has been renamed to *P. jirovecii*).

Frequency
IIP caused by *P. carinii* is among the most common diseases of laboratory rats, more common than any of the parvoviruses, for example. *Pneumocystis* is typically excluded from contemporary, well-managed colonies of immunodeficient animals, so lesions are infrequently seen in these.

Transmission
Animals are exposed primarily by contact with infected animals of the same species, as well as by fomites or aerosol. Immunocompetent animals will have an immune response that eliminates infection and shedding after 3-8 weeks, but immunodeficient animals will continue to shed indefinitely. Spores have been detected in the environment, but their persistence and the risk to facilities from environmental spores (such as those that may originate from infected wild rodents) is unknown.

Clinical Signs and Lesions
Immunodeficient mice and rats with pneumocystosis present with weight loss, ruffled fur or dry skin and a hunched posture; *Pneumocystis* is one of the classic causes of wasting (cachexia) in immunodeficient mice. Later, labored breathing, cyanosis and death may be seen. At necropsy, the lungs do not deflate. They are rubbery, enlarged and there may be pale, gray or red areas of consolidation. Microscopically, there is interstitial pneumonitis. Alveolar septa are thickened and infiltrated with mononuclear cells, and the alveoli are filled with *Pneumocystis* organisms and finely vacuolated eosinophilic material.

Lesions in immunocompetent rats (IIP) are somewhat similar but milder, and *Pneumocystis* organisms are usually difficult to find, except by PCR. Lungs may grossly have pale, gray or red areas. Microscopically, there is interstitial pneumonia, with thickened alveolar septa infiltrated with mononuclear cells, and often prominent perivascular lymphoid cuffs.

Pneumocystosis in weanling rabbits presents as mild pneumonia with slight interstitial fibrosis, and scant eosinophilic material in the alveoli. Inflammatory infiltrates occur as discrete nodular areas in the rabbit lung, and the organisms are found primarily along the alveolar epithelium. *P. oryctolagi* is diagnosed by the same methods as in rats and mice.

Diagnosis
Pneumocystosis in diseased immunodeficient animals is usually diagnosed through necropsy of animals exhibiting typical signs of chronic pneumonia. Lung tissue can either be examined through histopathology or PCR. Silver stains such as Gomori methenamine silver (GMS) are used to demonstrate the organism histologically and confirm its role in causing the clinical disease. PCR may be performed on nasal swabs, lung tissue (fresh or deparaffinized) or deep bronchoalveolar lavage; lung tissue is the best sample. Routine screening of immunocompetent animals may be accomplished by serology or PCR.

technical sheet

Interference with Research

Pneumocystis infection can cause significant morbidity and mortality in immunodeficient animals, and such animals with pneumocystosis are unsuitable for use in research.

In immunocompetent rabbits, the infection seems to be self-limiting. Rabbits with clinical signs of pneumonia should be provided with supportive treatment, as co-infection with other organisms may be synergistic.

Rats with IIP are unsuitable for use in inhalation studies, and anecdotal interference with anesthesia has also been reported. In addition, the lung lesions may confound histologic evaluation.

Prevention and Treatment

Pneumocystis infections can be treated by the administration of trimethoprim/sulfamethoxazole (50 mg and 250 mg/kg/day) in the drinking water. However, this does not eliminate the organism, but merely reduces morbidity. Antibiotic resistance due to mutations in the gene targeted by the sulfa drugs have been reported in human *Pneumocystis* isolates, so care should be taken with the long-term administration of antibiotics. Lines of animals infected with *Pneumocystis* should be rederived through embryo transfer or hysterectomy.

There is no information on environmental persistence of *Pneumocystis*. Since the most likely mode of transmission is from animal to animal, rederivation and limiting contact with animals with active infections should serve to clean a colony.

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Charles River Research Models and Services
T: +1 877 CRIVER 1 • +1 877 274 8371
E: askcharlesriver@crl.com • www.criver.com