

## Cilia-Associated Respiratory Bacillus (CAR Bacillus; CARB)

### Classification

Gram-negative, motile, slightly fusiform, non-spore-forming bacterium

### Family

Still unclassified, but mouse and rat isolates are genetically related to *Flexibacter* and *Fusobacterium* species.

### Affected Species

Rats, mice, rabbits, and some livestock species. Given the taxonomic range of these species, it is likely that other laboratory rodents including hamsters, guinea pigs, and gerbils, may also be infected.

### Frequency

Rare in contemporary laboratory rodent populations, depending on husbandry and exclusion. The infection has been documented in wild rodent and rabbit populations. No data exist for pet rodent and rabbit populations, but infections are likely to be common.

### Transmission

Transmission is primarily via direct contact. Animals can acquire the infection within the first week of birth, if born to infected mothers. Since this organism is transmitted through direct contact, bedding sentinels are not an efficient means of detecting this agent within a colony. The possibility of inter-species transmission is not resolved.

### Clinical Signs and Lesions

In all susceptible species, inapparent infections are possible. If clinical signs are present, they develop with prolonged infection and are typical for respiratory disease, with weight loss, ruffled fur, chattering or snuffling, and, in rats, chromodacryorrhea. Rats appear to have a more significant clinical presentation with CARB than mice. Lesions in rats are similar to those found in mycoplasmal respiratory disease. Grossly, animals have a mucopurulent bronchopneumonia, and microscopic examination reveals chronic bronchitis with ectasia. The dilated bronchi often contain mucus and a scattering of neutrophils, although occasionally

the inflammation can be suppurative. In uncomplicated CARB infections, the bronchial epithelium is usually preserved. There is often peribronchiolar cuffing composed of lymphocytes and plasma cells. The organisms can be seen amongst, and parallel to, the cilia of the respiratory epithelium. Although occasionally visible with H&E, they are readily seen if a silver stain is used. Lesions in mice are similar. In both mice and rats, CARB infection usually occurs concomitantly with *M. pulmonis*. In rabbits, the pathogenic significance of CARB is unknown, although no lesions have been attributed to it.

### Diagnosis

CARB may be cultured from affected animals, but culture is not recommended for routine diagnostic purposes. The organism has different requirements for culture than many bacteria, preferring cell culture media, supplemented with serum, cell cultures, or embryonated hens' eggs. Healthy-appearing populations of laboratory rodents are routinely monitored for CARB through serology (ELISA, MFIA™, or IFA), with PCR and/or histopathology used to detect CARB in diseased animals, confirming the presence of bacteria within the characteristic lesions. Reagents for serology are often bacterial lysates, and serology has good negative predictive value, but because of the numerous antigens present in the lysates, CARB serology has a higher frequency of false positives than does viral serology. PCR is the preferred confirmatory method for follow-up to positive CARB serology results, and is best performed on nasopharyngeal or tracheal swabs or lavage. Definitive diagnosis may also be made through the use of histology; silver staining of the respiratory epithelium will reveal CARB in the cilia. Histology is highly specific, although PCR to rule out other infections such as *Bordetella avium* in mice (also characterized by bacilli amongst the cilia) is still recommended. In addition, the sensitivity of histologic screening relative to PCR has not been established for CARB.

# technical sheet

## Interference with Research

Animals with signs of chronic respiratory disease are generally unfit for use. Speculation regarding impaired mucociliary clearance of CARB-infected animals has been published but has not been demonstrated, although it would be consistent with the histologic lesions observed. Inapparent infections may not have an impact on the health of the colony. Animals destined for use in research involving the respiratory tract should be free of CARB.

## Prevention and Treatment

CARB is transmitted via direct contact and there is no evidence for transmission by fomites, vectors, or aerosols. The primary consideration for exclusion of this agent from a facility should be the avoidance of direct contact between infected and uninfected animals. Colony animals should be screened regularly for CARB and incoming animals should be quarantined and screened for this organism. The appearance of this organism in an established facility, previously free of it, would indicate the entry of infected rodents, most likely wild or feral. Accordingly, the population would also be likely to become contaminated with multiple adventitious agents. The pest control program should be carefully reviewed.

Within an infected population, CARB tends to spread slowly. A test and cull program, using PCR of oral swabs combined with serology, and limiting animal movement, could be pursued. However, repopulation or rederivation are generally recommended. Rerderivation may be accomplished via hysterectomy and fostering or embryo transfer. One report in the literature describes treatment of experimental CARB infection in mice with ampicillin or sulfamerazine at 500 mg/l. Although there are no reports of vertical transmission of this agent, treatment of animals before rederivation is an option.

Given its fastidious growth requirements and respiratory tropism, it is unlikely that survival in the environment should play a significant role in the transmission of

CARB. Since it is a non-spore-forming organism, most typical animal room sanitation and disinfection procedures should serve to remove any CARB from the environment. As with any other contamination, non-essential materials should be discarded, and items cleaned with an appropriate disinfectant and/or autoclaved as necessary, before new animals are introduced.

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