

Are chlamydiae swine pathogens?

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Summary: In recent years, there has been a renewed effort to study swine chlamydiae, both because there is an increased awareness of chlamydial diseases and because we now have improved methods of isolation. Six different strains of chlamydiae have been isolated from cases of enteritis, pneumonia, and conjunctivitis in nursing, nursery, and finishing pigs. These isolates are all of the *C. trachomatis* type and are similar to the human *C. trachomatis* strains. However, molecular characterization has determined that they are distinctly different from the human strains. This report discusses only the enteritis, pneumonia, and conjunctivitis caused by these strains, although chlamydiae have been associated with arthritis and reproductive diseases in swine, as well.

The isolation of chlamydiae from cases of arthritis and pericarditis was first reported in the United States in the 1950s.¹ Since then, chlamydiae have occasionally been isolated from swine, but the isolates have not been characterized or inoculated back into swine to determine their ability to cause disease. Chlamydiae have been isolated fairly consistently from cases of arthritis in swine in Europe. Because of the lack of research, the significance of these chlamydial isolations is unknown. The number of unexplained reproductive failures in swine have fostered a new focus on this pathogen. However, reports of chlamydial isolations from swine reproductive tracts are few and there have been no attempts to experimentally reproduce the reproductive diseases.

Chlamydia spp

The genus *Chlamydia* includes over 60 strains that infect birds and/or mammals, including humans. Strains are classified according to what disease each strain causes and the host it infects. The strains currently are grouped into four species (*C. trachomatis*, *C. psittaci*, *C. pneumoniae*, and *C. pecorum*). Through the use of molecular techniques, the chlamydial strains can be reorganized into nine distinct groups, which correspond with our understanding of host range, diseases caused, and the virulence of the different strains. This regrouping creates three subgroups in *C. trachomatis* (human, mouse, and swine) and four subgroups in *C. psittaci* (abortion, guinea pig, feline, and avian). *C. pecorum* and *C. pneumoniae* species are unchanged. Table 1 summarizes the chlamydial groups, the major hosts infected, and the primary diseases.

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Diagnostic notes are not peer-reviewed.

Table 1

Summary of the chlamydial groups, the major hosts infected, and the primary diseases

| Species and/or group | Primary host | Known diseases |
|--------------------------------|----------------|--|
| <i>C. trachomatis</i> —human | human | trachoma, genital tract infections, conjunctivitis, neonatal pneumonia |
| <i>C. trachomatis</i> —mouse | mouse, hamster | pneumonia, ileitis |
| <i>C. trachomatis</i> —swine | swine | pneumonia, conjunctivitis, enteritis |
| <i>C. pneumoniae</i> | human* | pneumonia, systemic |
| <i>C. pecorum</i> | most animals † | wide range of diseases |
| <i>C. psittaci</i> —guinea pig | guinea pigs | conjunctivitis, reproductive |
| <i>C. psittaci</i> —feline | cats | rhinitis, conjunctivitis |
| <i>C. psittaci</i> —abortion | sheep, cattle | abortion |
| <i>C. psittaci</i> —avian | birds ‡ | conjunctivitis, respiratory, systemic |

* includes isolates from a horse and a koala

† isolates from sheep, cattle, goats, koala, and swine

‡ includes epizootic isolates from an outbreak in cattle and an outbreak in muskrats

On-farm investigations

Field investigations have focused on swine herds in Nebraska and Iowa. Chlamydiae were consistently isolated from or detected in conjunctival specimens from pigs affected with conjunctivitis or keratoconjunctivitis in all phases of production.² Many of the nursing and nursery pigs with conjunctivitis from these and other herds had diarrhea, and at necropsy most of the diarrheic pigs also had pneumonia. Although known pathogens were believed to be the causes of the diarrhea and the pneumonia, chlamydiae were also isolated from or detected in the intestines and lungs of affected pigs.

Experimental infections

Objectives of the experimental studies³⁻⁵ were to determine whether distinct *C. trachomatis* strains isolated from pigs with conjunctivitis, pneumonia, and enteritis could cause these respective diseases in gnotobiotic pigs. Gnotobiotic pigs were used because known pathogens were found together with *C. trachomatis* in the naturally occurring cases of pneumonia and enteritis.

Pneumonia

A distinct strain of *C. trachomatis* originally isolated from nursery pigs with pneumonia caused pneumonia in gnotobiotic pigs after nasal and intralaryngeal inoculation.³ Although several inoculated pigs became moribund or severely dyspneic after inoculation, the majority of inoculated pigs exhibited only mild dyspnea throughout the 35-day study. Gross lung lesions typical of bronchopneumonia were most severe in pigs necropsied 7–21 days postinoculation, whereas the lesions in pigs necropsied 28 and 35 days postinfection were less extensive, patchy, and more lobular in distribution. Inoculated pigs also developed diarrhea, presumably after swallowing nasally administered inocula. Chlamydiae were reisolated from the intestines of diarrheic pigs, and villus atrophy was seen histologically in sections of ileum.

Enteritis

Two distinct strains of *C. trachomatis* originally isolated from nursery pigs with diarrhea were fed separately to gnotobiotic pigs.⁴ Both strains caused diarrhea. Diarrhea was never profuse, but it did become projectile when handling some of the pigs. At necropsy, all diarrheic pigs had watery colonic contents with flecks of undigested curd. The presence of chyle in mesenteric lymphatics was variable. Histologically, small intestine from the diarrheic pigs was characterized by mild to severe villus atrophy, although some pigs fed large numbers of one strain also had evidence of villus necrosis.

Conjunctivitis

A distinct strain of *C. trachomatis* originally isolated from finishing pigs with conjunctivitis or keratoconjunctivitis was instilled into the conjunctival sac of gnotobiotic pigs.⁵ Inoculated pigs did not develop clinical signs of conjunctivitis or keratoconjunctivitis throughout the 28-day study. However, histologically, pigs necropsied 7 days postinoculation had moderate conjunctivitis, and pigs necropsied throughout the remainder of the study had mild conjunctivitis. Several inoculated pigs developed diarrhea 8–9 days postinoculation, presumably after swallowing conjunctiva-instilled inocula. Chlamydiae were reisolated from the intestines of diarrheic pigs and villus atrophy was seen histologically in the jejunum and ileum.⁵

Comments

Although *C. trachomatis* strains caused pneumonia, enteritis, and histologic lesions of conjunctivitis in gnotobiotic pigs, the question remains: are *C. trachomatis* strains pathogens in conventional pigs?

Although we hope that additional surveillance and experimental studies will help to answer this question, we suspect that the answer is “yes.” It seems that chlamydiae are intestinal pathogens in young pigs because intestinal lesions in some of the gnotobiotic pigs fed *C. trachomatis* were similar—if not identical—to those described in young pigs naturally infected with intestinal chlamydiae.⁵ The majority of gnotobiotic pigs in these studies did not exhibit severe clinical symptoms, which suggests that *C. trachomatis* strains, by themselves, cause a mild or subclinical disease in conventional pigs. And, of course, any clinical symptoms exhibited by pigs naturally infected with *C. trachomatis* could be influenced by environmental factors and/or the presence of other bacterial, mycoplasmal, and viral pathogens.

During our investigations, we found it interesting that nursing and nursery pigs with conjunctivitis also had pneumonia and enteritis, and that *C. trachomatis* was found in the conjunctiva, lungs, and intestines of these pigs. We speculate that *C. trachomatis* causes a “conjunctivitis-pneumonia-enteritis syndrome” similar to that seen in human infants born to mothers with genital *C. trachomatis* infection.⁶ Results of our experimental studies tend to support this.

Diagnostic considerations

Currently, diagnostic laboratories do not test routinely for chlamydiae in swine. However, in cases of enteritis that have the characteristics of a viral etiology or coccidiosis and in which no pathogen can be identified, it is advisable to test for chlamydiae. Of the diagnostic methods currently available, isolation and identification is the most effective. With swine strains, this method has been only partially successful because it is difficult to grow the bacteria on initial isolation and techniques must be modified. Immunohistochemical staining of histological sections appears to be quite promising, as more diagnostic laboratories are obtaining equipment to automate the staining. This technique appears to be very specific and sensitive.

The enzyme-linked immunosorbent assay (ELISA) has become very popular because it is easy to use. The kits have been designed to detect *C. trachomatis* in humans; however, because they detect the chlamydial group antigen, they will detect all strains of chlamydiae. The major problems are the cost and lack of sensitivity. Also, there have been problems with false positives with some tests. This may be due to the wide range of specimens used or to cross-reaction with other Gram-negative bacteria. In general with these tests, three conditions must be met to consider a diagnosis positive:

- a positive ELISA,
- clinical signs of chlamydiosis, and
- when the animal is necropsied, pathological lesions should be compatible with chlamydiosis.

Polymerase chain reaction (PCR) diagnostic tests are only now being developed for use in veterinary medicine. The PCR test developed for use on human *C. trachomatis* is species specific and will not detect other strains. The sensitivity is as good or better than well-controlled isolation procedures. When tests such as this are available for veterinary medicine, routine testing for chlamydiae will be possible, if the price is feasible.

Serology has never been very useful for diagnosing chlamydiae in veterinary medicine, as antibody is widespread and the number of strains are too great. The standard serological test is the complement fixation test. Titers to it are first seen at 10–14 days postinfection and are relatively short lived. Some cross-reaction with antibody to other Gram-negative bacteria may occur. Most of the ELISAs also have the same problems. We have been using the microimmunofluorescence test, which detects antibody to the outer membrane proteins of chlamydiae. The titers to it remain high for a longer period of time. In a limited survey, virtually all pigs have a titer to chlamydia by 8 weeks of age.

Treatment

The efficacy of antibiotics is unknown. Tetracycline and similar antibiotics are the standard for controlling chlamydial infections in most animals and in humans. In swine, they appear to have some benefit; however, it is short lived. Testing of our isolates from swine shows that swine chlamydiae are 10–100 times more resistant to tetracycline than most strains, which would account for the limited effectiveness of these antibiotics. Other antibiotics have not been tested. No vaccines are

available. Chlamydial vaccines produced for chlamydiae in other animals would likely have no efficacy in swine, as the strains are very different serologically.

References

1. Willigam DA, Beamer PD. Isolation of a transmissible agent from pericarditis of swine. *JAVMA*. 1955;126:118–122.
2. Rogers DG, Andersen AA, Hogg A, Nielsen DL, Huebert MA. Conjunctivitis and keratoconjunctivitis associated with chlamydiae in swine. *JAVMA*. 1993;203:1321–1323.
3. Rogers DG, Andersen AA, Hunsaker BD. Lung and nasal lesions caused by a swine chlamydial isolate in gnotobiotic pigs. *J Vet Diagn Invest*. 1996;8:45–55.
4. Rogers DG, Andersen AA. Intestinal lesions caused by two swine chlamydial isolates in gnotobiotic pigs. *J Vet Diagn Invest*. (In press).
5. Rogers DG, Andersen AA. Unpublished data.
6. Nietfeld JD, Janke BH, Leslie-Steen P, Robinson DJ, Zeman DH. Small intestinal *Chlamydia* infection in piglets. *J Vet Diagn Invest*. 1993;5:114–117.
7. Schachter J. Overview of Human Diseases In: *Microbiology of Chlamydia*, ed. AL Barron. Boca Raton, Florida: CRC Press, Inc. 1988.



Practice tips

Tape recorder

A real time saving device that I use in my practice is the microcassette tape recorder. These can be used for recording everything. When you use them for slaughter checks, an external microphone attachment makes them much more effective. I use mine for recording farm visits and changes, so this can be done immediately after leaving the farm. Many of my farms are corporate or absentee-owner farms, so all the billing is done after the fact. This allows you to account for everything while it is still current in your memory. Also, the time spent returning from farm visits can easily be used to dictate a farm visit report.

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