

Salmonella Abortusovis

Paratyphoid Abortion

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Importance

Salmonella Abortusovis is a bacterial pathogen that affects sheep, causing abortions and stillbirths in pregnant ewes and mortality in neonates. Abortion storms can occur when this organism is first introduced. Once it has become established in a flock, older ewes generally have good immunity, and abortions are typically limited to young or newly introduced animals. Aborting ewes occasionally develop metritis, peritonitis or septicemia as the result of a retained placenta, but unlike most other *Salmonella*, *S. Abortusovis* does not usually cause other health issues. It is not a significant pathogen for humans.

Salmonella Abortusovis is reportable to the World Organization for Animal Health (OIE), but outbreaks are uncommonly described outside a few regions, such as southern Europe. In 2003, this organism caused abortion storms in two cantons in Switzerland, a country where it had not been reported for more than 25 years. The subsequent investigation found low levels of exposure in sheep throughout the country. The Swiss experience suggests that *Salmonella* Abortusovis infections might be underdiagnosed in some areas.

Etiology

Salmonella enterica subspecies *enterica* serovar (serotype) Abortusovis, which is usually shortened to *S. enterica* serovar Abortusovis or *S. Abortusovis*, is a member of the Enterobacteriaceae. It is an aerobic, Gram-negative rod.

Salmonella Abortusovis is not the only *Salmonella* associated with ovine abortions. Other serovars (e.g., *Salmonella* Dublin, *S. Typhimurium*, *S. Montevideo*) can also cause reproductive losses in this species, either with or without systemic illness in the ewe.

Species affected

Salmonella Abortusovis is adapted to sheep and considered to be host specific; however, there are a few reports of its presence in goats, and older reports described this organism in dogs, rabbits and rats. Dogs and rats appeared to be transient intestinal carriers. Mice and rabbits can be infected experimentally. Antibodies to *S. Abortusovis* have been found in some wild ungulates including European mouflon (*Ovis aries*), Spanish ibex (*Capra pyrenaica*), red deer (*Cervus elaphus*), and fallow deer (*Dama dama*).

Zoonotic potential

Unlike other *Salmonella* species, *S. Abortusovis* does not seem to be a significant threat to human health. Human infections with this species appear to be very rare.

Geographic Distribution

Salmonella Abortusovis infections seem to be uncommon or absent in many countries; however, this organism is reported regularly in Europe, particularly southern Europe, and some sources describe it as being relatively common in western Asia. Between 2005 and 2017, infections or outbreaks were reported in some European countries, Russia, parts of Asia, some islands (e.g., New Caledonia, Cook Islands), and a few countries in the Middle East, Africa and South America. Other countries in the same regions report that they have never seen *S. Abortusovis*, or that the last outbreak occurred in the 1990s or earlier. In North America, Canada last reported *S. Abortusovis* in 1994, the status of the U.S. is described in OIE reports as "disease suspected but not confirmed," and Mexico has never diagnosed this disease.

Transmission

Sheep can be infected by ingestion, or via the conjunctiva, respiratory tract or genital tract. Most infections are thought to be acquired by ingestion. *Salmonella* Abortusovis mainly occurs in vaginal discharges, the placenta, aborted fetuses and infected newborns, although it has been documented in milk and colostrum, and rarely in the testes or preputial fluid of rams. Respiratory secretions might be infectious in sick young lambs. Vaginal discharges are highly infectious during the first week after an abortion, and smaller numbers of organisms have been found for

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up to a month. One report described finding *S. Abortusovis* nucleic acids in the vaginal secretions of some animals for up to a year (by PCR), but whether infectious organisms are still present at this time is uncertain. Experimental infections and most textbook descriptions suggest that this organism occurs only transiently in the intestinal tract, and fecal shedding is usually absent or insignificant except in animals with septicemia. One recent field study detected nucleic acids in the feces of a few ewes for 1-3 months after an abortion, and rarely for up to a year. Infectious organisms could not be cultured, but they might have been inhibited by the presence of *E. coli*.

Environmental contamination may contribute to the transmission of *S. Abortusovis*. *Salmonella enterica* has been reported to survive in feces, soil, water and vegetation for periods ranging from a few weeks to several months or more. *S. Abortusovis* is host specific, and most descriptions indicate that it is unlikely to be transmitted between flocks by animals such as rodents or birds. However, one older study reported that dogs and rats could carry this organism for 2-3 months after eating abortion products from sheep.

Disinfection

Effective disinfectants for Gram negative bacteria include 1% sodium hypochlorite, 70% ethanol, iodophors, hydrogen peroxide, quaternary ammonium compounds, phenolics, aldehydes (formaldehyde, glutaraldehyde) and other agents. *Salmonella* spp. are reported to be resistant to nitrites, but susceptible to disinfection by ozone. They are also susceptible to moist heat of 121°C (250°F) for 15 minutes or longer, and dry heat of 160–170°C (320-338°F) for 1 hour or more.

Incubation Period

Ewes infected experimentally at one month of gestation aborted after a 2-month incubation period, while animals inoculated during the third month aborted after an average of 20 days.

Clinical Signs

The major clinical sign is abortion, which occurs primarily during the last 4-6 weeks of gestation. Lambs may also be stillborn or die of septicemia within a few hours of birth. Some lambs that appear healthy at birth later develop diarrhea or respiratory signs, and die within the first month.

Most ewes that abort appear to be healthy, although some are reported to develop a transient fever and/or depression before aborting. A vaginal discharge may also be apparent for a few days before and after the abortion. Diarrhea is uncommon. Occasionally, ewes may retain the placenta and develop post-parturient metritis, peritonitis and/or septicemia from secondary bacterial invaders. Nonpregnant animals, other than neonatal lambs, do not seem to develop clinical signs.

Post Mortem Lesions

The aborted fetus and placenta are usually fresh, but occasionally autolyzed. The placenta may have nonspecific changes including edema and hemorrhages in the chorioallantois, and necrosis or swelling of the cotyledons. Multifocal suppurative inflammation, necrosis, edema or hemorrhages may be seen in the fetal tissues. The liver and spleen may be swollen and contain pale foci. In young lambs or ewes with diarrhea, there may be enteritis and abomasitis, with enlarged regional lymph nodes. Ewes that die of septicemia generally have acute metritis; the uterus is usually swollen and contains necrotic tissue, serous exudate and a retained placenta.

Diagnostic Tests

A presumptive diagnosis is supported by finding short, Gram-negative rods in direct smears of vaginal discharges, the placenta, or the stomach contents of an aborted fetus. *Salmonella Abortusovis* can be identified by culture, or by detecting nucleic acids directly in tissue samples with PCR.

S. Abortusovis can be isolated from vaginal discharges, the placenta, and fetal tissues including the liver, spleen and contents of the gastrointestinal tract. It is most likely to be detected in vaginal swabs when they are collected during the first week after an abortion. Specific recommendations for culture vary, but some authors have reported that this organism may not grow well on some *Salmonella* media, and enrichment broth may be inhibitory. *E. coli* has also been observed to inhibit its growth. *S. Abortusovis* grows relatively slowly in culture; colonies can be usually be found in 36-48 hours at 35-37°C, but occasionally they do not reach a significant size until 72 hours. Cultures can be identified with biochemical tests, serotyping and PCR. PCR methods that can detect *S. Abortusovis* directly in clinical samples have been published and tested in the field.

Serology can be helpful, especially as a flock test. A serum agglutination test (SAT) is used most often. It mainly detects IgM, and may not find antibodies in some animals after 2-3 months. Other serological tests have been described, including additional agglutination assays, hemagglutination inhibition, ELISAs, indirect immunofluorescence, complement fixation and gel immunodiffusion. An allergic skin test was also published. Some tests, including the allergic skin test and a recently described ELISA, can detect immune responses to *S. Abortusovis* for longer than the SAT.

Treatment

Antibiotics might prevent some pregnant ewes from aborting during an outbreak, but some studies reported that they are ineffective, and their usefulness is currently unclear. Antibiotics are also used to treat or prevent complications from a retained placenta, and employed in septicemic animals.

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Control

Disease reporting

Veterinarians who encounter or suspect *Salmonella* Abortusovis infections should follow their national and/or local guidelines for disease reporting. In the U.S., this infection should be reported immediately to state or federal authorities.

Prevention

S. Abortusovis is mostly likely to be introduced into a flock in infected sheep. Some animals seem to carry this organism subclinically, but how long they can remain carriers is still unclear. Detecting potential carriers can be difficult, as antibody levels can decline quickly. A recently described ELISA may be able to identify these animals longer than the serum agglutination test.

S. Abortusovis has probably spread through a group of ewes by the time abortions occur and the disease is diagnosed. However, to reduce contamination, ewes that have aborted should be isolated while they are shedding the organism, and abortion products and contaminated bedding should be destroyed. Fomites should be disinfected. Establishing a dedicated lambing area aids cleaning and disinfection efforts. Where *S. Abortusovis* was recently introduced into a country, quarantines and movement controls can help contain the outbreak. Vaccines aid in controlling the clinical signs in endemic areas.

Morbidity and Mortality

The timing of the infection seems to influence the probability that the ewe will abort. In one study, ewes inoculated at various points during gestation all aborted during the last few weeks of the pregnancy; however, animals infected during the third month were more likely to abort, compared to those given *S. Abortusovis* at one month of gestation. Ewes inoculated a month before mating had normal pregnancies.

Salmonella Abortusovis usually affects large numbers of animals when it enters a naïve flock of pregnant ewes. The abortion rate is often in the range of 30-50%, based on outbreaks in endemic regions, but rates up to 90% have been reported. Many live lambs in these flocks are born septicemic and weak, and die soon after birth. Fatalities in ewes are usually associated with complications such as metritis, and the reported mortality rates vary. Once *S. Abortusovis* becomes endemic in a flock, only young or newly introduced ewes tend to be affected, and abortions are often sporadic.

The prevalence of *S. Abortusovis* in many regions is uncertain. Recent serosurveillance in Switzerland suggests that some abortions caused by *S. Abortusovis* might be misdiagnosed as other agents where clinicians and laboratories are not expecting to find this organism. Few recent serological surveys have been published. Serosurveillance in Switzerland and Spain indicated that,

while the number of infected flocks may be high, some flocks may contain only a few seropositive sheep.

Internet Resources

Merck Veterinary Manual

<http://www.merckvetmanual.com/>

World Organization for Animal Health (OIE)

<http://www.oie.int>

OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals

<http://www.oie.int/international-standard-setting/terrestrial-manual/access-online/>

OIE Terrestrial Animal Health Code

<http://www.oie.int/international-standard-setting/terrestrial-code/access-online/>

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*Link defunct as of 2017