

Salmonella dublin Infections in Cattle in California

Richard L. Walker, DVM, MPVM, PhD
California Veterinary Diagnostic Laboratory System
University of California
Davis, CA 95616

Introduction

Salmonellosis is a commonly encountered disease of cattle. Of the many serotypes of *Salmonella* known to exist, *Salmonella typhimurium* and *S. dublin* are the two most frequently isolated from cattle. *Salmonella dublin* is isolated commonly from cattle in states west of the Rocky Mountains. Reports of isolations of *S. dublin* from states east of the Rockies are increasing.^{2,4} *Salmonella dublin* is also isolated commonly in Europe and South Africa. Unlike *S. typhimurium*, which shows no special affinity for a particular host, *S. dublin* is host-adapted for cattle. While other animal species can be infected with *S. dublin*, cattle account for approximately 96% of the isolations from animals. This host-adaptation for cattle has special implications regarding epidemiology and control measures. The purpose of this presentation is to give an overview of the current spectrum of *S. dublin* infections in dairy cattle in California.

Clinical Presentations

The clinical presentation of *S. dublin* infections depends on a variety of factors. These factors include endemicity of *S. dublin* on the farm, age and immune status of the cow, concurrent infections and management-related stresses. Calves most frequently manifest clinical disease, although disease also occurs in adults. This is in contrast to infections with *S. typhimurium*, which are more evenly distributed among different aged animals. A computer search of 480 cases of salmonellosis in cattle diagnosed at the California Veterinary Diagnostic Laboratory revealed that 210 were due to *S. dublin*, 205 were due to *S. typhimurium* and 65 were associated with other serotypes of *Salmonella*. Of the 210 *S. dublin* cases, 199 occurred in calves and 11 occurred in adult cattle. In contrast, of the 205 cases due to *S. typhimurium*, 101 cases were in calves and 104 were in adult animals.

Presentations in adult animals

Diarrhea

Cows previously unexposed to *S. dublin* may de-

velop a bloody diarrhea. Cows are febrile and depressed. Death may occur if affected animals are not treated. In herds where *S. dublin* is endemic, the diarrhea in cows is milder and may be accompanied by a slight fever. Some decrease in milk production may be noted. *Salmonella dublin* infections are infrequent in adult cattle in California. When disease does occur in adult animals, diarrhea is the most common manifestation.

Abortions

Abortions caused by *S. dublin* may also occur, usually in the last trimester. The abortion may result from either a bacteremia, where organisms spread to the placenta and fetus, or as a result of lysis of the corpus luteum due to PGF_{2α} release because of a concurrent diarrhea.⁶ Abortion is a relatively rare consequence of *S. dublin* infections in California, however, it is reported to be more common in Europe. Abortion was linked to only 2 of the 11 previously mentioned cases of *S. dublin* infections in adult cows. This would not account for abortions that were a result of lysis of the corpus luteum. *Salmonella dublin* would not be isolated from the fetus in these cases.

Asymptomatic Infections

Cows can be infected with *S. dublin* and remain asymptomatic. Asymptomatically infected cows may be persistent shedders, intermittent shedders or non-shedders.² A chronically infected cow may shed *S. dublin* in the feces or milk and thus be a source of infection for calves. Shedding may be triggered by stress due to parturition or a concurrent infection. Cows may remain infected for years, potentially their entire life.²

Presentations in calves

Diarrhea

Calf diarrhea caused by *S. dublin* is most commonly observed between one week and three months of age. The diarrhea is yellow to gray in color with a foul odor. In some cases blood and mucus are present. The intestinal mucosa is often necrotic. There may be petechiation on the serosal surfaces, a mild peritonitis and enlarged

mesenteric lymph nodes. Many of the cases, which present to the diagnostic laboratory, with a primary complaint of neonatal diarrhea are also septic.

Septicemia

The septicemic form of salmonellosis is the most common presentation of *S. dublin* infections in calves. Calves one week to three months of age are most commonly affected. Calves are febrile and often present with signs of respiratory distress. Diarrhea may or may not be observed as a concurrent problem. Petechial hemorrhages are often present on serosal surfaces, the spleen is enlarged, lungs are edematous and an interstitial pneumonia is present. Microscopic multifocal necrosis is often present in the liver.^{1,4} Meningitis, arthritis and osteomyelitis are possible but infrequent sequelae. Concurrent infections with respiratory pathogens, such as *Pasturella haemolytica* and *P. multocida* or agents of neonatal calf diarrhea are common. These mixed infections may simply reflect less than optimal calf-raising conditions.

Ischemic necrosis of extremities

Ischemic necrosis of feet, tip of the tail and ears is a possible sequelae of a *S. dublin* infection. It is thought that endotoxemia results in damage to the blood vessel endothelium and activates the alternate complement pathway, as well as blood clotting mechanisms. It is speculated that a localized form of disseminated intravascular coagulopathy is responsible for the terminal ischemia.⁵ This form of *S. dublin* infection is rarely seen in calves in California.

Treatment and Control

As with most infectious calfhood disease, minimizing environmental stresses and good colostrum management are important in controlling infection.¹ Control efforts for *S. dublin* infections should include minimizing fecal-oral spread through management changes. Infected calves should be separated to prevent transfer among calves. Efforts to minimize potential for cross-contamination with feeding utensils and other potential fomites is important. Carrier cows can be tested by bacteriologic culture or serological methods. Carrier animals should be removed, if economically feasible.

Various vaccines have been studied for control of *S. dublin* infections, including attenuated-live vaccines

with either streptomycin-dependent mutants or aromatic-dependent mutants, however, these are not commercially available.⁶ Commercial and autogenous bacterins are employed for control of salmonellosis, however, they have been effective in controlled trials. Vaccines employing common gram-negative core antigens have been reported to be beneficial for prevention of salmonellosis.

Treatment consists of early recognition of the problem, supportive care and use of antibiotics in septic infections. Antibiotics are used routinely to treat *S. dublin* infections in calves because septicemia is so common. Susceptibility testing should be performed on isolates because plasmid-mediated resistance can cause variable sensitivity patterns.

Public Health Concerns

Salmonella dublin is responsible for less than 1% of the human cases of salmonellosis reported by the Centers for Disease Control. Risk factors for *S. dublin* infections in humans are ingestion of raw milk or raw milk products, an underlying medical condition and advance age.³ Consumption of raw calf-liver extract, used in some medical "nutritional therapies," also appears to be a risk factor. Individuals working with cattle would be expected to have a greater chance for exposure to *S. dublin*. However, in one study, working with cattle was not found to be a risk factor for disease. Unpasteurized milk sold for human consumption in California is routinely tested for *Salmonella* because of public health concern. If *Salmonella* is detected, milk is considered adulterated and it will result in a recall of product and diversion of milk for pasteurization until the contamination problem can be resolved.

References

1. Anderson MA, Blanchard PC. 1989. The clinical syndromes caused by *Salmonella* infections. *Vet. Med.* 84:816-819.
2. Bulgin MS. 1983. *Salmonella dublin*: What veterinarians should know. *J. Am. Vet. Med. Assoc.* 182:116-118.
3. Fang FC and Fierer J. 1991. Human infections with *Salmonella dublin*. *Med.* 70:198-207.
4. Jubb KVF, Kennedy PC, Palmer N. Pathology of Domestic Animals. 1993. Academic Press, San Diego. Vol. 2, pp 223-226.
5. Quinn PJ, Carter ME, Markey B, Carter GR. *Clinical Veterinary Microbiology*. Wolfe Publishing, Spain. pp 227-228.
6. Smith BP. Salmonellosis. In: *Large Animal Internal Medicine*. Editor BP Smith. 1990. CV Mosby Company, St. Louis pp 818-822.