Bovine Leptospirosis

Bovine leptospirosis is one of the major cattle diseases in the United States causing major economic losses to the cattle industry. Obvious losses are abortion, stillbirth, death, and decreased milk production. Less apparent losses result from slow gains in weight of calves and infertility problems in mature females.

The disease of cattle in the United States is caused by infection with one or more of six known pathogenic leptospiral serotypes. Leptospires are long filamentous motile spirochetes which require special media for cultivation and can be visualized only with darkfield microscopy or special stains. The six serotypes isolated from US cattle are canicola, grippo, icterohaemorrhagiae, bardjo, pomona, and szwajizak (4, 52, 37, 19, 44, 17). All but bardjo and szwajizak are members of separate serogroups. Serologic test results obtained from diagnostic laboratories in 18 states provided the following reactor rates for 66,522 sera in 1973: bardjo, 7.2%; pomona, 6.5%; grippo, 1.4%; canicola, .7%; and icterohaemorrhagiae, .8% (8). Although antibodies of autumnalis and some other serotypes have been detected serologically, no isolations of these serotypes have been made.

Pathogenic serotypes of leptosira generally affect with varying virulence more than one host and are common in wildlife. Pomona is shed commonly by infected cattle and swine and by such wildlife as skunks, racoons, and opossums (36). Hardjo has been isolated only from cattle in the US. The extension of the disease in this country appears limited to cattle to cattle contact. Grippotyphosa is carried primarily by raccoons, opossums, muskrats, squirrels, and field mice (Microtus) (36, 41) and occasionally extends to cattle and other domestic animals. Canicola, the most prevalent serotype in dogs, may be carried also by wildlife (36). Icterohaemorrhagiae, which is distributed widely in the Norway rat, occasionally is transmitted to cattle where it can become a herd infection (41). The most recent serotype to be isolated from US cattle, szwajizak, has been isolated also from small rodents in other countries. However, in the US this serotype appears to be limited to cattle (17).

Leptospires usually enter through abrasions of the skin of feet and legs when cattle are wading in contaminated streams, field ponds, and marshy areas, or in surface water around cattle feeding areas. Leptospires also readily enter the mucous membranes of the eye, mouth, (from splattered urine), or genital tract during breeding (43, 44). Transmission through the food chain has been demonstrated in carnivores but appears not to be a factor in cattle (35). Upon entrance, the organisms migrate to the visceral tissue where they multiply rapidly and then are transported to all tissues of the body during a primary leptospiremia usually 6 to 8 days after infection. At this time, the host usually exhibits an increase in body temperature of 1 to 2 C lasting for 12 to 48 h.

The acute signs most frequently associated with leptospirosis in calves are rise in body temperature and anemia. Jaundice, hemoglobinuria, and death may occur in some severe infections (14). In adult cows, fever, agalactia, hemoglobinuria, and meningitis are encountered with various degrees of frequency in the acute stage of the disease. The involvement of the mammary gland results in a sharp reduction in milk production, yellow clotted milk, occasional blood-tinged milk, but little swelling of mammary tissue. The reaction is suggestive of an endotoxin reaction. Studies of tissue changes in experimental acute leptospirosis indicate a heat labile toxin apparently is produced which causes hemorrhage by increased endothelial permeability (2, 27, 30). Infusion of the udder at this time does not alter the course of this disease (31). Suppression of lactation in some cattle may persist beyond acute infection and last throughout the entire lactation.

Hemolytic anemia and hemoglobinuria occur during the acute stage of the disease (9).
Heat-labile hemolysin which lyses ruminant erythrocytes (38) has been detected in affected cattle. A direct relationship also has been demonstrated between the production of cold agglutinins and the onset of hemolytic anemia (5). Hematuria also has been associated with some outbreaks and is caused by vascular lesions in a hemorrhagic nephritis with resulting anemia (15).

Clinical meningitis frequently occurs in man but often not recognized clinically in animals (1). However, incoordination, increased excitability, and convulsions have been associated with some outbreaks (1, 16, 24, 39). Leptospires enter brain tissue in animal infections and persist for extended periods even in the absence of observable signs (29, 42).

Acute nephritis commonly follows penetration of leptospires through the intracellular spaces into the glomeruli and proximal tubules causing edema, hemorrhages, and cellular necrosis (18). If the disease progresses, localization in the kidney may result in extensive interstitial nephritis with marked interstitial cellular infiltration with lymphocytes, plasma cells, and connective tissue. The leptospires usually remain in the lumen of the proximal convoluted tubules where they multiply and are released with the urine. Occasionally, the leptospires penetrate the epithelial cells and possibly remain for extended periods free from antibody effects (22). Localization of leptospires in kidney tissue may cause little stimulation of tissue during subacute and chronic stages of the disease resulting in shedding of active leptospires in urine from a host serologically negative for the homologous serotype (22). Leptospires have been isolated from 30% of rat and cattle kidneys from animals when the sera of the hosts were negative by microscopic agglutination test (4, 28).

Ocular lesions due to vascular congestion occur occasionally in the acute disease in cattle (23). The chronic lesions due to hypersensitivity reactions associated with periodic ophthalmia in horses are not often seen in cattle. Abortion and stillbirths are the signs most frequently recognized in bovine leptospirosis. Interruption of fetal life results from direct penetration of the fetal tissues following migration of the leptospires from the placenta of the dam at the time of acute illness. Abortion and stillbirths which occur 1 to 4 wk after acute illness may originate at any stage of gestation but most commonly affect the fetus during the last half of the gestation period. Leptospires are often present at delivery but are usually dead due to autolytic changes in the fetus (12, 34, 45, 52). Fennestad and Borg-Petersen (12) detected agglutinins in fetal calf serum as early as 163 days of gestation following an experimental infection with L. saxkoebing. Therefore, sera when available from aborted or stillborn fetuses may provide diagnostic information. The response of a fetus to a maternal infection depends upon serotype involved, virulence of the leptospires, age of the fetus, and resistance of the dam.

Infertility has been associated with various serotypes but most frequently with the less pathogenic leptospiral serotypes such as hardjo and szwajizak (17, 21). Retained placentas which frequently occur following leptospiral abortions and stillbirths may contribute to later infertility problems. Vaccination of all cattle in endemic herds has been associated with reduction in problems of infertility, suggesting chronic low grade infections may be related to the problem (21).

Agglutinins appear in cattle sera a few days following onset of acute signs, increase for 1 to 3 wk, and persist from several weeks to as long as 8 to 10 yr in some animals. As the microscopic or plate agglutination test measures primarily the IgM antibody content and requires antigens, the persistence of agglutinins for extended periods suggests that chronic infections may be involved. Neutralizing antibodies which appear after the agglutinins, are primarily IgG antibodies. These persist longer than response of IgM and appear to be the primary protective antibodies (25, 33, 51). Variation in antibody responses between animals makes it difficult to diagnose an infection by testing a few individual animals within a herd. Testing of 10% or more of the herd provides a diagnostic test of greater reliability and becomes more decisive when annual tests of the herd are part of the herd health program.

Although diagnosis of leptospiral infections in a herd usually is based upon serologic testing, isolation of the leptospires from the urine or tissues of affected animals in special media
provides the most accurate diagnosis (11). Urine usually contains leptospires as early as 10 days following an infection and may have leptospires for as long as 3 mo. Urine provides the most reliable source. Culturing of fetal tissues is seldom reliable in cattle due to autolysis (45).

Leptospires can be isolated in a variety of media as long as it contains either mammalian sera or mammalian albumin. Semisolid media are more efficient than liquid media in supporting the growth of new isolates.

Treatment of leptosporial outbreaks in dairy herds is a difficult procedure as the most effective chemotherapeutic agents result in residues in the milk. Dihydrostreptomycin has been the most effective antibiotic due to its persistence in the kidney and uterine tissues (10, 46). Its use is justified on a selective basis if only animals showing signs are treated. The owner must be informed of the need to dispose of the milk during treatment. However, infusion of the udder of cows with agalactiae does not alter the course of the mammary involvement (31).

Vaccination of the entire herd at 6 or 12 mo intervals with leptospiral bacterins of serotypes endemic in the area provides the most economical preventative procedure (6, 53). As all the bacterins commercially available are inactivated cultures, annual vaccination is necessary to provide adequate neutralizing (IgG) antibodies (25, 28). The neutralizing antibodies which can be measured by hamster protection tests or growth inhibition tests indicate reduction in the antibodies from 8 to 12 mo after vaccination (25, 33, 50, 51). In the United States, multivalent bacterins containing grippotypbosa, bardjo, and pomona (47) and canicola and icteroabamorrbagiae are now commercially available. Recent host efficacy studies in cattle indicate that leptospira bacterins are effective in preventing clinical illness and urinary shedding (26). However, vaccination should be avoided in cattle less than 4 mo of age as colostral antibodies in endemic areas can interfere with antibody development (7, 20, 40).

Transmission of leptosporial infections can be reduced by adoption of preventative procedures which limit dissemination. As pomona and szwajizak serotypes are carried most frequently by cattle, maintaining closed herds, testing all replacements, and fencing cattle away from streams and ponds can reduce transmission. Other serotypes such as grippotypbosa and icteroabamorrbagiae which usually are carried by wildlife are involved less commonly but are more difficult to avoid. Also, canicola carried by the dog is difficult to avoid due to the wide areas traveled by many dogs. Although some vaccinated cattle develop subclinical infections and may shed leptospires in their urine following exposure, it appears not to be significant epidemiologically as the shedding period is short and the number of organisms low (3, 21).

REFERENCES


50 Tripathy, D. N., L. E. Hanson, and W. A. Krumrey.

Journal of Dairy Science Vol. 59, No. 6

