

Bovine Protozoal Abortions in California

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Bovine protozoal abortion (BPA) associated with a fetal infection by a newly recognized protozoan parasite is now the most common type of infectious abortion identified in California cattle. Since 1985, diagnosticians in the California Veterinary Diagnostic Laboratory had noted a distinct pattern of histologic lesions which occurred in fetuses submitted from drylot dairies. The fetal lesions consisted of focal nonsuppurative necrotizing encephalitis, nonsuppurative myocarditis and myositis, and widespread nonsuppurative inflammatory infiltrates in other organs. While the cause of these lesions was not initially apparent, the lesions were similar to those seen with *Toxoplasma gondii* infection in sheep.⁶ However, there was no serologic evidence of *T. gondii* infection in the cattle that had aborted. In 1990 the bovine abortion cases submitted to the California Veterinary Laboratory over a 2 year period were compiled and examined extensively. Brain and heart lesions suggestive of a protozoal infection were observed in 18% of all fetuses submitted throughout California.³ In another survey of abortions, taken primarily from drylot dairy cattle in the San Joaquin valley of California, an even higher incidence of presumed protozoal infection was observed. Among 391 fetuses examined, 95 (24%) had fetal lesions typical of a protozoal infection.¹ Extensive microscopic examination of the brains of these fetuses with lesions was successful in identifying protozoa in over 20% of the cases which established a link between an unidentified protozoal infection and the presence of the fetal lesions.

The presumed protozoal etiology for these California abortions has been subsequently confirmed by retrospective immunoperoxidase testing of the fetal tissues using antisera to *Neospora caninum*.^{2,5} This antisera was selected after a report by Thilsted and Dubey in 1989 described an abortion storm on a dairy in New Mexico.¹⁶ The fetuses had histologic lesions typical of a protozoal infection and an immunoperoxidase staining procedure using *N. caninum* antisera was successful in positively staining protozoa in the fetal tissues.¹³ A similar technique has been used in California on over 450 fetuses presumed to have a protozoal infection. Over 330 positive cases have been identi-

fied. It is now clear that a *Neospora*-like protozoa infection is associated with a major portion of abortion storms on California dairies and is the most common cause of abortion identified in California (see table 1).² In comparison with other infectious causes of abortion, BPA is 3.5 times more frequently diagnosed than the most common bacterial cause (*Actinomyces pyogenes*) and 5 times as frequent as the most common viral cause of abortion (IBR).

TABLE 1 Comparison of causes for 468 bovine abortions*

Diagnostic Category	No.	% total
Cause identified	213	45.5
Infectious		
Protozoal	90	19.2
<i>Neospora</i> -like (89)		19.0
<i>Sarcocystis</i> sp (1)		0.2
Bacterial	76	16.2
Viral	26	5.6
Fungal	5	1.1
Epizootic bovine abortion	8	1.7
Non-infectious	8	1.7
Cause not identified, lesions of possibly infectious cause detected	115	24.6
Cause not identified, no lesions indicative of infectious disease detected	140	29.9

*Based on examination of aborted fetuses and fetal tissues submitted to the California Veterinary Diagnostic Laboratory (Tulare) from January 1, 1985 to June 30, 1989.

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The gestational ages of fetuses aborted due to BPA range from 3 to 8 months. Over 60% of the fetuses abort between 5 to 6 months gestation. Gross lesions are not diagnostic. The fetuses are almost invariably autolyzed with accumulations of serosanguineous fluid in the body cavities. On occasion, a fetus will have pinpoint to linear white foci in the skeletal muscles or heart. These macroscopic lesions correspond to the microscopic lesions of nonsuppurative myositis and myocarditis. The most significant le-

sions are observed in the brain. A pattern of multifocal nonsuppurative encephalitis is seen with variable degrees of focal necrosis (Figure 1a, 1b). Other lesions that contribute to a diagnosis include interstitial pneumonia, portal hepatitis and interstitial nephritis. A fetus may be infected with the *Neospora*-like agent and survive to completion of the pregnancy. Several reports indicate that these calves are usually undersized and exhibit paresis or paralysis due to damage in the spinal cord caused by the protozoal infection.^{4,11,14}

Empirical observations of BPA outbreaks on California dairies suggest that the disease may be associated with explosive epidemics in some herds in which 20% of pregnant cows may abort in a few weeks. In other herds, a persistent lower level of abortion may occur over a period of years. Initial epidemiological investigations have found that among 364 dairies that submitted aborted fetuses over a 6 year period there were 103 dairies (28%) that had this infection. This crude estimate of prevalence is undoubtedly low because as more abortions are sampled on a given dairy, the likelihood of identification of this infection is increased. At the present time, this infection has been identified in abortions from over 125 dairies throughout California.

The precise identity of the BPA organism is not certain. The BPA agent has been referred to as *Neospora*-like because of its morphological and antigenic similarities to *Neospora caninum*, a newly recognized protozoal organism which was first isolated in 1988 from a litter of puppies with clinical signs of central nervous system disease.^{9,10} By light microscopy, *N. caninum* is very similar to *T. gondii* but there are antigenic and ultrastructural characteristics which distinguish these organisms.^{4,5,10,13} Toxoplasmosis is a well-documented cause of abortion in sheep and goats.^{6,8} However, it is doubtful that *T. gondii* is a significant cause of abortion in cattle.⁷ In cattle, the diagnosis of *N. caninum*-like infection has been based on select morphologic features coupled with tissue immunohistochemistry using antisera against *N. caninum*.^{2,5,11,12,15,16} Recent work has shown that while the *Neospora*-like organism in cattle is very similar to *N. caninum*, it is antigenically distinct from it, suggesting that the cattle parasite may be a new, closely related protozoan.⁴

A presumptive diagnosis of abortion due to *Neospora*-like protozoal infection is made on the presence of histologic lesions that are consistent with the infection. At present, the diagnosis of fetal infection by the *Neospora*-like agent can be only confirmed by the immunohistochemical procedure on fetal tissues (Figure 1c, 1f, 1g). The protozoa has not been isolated from cattle or aborted fetuses and there is no serologic test available for testing cattle for exposure to this agent. Therefore, more information about this protozoa is required if progress is to be achieved in the prevention and treatment of this disease problem. The parasite must be isolated from cattle and better character-

ized biologically and immunologically. A serologic test could then be developed to facilitate diagnosis and epidemiologic investigations. Epidemiologic studies are needed to determine the disease prevalence, risk factors associated with infection, and means by which the parasite is transmitted. It is hypothesized that the organism may be spread by ingestion of contaminated feces from another animal host, as is the case with some other coccidian parasites.

Legends:

Figure 1 Photomicrographs of sections of brain from fetuses naturally infected with a *Neospora caninum*-like organism.

A) Focus of central necrosis surrounded by a zone of mononuclear inflammatory cells and glial cells (arrow). H&E stain; bar = 65µm.

B) Inflammatory focus with infiltration of mononuclear cells (arrow). H&E stain; bar = 75µm.

C) Focus of central necrosis containing 3 *N. caninum*-like tachyzoites (arrows). Immunoperoxidase stain with *N. caninum* antiserum; bar = 33 µm. Inset is a higher magnification of tachyzoites (arrows); bar = 7.3µm.

C) Group of tachyzoites (arrow). Notice faint staining of zoites. H&E stain; bar = 7.3 µm.

E) Tissue cyst with a thick cyst wall (arrow). H&E stain; bar = 7.3µm.

F) Group of tachyzoites stained with *N. caninum* antiserum; bar = 7.3 µm.

G) Tissue cyst stained with *N. caninum* antiserum; bar = 10.9 µm.

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Fig. 1.

