Causes and Prevention of Bovine Abortion

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Introduction

Abortion is a particularly costly and vexing problem for veterinarians and cow/calf producers. Determining the causes of bovine abortion is difficult for several reasons, and despite the advances in diagnostic technology of the past few years, diagnostic success in bovine abortions seldom reaches 50% in laboratories around the world. Table 1 summarizes the results of diagnostic efforts on bovine abortions over the past 3 years at the South Dakota Veterinary Diagnostic Laboratory where specimens from 600 to 1000 aborted calves are examined each year. With the exception of dystocia, twinning, trauma, and anomaly (which in some cases may be caused by infection) all the causes listed are infectious, i.e. bacterial, viral, fungal, or protozoan. Because toxic, metabolic, and hereditary causes of abortion seldom result in a product or lesion readily recognizable in fetal tissues, these causes of abortion usually remain undetected by diagnosticians.

Table 1. Summary of the results of diagnostic efforts on aborted bovine fetuses, 1987-1989.

	Number			
Diagnosis	**1987**	**1988**	**1989**	**total**
BVD	41	40	41	122
Mycotic placentitis	33	29	52	114
IBR	39	40	20	99
Misc. Bacterial	22	39	37	98
Bacillus sp	40	33	24	97
Actinomyces (Corynebacterium)	17	35	33	85
Listeriosis	14	2	8	24
Dystocia	2	9	11	22
Leptospirosis	11	6	4	21
Anomaly	4	8	7	19
Twins	6	6	6	18
Misc.Viral	9	3	3	15
Campylobacter sp	4	9	1	14
Brucella sp	3	0	0	3
Totals	245	259	247	751
Undiagnosed	464	560	521	1545
Total Cases	709	819	768	2296

Obviously the stockman wants every pregnant cow to go to term and deliver a live, healthy calf. This is an unrealistic expectation, but the level of abortion in a herd that should elicit alarm has not been determined exactly. A maximum loss of 3%, while not desirable, probably is not unreasonable. Some of these losses may result from certain inherited hormonal deficiencies, and routine culling usually keeps this problem to a minimum. As with any average figure, this 3% loss does not occur uniformly each year in every herd. Therefore fewer than 1% "normal" abortions may occur in a herd for several years, and then the number may exceed 3% for 1 or more years. This makes it difficult to set a precise figure for the number of abortions that should be accepted before investigation into the cause is started, but in general, diagnostic efforts should be initiated any time more than 1% of the herd abort.

Infectious Causes of Bovine Abortion

Epidemic vs Sporadic Abortion: Some infectious causes of abortion, because of their contagious nature, tend to cause epidemics of abortion. Noncontagious infections usually arise from a source in the environment other than another infected animal, and they often affect only individuals. The exact reason some animals within a herd are affected by these organisms and others are not is difficult to explain, but in some cases there are predisposing factors that lower certain individuals' resistance at critical times and allow infections to occur that the animals would ordinarily resist.

Infectious Causes of Epidemic Bovine Abortion

IBR--Bovine herpesvirus, group I, which causes infectious bovine rhinotracheitis (IBR) is a commonly diagnosed cause of bovine abortion in the northern plains states. However, the percentage of IBR abortion diagnosed at the South Dakota Diagnostic Laboratory has declined from a high of 24% of all cases examined in 1974 to an average of about 5% in the last 5-10 years. There are carriers of the latent virus in almost every herd, and if such an animal is subjected to undue stress or the immune system is otherwise impaired, the virus may be reactivated and spread to susceptible cattle. Newly introduced cattle

may also carry the highly contagious infection into a herd through which it may spread rapidly. It frequently causes abortion without producing other clinical signs. The infection may cause abortion in 50% or more of the cows in a herd that contains many susceptible cows. The minimum time from infection to abortion is about 3 weeks, but cows may abort 3 months or more after being infected. Because of this extended incubation period, abortions may continue for several weeks in herds vaccinated after abortions have started. In order to avoid misunderstandings, veterinarians should make it clear to herd owners that vaccination in the midst of an IBR abortion epidemic often fails to halt abortions.

Calves aborted because of IBR virus infection usually are retained in the uterus 24-72 hours after death. Thus the fetuses characteristically are moderately to severely autolysed, which results in large collections of serosanguineous fluid in their body cavities and collections of what appears to be clotted blood around their kidneys. Gross lesions are usually not present; however, fetuses aborted about 6 months of gestation or earlier may have small (< 1 mm diameter) white spots in their lungs and/or livers. Nothing about the gross appearance is pathognomonic. Direct fluorescent antibody (FA) examination of frozen sections of fetal kidney is greater than 90% effective in diagnosing the infection. FA examination of other fetal tissues and placenta is much less accurate. Microscopic focal hepatic necrosis occurs very consistently and this lesion along with the FA results makes diagnosis of IBR abortion quite certain. The virus can only be isolated from fetal tissues in about ⅓ positive cases. Virus isolation is most effective as a diagnostic procedure when only placental tissue is available for examination.

The only method of preventing IBR abortion is by maintaining a high level of immunity in the herd through vaccination. The intranasal modified live vaccine is probably the most safe and effective. Intramuscular modified live vaccines generally are effective, but most of them should not be used in pregnant cows. The killed vaccines are safe but may not be as effective as the modified live vaccines. Vaccination of all brood animals every year is an economical insurance program.

Bovine Viral Diarrhea Virus (BVDV) -- In the 7 years prior to 1981, BVDV was detected in an average of 1.2% of the aborted calves examined at the South Dakota Diagnostic Laboratory. In 1981, the virus was found associated with 5.1% of the bovine abortions, and since that time the average has been 5.4%. The large increase in BVDV-associated abortions in 1981 corresponded with the vaccination of several thousand pregnant cows with a BVDV-contaminated scours vaccine. Despite the fact that diagnostic methods for BVDV have remained essentially the same over the years, the prevalence of abortions associated with the virus continues to be about 5 times what it was prior to 1981. A great deal has been learned about BVDV infection in the past 10 years, but in my opinion, we still do not fully appreciate all the effects of this infection on bovine reproduction and other bovine diseases.

Infection with BVDV reduces a cow's resistance to other infections by its effects on the immune system. Thus, a cow infected with BVDV may be more susceptible to other infections which may result in abortion. In this case, BVDV infection may not be the direct cause of abortion but may contribute to abortions caused by other infectious agents. We find BVDV in up to ⅓ fetuses aborted because of fungus, *Bacillus* sp., or *A. pyogenes,* infections. In these cases the lesions in the fetus and placenta are charactereistic of bacterial or mycotic infections, not BVDV.

The number of BVDV abortions that occurs when the infection is introduced into a herd depends on the number of susceptible cows involved, the prevailing stage of gestation of the cows in the herd, and the virulence of the infecting virus. In some cases cows may have diarrhea, fever, and other signs of illness 1 to 3 weeks before abortions start. However, abortion is often the only sign of the infection.

Calves infected during the middle part of gestation usually succumb to the disease and are aborted. Calves infected during the last third of gestation usually resist the infection and often are born normal, free of virus, and with antibodies to the infection. These events may vary depending on the virulence of the strain of virus involved. A major complicating factor is the recently recognized fact that calves infected in the first 4 months of gestation may be born apparently normal but persistently infected with BVDV. Most of these animals die of mucosal disease within the first year, but a small percentage of them lives long enough to reproduce. The calves they produce are also persistently infected. All persistently infected animals continuously excrete tremendous numbers of viruses with their nasal, oral, and reproductive secretions, and the infection often is introduced into a herd by the purchase of one of these animals. Persistently infected animals can only be detected by virus isolation from blood or nasal or reproductive secretions. Serologic methods cannot be relied upon.

Characteristic gross or microscopic lesions do not occur consistently in calves aborted because of BVDV infection. However, several lesions have been associated with the infection. These include cerebellar hypoplasia, alopecia, congenital cataracts, and abnormally small, weak calves. Each year we have seen several aborted calves with lesions of chronic passive congestion including an enlarged, fibrous liver with dilated sinusoids; an enlarged flabby heart, often with mild nonsuppurative myocarditis and extensive ascites. We have detected BVDV in about ¼ of the calves with these lesions.

Virus isolation from pooled fetal tissues has proven to be the most accurate method of diagnosis in our hands. A direct FA examination of kidney and spleen is helpful, and a positive result is accompanied by virus isolation about 80% of the time. However, the virus frequently is isolated

from calves with a negative FA result. Calves are capable of producing antibodies to BVDV rather early in gestation, and the presence of BVDV-specific antibodies in serum or body cavity fluids from aborted calves or precolostral serum from calves born alive is a good indication of prenatal infection. However, the precise titer of antibodies that may be considered significant is unknown. With our system, I usually consider virus neutralization titers below 1:40 of questionable significance. The absence of fetal antibodies does not exclude the possibility of BVDV infection.

Vaccination with a modified live or killed vaccine is recommended as a preventive measure. However, there are strong indications that cows vaccinated with vaccines that are presently available are not always able to protect their fetuses from infection. There is more to be learned about the differences in the various strains of BVD viruses and methods of immunization against them.

Leptospirosis--There are about 180 different serovars of leptospires known in the world, and immunity to one serovar does not necessarily protect an animal from infection by another. Although 6 serovars of leptospires are known to infect livestock in the USA, serovars *pomona* and *hardjo* affect cattle most often in this country. While infection by either of these types of leptospires can result in abortion, their relationships to cattle and the diseases they produce differ considerably.

Swine are probably the natural or maintenance hosts for serovar *pomona*, and because swine and *pomona* are well adapted to each other, this infection often results in a mild disease, the only sign of which is abortion. Cattle are abnormal hosts for *pomona*, and when they become infected with this serovar, it frequently results in a rather severe disease. There may be liver and kidney damage and hemolysis. The infection may result in death especially of calves, and it may cause severe abortion storms in herds that contain many susceptible cows. Infected cattle mount a strong immune reaction to the infection, and if left to run its course, the infection may disappear from the herd over a period of time.

Cattle are natural or maintenance hosts of *hardjo*, and the 2 species are well adapted to each other. Therefore, the infection in cattle is often very mild or produces no noticeable signs other than abortion and possibly infertility and agalactia. Affected cows usually recover in a week or two. The immune reaction of cattle to a *hardjo* infection often is very mild, and some cattle become permanent carriers in their kidneys, reproductive tract, udder, or central nervous system. Some of these persistent carriers have no antibodies detectable by the usual blood test. Once a *hardjo* infection becomes established in a herd it will pass to the calves from carrier cows and remain in the herd indefinitely unless steps are taken to eliminate it.

Diagnosis of leptospiral abortion presents difficult problems. *Hardjo* infection produces no specific gross or microscopic lesion in the fetus or placenta. *Pomona* infection occasionally causes mild fetal icterus and interstitial nephritis. Serovars such as icterohaemorrhagiae and *grippotyphosa* that seldom affect cattle are more likely to produce gross and microscopic lesions especially of the kidneys. Isolation of leptospires from tissues is a difficult, time- and labor-consuming task with few rewards. It is unsuitable for routine diagnostic use. Fetal calves can produce antibodies to some serovars of leptospires, but they do not do it consistently. Fetal serology has proven insensitive when used in large scale attempts to diagnose leptospirosis. Extensive use of multivalent leptospiral vaccine in cattle has rendered the interpretation of results of serologic examination of individual aborting cows virtually impossible. Cows that abort because of leptospiral infection have reached the peak of their titers by the time they abort, therefore, examination of paired serum samples usually provides little significant diagnostic information. Serologic diagnosis is also made difficult by the fact that up to 25% of cows infected with *hardjo* produce no antibodies, and cows infected with *pomona* may maintain a significant titer for months to years after the infection has been resolved.

At present, the best available method of diagnosing leptospiral abortion is the direct FA using a multivalent leptospiral conjugate on frozen sections of fetal kidney. The test is known to be relatively insensitive even when good equipment and conjugates are used by an experienced technician. Diagnosticians badly need a multivalent DNA probe for detecting leptospires in tissues. Hopefully one will become available in the near future.

Most contemporary leptospiral vaccines contain 5 of the serovars known to affect livestock in this country, and some now also contain serovar *bratislava*; however, results of recent research indicate that the serotype of *hardjo (prajitno)* used in vaccines for years is not effective in cattle. Some vaccines may contain the serotype of *hardjo* that occurs in this country (bovis), but it also appears ineffective in immunizing cattle. Until these problems are solved, vaccination for *hardjo* is of questionable value, and it is difficult to make specific recommendations concerning control by vaccination. However, generally it is recommended that in a herd that has no history of exposure, all the cattle should be vaccinated twice at 6-month intervals the first year and at least yearly thereafter. In herds known to be infected or liable to exposure, it may be necessary to vaccinate all cattle every 3 months for 2 or more years to prevent spread of the infection. In these cases it is especialy important to vaccinate calves by the time they are 2 months old and to repeat the vaccination every 2 to 3 months until they are breeding age.

Blood samples should be taken from purchased cattle or from those entering the herd from other sources, and these cattle should be kept separate from the resident herd until results of the test show them to be free of leptospiral infection. It is often difficult to determine by the results of

a blood test whether or not cattle are infected, especially if the vaccination history is unknown. Vaccination may cause a titer as high as 1:1600 within 2 weeks, but in the majority of cattle the titer will decline below 1:200 by 8 weeks after vaccination.

Campylobacteriosis--There are many species of *Campylobacter* at least 3 of which are known to infect cattle. Two of these, *C. fetus* ssp. *fetus* and *C. jejuni*, cause intestinal infections, but occasionally these organisms gain access to the blood stream in pregnant cows and cause abortion. Abortions caused by these 2 species usually are sporadic rather than epidemic. However, the other species known to infect cattle, *C. fetus* ssp. *venerealis*, causes a venereal infection which results in female infertility and abortion. Infertility is the predominant sign of venereal campylobacter infection in cattle, but after the infection has been in the herd a year or more, abortions become more common. Up to 10% of the cows in a herd may abort from this infection.

Fifteen to 20 years ago, campylobacter infection was one of the most common causes of bovine abortion, but yearly vaccination has almost eliminated this infection from the beef cattle population. Artificial insemination using properly treated semen also prevents the transmission of this infection. Despite the current rarity of the disease, cattlemen cannot relax their guard against it . The infection is still present in some cattle, and introduction of a single infected animal into an unprotected herd will allow the disease to spread rapidly. Five cases of venereal campylobacteriosis involving 4 herds were diagnosed this year (1989-90) at the South Dakota Diagnostic laboratory. This is more than had been seen in any of the past 10 years. The apparent increase in prevalence may indicate that vaccination is not being done as religiously as it was in the past, or the vaccines currently being used are now as effective as those used previously. The trend toward mixing numerous antigens in single dose vaccines may result in diluting some antigens to the point that they are not effective. Vaccination against the venereal form of the infection does not protect against the intestinal infections.

Abortions caused by campylobacter usually occur at 6 to 8 months of gestation. The fetuses are not autolysed, and often the lungs are partially expanded indicating that the calf was alive when expelled. Gross lesions of fibrinous peritonitis and pleuritis as well as mild necrotic placentitis commonly occur. Microscopic lesions of suppurative pneumonia and placentitis occur consistently, and focal hepatic necrosis occurs occasionally. None of the lesions is pathognomonic. Dark-field examination of stomach content reveals the organism which is readily identified by its morphologic characteristics and its unique method of motility. Final diagnosis is made be isolating and identifying the organism.

Trichomoniasis--Tritrichomonas foetus infection received little atention for several years, but recently the prevalence of the disease appears to have increased especially in the western part of the country. Female infertility with irregular heat cycles, and pyometra are more characteristic of the infection than abortion which occurs in only about 5% of infected cows.

Since the only medication proven effective in curing infected bulls has been disapproved, the best remaining method of controlling the infection is by testing and slaughtering infected bulls. Most cows eliminate the infection from their reproductive tract within a few weeks if not reinfected; however on rare occasions, a cow may remain infected through a pregnancy. If this happens, spread of the infection will start again as soon as natural breeding commences. A vaccine presently is available but its effacacy in the field is yet to be proven.

The abortions occur before 5 months of gestation, and there are no characteristic lesions. The organisms can be seen by direct microscopic examiantion of fetal stomach content and uterine fluids. They can also be isolated from these specimens by using proper techniques. Culture of prepucial smegma from bulls is a more effective method of diagnosing the infection in a herd. The presence of a single infected animal indicates herd infection.

Ureaplasma diversum Abortion--Diagnosticians in Canada have found *Ureaplasma diversum* associated with a fairly high percentage of bovine abortions. It is reported far less commonly in the USA, perhaps because of inadequate diagnostic procedures. Over a 3 year period at the South Dakota Diagnostic Laboratory, we cultured about 2500 bovine fetuses and isolate *U. diversum* from less than 1% of them.

Gross lesions do not occur in the fetus, but often there is thickening of the amnion and the chorioallantois with foci of fibrin and hemorrhage. Microscopically these areas are fibrosed and have large accumulations of mononuclear cells. There also may be necrosis, fibrin, and mineralization. Microscopic lesions in the fetus include pulmonary alveolitis with necrosis of the epithelium and accumulations of lympocytes around the airways.

Ureaplasma is a common inhabitant of the prepuce of bulls where it is not associated with lesions. It is frequently present also in the vulva of cows where it may cause suppurative vulvitis. Abortions and infertility may occur more often with artificial insemination than with natural service, presumably because *U. diversum* is carried through the cervix on the insemination pipette. Its presence in an aborted fetus is only considered significant when it is accompanied by characteristic lesions. There are no specific control methods.

Sporadic Bovine Abortion

Mycotic Placentitis--Mycotic infection of the placenta is one of the most common causes of sporadic bovine abortion. It occurs when fungal spores enter a pregnant cow's blood stream (possibly through breaks in the lining of the upper digestive tract), settle at the junction of the maternal

and fetal placentas, grow and attack the placental tissues. All feed that cows eat contain fungal spores. Some feeds, such as improperly preserved silage and hay that has been wet, contain many more spores than others. Many of these common molds are capable of causing abortion under the right conditions. Exactly what these conditions are is not known, but feeding extremely moldy feeds increases exposure, and any circumstance that reduces the cow's resistance to infection increases the changes of mycotic abortion. BVDV infection may be one of the most common predisposing factors in mycotic abortion.

There are no specific means of preventing mycotic abortions other than keeping cows in good health through good management and nutrition and not feeding obviously moldy feeds.

The infection consistently causes severe placentitis. The non-septate fungi, *Absidia* sp., *Mucor* sp., and *Rhizopus* sp., cause severe, extensive necrotic placentitis with infarction and sloughing of the maternal caruncle. In these infections, the calf has generally been dead 12 to 24 hours before it is expelled. When *Aspergillus* sp. is involved, the calf is usually alive at the time abortion starts, and occasionally it is born alive. Aspergillus infections may not cause placentitis that is as severe or extensive as that which the non-septate fungi produce.

In about ⅓ of mycotic abortions, the fungus infects the fetus. Dry, raised or moist, flat skin lesions are most commonly encountered. Mycotic fetal pneumonia occurs occasionally, and mycotic brain abscesses occur rarely.

Because fungal spores are ubiquitous, the isolation of fungus from stomach content or placenta is not conclusive. Hyphae must be visually associated with lesions to make a definite diagnosis. Hyphae may be visible in fixed tissue sections stained with H & E, but often it is necessary to use a silver stain to disclose the presence of hyphae. Scrapings from skin lesions or placenta may be digested with KOH and examined with a light microscope, or 0.05% calcofluor white may be added to the KOH and the preparation examined with a flouorescent microscope.

Listeriosis--Listeria monocytogenes occurs commonly in the cow's environment, but it multiplies in poorly preserved silage. This is the most common but not the only source of the infection. The brain infection seldom occurs at the same time as abortions. Sometimes several pregnant cows are exposed to the source of infection at the same time, and cows that abort from the infection shed the organism with their uterine discharges for several days, thus exposing other cows. Therefore, while listerial abortions are usually sporadic, under these circumstances epidemics of listerial abortion occur.

There are no specific methods of preventing listerial abortion. Vaccination has not proven effective and would be of doubtful economic value given the sporadic nature of the infection. Once listerial abortion has been diagnosed, pregnant cows should be moved to another area and their source of feed changed if possible. Oral treatment of the entire herd with antibiotics may also reduce the number of abortions that occur in an exposed herd.

Listerial abortions occur at all stages of gestation, and the fetus is usually badly autolysed. The liver is somewhat shrunken and has the consistency and color of putty. Numerous small (1mm or less in diameter), indistinct white to gray spots are present under the capsule of the liver. Autolysis often obscures these microabscesses from microscopic view. The diagnosis is confirmed by the isolation and identification of the organism from the fetal stomach content or organs. Unlike listerial encephalitis, isolation of the organism from aborted fetuses presents no problems, and its presence can usually be confirmed within 24 hours after inoculation of media.

Actinomyces (Corynebacterium) pyogenes--This bacterium often causes diseases of cattle including abscesses and pneumonia. It is one of the most common causes of sporadic bovine abortion. There are no specific methods to control this infection other than maintaining the resistance of cows through food management. BVDV infection may be a common predisposing factor in this infection also.

A. pyogenes abortions occur most commonly after midgestation, and the fetuses are usually moderately to severely autolysed. Gross and microscopic suppurative, fibrinous peritonitis, pleuritis, and placentitis occur commonly. The diagnosis is confirmed by the isolation and identification of *A. pyogenes* from the fetal stomach content or tissues. The presence of *A. pyogenes* in the fetal placenta, especially if the organ has been retained for several hours, does not necessarily implicate the organism as the cause of the abortion, because *A. pyogenes* is a common post parturient invader of the bovine uterus.

Bacillus sp.--Cows are exposed to several species of *Bacillus* in the environment every day, but these organisms seldom cause disease. However, 2 species *(Cereus* and *licheniformis)* frequently cause sporadic abortion. We do not know specifically what conditions allow these rather nonpathogenic organisms to cause abortion, but as with mycotic and *A. pyogenes* infections, BVDV infection often accompanies a bacillus infection.

Bacillus abortions usually occur late in gestation, and the fetuses usually are not autolysed. Fibrinous peritonitis and pleuritis are frequently present, but the most characteristic gross lesion, when it is present, is fibrinous epicarditis. There usually is extensive necrosis of the cotyledons, and the fetal side of the placenta often is brown to orange and has the appearance of Moroccan leather. Microscopically there is suppurative pneumonia and placentitis often associated with masses of large bacterial rods. The organism is easily isolated from fetal stomach content and organs.

Miscellaneous Infections--Many other bacteria, some that cause diseases other than abortion and others that merely frequent the environment of cattle, can occasional-

ly cause abortion. *Escherichia coli* is a good example of this type infection. Generally there are no specific measures available to control these infections.

Noninfectious Causes of Bovine Abortion

Toxins

Because the cause of abortions frequently cannot be determined, it is natural that we often resort to simplistic answers to the problem. Stated directly, the most common of these simplistic solution is, "Cows eat. Cows abort. Therefore, what they eat must cause them to abort". The hundreds of feed samples submitted along with abortion specimens to diagnostic laboratories is evidence of the prevalence of this theory.

The possible toxic causes of bovine abortion appear to be unlimited. In general, the fetus is more susceptible to adverse effects of intoxication than is the dam. Therefore, subclinical intoxication of a pregnant cow with a substance that readily crosses the placental barrier may severely affect her fetus and result in abortion. While the exact extent of their involvement is unknown, nitrate, pine needles, mycotoxins, and endotoxins perhaps are the toxic agents most commonly suspected of causing bovine abortion.

Nitrate--There is little doubt that nitrate intoxication can result in abortion; however, the exact circumstances involved remain uncertain. Experimental attempts to produce abortion by feeding pregnant cows inorganic nitrates have produced varying results even when clinical signs of nitrate toxicity were produced in cows. Many think that subclinical nitrate intoxication frequently results in abortion, but many others, including myself, doubt that this a major problem.

Diagnosis of nitrate toxicity abortion by examination of the fetus is very difficult. Definitive lesions do not consistently occur, and detection of toxic nitrate products in fetal tissues or fluids remains a tentative procedure for which standards have not been established. While it is an indirect approach, examining feed and water for toxic levels of nitrate appears to be a more certain diagnostic method.

Pine Needles--Needles from Ponderosa pine trees are frequently suspected of causing bovine abortion, and abortions have been produced experimentally by feeding them to pregnant cows. Many cows refuse to eat pine needles even when starved, while others appear to eat them readily. The exact toxic element in pine needles has not been identified.

A tentative diagnosis of pine needle abortion can be made when the herd history includes late term abortions with consistently retained placentas, access to Ponderosa pines, and in addition, laboratory examinations have eliminated as much as possible the likelihood of infectious causes.

Mycotoxins--Toxins produced by fungi frequently are suspected of causing bovine abortions and reason supports these suspicions, but expermental and clinical proof of their involvement is lacking. Over the years we have analyzed for mycotoxins several hundred feed samples submitted with bovine fetal specimens. I cannot recall a single instance when we were definitely able to incriminate mycotoxins as the cause of the problem.

Endotoxins--Bacterial endotoxins undoubtedly are an underdiagnosed cause of sporadic bovine abortion. These substances cause abortion by causing the release of prostaglandins and by other effects on the pregnant cow. The result is the early expulsion of an otherwise normal fetus. Because of this, examination of the fetus provides no clue to the cause of the abortion. An accurate clinical history of the individual aborting cow (something which is seldom available for beef cows) is the only hope of defining the cause of the abortion.

Hereditary Causes of Abortion

Abortion, premature birth, or stillbirth may result from congenital defects, but such defects may be caused by either heredity or environmental factors such as toxins or viral infections. Congenital defects caused by environmental factors do not follow familial patterns, but whether or not familial patterns are involved in a particular case often is not evident without extensive investigation of numerous events. Determining the cause of a particular congenital defect is complicated by the fact that a single defect such as arthrogryposis can result from numerous genetic as well as environmental factors. Because of this, one must be careful not to consider all congenital defects as hereditary.

In the past, it was common to see several cases of each of the following hereditary diseases each year at the South Dakota Diagnostic Laboratory. However, in the past several years they have become rare which indicates that the breeders of purebred cattle of these breeds have done an excellent job of eliminating carrier bulls from the breeding stock.

Osteopetrosis--This hereditary disease occurs mainly in Angus cattle and is an autosomal recessive trait. The calves are aborted dead in fresh condition at between 251 and 272 days gestation. They are characteristically smaller than normal and have a short lower jaw with impacted molars. The long bones lack a marrow cavity.

Hydrocephalus--This anomaly occurs as a simple recessive autosomal trait in several cattle breeds, but occurred most commonly in Herefords in our area. The calves may be stillborn or born alive but premature. The excess fluid collected in the ventricles of the brain may or may not be evident as an enlarged cranium. In Herefords there is kinking of the mesencephalon at the anterior portion of the aqueduct.

Arthrogryposis--This anomaly which results from an autosomal recessive trait in Charolais cattle often is accompanied by a cleft palate and the lack of patellas. It occurred rather commonly in the past. The calves are usually stillborn near term and the anthrogryposis is bilateral and symmetrical.