Diagnosis and Control Measures for Opportunist Infectious Causes of Reproductive Failure

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Reproductive wastage continues to result in severe economic losses for beef producers throughout the world. The average herd abortion rate reported in various studies in the literature varies from 2% to 12%, with much of the variation attributed to differences in case definition (what constitutes an abortion), methods of data recording, management styles, geography and prevalence of bovine abortifacients. It is interesting to note that in spite of an abundance of vaccine products for abortion prevention, these figures remain virtually unchanged. Old abortion foes such as brucellosis and IBR are replaced by organisms as intriguing as Neospora caninum, or common environmental bacteria and fungi such as Bacillus sp. and Aspergillus sp.. The endless battle for prevention of abortion losses continues. The only difference is that today, the foe is often constantly present in the cow's environment; slow growing and somewhat unpredictable, waiting for the right opportunity to attack. This presentation will discuss the methods of diagnosis for the common causes of bovine abortion with a focus on these opportunistic pathogens and explore possible strategies to mitigate reproductive losses.

Diagnosis of bovine abortion is a challenging and often frustrating process that can cause a great deal of aggravation for the practitioner and producer. The services of a diagnostic laboratory are often required in order to reach an etiologic diagnosis in abortion cases. This may or may not be a pleasant experience depending on the level of communication that exists between the producer, practitioner and the laboratory staff performing the work. Success rates for abortion diagnosis are often very low averaging around 30% in most laboratories. Most cases of non-infectious abortion will go undiagnosed. The Animal Disease Research and Diagnostic Laboratory (ADRDL) at South Dakota State University has for many years adopted a uniform approach for dealing with cases of bovine reproductive failure that is unique in the field of veterinary diagnostic medicine. Unique does not necessarily mean the only way or the best way. At ADRDL, all cases of reproductive failure are assigned to one pathologist (i.e. a reproductive disease specialist) who acts as case coordinator until the case is completed. The most obvious advantages of this system are consistency and accountability. As the reproductive disease specialist, I also encourage practitioners and producers to develop a standardized approach to deal with diagnosis of reproductive wastage. As a diagnostician, I am often limited by the information and samples that I am provided. Submission of case material for abortion diagnosis is a straightforward process. However, a high percentage of submissions every year are incomplete, reducing the already limited diagnostic success rates. Start every abortion investigation by obtaining a complete history including a description of on farm management practices, vaccination protocols and an evaluation of recent on farm events that may have predisposed the cow to abortion disease. Previous disease problems, new purchases and nutritional programs should be recorded. A complete history is received with probably less than 10% of submitted cases.

An intact fetus and placenta are desirable for diagnostic evaluation. If the fetus is large and shipping costs become prohibitive, a complete necropsy should be performed on the farm or at the veterinary clinic. Veterinarians should encourage producers to attempt to recover placenta. Often the placenta is retained and must be retrieved from the cow, or is left lying on the ground or lost to scavengers. The placenta is the <u>most</u> important tissue for abortion diagnosis. If the placenta is unavailable, the probability of diagnosis is significantly reduced. A whole, intact placenta is rarely received for examination. Often only a small portion of placenta is recovered and may be devoid of any cotyledonary structures. Rarely are such samples diagnostically useful.

Histologic changes in placenta are often multifocal in distribution requiring multiple sections to be examined to give the diagnostician the best chance of detecting subtle areas of placental damage. Placentitis results in disruption of placental functions including oxygen transport and exchange, nutritional support for the fetus, hormone and growth factor production that can affect normal parturition and fetal development. Chronic inflammation associated with release of cytokines and pro-inflammatory factors alter normal physiologic processes that occur at the fetal maternal interface. Fetal macrophages within the placenta are rare in the early gestational fetus, but by 8 months gestation, they have increased 10-fold. These macrophages are numerous within the allantoic stroma within areas of inflammation and often appear to contain debris or organisms in their cytoplasm. The role of these cells in cell defense against infectious agents as well as their role in dissemination of organisms is unknown. I believe that a significant number of still born or weak-born calves and lambs that are presented every late winter and spring are the result of placental dysfunction, often associated with chronic placentitis. The outcome of pregnancy (abortion, stillborn or weak-born) often depends on how long the fetus can survive with a damaged placenta.

Opportunistic Bacterial Infections

The vast majority of bacterial causes of abortion today involve opportunistic pathogens. These organisms are not readily infectious, and are common inhabitants of the host or its environment. These bacteria gain entrance to the blood stream of the dam and occasionally set up an infection in the placenta. *Arcanobacterium pyogenes* and *Bacillus sp.*, followed by *Escherichia coli*, *Histophilus somni*, *Pasteurella sp.*,*Listeria sp.*, *Staphylococcus sp.*, *Streptococcus* *sp.* are common isolated. Basically any bacteria that can find its way into the blood stream, and get to the placenta can be an opportunistic pathogen. These opportunists are usually associated with sporadic abortions, unless specific risk factors give a particular organism the chance to affect multiple animals. Cattle with abscesses or a history of feet problems seem to have problems with *Arcanobacterium pyogenes*. Cattle exposed to processed bales with a great deal of soil associated spoilage can have increased problems with *Bacillus sp.*. *Listeria sp.* is usually associated with poorly fermented silage feeding. Opportunists can cause abortion at any stage of gestation, but most are associated with late gestation. Gross lesions in the fetus and placenta are rare, but can include exudate on the placental surface, or possibly increased fluid in body cavities, occasionally with fibrin. Histologic lesions include suppurative fetal pneumonia, mild perivascular inflammation in the epicardium and lessor extent myocardium, increased portal inflammatory cells in liver, and inflammatory cell pooling in blood vessels in the brain and other tissues. A variably severe, multifocal, necrotizing and suppurative placentitis is a common lesion if adequate placenta is examined. Numerous intralesional bacteria are often observed histologically, especially in the case of Arcanobacterium pyogenes induced abortion. Bacterial culture of these organisms is usually straight forward, until you realize that rarely do autolyzed fetuses yield pure growth of a single organism.

Control Strategies

Control and prevention of opportunistic bacterial and fungal organisms presents a unique challenge for producers and veterinarians. Specific vaccines are not commercially available and the ubiquitous nature of these organisms nearly guarantees some level of exposure through normal livestock feeding practices will occur. Potential control efforts usually revolve around reducing exposure to opportunistic agents, especially dirt bugs and fungi, by monitoring feed quality and avoiding feeding practices that increase risks, such as feeding on the ground and feeding obvious moldy feedstuffs. Possible mitigation of placental damage by therapeutic use of antibiotics during the later stages of gestation has been explored by veterinarians and producers in recent years. Common treatment protocols include pulse feeding of tetracycline based antimicrobial products during the last trimester of gestation. These therapies attempt to reduce placental damage and preserve functions that are critical for fetal survival and the viability of the newborn calf. The organisms that are targeted with approach are usually extremely sensitive to the selected antibiotics, and anecdotal results from producers and Veterinarians, suggest that treatment results in a decrease in abortions and stillbirths and an increase in live-born calves. Additionally, producers that report primarily a problem in weak-born calves have indicated an improvement in overall calf viability. Additional controlled studies are warranted to determine significant risk factors and the efficacy of potential control strategies.

Bovine Abortion - Sample Submission

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1. Fetus and placenta

a. The entire fetus and placenta, chilled, not frozen, are the preferred specimens when transportation can be arranged.

When the entire fetus cannot be submitted to the laboratory, the following specimens are the minimum if a complete examination is to be done.

Formalin fixed	Fresh (chilled)
lung	lung *
liver	liver
kidney	kidney
spleen	spleen
heart	heart
brain (1/2)	brain*
skeletal muscle (tongue, diaphragm)	placenta*
placenta (grossly examine for focal lesions)	

Also collect:
stomach content - 1-3 ml in sterile disposable syringe**
thoracic fluid or heart blood from fetus - 3-5 ml in sterile disposable syringe**

Maternal blood should be collected and 3 - 5 ml of serum should be separated from the clot. Serology on individual animals is often unrewarding. Samples should be saved for further evaluation in a whole herd profile at a later date, if not submitted with the initial case.

Put the fresh tissues in sterile bags, and chill or freeze if delivery to the lab will be prolonged. Put formalin-fixed tissue in an unbreakable, leak-proof container. Label samples accordingly. Always ship samples in an insulated container with enough ice packs to maintain refrigerated conditions until arrival at the laboratory.

*package these tissues in separate bags
**transfer to sterile tube if possible

Do not hesitate to contact the laboratory for assistance in sample collection or submissions procedures! Procedures will vary from lab to lab.