Background

Bovine viral diarrhea virus is a problem for both cow-calf and feedlot producers. There are two types of BVD infections that are caused by different strains of the BVD virus. Type 1 BVD results in a brief, mild disease that causes diarrhea, fever and increased respiration rate. In severe cases, it can weaken the immune system so that calves are more likely to contract secondary bacterial pneumonia, leading to Bovine Respiratory Disease (BRD) in the feedlot. Type 2 BVD causes a more severe form of the disease and can be fatal. Pregnant cows that are infected can give birth to persistently infected calves. At the cow-calf level, BVDV can impact fertility, cause abortion, or produce calves with congenital defects or persistent BVD infections. Persistently infected calves do not get sick, but can pass the disease to others.

Current BVD vaccines exist in either a modified live or killed form. While modified live vaccines are generally effective, they are not safe for use in pregnant animals. Killed vaccines are safe for all classes of animals, but have lower effectiveness in terms of inducing long-term immunity. The only way to completely eliminate BVDV infection is to reduce the numbers of infected animals in a herd. DNA vaccines offer hope in this regard. DNA vaccination involves inserting the DNA from the bacteria or virus that causes the disease into a plasmid or viral vector, so that cells can produce infectious agents. Ancillary systems are then used to deliver the DNA into cells and stimulate immunity.

Objectives:

To develop a DNA vaccine delivery method that will lead to stronger, longer lasting immune responses to bovine viral diarrhea virus (BVDV).

What They Did:

The TriGrid™ Delivery System is a relatively new method of delivering DNA vaccinations using a process called electroporation. Electroporation uses electrical impulses to create pores in cells that make DNA insertion into cells easier. This system uses multiple active electrodes arranged around a central microinjection needle. The TriGrid™ system was compared with conventional intramuscular (IM) DNA vaccine injections in terms of ability to elicit a stronger, longer lasting immune response to BVD. Newborn calves with maternal antibodies were also vaccinated using both delivery methods to determine whether either method provided BVD protection even in the presence of maternal antibodies. The final trial compared a two-dose vaccination strategy (weaning and feedlot entry) with three vaccinations as well as the duration of immunity induced by the TriGrid™ Delivery System.

What They Learned:

Calves generally reacted well to injections using the TriGrid™ system, without having to be anesthetized or sedated, and no tissue damage was generated. This indicates that this method could be practical for delivering DNA injections. The researchers found that immune system response when the DNA vaccine was delivered using the electroporation method as compared to conventional IM injections. The same type of delivery protected newborn calves from clinical signs of disease, while conventional IM delivery of the DNA vaccine only partially prevented mortality and morbidity from BVDV. More research is needed to investigate how maternal antibodies are affected by the DNA vaccine delivery method. Additionally, the researchers discovered that two immunizations using this method (one at weaning and one upon entry to the feedlot) provided the same amount of protection from BVD as three immunizations, and that this level of immunity persisted for at least four months.

What It Means:

There are currently no DNA vaccines approved for use in cattle, but there are DNA vaccines approved for use in horses, calves, and dogs, and many DNA vaccines undergoing human clinical trials. The many benefits of DNA vaccination, such as low cost of production and immunity in acutely, subacute and chronic disease, are making it an attractive option to combat disease. As one of the problems with DNA vaccines has been delivery, this research proved that electroporation is a simple and effective method of delivery for a DNA vaccine against BVD for calves of all ages. As economic losses from BVDV are estimated to be about $2 billion annually in North America, this technology could have a beneficial impact on the competitiveness of both Alberta and Canadian cattle when it becomes available to industry.

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