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Comparison of Attenuated and Inactivated Bovine Virus Diarrhea (BVD) Vaccines

I.A. Schipper,* Alan Misek,* Jerry Pommer*, William Slanger**

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Fargo, North Dakota 58105

*Department of Veterinary Science, North Dakota State University
**Department of Animal Science, North Dakota State University

**AGRICULTURAL EXPERIMENT STATION
NORTH DAKOTA STATE UNIVERSITY
FARGO, NORTH DAKOTA 58105**

BOVINE VIRUS DIARRHEA

Bovine virus diarrhea (BVD) was first described in the United States in 1946. In 1953 a more severe form of this disease was reported and described under the terminology "mucosal disease."[48] This report was followed by numerous reports indicating BVD-mucosal disease to be a wide spread viral disease of the North Central states.[54 55 56]

It was demonstrated that animal-to-animal spread could be achieved via water and that the virus had the ability to pass through the placenta in all stages of gestation and infect the bovine fetus.[3 6 10 20 29 32 53 54 58 63] Infection of the fetus resulted in antibody production in the fetus.[4] Some of the calves appeared normal when delivered but died 18-96 hours later.[50] The nares, dental pads, and conical papille of the cheek exhibited edematous hyperemic areas. The nasal turbinates were necrotic, hyperemic and congested. Tracheal lesions included petechial and acchymotic to "paint brush" type of hemorrhage extending throughout the mucosa. The esophageal lesions consisted of necrotic areas 1-6 mm in diameter which presented a punched out type of ulcer when mild pressure was applied. Ruminal lesions consisted of ecchymotic hemorrhages. A few petechial hemorrhages were observed in the omasum and the abomasum. The pyloric valve was edematous and hyperemic. Usually an area of necrosis existed on the gastric side of the pyloric valve. Frequently necrosis and hemorrhage was observed adjacent to the ileocecal valve. The above findings have been described by a number of other investigators.[6 10 20 29 39 57 63]

It was demonstrated that the North Dakota agent could be grown in tissue culture when no bovine serum was utilized or when bovine serum containing no BVD antibody was utilized.[44 45 58 61] This viral isolate was reportedly the only isolate that could be consistantly passed under laboratory conditions in the United States Armed Forces Institute of Pathology.[37] It was also demonstrated that this agent was serologically identical to others isolated in the United States and other countries, and that the BVD and mucosal disease virus were identical.[17 30 32 33]

In the older animal, the clinical signs and pathology originally described include a profuse diarrhea, lacrimation, excessive salivation and dehydration, oral and digestive tract ulceration and petechial to ecchymotic hemorrhages throughout the digestive system. Lameness, ocular lesions, and blindness were observed in approximately 10% of the clinical cases. Mortality was frequently 100%.[47 48 56] It has been suggested that stress such as chilling, transportation, dust, and other stress factors contribute to the clinical signs of mucosal disease. More recent observations indicate that the mortality is less frequent than originally observed.[59 60 62] In many instances cattle will be infected but exhibit no or mild clinical symptoms. Animals with no history of clinical infections frequently have antibody titers indicating previous exposure. Other signs frequently observed include abortion, infertility, weak calves, mummified feti, and various teratogenic responses.[3 63]

The BVD viral agent has also been associated with the swine, sheep (Border Disease) and deer and is presently recognized world wide in cattle.[1 2 5 7 18 49]

PROPHYLAXIS

Commercial attenuated (living) vaccines became available to the livestock industry in 1964. The vaccines were moderately effective but too frequently had been associated with post-vaccination outbreaks of BVD.[9 19 23 26 33 34 41 46] Many suggestions have been presented as to the causes of the post-vaccination reactions, including the presence of maternal immunity which will interfere with vaccination response, in-utero or neonatal exposure to the BVD virus resulting in immune tolerance, and the animal being in the incubation stage of BVD or IBR at the time of vaccination.[12 13 21 28 36 42] Additional possible related factors include BVD vaccines that are insufficiently attenuated or contamination of the vaccine with virulent BVD virus or exposure to stress.[22 24 27 41 46 51 59] It has also been demonstrated that the BVD virus will supress interferon production and cause white blood cell injury, thus decreasing the animals' means of counteracting infection.[11 25 43 52] In many instances the vaccines have been administered incorrectly. Though there are many suggested causes of BVD post-vaccination reactions, adequate preventive measures have not been forthcoming.[35] In summary, it is evident that the attenuated BVD vaccine either plays an active part in post-vaccination disease outbreaks or does not prevent the BVD infection.

One means of avoiding BVD post-vaccination outbreaks should be the use of inactivated (killed) vaccines. Preliminary investigations indicate that an inactivated BVD vaccine is an effective means of producing antibody titers. Inactivated BVD vaccines produce an anamnestic response, can be administered safely to cattle of all ages, will never revert to a virulent status and the producer will not be introducing a disease producing agent into the herd.[38 40]

EXPERIMENTAL PROCEDURE

Experimental Animals

Animals utilized in this investigation consisted of dairy type calves at least three months of age. The calves were purchased while under one week of age and held in isolation until utilized in this investigation.

Investigational procedures

The vaccines utilzied in this investigation were commercial vaccines prepared from the Singer

Strain of BVD virus.[a,b] The vaccines were administered deep intramuscularly and in dosages recommended by the manufacturers.

a. Triangle — Fort Dodge Laboratories, Fort Dodge, Iowa.

b. Attenuated BVD vaccine — Dellen Laboratory, Omaha, Nebrasdka.

All calves were bled prior to the first vaccination and at designated periods thereafter as presented in the included data. Blood serum antibody titers to BVD were determined by the serum neutralization (SN) test.

Forty-four calves received the inactivated BVD vaccine intramuscularly as prescribed by the manufacturer. Fifteen calves received the attenuated vaccine intramuscularly as prescribed by the manufacturer.

RESULTS

The results of the investigation are presented in Figure 1.

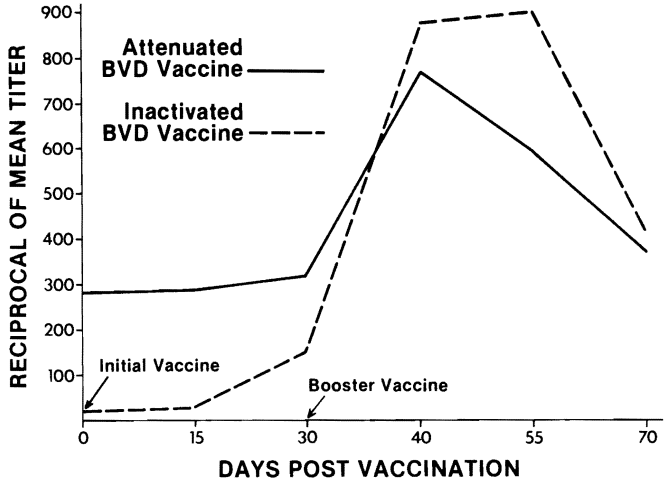

Figure 1. Reciprocal of Mean Blood Serum Titers Following Vaccination with Attenuated or Inactivated BVD Viral Vaccines.

At the time of vaccination there was a mean serum titer difference of 272 between the groups of calves utilized for vaccination with attenuated and inactivated BVD vaccines. Previous to the initiation of the investigation, the calves to be utilized for each vaccine were placed in separate groups and housing areas. The group receiving the attenuated vaccine apparently became infected with BVD and developed titer during the pre-vaccination period.

The initial response to either attenuated or inactivated vaccines was insignificant regardless of the existing titers. The major response observed for both vaccines occurred following the second (booster) vaccination. Blood serum titers reached a peak within 10 days following the second vaccination and an antibody titer was still demonstrable 30 days later. Additional investigations are continuing to determine the response to the additional vaccinations at approximately five months later as well as the rate of decay of the existing antibody titer.

No clinical reactions were detected following either of the initial or the booster administrations of either vaccine.

DISCUSSION

It is frequently stated or implied without documentation that it is necessary to vaccinate twice when using an inactivated vaccine, but only a single vaccination is necesary when utilizing an attenuated vaccine.[16] This study and several others have demonstrated that two administrations of vaccine are necessary to obtain maximum protective benefits based on blood serum antibody titers with either an attenuated or inactivated BVD vaccine.[8 14 15 31 34]

It has also been demonstrated that inactivated BVD vaccines will provide comparable protection to that of the attenuated BVD vaccine as determined by the blood serum antibody titers to the BVD virus. The decay of blood serum antibody titers for the first 30 days following maximum serum titers are comparable. A more complete study of changes in blood serum titers will require additional vaccination and challenge with BVD vaccines or virus to determine the possibel additional effect of titer existing during the first 70 days post vaccination.

Based on this study and others, it is readily evident that the inactivated BVD vaccine has the ability to produce optimum serum antibody titers to the BVD virus, is capable of producing an anamnestic response following the second vaccination and is safe to use on young cattle.

SUMMARY

Based on this study and others, it is evident that the inactivated BVD vaccine employed in this investigation will produce high levels of antibodies to the BVD virus, will not produce BVD through vaccination and can be used on calves of feeder age as well as pregnant cows.

The safety aspect of this vaccine as compared to attenuated BVD vaccines is evident.[3 6 9 10 20 29 31 32] Cattlemen using the inactivated vaccine should have no fear of introducing a disease virus into the herd. In addition, the problem of post-vaccination reac-

tions or disease outbreaks will be eliminated and this vaccine will not revert to the virulent form that could cause immense losses to the cattle industry.

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