HEALTH MANAGEMENT OF THE SUCKLING BEEF CALF

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Abstract

Early vaccination of the suckling beef calf in the face of maternal antibody (IFOMA) remains controversial. Researchers tend to look for changes in antibody response (seroconversion), evidence of T-cell activation, or the researchers provided a post-vaccination challenge with a virulent pathogen after maternal antibody had waned to determine if the immune response was protective. However, protecting the health of the suckling calf goes far beyond vaccination strategies. Maternal nutritional management, calving ease, calf scours prevention, and prevention of "summer pneumonia" are all just as important as the vaccination program. This talk is designed to give an overview of the risk factors and prevention strategies to be considered to keep the suckling calf health and growing.

Key Words: Suckling calf, Vaccination, Colostrum, Maternal Antibody

Introduction

Early vaccination of the suckling beef calf in the face of maternal antibody (IFOMA) remains controversial.[1-5] A multitude of research studies have attempted to shed light on the immune system's response to various antigens in these young animals. The design of these studies tended to look for changes in antibody response (seroconversion), evidence of T-cell activation, or the researchers provided a post-vaccination challenge with a virulent pathogen after maternal antibody had waned to determine if the immune response was protective. This work has been successful in helping to determine the various factors that affect immune response when maternal antibodies are present. However, results from clinical beef practice may not be as "clear cut" as the research due to the inclusion of multiple

variables such as level of colostrum ingested and absorbed, variations in age and immune status at the time of herd vaccination, subclinical disease present on the ranch, environmental or nutritional stress, or the presence of internal parasites. All of these factors can have an effect on response to vaccination in these calves and have to be considered when designing a vaccination program.

Colostrum and Immunity in Young Calves

Due to the structure of the bovine placenta calves are born agammaglobulinemic. This emphasizes the need for an adequate amount of colostrum to be ingested by the calf to ensure the absorption of maternal antibodies. These antibodies represent a critical component of colostrum. Calves with failure of passive transfer will not begin to produce their own IgM antibodies until approximately 4 days after birth. But even then, levels do not reach functional levels until the 8^{th} day of life. It may take nearly 30 days for appreciable levels of IgG_1, IgG_2, and IgA to be produced. This leaves the calf vulnerable to environmental pathogens and an increase risk of morbidity and mortality.

Colostrum also contains a high level of maternally derived cytokines. It is not clear if these molecules are produced by the mammary gland or are derived from the leukocytes found in colostrum. Whatever their origin, cytokines play an important role in the development of the calf's immune function. Cytokines such as IL-6, interferon-gamma, and IL-1β, may aid in the development of the proinflammatory response in the newborn calf. This involves recruiting neonatal lymphocytes into the gut to help with normal development of the immune system. With absorption of these cytokines neonatal neutrophils are stimulated to phagocytize bacteria. Other absorbed cytokines are responsible for suppressing the local immune response in the gut so that it may be colonized by microbes.

The final component found in colostrum that is critical for immune function development in the calf are various leukocytes. The distribution of these cells is similar to the peripheral bloodstream but with a larger proportion of macrophages (20-40%) and a smaller fraction of lymphocytes and

neutrophils. The vast majority of lymphocytes are T-lymphocytes and those that are absorbed reach peak levels at 24 hours of age. This is critical because calves that receive these maternal leukocytes develop antigen-presenting cells at a much faster rate. These antigen-presenting cells are the cornerstone of the immune system's ability to respond to pathogens and vaccination (acquired immune response). So while immunoglobulin levels in colostrum are critical for immediate protection of the calf from disease, maternally derived cytokines and leukocytes play an important role in long term survival of the calf.

Vaccination in the face of maternal antibody (IFOMA)

Due to typical handling patterns on the ranch, it is common to vaccinate young calves in the first 3 months of life. There is solid evidence that vaccination at "branding time" or "grass turnout" can be effective in priming the immune system of the young calf.[1,2] Calves with high levels of maternal antibodies at 2-3 months of age will not seroconvert following initial MLV IBR vaccination but will show an animistic response when revaccinated at 7-8 months of age. Multiple other vaccinations trials involving BRD viral pathogens, *M. haemolytica*, and *H. somnus* have shown similar responses in calves vaccinated at this age. As a general rule, killed vaccines will require two doses given 2-4 weeks apart in order to show an antibody difference when compared to unvaccinated controls. It is interesting to note that calves vaccinated at 10 days of age or younger may show evidence of a T-cell response (increased lymphoid blastogenesis) after vaccination. However, these calves showed no increase in serum neutralization titer when revaccinated at weaning. Therefore it would appear that parenteral vaccination prior to two weeks of age should be discouraged.

Similar studies have been performed in young calves with BVD vaccination and challenge. Various vaccination schedules were performed on calves that had been fed high quality colostrum versus calves fed colostrum without BVD antibodies versus those that were colostrum deprived. These studies typically involved early vaccination and exposure to the virus at varying times post-vaccination. As

expected, unvaccinated colostrum deprived calves showed the greatest losses (morbidity and mortality) when infected with virulent BVD virus. On the other hand, these studies have shown that homologous protection against a virulent BVD strain is possible in calves that were either vaccinated with a MLV vaccine or exposed to BVD between 10-14 days of age. This protective effect was clinically evident even in the face of little to no serum antibody present in these calves at the time of infectious challenge.

Research that has evaluated immune response in the young calf has shown that not all antigens in a vaccine are capable of driving memory or seroconversion equally. Calves can mount an immune response to vaccination even at 1-2 weeks of age in the face of relatively high levels of maternal antibody. This response varied by antigen and calf age when vaccinated with a pentavalent MLV vaccine. Calves were vaccinated at 1-2 vs. 4-5 vs. 7-8 weeks of age followed by a Type 2 BVD challenge 12 weeks later. Calves in the older two groups showed an anamnestic response to viral challenge while the youngest calves did not. However, calves in all age groups did show a T cell response to BVD infection to both type 1 and 2 and were significantly better protected against clinical disease. There was no consistent evidence of a T cell response or change in titers to IBR, BRSV, or PI3 after vaccination in calves of any age in this trial. However, calves were not challenged post-vaccination with any of these viruses. The take home message is that the immune response will vary based on calf age, antigens in the vaccine, type of vaccine used (MLV vs. killed), and number of times vaccinated.

Considerations for Early Vaccination

Vaccination protocols have to be tailored to individual herds since the factors that affect response to vaccination vary by location. Some general considerations when vaccinating in the face of maternal antibody in young calves would include:[3,6,7]

1. Vaccination as early as one month has shown the ability to prime the immune system for later response to revaccination or disease exposure. Modified-live vaccines have been studied more in depth in these studies but multiple doses of a killed product may also be useful.

2. Multiple doses of vaccines (killed or MLV) will be more successful in stimulating an immune response compared to a single dose. Revaccination will be most effective if it is given 3-4 weeks after the initial dose. It would also seem advisable to limit the number of vaccines given to a young calf at any one time.

3. Vaccination IFOMA will rarely produce seroconversion and the younger the calf the less likely a titer change will be detected. This lack of seroconversion does not indicate a lack of response or vaccine failure. One would expect a T-cell response but it is not possible to routinely measure this response with our currently available diagnostic technology.

4. Calves that have experienced either partial or complete FPT should be vaccinated as a means of protection from disease exposure. This vaccination needs to occur before calves are exposed to pathogens.

5. As research appears to support an age associated response to vaccination, it would be best to wait as long as possible to utilize parenteral vaccination in these young calves. Waiting until the calves are ***at least*** 30 days of age will improve the odds of having them respond to all the antigens in the vaccine. If calves need to be vaccinated earlier than this, then intranasal vaccines should be considered.

6. Calves which are unstressed, parasite free, have adequate levels of fat soluble vitamins and microminerals, and are in a positive energy balance will respond best to vaccination no matter when it is given. Stress reduction and limiting pathogen exposure are key components to a successful vaccination program.

Summary

The development and expansion of the bovine immune system is a process that begins as a healthy fetus that absorbs an adequate amount of colostrum in a timely fashion. Colostral absorption is critical for immediate protection of the calf as well as long-term immune system development. While we are still trying to determine the optimum way in which to present antigens to the young calf, research and clinical experience would indicate that it is possible to immunize these calves. Our current understanding would indicate that it is better to wait a minimum of 30 days before attempting to immunize the calf with a parenteral vaccine. This would increase the chances that the calf would respond to all the antigens presented in the vaccine. If forced to vaccinate prior to this time then the use of an IN vaccine or revaccination in 3-4 weeks would be a reasonable management practice. However, it is still important to remember that the construction of proper vaccination protocols still involves the

practitioner evaluating an individual operation to determine the most efficient manner to deliver needed antigens.

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