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Calf Note #152 – Effect of prepartum stress on IgG absorption in the newborn

Introduction

Immunity in newborn calves is often (usually) though of in terms of the acquisition of passive immunity that occurs in the first 24 hours after birth. Absorption of IgG from colostrum and concomitant serum IgG concentrations set the stage for calf health and productivity. However, there may be more to the story than simply feeding colostrum to newborn calves and expecting all calves to absorb IgG efficiently and achieve successful passive transfer.

Research shows significant variation in the ability of calves to absorb IgG from colostrum and achieve adequate passive immunity. For example, Jones et al. (2004) reported that apparent efficiency of IgG absorption ranged from <10% to >25% in Holstein calves fed the same pooled colostrum at similar times after birth and according to body weight. So, why is there such variation in serum IgG concentration? And, further, do some calves remain susceptible to disease even though they may obtain adequate passive immunity in the first 24 hours of life (defined as at least 10 g/L of serum IgG).

Increasingly, we're learning that nutrition, management and stress imposed on the dam can have serious and long-term effects on the newborn. Recent research clearly points out this effect.

The research

Research with newborn piglets (Tuchscherer et al., 2002) shows the effect of prenatal stress on acquisition of passive immunity very well. In this study, the researchers used 33 Landrace × Duroc sows. Seventeen of these sows were exposed to an acute stress during weeks 12 to 16 of gestation. Sows were stressed by restraining them with a nose sling for five minutes per day between 10:00 and 10:30 a.m. Control sows (n = 16) were not restrained. During the final week of gestation, all sows were moved to farrowing pens and all animals were unrestrained.

Restraining the sows increased concentration of cortisol in their blood. Cortisol concentration in control pigs averaged 34 nmol/ml of serum compared to 112 nmol/ml in restrained sows when measured 10 minutes after the animals were restrained.

Item	Control	Stress	*P*
Stillbirths, %	7.4	11.3	0.18
Disease, %	12.3	28.2	0.0001
Died, %	5.6	13.6	0.0007
Colostrum IgG, g/L	35.7	38.2	NS
Serum IgG, g/L	46	41	0.01
Lymphocyte Index*	1.9	1.6	0.001

Table 1. Effect of prenatal stress on absorption of IgG by newborn piglets. From: Tuchscherer et al., 2002.

Effects of prepartum stress on piglet passive immunity and health were dramatic. Piglets born

from stressed sows tended to be more likely stillborn (11.3% of piglets vs. 7.4% in control piglets P = 0.18), more likely to have disease and die (by nearly 3×) compared to piglets born to control sows (Table 1).

An interesting observation in this study was that serum IgG concentration was significantly reduced in piglets born to stressed sows. The reduction occurred in spite of the fact that colostrum IgG concentration was unaffected by prepartum stress.

Why would pigs have lower serum IgG concentration at one day of age? The two possible reasons either that piglets consumed less colostrum or they were less efficient in absorbing the colostrum they were fed.

The researchers also reported the lymphocyte proliferation (Table 1 reported as "lymphocyte index"). This index measured the ability of lymphocytes to respond to various antigens (pokeweed mitogen, lipopolysaccharide, and concanavalin A). At one day of age, lymphocytes from piglets born from stressed sows were less responsive to stressors, indicating that these piglets were more susceptible to disease. Some of these impairments were observed as late as five weeks of age.

These data show clearly that the newborn's ability to mount an immune response (i.e., the cellular immune response) is very sensitive to events that occur prior to birth. Cellular immunity is an essential part of the overall immune response and, if depressed, will make the newborn animal much more susceptible to disease and death. Thus, if prenatal stress impairs the cellular immune response of newborn animals, poor management during gestation may increase the risk of problems with newborns.

What forms of stress are likely to cause similar responses? Some stressors include heat stress, cold stress, prepartum disease, nutritional imbalance, transport and handling and many others. It's clear that the latter stages of gestation are critically important to the development of the calf's immune system and we can impair that development by stressing the cow prior to calving.

Sows – same for cows?

The research we've investigated used sows as the experimental animal. Would we expect a similar response with cattle – beef or dairy? This answer is less clear. There are some data that suggest that stressors can affect calves immunity negatively. For example, Hough et al. (1990) reported that calves fed colostrum from cows that were fed inadequate amounts of nutrition achieved lower serum IgG concentration at 24 hours after birth. Stott (1980) also concluded that stress has been a "ready explanation" for poor IgG absorption in newborn calves. The most likely contribution to this observation is due to prepartum stress in the cow and subsequent effects on the calf.

Clearly, a take-home message of this research is that what we do to the cow prior to calving we also do to the calf. Unnecessary stress imposed on the dam certainly may affect the calf's ability to absorb antibodies and may permanently impair it's overall immunity. High rates of young calf

morbidity and mortality could conceivably be at least partially attributed to how we manage cows prior to calving.

Proper nutrition, housing and management of dry cows are a good strategy to improve the health of newborn calves. Minimize stress on your cows and you'll (likely) improve the health of your calves. Best of luck!

References

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