

Beef Split Sessions

GENERAL

Moderator: Bradley Mills

Immunology of the “Early Weaned” Beef Calf

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Abstract

Early-weaning of beef calves is a management system that is gaining popularity. Numerous recent studies have documented the potential economic benefits of early weaning that can be measured in increased weight gain and feed efficiency in calves, and body scores and reproductive rates in cows. The bovine immune system is competent at birth; however, maturational changes occur from birth to puberty. The effect of early weaning on this maturational process is poorly understood at present. Exposure to endemic microbes during this period may also have a priming effect on the immune system that may be altered in early weaned calves.

What are the Economic Benefits of Early Weaning?

Recently there has been increased interest in early weaning of beef calves. Several studies have examined the effects of early weaning on the nutritional status and growth characteristics of early weaned calves. Myers and colleagues¹⁰ have compared various production systems employing early weaning and demonstrated improved gain, feed efficiency and quality grades in early weaned compared to conventionally weaned steers. They also demonstrated increased body condition scores and higher reproductive rates in the dams of early-weaned (EW) calves¹¹. Similarly, Baker-Neef *et al*³ found that early weaning of steers at 100 d of age versus 200 days decreased total dry matter intake, improved gain:feed and lowered cost of gain, but the return to the cow-calf enterprise was decreased due to lighter carcass weights. Fluharty⁷ demonstrated that feeding high concentrate diets to EW beef calves accelerated growth rate and fat deposition early in the feeding period. Taken together, available data indicate that early weaning can have economic benefits that may be related to accelerated ruminal development in early weaned calves.^{1,2} Most of these studies have apparently been examined in low challenge situations, or at least any effect of disease has not been monitored.

How does the Bovine Immune System Change in the Early Post-natal Period?

In contrast to increasing knowledge concerning the effect of early weaning on various production parameters, there is very little currently known about the effects of early weaning, versus conventional weaning, on the postnatal development of the immune system in calves. It has been well-established that considerable development of the immune system occurs *in utero* in cattle and that the immune system of the newborn calf is competent, but not fully mature.⁴ Young ruminants are born with high concentrations of $\gamma\delta$ T lymphocytes, the function of which is not well understood.⁸ The concentrations of these cells in blood progressively decrease with age until maturity.⁸ Effects of early weaning on this process have not been examined. Wyatt *et al*¹⁶ examined changes in intraepithelial lymphocyte populations in suckling and weaned calves and reported that in younger calves B lymphocytes predominate, while in older (weaned) calves T lymphocytes comprising both CD4+ and CD8+ subsets, predominated in the gut. How these changes may be effected by weaning schemes was not examined. Pollack and colleagues¹² investigated the effects of weaning on antibody responses in young calves and demonstrated that weaning affected the responses to antigens given near weaning, but not to antigens. In a companion study,¹³ the same authors examined the effects of early weaning and nutrition on the development of immune responses and showed that the choice of husbandry conditions altered cellular immune responses in young calves with increased delayed type hypersensitivity reactions, increased concentrations of BoCD2+ and BoCD8+ T cells in the blood, and decreased mitogen-stimulated lymphocyte blastogenesis responses in early-weaned calves. These effects were determined to be primarily nutritional. There are relatively few data addressing responses to vaccines in neonatal calves. Cortese and colleagues⁴ demonstrated that young seronegative dairy calves could mount a protective response to parenterally administered BVD vaccines. Subsequent studies⁵ demonstrated that induction of this

response could be blocked by high concentrations of maternal antibody. Young early-weaned seronegative calves also responded with protective responses to BRSV⁶. The effect of early weaning versus conventional weaning on the responses to parenterally administered vaccines has not been comparatively examined, although there is increasing interest in vaccinating young beef calves while they are still nursing.

What effect might exposure to pathogens during the early post-natal have on development of the immune system?

A major effect of early weaning on the development of the immune system in young cattle may involve differences in exposure to various pathogens that are endemic in the cow herd, while calves are still under the protective umbrella of maternal antibodies. Exposure to agents such as BRSV or PI3 while calves still have maternal antibodies may effectively "prime" the calves to respond more effectively later in life. One study conducted by Lehmkuhl and Gough⁹ more than 25 years ago implies that this may be the case. Similarly, recent work by Ridpath and colleagues¹⁴ demonstrates that young seropositive calves that are exposed to BVDV mucosally by infections are effectively primed and do not develop disease upon subsequent exposure to virulent BVDV once maternal antibodies have decayed. Such priming may not occur, or be less likely to occur if calves are early-weaned versus remaining with the herd until they are approximately 6 months of age and their immune systems are more functionally mature. Another unexamined effect may be the role of passive local antibodies present in milk on the interaction between enteric pathogens and/or pathogens that gain systemic entrance via the gastrointestinal tract.

Conclusion

At present, although many investigators have demonstrated an economic benefit to early weaning, there are currently more questions than answers regarding the effect of this procedure on the development or maturation of the immune system in young cattle and how this might effect the response to pathogens during the feeding period.

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