Studies of Prevention of Failure of Passive Transfer in Neonatal Calves

Dave De Klyen, *BSc, MSc;* **Steve Smith**, *BSc*

ABSTRACT

Failure of passive transfer (FPT) of immunity or antibody is a term for the condition that occurs when a baby calf fails to obtain or absorb adequate quantities of immunoglobulin from colostrum. IgGs comprise the largest fraction of immunoglobulin in colostrum and are a critical factor when assessing the quality of colostrum or serum levels in the calf. Failure of passive transfer costs the cattle industry millions of dollars annually. Numerous factors influence the immunoglobulin content of colostrum. Insufficient quantity and inferior quality of colostrum, poor maternal instincts and suckling drive of calves are some of the reasons for inadequate serum immunoglobulin levels in the neonatal calf.

(Bovine IgG) is a colostrum supplement that provides broad-spectrum antibodies to enhance the value of colostrum fed to calves in the first twenty-four (24) hours after birth. Field trials are necessary to prove the efficacy of the products. La Belle Associates Inc. has performed a number of such trials.

INTRODUCTION

Colostrum is the thick, creamy yellow, first secretion from a cow's udder following calving. Biologically, colostrum is a very complex fluid rich in nutrients, antibodies and growth factors. In cows the antibodies provide passive immunity to the newborn calf, whereas the growth factors especially stimulate the growth of the gut. The other antimicrobial components of colostrum include lactoferrin, lysozyme and lactoperoxidase. It contains more protein, fat, energy, vitamins, and minerals than normal milk. However, the immunoglobulins (IgG) content is the component essential for protecting the calf against disease. For highest IgG value colostrum should be removed from the udder in the first several hours after calving.

The beef/dairy calf is born without IgG, or antibodies, in its blood to help protect it from disease. Consequently, its chance for survival in the first few weeks of life is greatly reduced if it does not receive IgG.

The intake and absorption of colostral immunoglobulins, which include antibodies against disease, are essential to the health of the newborn calf. The newborn calf is virtually devoid of circulating antibodies and thus relies on antibodies acquired from colostrum for protection against common disease-causing organisms (pathogens). Significant amounts of the antibodies obtained from good quality colostrum, if fed early enough, are transferred across the small intestine and into the blood during the first few hours of life (passive transfer). Antibodies entering the blood are further distributed to various parts of the animal's body. The absorbed antibodies protect against systemic invasion by pathogens while antibodies that are not absorbed play an important role in protection against intestinal disease.

During absorption, the proportion of antibodies entering the blood depends on the colostral quality (total concentration of antibodies), and the volume that actually reaches the calf's intestine during the early hours of life.

Ingestion and absorption of colostral immunoglobulins are two of the most important aspects in the prevention of neonatal calf disease because calves acquire virtually no immunoglobulins in utero. In spite of this

knowledge, failure of passive transfer (FPT) remains extremely common in the US dairy industry [1]. Calves with inadequate immunoglobulin concentrations have reduced growth rates, increased risk of disease and death, increased risk of being culled, and decreased milk production in their first lactation [2] [3] [4] [5]. Consequently, FTP has profound effects on the survival and productivity of heifers.

The transfer of immunity from colostrum ingestion is generally considered to be adequate if serum IgG concentrations are above 1,000 mg/dl [6]. Several steps are critical to ensuring adequate colostral immunity. These include administering a sufficient quantity of good quality colostrum to provide adequate immunoglobulin mass within the first few hours of life. However, liquid colostrum might be lacking in quality or compromised in some other way. Therefore, a powdered supplement may be necessary to dose at the time of birth to ensure protection.

La Belle has performed numerous efficacy trials on passive transfer. A summary of these studies is as follows.

MATERIALS AND METHODS

For over twenty years, La Belle has conducted a number of different passive transfer studies. A typical protocol is as follows:

Twenty-five (25) colostrum deprived calves are obtained from local dairies for each trial. These calves are obtained immediately after an attended birth in order to prevent them from nursing from the cow. Calves are housed in barn stalls with straw bedding.

Animals are deprived of maternal colostrum and fed the appropriate feeding. Each calf received one dose of La Belle manufactured bovine origin colostrum and bled within four hours of birth. Eight to ten hours later, all calves are fed non-medicated milk replacer and fed every twelve hours after. Calves are bled prior to dosing or suckling and again at 24 hours after initial feeding.

Bovine IgG: Manufactured by La Belle Associates, Inc. and products are labeled with approved experimental label stating experimental group number, serial number, date and establishment license number.

Specimen Analyses: Blood samples are centrifuged and serum harvested within two hours of collection Serum IgG levels (mg/dl) are determined using the Single Radial Immuno-Diffusion (RID) test kit. Serum from time 0 and 24 hour collections were tested in quintuplet assays.

General health of each calf was recorded at each blood collection. Each calf was monitored to ensure it was not dehydrated, exhibited the appropriate energy level and was not running a fever. All animals were monitored until ready to be released to a calf raising facility if healthy. Typically, only two days are needed to complete each calf in the study.

RESULTS

Serum IgG results and percentage of transfer for the four recent FTP studies of La Belle products is summarized in Figure 1. An average of 26.2% absorption was confirmed in calves fed La Belle manufactured bovine origin colostrum. Generally, a supplement gives an average of 20% transfer efficiency. La Belle products performed above this level of acceptable absorption.

The transfer rate can be defined by the amount of IgG found in the bloodstream 24 hours after birth and is calculated by subtracting the amount of IgG in the blood (mg/dl), multiplying by the average blood in the calf (35dl) and dividing by IgG fed. Of the replacers, the average blood IgG concentration was 1093mg/dl. These results demonstrated full replacement.

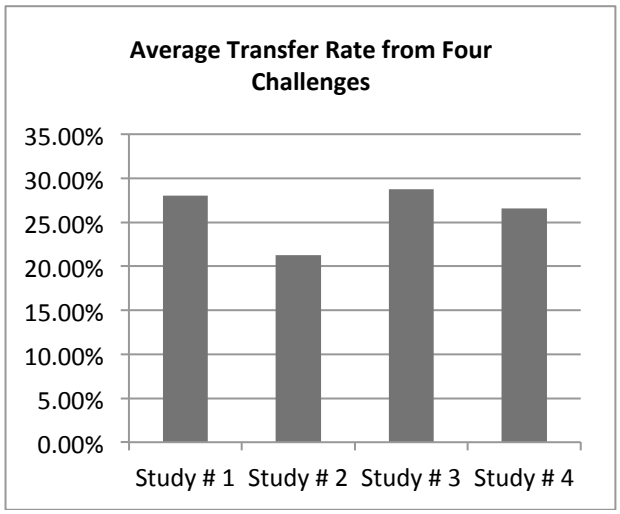

Figure 1. Average Transfer Rates of Four Recent Challenges

DISCUSSION

An average transfer rate of 26.2% indicates that absorption of IgG is effective in calves that received La Belle colostrum. The amount of immunoglobulins, transfer rate, and absorption achieved the necessary results for prevention of FTP.

The recommended amount of IgG needed to prevent FPT is 1000mg/dl. The United States Department of Agriculture Center for Veterinary Biologics considers a minimum of 36 g in the dose for prevention of FTP. La Belle has met and exceeded this minimum standard of the USDA-CVB and has received US Veterinary licenses in product codes 3606.00 and 3606.02 as well as 3610.00 and 3610.01.

REFERENCES

[1] Weaver, D.M., J.W. Tyler, D.C. VanMetre, D.E. Hostetler, and G. M. Barrington. 2000. Passive transfer of colostral immunoglobulins in calves. J. Vet. Intern. Med. 14:569-577.

[2] DeNise, S.K., J.D. Robison, G.H. Scott, and D.V. Armstrong. 1989. Effects of passive immunity on subsequent production in dairy heifers. J. Dairy Sci. 72:552-554.

[3] Tyler J. W., D. D. Hancock, L. Wilson, F. Muller, D. Krytenberg, and S. Bradish. 1999. Effect of passive transfer status and vaccination with Escherichia coli (J5) on mortality in comingled dairy calves. J. Vet. Intern. Med. 13:36–39.

[4] Virtala, A. M., Y. T. Grahn, G. D. Mechor, and H. N. Erb. 1999. The effect of maternally derived immunoglobulin G on the risk of respiratory disease in heifers during the first 3 months in life. Prev. Vet. Med. 39:35–37.

[5] Faber, S.N., N.E. Faber, T.C. McCauley, and R.L. Ax. 2005. Effects of colostrum ingestion on lactational performance. Prof. Anim. Sci. 21:420-425.

[6] McGuirk, S. M. and M. Collins. 2004. Managing the production, storage and delivery of colostrum. Vet Clin North Am Food Anim Pract. 20(3):593-603.