Plasma Transfusions in Failure of Colostral Immunoglobulin Transfer (1)

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Introduction

Partial or complete failure of colostral immunoglobulin transfer (FCIT) is frequently encountered in neonatal calves and is associated with increased morbidity and mortality (2-5). Therapy for FCIT and associated diseases may include administration of antimicrobials, fluids, various supportive measures and attempts to restore protective levels of circulating immunoglobulins (Ig) (5). Because FCIT is frequently encountered after gut closure to absorption of exogenous Ig, administration of Ig in plasma or whole blood has been used to restore protective levels of Ig. Recommendations for plasma administration to neonatal calves are empirical and have been based upon practices commonly used in neonatal foals. A commonly recommended dose is administration of plasma at 20ml/kg body weight (5).

In the present study, plasma administration was studied in newborn calves with FCIT. The purposes of the study were: 1.) To determine if administration of plasma at 20ml/kg would produce protective levels of circulating Ig in calves with FCIT; and 2.) To compare levels of circulating Ig in calves administered plasma IP once, IV once, and IV twice with 7 days between dosing. In addition, calves with FCIT and administered plasma were compared to calves receiving colostrum.

Materials and Methods

Animals and Design: Colostrum-deprived newborn Holstein calves (n=18) were obtained and FCIT was confirmed by a negative sodium sulfite turbidity test (6) or by presence of total plasma proteins <4.5gm%. Calves were weighed on presentation and were randomly allocated to one of three treatment groups in which calves received plasma at 20 ml/kg as follows: 1.) IV once on day 0; 2.) IV twice on days 0 and 7; and 3.) IP once on day 0. Calves were housed comingled in groups of 3-6 calves and were fed milk replacer at the rate of 12% body weight, divided into 2 feedings. Water, alfalfa hay and calf starter concentrate were available free-choice. In addition, 6 newborn Holstein calves known to have consumed colostrum were also obtained and handled similarly.

Plasma: Pooled bovine plasma was obtained commercially (7). Bacteriological and virology studies and endotoxin analysis on the plasma indicated no infectious agents and zero to insignificant levels of endotoxin. Intravenous administration of plasma was via a catheter placed in the jugular vein. Intraperitoneal administration of plasma was via a catheter aseptically placed in the paralumbar fossa. Total time of administration was approximately 60 minutes.

Clinical and Laboratory Measurements: Rectal temperatures, fecal scores, presence of illness and treatment were recorded daily for the first 14 days and on days 21 and 28. Blood was collected according to the same schedule and serum was prepared. Serum concentrations of Ig G1, G2, M and A were determined by single radial immunodiffusion (8).

Statistical Analysis: The study was analyzed as a completely randomized design. Analysis of variance of data was performed employing a model containing the factors of treatment, calves within treatment, time and treatment by time interactions. Due to the presence of repeated measurements on each animal, factors containing time after treatment terms were analyzed via a Conservative F test.

Results

Means (+SD) for serum Ig concentrations for treatments vs. time are in Table 1. There were significant ($P<0.05$) differences in serum Ig concentrations (total Ig and Ig G1, G2 and A) among treatments and for time after treatment. Mean concentrations of all Ig's except IgM were significantly greater in calves fed colostrum as compared to calves receiving plasma. Serum Ig concentrations were comparable in calves given plasma IV and IP through day 7 of the study. Calves administered plasma IV twice showed increased serum Ig G1 and G2 after the second administration. Serum IgA was ot influenced by plasma administration.

Means (+SD) for clinical data and average daily weight gains are given in Table 2. There was no significant differences in rectal temperatures among treatments, although calves fed colostrum tended to have lower mean rectal temperatures. Mean fecal scores were not significantly different among treatments but again tended to be lower in calves fed colostrum. Mean prevalence of illness and

TABLE 1. Mean (±SD) Serum Ig Concentrations (MG%) For Treatment vs. Time (Day 0 values are pre-infusion values and Day 1 values are approximately 24 hours post-infusion).

Treatment by time	Total Ig	IgG1	IgG2	IgM	IgA
Colostrum					
Day 0	1761±761	1221±483	118±66	65± 22	211±112
Day 1	1826±743	1270±453	126±67	224±155	189± 99
Day 8	1457±573	1171±377	113±58	124±118	48± 48
Day 28	1146±384	983±321	139±97	22± 35	2± 4
IV Once					
Day 0	0± 0	0± 0	0± 0	0± 0	0± 0
Day 1	262± 84	192±105	66±21	4± 7	0± 0
Day 8	267±100	174±112	48±16	44± 25	0± 0
Day 28	565±186	436±153	79±45	43± 40	8± 11
IV Twice					
Day 0	58±133	48±129	0± 0	11± 26	0± 0
Day 1	315±100	234±156	65±22	16± 20	0± 0
Day 8	508±141	359±133	100±24	50± 32	0± 0
Day 28	990±328	797±298	131±28	55± 24	7± 12
IP Once					
Day 0	53±131	58±130	0± 0	0± 0	0± 0
Day 1	321±145	250±156	66±15	6± 8	0± 0
Day 8	349±156	252±167	49±17	48± 26	0± 0
Day 28	731±396	575±364	86±47	66± 22	6± 8

treatment was significantly lower ($P<0.05$) in calves fed colostrum but not different among plasma treatments. Average daily weight gains of calves for the 28 days of observation were not different among treatments, but tended to be higher for calves fed colostrum.

Discussion

Plasma administration to newborn calves with FCIT increased total Ig, predominantly due to IgG1 and IgG2. Administration of this plasma at the recommended dose of 20 ml/kg did not produce protective levels of circulating Ig. This was influenced by the low pre-treatment levels of Ig in calves receiving plasma and the low concentration of Ig in the plasma used in this study.

Infusion of plasma via either the IV or IP routes produce comparable levels of Ig, indicating the effectiveness of the IP route. As a second IV infusion of plasma produced further increases in serum concentrations of Ig, repeated dosing may prove beneficial.

TABLE 2. Means (±SD) for Clinical Data and Average Daily Weight Gain (Kg/Day).

Treatment	Fecal Score (A)	Illness (B)	Treatment (C)	ADG
Colostrum	1.79±0.45	0.09±0.29	0.09±0.29	0.56±0.16
IV Once	2.22±1.46	0.29±0.46	0.27±0.45	0.51±0.10
IV Twice	2.23±1.70	0.44±0.50	0.44±0.50	0.44±0.16
IP Once	2.02±1.75	0.29±0.46	0.25±0.43	0.50±0.17

A Feces Scored Daily From 1=Normal Feces to 5=Fluid Diarrhea.
B Mean Daily Proportion of Calves With Any Illness.
C Mean Daily Proportion of Calves Treated For Any Reason.

The dose of plasma required to produce protective serum Ig concentrations in calves with FCIT appears to be influenced by the Ig concentration of the recipient and the Ig concentration of the plasma administered. A dose greater than 20 ml/kg may be required in some cases. Practical considerations would indicate that plasma administered to calves should have high concentrations of Ig and that post-treatment testing should be performed to assure that protective levels of Ig have been attained. Other obvious considerations are cost-effectiveness and the possibility of transfer of infectious agents.

References

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