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Carrie Hammer
Iowa State University

Josie Booth
Iowa State University

Howard Tyler
Iowa State University

L. Etzel
American Protein Corporation, Inc.

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Adequacy of a Concentrated Equine Serum Product in Preventing Failure of Passive Transfer of Immunity in Neonatal Foals

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Carrie Hammer, Graduate Research Assistant, Josie Booth, Graduate Research Assistant, Howard Tyler, Associate Professor of Animal Science, and L. Etzel, American Protein Corporation, Ames, Iowa

Summary and Implications

The primary objective of this study was to determine if an orally administered concentrated equine serum product provided in the first hours of life could prevent failure of passive transfer in foals. To achieve this objective, ten foals of Quarter Horse breeding were utilized. Treated foals were administered 250 ml of an oral serum product at 1 and 3 h of age via nasogastric intubation. These foals were muzzled to prevent nursing from their dam. Supplemental milk replacer (200 ml/feeding) was provided to the treated foals at 6 h and 9 h of age. Mares of treated foals had their udder stripped at 1, 3, 6, and 9 h post parturition. The initial colostrum collected (200 ml) was fed back to the treated foals when the muzzle was removed at 12 h of age. Control foals were allowed to nurse from their dams ad libitum. Jugular blood samples were obtained from all foals for determination of concentrations of plasma IgG. Plasma IgG concentrations were higher ($p < .05$) for treated foals compared to control foals at 5 h and 48 h of age. Plasma IgG concentrations were not different ($p > .10$) at all other time periods measured. All treated foals had plasma IgG concentrations over 700 mg/dl by 10 h of age, showing that the oral IgG treatment was effective in preventing failure of passive transfer in foals.

Introduction

Foals are essentially agammaglobulinemic at birth, and ingestion of adequate amounts of colostrum is essential to provide the neonatal foal with passive immunity. Failure to obtain adequate passive immunity occurs in 15% or more of Thoroughbred and Standardbred foals, and results in increases in morbidity and mortality.

In an attempt to increase immunoglobulin levels in foals suffering from partial or complete failure of passive transfer (FPT), many oral and intravenous equine immunoglobulin supplements have been developed. If a foal is less than 24 hour old and FPT is confirmed or suspected based on history, oral immunoglobulin products can be administered if no banked equine colostrum is available.

Bovine colostrum can be offered and results in serum concentrations of IgG over 1300 mg/dl. Unfortunately, the half-life of bovine IgG in the foal is much shorter than

equine IgG (7.4 - 9.4 d for bovine compared to 26 d for equine IgG). Also, the ability of the bovine IgG to detect and present antigen to the foal's immune system successfully has not been fully evaluated.

Most oral equine immunoglobulin products contain relatively low IgG levels and fail to increase serum IgG concentrations above 500 mg/dl. Therefore, the objective of this study was to evaluate the adequacy of a concentrated oral purified equine serum product containing much higher concentrations of equine IgG (36 g of IgG/dose).

Procedures

Ten foals of Quarter Horse breeding were alternately assigned to either the treated group or the control group. The dams of the foals ranged in age from 4 to 21 years. Treated foals were administered 250 ml of an oral serum product at 1 h and 3 h of age via nasogastric intubation. These foals were muzzled to prevent nursing from their dam. Supplemental milk replacer¹ (200 ml/feeding) was provided to the treated foals at 6 h and 9 h of age. Mares with treated foals had their udders stripped at 1, 3, 6, and 9 h post parturition. The initial colostrum collected (200 ml) was fed back to the treated foals when the muzzle was removed at 12 h of age. Control foals were allowed to nurse from their dams ad libitum. Ten ml jugular blood samples were collected into tubes using EDTA as the anticoagulant. Samples were obtained from all foals (5 treated/5 control) at 1, 3, 5, 7, 9, 10, 11, 12, 24, and 48 h of age for determination of concentrations of plasma IgG.

Equine serum was purchased from a closed herd of horses and the IgG was concentrated to 72% purity and verified by radial immunodiffusion. The purification process involved enriching the IgG through standard chemical precipitation which resulted in the removal of albumin. The spray dried product was balanced with 1% dextrose and 0.1M glycine and mixed in 250 ml of warm distilled water prior to feeding. Each dose contained 36 g of IgG for a total dose of 72 g (2 doses/treated foal x 36 g/dose).

Plasma was harvested from all blood samples by centrifugation and IgG concentrations were determined by radial immunodiffusion.

Data were analyzed using the analysis of variance (ANOVA) procedure of SAS and included foal within treatment interaction as the error term. Independent effects included in the statistical model were birth weight, dam parity, dam age, and foal sex. Initial IgG level at 1 h was

included as a covariable. Significance was declared as P values less than 0.05.

Results and Discussion

Average foal weight was 50 kg (S.D. \pm 6 kg) for control foals and 47 kg (S.D. \pm 5 kg) for treated foals. Mean values and ranges for plasma IgG concentrations at all sampling periods are presented in Table 1. Plasma IgG concentrations were higher ($p < .05$) for treated foals compared to control foals at 5 h and 48 h of age. Plasma IgG concentrations were not different ($p > .10$) at all other time periods measured. All treated foals had plasma IgG concentrations in excess of 700 mg/dl by 10 h of age.

Mean pre-suckling colostrum values at 1 h were 14,466 mg/dl for dams of control foals and 11,714 mg/dl for dams of treated foals. There was no difference in colostrum IgG concentration between the two groups of foals.

There are few viable options for producers within the first 24 hours after a foal is born to prevent failure of passive transfer if supplemental colostrum is not available. The oral equine products currently marketed fail to raise IgG levels to an adequate level, however, there is some evidence that they can provide protection against illness. Intravenous IgG products not only raise foal serum immunoglobulin levels, but also have the advantage that they can be administered to a foal of any age. Drawbacks to intravenous IgG products include both the invasive nature of administration and the risk of adverse systemic reactions. Typical reactions include tachypnea, tachycardia, shaking, depression, diarrhea, abdominal discomfort and hyperemic mucous membranes. Therefore, oral products provide a safe alternative for foals from mares with a history of inferior colostrum quality, foals with a history suggestive of FPT, or simply as a preventative measure.

Concentrations of IgG in the control foals were relatively low. It is possible that the frequency of sampling interrupted normal foal behavior and resulted in a decrease in suckling as one control foal still had an IgG concentration of zero at 3 h. If control foal IgG concentrations had been higher, there may have been significant differences between the two groups of foals, however, all treated foals still attained IgG levels above 700 mg/dl and two foals achieved levels greater than 1000 mg/dl.

Even though foals from this study were allowed to nurse their dam after 12 h of age, the results show that adequate plasma IgG levels can be achieved through the routine oral administration of a concentrated immunoglobulin product within the first 5 hours after birth. The increased concentration of IgG observed in the treated foals can be attributed to the high concentration of IgG contained in the serum product administered in this study.

Plasma IgG values were higher at 48 h in treated foals compared to control foals; this can be explained by the

administration of dam's colostrum after the 12 h sample. It is also possible that the equilibrium process was altered in the treated foals by the 12 h colostrum feeding. It takes approximately 2-3 d for IgG to reach equilibrium between the intravascular and extravascular space and this process may have been delayed in the treated foals by the 12 h colostrum administration.

Because this is a newly developed product, further studies are needed to test the efficacy of the product for prevention of illness in colostrum deprived foals. The preliminary results from this trial support the use of this product for prevention of FPT in newborn foals.