The Effect of Intravenous Plasma Transfusion on Granulocyte and Monocyte Activity in Neonatal Calves with Failure of Passive Immunity

Victoria Yang, Munashe Chigerwe
University of California, Davis School of Veterinary Medicine

Background

- Approximately a third of pre-weaning mortality occurs during the first three weeks of life due to failure of passive immunity (FPI).
- Due to cattle’s syndesmochorial placenta, calves acquire immunoglobulins (Ig) and maternally derived immune cells through the ingestion of colostrum during the first 24-36 hours of life.
- Calves with FPI (serum [IgG] < 1000 mg/dL) at 4 days of age experience higher mortality rates compared to calves with serum [IgG] > 1000 mg/dL.
- Currently, sick calves older than 48 hours with FPI are managed in part with administration of intravenous (IV) bovine plasma with the assumption that the administered plasma IgG achieves immunoprotection consistent with adequate transfer of immunity.
- A recent study indicated that calves administered IV bovine plasma only achieved serum IgG consistent with adequate transfer for up to 12 hours. Thus IV administered plasma is short lived.
- The effect of IV bovine plasma administration on immune cells in calves with FPI in cattle is unknown.

Hypothesis

Intravenous bovine plasma transfusion at a dose rate of 30 ml/kg improves phagocytic and oxidative burst activity of granulocytes and monocytes in neonatal dairy bull calves with FPI.

Research Questions

1. What is the effect of intravenous plasma administration at the recommended dose of 30 ml/kg on phagocytic and oxidative burst activity of granulocytes and monocytes in calves with FPI?
2. What is the mortality rate over 7 days among calves with adequate transfer of immunity, sick calves with FPI administered with plasma, and non-sick calves with FPI administered with plasma?

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Results

- There was no difference in WBC counts before and after transfusion for the SG and NG group (P = 0.156).
- Granulocytes or monocytes oxidative burst and phagocytic activity among the 3 groups were not different (P > 0.05).
- Granulocyte and monocyte oxidative burst and phagocytic activity were higher at 2 and 12 hours post transfusion compared to 72 hours (Day 7) post-transfusion (P < 0.0001).
- Figure 1. represents serum IgG concentrations before and after plasma transfusion in the SG and NG groups.
- The SG and NG groups maintained IgG > 1000 mg/dL, for up to 12 and 24 hour, respectively.
- Half-life of IgG in the CL group (19.4 days) was longer than SG (6.9 days) and NG (3.8 days) groups.
- There was no difference in calf mortality or survival rates among the 3 groups during the first 7 days of life.

Methods

- Study was performed at UC Davis Animal Science Feedlot, California.
- Data was collected from 29 Jersey bull calves, assigned to 1 control group and 2 treatment groups.
- Control Group (CL): 9 calves, fed 3L of pasteurized colostrum once within 2 hours after birth.
- Non-sick group (NG): 11 calves fed 1L of pasteurized colostrum once within 2 hours after birth. Assigned to the group based on their health status as “non-sick” at 4 days of age.
- Sick Group (SG): 8 calves fed 1L of pasteurized colostrum once within 2 hours after birth. Assigned to the group based on their health status as “sick” at 4 days of age.
- At 4 days of age, bovine plasma was administered to NG and SG calves at 30 ml/kg. Refer to Table 1. for procedure schedule of blood sampling and plasma transfusion.

Conclusions and Clinical Importance

IV bovine plasma transfusion at 30ml/kg did not improve phagocytic or oxidative burst activity of granulocytes and monocytes in dairy bull calves with failure of passive immunity.

- IV bovine plasma transfusion had no effect on total WBC counts following plasma transfusion in calves with FPI.
- Plasma transfusion had no effect on mortality or survival rates over 7 days among calves with adequate transfer of immunity, sick calves with FPI administered plasma and non-sick calves with FPI administered plasma.
- Plasma derived IgG half-life of 6.9 and 3.8 days in sick calves and non-sick calves, respectively, was catabolized faster compared to colostrum derived IgG (half-life of 19.4 days) in neonatal dairy bull calves.
- Survival over the 7 days among the 3 groups was compared using survival analysis.

Data Analysis

- WBC counts before and after transfusion were compared using the Wilcoxon signed rank.
- Phagocytic and oxidative burst activity of granulocytes and monocytes among the 3 groups were compared using a 2-way ANOVA.
- Logistic regression was performed to evaluate the probability of a mortality event while non-linear regression was used to calculate IgG half-lives.
- Survival over the 7 days among the 3 groups was compared using survival analysis.

Plasma-derived IgGs were compared using single radial immunodiffusion.
- Granulocyte and monocyte phagocytic and oxidative burst activity were determined using the Phagoburst and Phagocytosis, respectively by flow cytometry.
- Complete blood count was determined by a hematology analyzer.

References