Effect of Histamine on Intestinal Absorption of Gamma Globulin in Newborn Calves

Abstract

Newborn calves were isolated from their dams before they were suckled and within 3 hr of birth were fed 1 liter of cow's milk containing either: a) no additives, b) 75.0 g gamma globulin, or c) 75.0 g gamma globulin and 2.0 mg histamine. Additional feedings were at 7 and 15 hr after the initial meal. Serum gamma globulin was determined before and at 1, 3, 5, 7, 11, 15, and 23 hours after the first feeding. Differences in serum gamma globulin between calves that received histamine-supplemented milk and gamma globulin and those that received only added protein in milk were insignificant. In all calves receiving gamma globulin, serum gamma globulin increased after the first two feedings, but the values plateaued thereafter. The gamma globulin in serum of calves fed only milk remained negligible.

Introduction

Previous work (4, 7) has shown that bovine colostrum contains a relatively high concentration of histamine. Following parturition, colostral histamine falls rapidly from .9 μg/ml to levels in normal milk, about .3 μg/ml (7). It has been postulated: a) that the high concentration of colostral histamine may function in the selective transfer of plasma immune globulins by the mammary gland into the colostrum (7), and b) that the high level of this amine promotes transfer of ingested globulin across the intestinal epithelium in the newborn calf. The present experiment was designed to test the latter hypothesis.

Experimental Procedures

Twelve Holstein calves were isolated from their dams before suckling and were away from the cows throughout the experiment. Each calf was assigned at birth to one of three dietary regimes. At each feeding, all animals in the first group received 1 liter of cow's milk, calves in the second group consumed 75 g of lyophilized crude gamma globulin in 1 liter of milk, and those in the third group received 2 mg of histamine plus 75 g of gamma globulin in 1 liter of milk. Calves were initially fed within 3 hr and usually within 1 hr of parturition. Subsequent feedings were at 7 and 15 hr after the first meal. All calves were fed via a nipple pail. Five milliliters of blood were obtained from the jugular vein before the initial feeding (pre-feed) and at 1, 3, 5, 7, 11, 15, and 23 hr after it; and the sera were analyzed for gamma globulin.

Serum gamma globulin was calculated from measurement of total serum protein by the Biuret method and percentage serum gamma globulin by electrophoresis. Biuret determinations were with Uni-Tech Biuret Reagent, and the optical density was read at 540 μd. Electrophoresis was on cellulose acetate strips (5), and percentage of gamma globulin was determined on a Photovolt Densicord densitometer.

Lyophilized crude gamma globulin fed to the calves was prepared from bovine colostrum from normal cows. Colostral casein was removed by adding 4.5 ml of .33% rennin and .5 ml saturated CaCl₂/150 ml of colostrum. Samples were incubated at 37 C for 20 min to allow the casein to clot and subsequently centrifuged for 10 min. Whey was poured off and filtered through coarse filter paper. All batches of whey were frozen, then thawed, pooled and refrozen before further treatment. Crude gamma globulin was prepared from this whey by ammonium sulfate fractionation as described by Smith (6), except that whey proteins were precipitated only once. The precipitate was then dialyzed and lyophilized before use. Electrophoresis of the lyophilized material showed that at least 70% migrated as gamma globulin.

Results and Discussion

The results of the experiment, (Fig. 1), revealed no significant differences in serum gamma globulin between calves that received lyophilized bovine gamma globulin and those that consumed gamma globulin and histamine. Apparently supplemental histamine did not increase absorption of gamma globulin by the intestine of these calves even though the concentration of histamine fed to the calves was greater than that in the colostrum of most dairy cows (4, 7). This suggests that the high
free histamine in colostrum is not required for significant absorption of gamma globulin in newborn calves.

There were constant increases in serum gamma globulin after the first and second feeding in calves given gamma globulin, either with or without additional histamine. In both cases, the mean values 7 hr after the initial feeding were significantly higher (P < .05) than the pre-feeding samples, and likewise, the 11 hr levels were greater (P < .05) than the 7 hr values. However, the serum gamma globulin plateaued after the third feeding, i.e., at approximately 16 hr of age. This agrees with other reports (1, 2) that the ability of calves to absorb macromolecules declines within several hours of birth.

A low gamma globulin was in the serum sample of all calves before feeding. In those receiving only milk, the concentration remained low throughout the experimental period. Hypogammaglobulinemia in newborn colostrum-deprived calves has been well established (1, 2, 3).

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References


Fig. 1. Serum gamma globulin in newborn calves after receiving 1 liter cow's milk per feed (▲), 1 liter cow's milk plus 75 g lyophilized bovine gamma globulin per feed (●), or 1 liter cow's milk, plus 75 g lyophilized bovine gamma globulin, plus 2 mg histamine per feed (■). Values are means ± standard error.