Adverse Effects of Cow Milk in Infants

THIRTIETH

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Thursday, September 14, 2000 • 1:30–3:00 p.m.

Parklawn Building, Conference Room 3B-37

Presenter: Ekhard E. Ziegler, M.D.

PROFESSOR OF PEDIATRICS, AND DIRECTOR, FOMON INFANT NUTRITION UNIT, UNIVERSITY OF IOWA, IOWA CITY, IA

Reactor: TBA

Moderator: TBA

Research Roundtable 30

Bring your lunch, and enjoy the desserts and beverages provided.

U.S. Department of Health and Human Services
HRSA
Health Resources and Services Administration
Maternal and Child Health Bureau

RSVP: On-site participants—Benita Delemos, National Center for Education in Maternal and Child Health; e-mail: bthornton@ncemch.org; phone: (703) 524-7802
Teleconference participants—Sarah Kuester, Centers for Disease Control and Prevention; e-mail: sak2@cdc.gov; phone: (770) 488-6019

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Research Roundtable

About the Presenter...

Ekhard E. Ziegler, M.D., is professor of pediatrics and director of the Fomon Infant Nutrition Unit, Department of Pediatrics, University of Iowa, where he has been for 27 years. Dr. Ziegler, a practicing neonatologist, studies nutrition of normal and premature infants. His research interests include zinc and iron, which he studies with the use of stable isotopes. He has conducted research on the growth of breastfed and formula-fed infants and the effects of varying protein intakes. In premature infants, he studies protein and iron needs as well as methods for fortifying breast milk. His interest in cow's milk–induced fecal blood loss originated with a study published in 1981 that made the then-surprising discovery that many normal infants lose blood through feces when they are fed cow's milk.

Adverse Effects of Cow Milk in Infants

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Ekhard E. Ziegler, M.D.
University of Iowa

Statement of the Problem

Iron deficiency remains the leading nutritional deficiency among infants and children. When iron deficiency is severe enough to cause anemia, cognitive development is likely to be impaired.

Current evidence shows that the feeding of cow's milk is an important determinant of iron nutritional status in infants and toddlers. The American Academy of Pediatrics and the Institute of Medicine currently recommend that infants be breastfed or fed infant formula until they reach 1 year of age, and that they not be fed cow's milk until then. It is not known through which mechanism(s) cow's milk feeding affects iron nutritional status. One known effect of cow's milk, however, is that it introduces fecal blood loss, which has been demonstrated in infants less than 6 months of age. The present project sought to gather data about cow's milk–induced fecal blood loss in infants 6 to 12 months of age to help determine whether current recommendations are practical for these infants.

Hypotheses

The study hypothesis was that cow's milk feeding causes medically important fecal blood loss in infants 6 to 12 months of age. Specifically, it was hypothesized that infants lose more fecal blood when they are fed cow's milk than when they are fed infant formula, that fecal blood loss is associated with clinical

symptoms, and that fecal blood loss leads to lower iron nutritional status.

Study Design and Methods

The project used a longitudinal design in which each infant was fed infant formula during a 1-month baseline period, followed by cow's milk during a 2- to 3-month period. Subjects were normal infants. Studies of nearly identical design were performed with 34 infants who were 7½ months old when cow's milk feeding started (group 1), 31 infants who were 9½ months old when cow's milk feeding started (group 2), and 28 infants who were 12 months old when cow's milk feeding started (group 3). In each case the infants were fed infant formula during the baseline period, after which they were fed cow's milk for 2 months (groups 1 and 3) or 3 months (group 2). Each group was divided into subgroups of infants who had been breastfed before their involvement in the study and those who had not. Stool specimens (spot stools) were collected during the baseline period and repeatedly after cow's milk feeding began. In addition, in group 2, 96-hour stool collections were performed during the baseline period and repeatedly during the cow's milk feeding period. A blood sample was taken from all infants just before the change from formula to cow's milk and monthly after cow's milk feeding began. Fecal hemoglobin concentration was determined quantitatively and expressed as µmol/g dry stool. Also, a guaiac (Hemoccult) test was performed on each stool specimen.

The primary outcome was fecal hemoglobin concentration during the cow's milk feeding period. The sample size was decided by (1) determining the number of infants needed to detect a rise in fecal hemoglobin concentration, (2) allowing for attrition, and (3) allowing for expected differences in the response of formerly breastfed infants to cow's milk feeding.

Findings

Infants in group 1 showed a significant increase in fecal hemoglobin concentration during the cow's milk feeding period. Nine infants (26 percent) were classified as responders. They had a mean fecal hemoglobin concentration of 4,046 µmol/g stool. The increase in fecal hemoglobin concentration was much more marked in infants who had been breastfed earlier than in those who had been fed formula from birth. In fact, in the formula-fed infants the fecal hemoglobin concentration increase during the cow's milk feeding period was not statistically significant.

Group 2 infants had baseline fecal hemoglobin concentrations that were significantly higher than group 1 infants' when the group 1 infants were 7½ months of age. Group 2 infants showed an increase in fecal hemoglobin concentration during the cow's milk feeding period, but it was less pronounced than in infants in group 1 at 7½ months of age and was not statistically significant. Nine infants (29 percent) were classified as responders. They had a mean fecal hemoglobin concentration of 2,711 µg/g stool. This group's response to cow's milk feeding was not clearly related to whether infants were initially breastfed. Fecal hemoglobin concentration as determined in 96-hour stool collections increased significantly during cow's milk feeding and was significantly higher in responders than in nonresponders. Responders excreted on average 16.1 (SD 6.5) mg of hemoglobin per day. Hemoglobin excretion was, on the whole, somewhat lower than was expected based on spot fecal hemoglobin concentrations.

Group 3 infants were fed cow's milk starting at 12 months of age. Baseline fecal hemoglobin concentration was again higher than that of infants who began receiving cow's milk at 7½ months of age but was not different from those who began receiving it at 9 months of age. During the cow's milk feeding period there was no appreciable increase in group 3 infants' fecal hemoglobin concentration. Two infants were classified as responders, but even in these infants the response was modest and transient.

Iron nutritional status (blood hemoglobin concentration, plasma ferritin) in all groups was not measurably affected by cow's milk feeding, nor did responders show an effect compared to nonresponders. The only exceptions were the responders among those fed cow's milk starting at 9 months of age who, after 3 months of cow's milk feeding, showed significantly lower plasma ferritin concentration than non-responders.

Although we tried to keep records in the home and conduct interviews with caregivers, it was not possible to identify a clinical correlate of intestinal blood. Neither time spent crying or fussing nor the incidence of regurgitation, vomiting, or cramping were related to intestinal blood loss. We had to conclude that fecal blood loss is truly clinically silent.

Conclusions

The results of this and earlier studies suggest that cow's milk induces fecal blood loss in infants. The loss is pronounced in young infants, diminishes in intensity

during the second 6 months of life, and ceases by 12 months of age. Adverse effects of cow's milk on iron nutritional status were difficult to demonstrate, probably because of the short observation periods (mostly 2 months). Fecal blood loss is clinically silent.

Recommendations

Iron deficiency in infants and toddlers is clearly associated with the feeding of cow's milk in infancy, especially when started early. The present study establishes that fecal blood loss is probably not the main cause, and certainly not the only cause, of the poor iron nutritional status associated with cow's milk feeding in infancy. Whether the main cause is impairment of absorption of dietary iron caused by cow's milk remains to be established. Regardless of the mechanism involved, the fact that cow's milk feeding affects iron nutritional status negatively, coupled with concern about the high potential renal solute load of cow's milk, argues in favor of retaining the general recommendation that cow's milk not be fed during the first year of life. However, it is clear that during the last 3 months of the first year of life concerns about cow's milk diminish to the point at which its advantages (high protein and calcium content, low cost) may begin to outweigh its disadvantages. Until we are able to obtain more information, it seems prudent to continue recommending against feeding cow's milk to infants under 12 months of age.

Publications

Jiang T, Jeter JM, Nelson SE, Ziegler EE. 2000. Intestinal blood loss during cow milk feeding in older infants: Quantitative measurements. *Archives of Pediatric Adolescent Medicine* 154:673–678.

Ziegler EE, Jiang T, Romero E, Vinco A, Frantz JA, Nelson SE. 1999. Cow milk and intestinal blood loss in late infancy. *Journal of Pediatrics* 135(6): 720–726.

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