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CASE REPORT

Extrinsic Iron Staining in Infant Teeth from Iron-Fortified Formula and Rice Cereal

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Extrinsic staining of teeth due to excessive iron intake has been reported previously in the literature. We describe a 7-month-old infant who presented with extrinsic teeth staining due to inadvertent over consumption of dietary iron. The infant was fed iron-fortified formula and rice cereal. Rice cereal, fortified with iron, was being used as part of a normal infant diet and as a thickening agent when added to the formula for treatment of gastroesophageal reflux. After several months of administration, "blackening" of the infant's teeth was noted by the mother. The stain was removed by the pediatric dentist who simply scraped the affected teeth. No further staining occurred after the amount of dietary iron was reduced.

KEYWORDS infant cereal, infant formula, iron, teeth staining

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INTRODUCTION

Adequate iron intake by newborn infants is necessary to support the expansion of red blood cells, which are responsible for producing hemoglobin, an oxygen carrying molecule important for infant growth.[1] Commercially available infant formulas are fortified with iron in order to augment iron stores and prevent the development of iron deficiency anemia. Likewise, many other baby foods also contain iron as an additive. We report an infant with extrinsic staining of the teeth possibly due to over consumption of dietary iron that was being administered from multiple sources.

CASE REPORT

A 3.74 kg male was born via vaginal delivery at 39 weeks gestation. Breast-feeding was initiated at birth. At 2 weeks of age, the infant weighed 3.83 kg (50th percentile for age) and was started on supplemental feeds of Enfamil with iron (Mead Johnson Evansville, Indiana). At approximately 5 weeks of age, the infant continued to have poor weight gain due to large emesis or "spitting up" of significant volumes of formula after each feeding. The pediatrician instructed the mother to thicken the formula using rice cereal and to give smaller volumes at more frequent intervals. The infant was also started on ranitidine 15 mg by mouth twice daily (1.5 mg/kg/dose). Thickening the feedings, accompanied by administration of an H2-blocker, improved the symptoms of gastroesophageal reflux and the baby began to gain weight appropriately. The mother continued to breastfeed the infant until he was two months of age. At that time, the infant was switched to iron-fortified formula thickened with rice cereal as the sole source of nutrition. By 4 months of age, the infant continued to thrive and his weight increased to 7.5 kg, which placed him at

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the 75th percentile of weight/height for age. The infant continued to receive thickened bottle feedings with concurrent oral ranitidine twice daily. Over the next several months the diet progressed appropriately for age. At about 7 months of age, the mother noticed a "blackening" of the infant's front teeth and scheduled an appointment with the local pediatric dentist. There was no family medical history of tooth staining.

On physical examination the infant was noted to have a black stain on the exterior of the front upper and lower teeth. The dentist diagnosed the infant with extrinsic tooth staining, which resembled iron staining that is generally attributed to supplemental iron or vitamins containing iron. The dentist removed the extrinsic staining by scraping the affected teeth. The only medication that the infant had been taking was ranitidine and no herbal products had been administered. The infant's diet consisted of introductory (Stage 1) baby foods and rice cereal in addition to iron-fortified formula thickened with rice cereal. The formula and rice cereal provided at least 80 mg of elemental iron/day, with additional iron being provided through the Stage 1 foods that varied daily according to the foods chosen. Perhaps due to the good weight gain, neither the dentist nor pediatrician recommended reducing the amount of iron in the diet at that time. However, the mother decided to eliminate the rice cereal from the infant's bottles (approximately 40 mg of elemental iron per day) and no further staining was noted at the 6-month follow-up dental visit.

DISCUSSION

Both extrinsic and intrinsic tooth staining has been described in the literature. Extrinsic stains are located on the outer surface of the tooth structure after eruption through the gums into the mouth, and caused by topical or extrinsic agents. This is in contrast to intrinsic stains, which occur following a change in the structural composition of the tooth. The etiology of extrinsic tooth staining can be divided into two categories. First are those compounds that are incorporated into the pellicle and produce a stain due to their basic color.[2] The pellicle is a thin layer of salivary glycoproteins that are deposited on the teeth through normal biologic processes. The second etiology, as presented in this case report, is due to a chemical interaction at the tooth surface. Extrinsic discoloration that has been associated with iron salts in liquid form is thought to result from a chemical interaction between hydrogen sulfide producing micro-flora and iron.[3-4] Through morphological studies, black extrinsic tooth stain has been determined to be a form of bacterial plaque. The pigment in the plaque giving the black color is a black insoluble ferric compound.[4] It is likely that the multiple sources of iron-fortified infant foods were the origin for the ferric compound that produced the black extrinsic stain noted in our patient.

Factors affecting the amount of iron in the body may be classified as dietary, host-related, or environmental. The amount and type of iron ingested, as well as the presence of inhibitors and enhancers of iron absorption control the amount of iron that is ultimately absorbed.[6] The ranitidine prescribed for this infant may have altered the iron bioavailability, due to decreased gastric acidity; however, there is no published drug-drug interaction information for ranitidine and iron. The elemental iron requirement needed to meet the hematological demand and sustain adequate iron stores in the term infant is estimated to be 1-2 mg/kg/day (maximum = 15 mg). Daily iron dosing recommendations are estimates at best, due to multiple variables which may alter the amount of metabolizable iron that is absorbed and retained by the infant.[1] For example, iron in breast milk, although low in iron content, is generally well absorbed by infants with estimates of up to 50% absorption compared to only 12% of iron being absorbed from infant formulas.[5]

To help augment this iron requirement for formula-fed infants, commercially available infant formulas are fortified with iron. Infant formulas have been classified by the United States Food and Drug Administration as either low-iron formulas or iron-fortified formulas based on their iron content. By definition, iron-fortified formulas contain more than 6.7 mg/L of elemental iron (Table).[1] An additional source of dietary iron is available from infant cereals.[8] These cereals also provide a non-pharmacological option for treating gastroesophageal reflux in infants when used to thicken the

Table. Iron content of commonly used infant formulas[7]

Infant Formula	Iron Content (mg/L)
Iron Fortified Formulas	
Alimentum[a]	12
Alsoy[b]	12
Good Start 2 Essentials[b]	12
Good Start Supreme[b]	10
Enfamil with Iron 20 kcal/oz; 22 kcal/oz; 24 kcal/oz[c]	12; 13; 14.4
Enfamil Premature Formula w/Fe 20 kcal/oz; 24 kcal/oz[c]	12; 15
Enfamil Lactofree[c]	12
Isomil[a]	12
Isomil DF[a]	12
Nutramamigen[c]	12
Pregestimil 20 kcal/oz; 24 kcal/oz[c]	12.5;15
ProSobee[c]	12
Similac with Iron 20 kcal/oz[a]	12
Similac Special Care with Iron 20 kcal/oz; 24 kcal/oz[a]	12; 14.4
Low Iron Formulas	
Enfamil 20 kcal/oz; 24 kcal/oz[c]	4.7; 5.6
Enfamil Premature Formula 20 kcal/oz; 24 kcal/oz[c]	3.3; 4
Similac 20 kcal/oz[a]	4.7
Similac Special Care 20 kcal/oz; 24 kcal/oz[a]	3 ; 3
Similac PM 60/40[a]	1.5
Similac Special Care 20 kcal/oz; 24 kcal/oz[a]	2.5; 3

a = Ross Products, A Division of Abbott Laboratories, Columbus, Ohio
b = Nestle, Glendale, California
c = Mead Johnson Nutritionals, a Division of Bristol Myers Squibb, Evansville, Indiana

formula, as in this case report. The standard recommendation for thickening a bottle is 1 tablespoon (tbsp) rice cereal (Gerber 1.65 mg of elemental iron/tbsp) for every 1 ounce of formula (Enfamil Lipil with Iron, 0.36 mg of elemental iron/ounce). For example, an 8 ounce bottle of formula thickened with iron-fortified rice cereal would contain approximately 16.1 mg of elemental iron. Consequently, when iron-fortified infant formula is supplemented with iron-fortified rice cereal the infant may exceed the daily requirements for iron which may lead to adverse effects.

SUMMARY

Iron deficiency anemia remains a concern in infants not receiving adequate dietary iron because iron stores, which are present at birth, are depleted at around six months of age.[5] Those infants who are unable to meet the recommended daily requirements may need to receive infant formulas and cereals that are fortified with iron. This case report describing extrinsic tooth staining highlights the need for healthcare providers to pay careful attention and assess iron intake by infants receiving

multiple sources of iron. The authors do not imply nor recommend that low-iron formulas be used or that iron-fortified products be eliminated. However, parents should be instructed to begin brushing their children's teeth morning and evening as soon as the teeth erupt through the gums, and begin flossing between the teeth once every day as soon as teeth contact one another.[9] If extrinsic staining occurs, dental consultation should be sought and sources of iron in the diet assessed.

DISCLOSURE The authors declare no conflicts or financial interest in any product or service mentioned in the manuscript, including grants, equipment, medications, employment, gifts and honoraria.

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