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Oral and systemic findings in biliary atresia: report of 11 cases

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Abstract

Eleven children, eight females and three males, ranging in age from 17 months to seven years, eight months, with surgically corrected biliary atresia, were examined for oral problems. Four children had green staining of both primary teeth and gingival tissues. Five children had abnormally large pulp chambers, and four had delayed primary tooth eruption. A significant relationship between primary tooth stain and gingival stain at the .005 level was found. No other statistically significant relationships between oral and physical or laboratory findings were noted.

Biliary atresia is a rare condition occurring in approximately one in 10,000 live births and affecting nearly 300 newborns in the United States each year.[1] The condition is characterized by perinatal jaundice, hyperbilirubinemia, tissue staining by excess bile pigments, and hepatosplenomegaly. Growth retardation and nutritional failure are common in early life, and death often occurs by five years of age. Early diagnosis and surgical intervention have decreased morbidity, returned growth and development to normal and improved the prognosis for survival.[2]

Potential oral involvement ranges from delayed dental and skeletal development to intrinsic staining of the dentition with biliverdin, a bile pigment. Only one report appears in dental literature describing biliary atresia and its oral manifestations.[3] This paper presents a series of 11 children afflicted with biliary atresia who received surgery to ameliorate the condition. Oral and systemic manifestations are presented, and pertinent relationships between oral and physical or laboratory findings discussed.

Literature Review

Biliary atresia is a complex condition characterized by progressive obliteration of the intra- and extrahepatic duct system. Etiology of biliary atresia is unclear. Current thought discounts a genetic or developmental cause. Prenatal or neonatal viral infection may be contributory, leading to a more extensive disease process involving the entire hepatic system.[4]

If untreated, biliary atresia causes continued degeneration of the biliary tract leading to intrahepatic bile accumulation and cirrhosis. Jaundice and hyperbilirubinemia continue. Bile passage to the intestine is decreased or completely blocked and malabsorption of fat-soluble vitamins A, D, and K occurs. Bleeding due to inadequate vitamin K absorption and inadequate synthesis of clotting factors VII, IX, X, and prothrombin is common as are rachitic changes in bone due to inadequate vitamin D.[5] Osteomalacia and growth retardation also are a result of poor vitamin D absorption.

Recent surgical advances, modifying a portoenterostomy procedure first described by Kasai,[6] have improved the prognosis of biliary atresia.[7,8] The modified portoenterostomy, usually done by 10 weeks of life, involves two steps. The extrahepatic biliary duct system is removed and the system is replaced by an anastomosis of the intestine to facilitate bile drainage. Lilly[8] and others have modified the Kasai procedure to provide temporary externalization of the intestinal section to allow bile collection and measurement. This modification also reduces cholangitis (Figure 1).

The critical factor in surgical success is early detection and prompt intervention, usually within the first two months of life. Later surgery often meets with equivocal success.

Even the successfully treated child often has profound medical problems. Recurrent cholangitis, nutritional and growth deficiencies, delayed developmental milestones, portal hypertension, osteomalacia, and osteoporosis often occur.[9,10] Also, the condition often is accompanied by psychosocial problems affecting child and family.[11] Severe dental caries and teeth staining have been noted[3] (Figure 2).

Treatment for multiple medical problems may be episodic or preventive. Antibiotics are used to control cholangitis, aminoglycoside is used for acute infections,

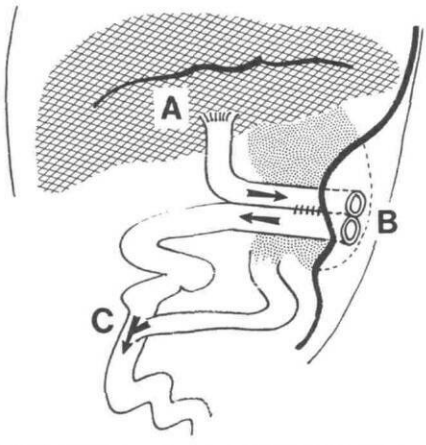
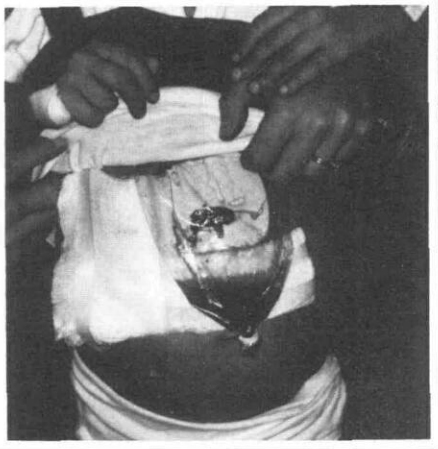


Figure 1a(left). Diagram of the modified Kasai portoenterostomy showing (A) anastomosis of intestine to transected bile duct at hilus of liver, (B) cutaneous double-barreled enterostomy for bile drainage and monitoring, and (C) enteroenterostomy site where intestinal segment from liver joins main gastrointestinal tract again. Arrows indicate bile and intestinal flow.

Figure 1b(right). Photograph of external site of double-barreled enterostomy with collection bag for bile, corresponding to (B) in Figure 1a.



and trimethoprim, sulfamethoxazole and phenobarbital are prescribed as prophylactic measures.[12] Formulas containing medium-chain triglycerides[a] can be used to promote maximum fat absorption and reduce steatorrhea as well as help correct growth deficiencies and fat-soluble vitamin deficiencies. In particular, vitamin D deficiencies associated with rachitic changes can be treated by supplementation with 1, 25 dihydroxyvitamin D_3.[9,11] Vitamin K supplements may be used in the treatment of bleeding problems since liver-dependent clotting factors usually are deficient. Portal hypertension may result in esophageal varices, ascites, or both. Physical therapy is employed to overcome lags in gross motor skills. Support and counseling are important adjuncts for the affected family.

Methods

The sample comprised 11 children, eight females and three males, with surgically corrected biliary atresia ranging in age from 17 months to seven years, eight months, with a mean age of four years, four months. Each child received a clinical hard and soft tissue examination by one of two examiners (GB and RS) as a part of the child's overall health care. Bitewing radiographs were made for children when posterior tooth contact prevented visual and tactile examination of interproximal surfaces. Subjective evaluations regarding staining and dental development were made by the three primary investigators (GB, RS, PC) using photographic and radiographic data and norms for each age group. Laboratory data regarding calcium, phosphate and vitamin E were collated from recent postoperative serial laboratory testing results and represented the range of values obtained. Growth retardation was assessed by comparing serial height and weight measurements to standard height and weight charts. Success of surgical intervention, which took place prior to two months of age for all subjects, was determined from a history of postoperative cholangitis and adequacy of bile drainage.

Selected dental and medical parameters were evaluated for significance of relationship using the Fischer Exact Probability Test for small samples.[13]

Results

Findings are depicted in Tables 1 and 2. Only four of 11 children had green staining of primary teeth. Of the two children with permanent teeth, only one had green staining of permanent teeth. Soft tissue abnormalities other than gingivitis or periapical abscesses related to extensive caries were identified in only one child, who had migratory glossitis. Gingival staining was found in four of 11 children, and the relationship between gingival staining and primary dentition staining was found to be significant at the .005 level.

The dentitions were evaluated for caries and developmental status including morphologic abnormalities, eruption, and osseous changes in alveolar bone. Dental caries, as measured by decayed, missing, and filled surfaces, was present in seven of 11 children. Four children, two in the older half of the sample and two in

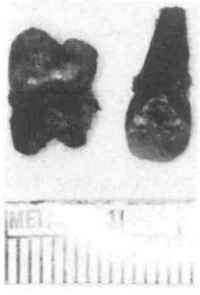
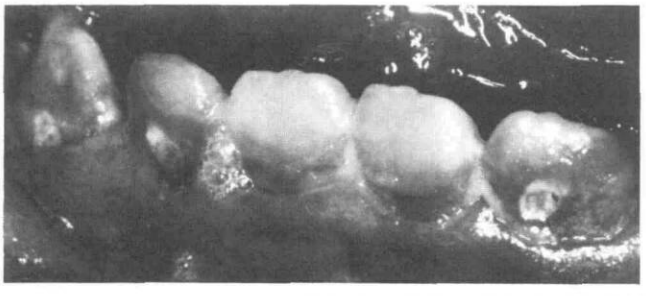


Figure 2a. Postoperative specimen consisting of two extracted primary teeth showing staining of teeth with biliverdin.

Figure 2b. Intraoral photograph showing staining of teeth as well as cervical dental decay in a child with biliary atresia.



[a] Portagen and Pregestimil, Mead Johnson Nutritional Division, Evansville, IN.

	Birthdate Age at Exam	Sex	Primary Stain	Permanent Stain	Gingival Stain	Soft Tissue Pathosis	Dental Caries Surface d-m-f / Total	Morphologic Abnormalities	Eruptive Status	Osseous Abnormalities
1	5-1-73 7-8	F	No	No	No	No	24-5-0 29	No	Normal	No
2	9-6-73 6-6	F	Yes	Yes	Yes	No	0-0-0 0	No	Normal	No
3	1-22-75 5-4	F	Yes	NA	Yes	No	0-0-0 0	Yes*	Normal	No
4	4-8-75 5-4	M	No	NA	No	No	14-0-0 14	Yes*	Delayed	No
5	7-27-75 5-0	F	No	NA	No	No	7-0-0 7	No	Delayed	No
6	1-27-74 4-10	F	No	NA	No	No	5-0-0 5	No	Normal	No
7	8-25-75 4-4	F	No	NA	No	No	24-5-0 29	No	Normal	No
8	7-30-76 3-4	M	Yes	NA	Yes	Yes**	30-0-0 30	Yes*	Delayed	No
9	3-23-77 3-0	M	Yes	NA	Yes	No	24-0-0 24	Yes*	Normal	No
10	6-10-79 1-5	F	No	NA	No	No	0-0-0 0	Yes*	Normal	No
11	8-22-79 1-5	F	No	NA	No	No	0-0-0 0	No	Delayed	No

* Large pulp chambers/canals. ** Migratory glossitis.

Table 2. Laboratory and physical findings in 11 children with surgically corrected biliary atresia.

	Serum Calcium* (meq/L)	Serum Phosphate** (mg/dL)	Vitamin E*** Deficiency	Growth Retardation	Surgical Success
1	Normal	Normal	Yes	No	Yes
2	Normal	Normal	Yes	Yes	No
3	Normal	Normal	Yes	No	Yes
4	Low	Low	Yes	No	Yes
5	Normal	Normal	No	No	Yes
6	Low	Low	Yes	No	Yes
7	Low	Normal	Yes	No	Yes
8	Low	Low	Yes	Yes	No
9	Low	Low	Yes	Yes	No
10	Normal	Normal	Yes	Yes	No
11	Normal	Normal	Yes	Yes	Yes

* Normal range considered 4.4–5.3 milliequivalents/liter. ** Normal range considered 3.6–5.6 milligrams/deciliter. *** Normal range considered 5–10 micrograms per milliliter.

the younger half, were caries-free. Extensive caries, defined in this study as 20 or more carious surfaces, was found in four of the seven subjects with dental caries. Mild to moderate caries (five to 14 surfaces) was found in three subjects.

Morphologic changes in the teeth were evaluated by visual and radiographic examination and five of 11 children were found to have enlarged pulp chambers. Dental development was found to be delayed in four of 11 children, based on comparison of clinical and radiographic findings with norms for each age group.

Table 2 shows physical and laboratory findings for the 11 children in the sample. Five subjects had low serum calcium levels and four of the five had concomitant low phosphate levels, using serum calcium and phosphate ranges of 4.4–5.3 meq/L and 3.6–5.6 mg/dL, respectively, as the basis for comparison.

Ten of 11 subjects had vitamin E deficiencies, based on serial assessments, using 5–10 micrograms/ml as the basis for comparison. Vitamin E levels were used rather than vitamin D levels, since laboratory assessment of vitamin E levels is more easily done and vitamin E levels

are considered to be indicative of absorption of fat-soluble vitamin D.

Growth retardation was assessed using standard height and weight charts and serial measurements. Subjects who had a history of failure to maintain growth rates at the time of the study were deemed retarded in growth. Five of 11 children showed growth retardation.

Surgical success, as measured by incidence of cholangitis and bile drainage, was evaluated and seven of 11 children were considered successful surgical cases.

An attempt was made to relate oral findings with physical and laboratory data to identify significant relationships between various oral findings and oral, physical, and laboratory data. Statistical analysis showed only one significant relationship between primary dentition staining and staining of gingival tissues.

Discussion

A previous report of biliary atresia found green staining of primary teeth in two children and severe dental caries suggestive of nursing bottle decay in one child.[3] These 11 cases suggest that staining of primary teeth and severe dental caries need not be routine findings in surgically corrected biliary atresia.

The lack of universal tooth staining in these cases may be due to many factors. One factor may be the initial severity of the disease, although no quantitative measure of severity was available for this series. If surgical success can be assumed to be indicative of initial severity, one would expect that staining of teeth would be closely correlated with surgical failure. Analysis showed no relationship between surgical outcome and tooth staining, but surgical success may be an inaccurate measure of initial severity.

Since the crowns of the primary teeth are largely formed in utero, staining probably occurs prior to surgical intervention. The cause of primary dentition staining may lie in in utero factors and it is unlikely that surgery in itself is an important factor.

The highly significant relationship between gingival and primary dentition staining suggests a common etiology or a threshold for hard and soft tissue staining.

No systemic factor evaluated in this study emerged as significantly related to either dentition or soft tissue staining. This may be due to the parameters used or the fact that the data used were from postoperative rather than preoperative laboratory studies. The cause of dentition and soft tissue staining needs to be studied further.

The wide variation in dental caries incidence deserves comment. In this series four children had extensive decay while four others were caries-free. The remaining three cases exhibited mild to moderate caries. No attempt was made to describe the caries pattern or attribute a behavioral factor such as excessive or inappropriate bottle use. However, children with biliary atresia often receive frequent and prolonged bottle feeding with a formula promoting growth and fat absorption. Bottle feeding may also be used for pacification well into early childhood. For these reasons, the extensive dental caries observed in this series may be from bottle feeding; however, the presence of four caries-free subjects suggests that dental decay need not be a routine finding.

The lack of a significant relationship of dental development to growth retardation, or calcium-phosphate levels was surprising. This failure to identify a significant relationship between tooth eruption and either calcium-phosphate levels or general growth retardation may be a factor of the small sample size or the lack of sensitivity of the parameters used, or both. Figure 3 clearly shows the delayed dental development of Subject 8 who was three years, four months of age at the time of this study. It is interesting to note that three of the four youngest children who exhibited large pulp chambers and general growth retardation were not considered surgical successes. The lack of consistency in the older segment of the series may be attributed to either the inadequacy of the mature primary dentition as a precise visual and radiographic indicator of developmental status, or the operational definition of surgical success. The permanent dentition may prove to be a more precise indicator of dental development and may provide significant relationships with general growth parameters in these children. It also may be that the older children's general growth parameters had responded to supportive measures while their dentitions responded less or not at all.

These 11 cases suggest that oral findings of tooth staining and dental caries in biliary atresia may be variable. The lack of relationship between oral findings and systemic factors in this study may be the result of the parameters used, the small sample size, or represent a true variability, indicative of the complexity of biliary atresia.

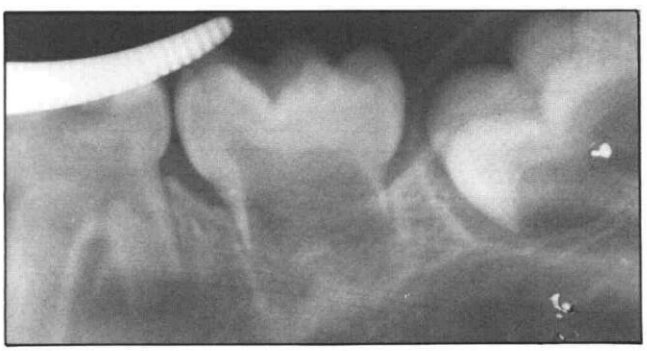


Figure 3. Periapical radiograph of Subject 8 showing delayed dental development and enlarged pulpal chambers and canals (taken when the subject was three years, four months).

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