Investigating a Correlation between Hyperbilirubinemia in Infancy and Caries Risk

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ABSTRACT

Purpose: High serum levels of bilirubin have been implicated in causing developmental tooth defects, and it is known that developmental tooth defects are associated with elevated caries risk. The purpose of the present study was to investigate whether a diagnosis of early childhood caries or severe early childhood caries in children under the age of 6 was associated with a.) increased frequency of diagnosis of hyperbilirubinemia, and b.) increased frequency of treatment for hyperbilirubinemia with phototherapy, when compared to the general pediatric population.

Methods: Two retrospective chart reviews were done on children that were treated for caries at the Medical University of South Carolina (MUSC) whose birth records were available for review. The first retrospective chart review analyzed data between the years of 2017 and 2023 for patients who had a diagnosis of early childhood caries, receiving dental treatment under general anesthesia. The second retrospective chart review analyzed data between the years of 2013 and 2023 for all patients under the age of 6 who were treated in the Pediatric Dentistry Clinic at the Medical University of South Carolina. The bilirubinometry index, transcutaneous bilirubin levels, peak total serum bilirubin levels, peak direct serum bilirubin levels, a diagnosis of hyperbilirubinemia (yes or no), phototherapy treatment (yes or no), and gestational age at birth were recorded. Statistical analyses were performed.

Results: The first retrospective chart review analyzed 1000 total charts, and 314 fit the criteria for inclusion. The second retrospective chart review was performed to include more patients and more criteria to investigate a relationship between a diagnosis of hyperbilirubinemia and a diagnosis of early childhood caries. Out of roughly 6000 total charts reviewed, 769 fit the criteria for inclusion. Of the 242 patients who were diagnosed with hyperbilirubinemia, 105 patients were diagnosed with early childhood caries (43.39%). The Chi-squared test revealed a p-value of 0.03, so the null hypothesis is rejected, and the conclusion is there is a relationship between a diagnosis of hyperbilirubinemia and a diagnosis of early childhood caries. The phi coefficient represents a very weak association between these two variables.

Conclusion: In the patient population evaluated in this study, there is a very weak association between hyperbilirubinemia in infancy and a diagnosis of early childhood caries under 6 years of age.

OBJECTIVE/BACKGROUND

Early childhood caries (ECC) is the most prominent chronic disease of childhood. It is defined as the presence of 1 or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. Severe early childhood caries (S-ECC) is defined as any sign of smooth-surface caries in children younger than 3 years of age or 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score of greater than or equal to 4 (age 3), greater than or equal to 5 (age 4), or greater than or equal to 6 (age 5) in children ages 3 to 5.[1] The development of ECC is a multifaceted relationship with a variety of causal influences. Developmental tooth defects are associated with an increased risk for early childhood caries. The coronal portions of tooth structure in the primary dentition develop between the 2nd trimester of pregnancy and through the first year of life of the infant. Therefore, this time period is particularly susceptible to disturbances causing developmental tooth defects. Hyperbilirubinemia is a condition which manifests during infancy. Children with extremely high levels of serum bilirubin may require treatment in the form of phototherapy. Elevated bilirubin levels may have the potential to impact the processes of dentinogenesis and/or amelogenesis, and the resultant developmental tooth defects that may be incurred from such systemic disturbances may increase the risk for early childhood caries. This study sought to investigate whether a general pediatric population and their diagnoses of no caries, early childhood caries, or severe early childhood caries had a higher likelihood of receiving a diagnosis of hyperbilirubinemia in infancy and of having required phototherapy intervention.

METHODS

Upon IRB approval, a dataset was obtained for all patients under the age of 6 who received treatment in the Pediatric Dentistry Clinic at the Medical University of South Carolina between the years of 2013 and 2023. The medical records of these patients who were born at the Medical University of South Carolina were reviewed. The bilirubinometry index, transcutaneous bilirubin levels, peak total serum bilirubin levels, peak direct serum bilirubin levels, a diagnosis of hyperbilirubinemia (yes or no), phototherapy treatment (yes or no), and gestational age at birth (term vs. preterm and categorized in ranges of 37+, 36-29, and < 28 weeks) were recorded. Chi-squared tests of independence were used to determine the relationships between these variables.

RESULTS

Of the nearly 6000 dental charts reviewed, 718 met the criteria for inclusion. The Chi-squared test of independence was used to explore the relationship between different sets of variables.

The first looked at patient populations diagnosed with no caries, early childhood caries, or severe early childhood caries and the diagnosis of hyperbilirubinemia. This data can be found in Table 1. Of the 718 patients evaluated, 228 did not have caries and did not have hyperbilirubinemia. Of the 718 patients evaluated, 365 did not have caries. 137 of those patients were diagnosed with hyperbilirubinemia (19.08%), and 228 of those patients did not have a diagnosis of hyperbilirubinemia (31.75%). Of the 242 patients who were diagnosed with hyperbilirubinemia, 137 of those patients did not have caries (56.61%), 40 patients had a diagnosis of early childhood caries (16.53%), and 65 patients had a diagnosis of severe early childhood caries (26.86%). Of the 476 patients who did not have a diagnosis of hyperbilirubinemia, 228 patients did not have caries (47.9%), 95 patients had early childhood caries (19.96%), and 153 patients had severe early childhood caries (32.14%). The p-value for this analysis was 0.09, so the null hypothesis failed to be rejected, and it was concluded there is no relationship between a diagnosis of hyperbilirubinemia and a diagnosis of caries status and a diagnosis of hyperbilirubinemia.

Table 2 shows the distribution of patients' gestational age and diagnosis of hyperbilirubinemia. A relationship was determined between gestational age and a diagnosis of hyperbilirubinemia with a p-value of p<0.0001 and a phi value equal to 0.41. There was also a high association between phototherapy treatment and pre-term birth (less than 36 weeks gestational age), with a p-value of p<0.0001 and a phi value equal to 0.61.

The next analysis included evaluating patient populations diagnosed with no caries or any early childhood caries, which included those patients who had a diagnosis of severe early childhood caries. This data can be found in Table 3. Of the 718 patients evaluated, 228 patients did not have caries and did not have hyperbilirubinemia (31.75%). Of the 718 patients evaluated, 365 did not have caries. 137 of those patients were diagnosed with hyperbilirubinemia (19.08%), and 228 of those patients did not have a diagnosis of hyperbilirubinemia (31.75%). This is consistent with the data collected in the first format of this study. Of the 242 patients who were diagnosed with hyperbilirubinemia, 137 of those patients did not have caries (56.61%). Of the 242 patients who were diagnosed with hyperbilirubinemia, 105 patients had a diagnosis of early childhood caries (43.39%). Of the 476 patients who did not have a diagnosis of hyperbilirubinemia, 228 patients did not have caries (47.9%), and 248 had early childhood caries (52.1%). Of the 718 patients evaluated, 105 patients were diagnosed with hyperbilirubinemia and diagnosed with early childhood caries (14.62%). Of the 353 patients who were diagnosed with early childhood caries, 105 patients were also diagnosed with hyperbilirubinemia (29.75%). Of the 242 patients who were diagnosed with hyperbilirubinemia, 105 patients were diagnosed with early childhood caries (43.39%). The Chi-squared test revealed a p-value of 0.03, so the null hypothesis is rejected, and the conclusion is there is a relationship between a diagnosis of hyperbilirubinemia and a diagnosis of early childhood caries. The phi coefficient represents a very weak association between these two variables.

Table 1. Diagnosis of Hyperbilirubinemia vs. ECC, S-ECC

ECC	Hyperbilrubinemia Diagnosis: No	Yes	Total
No	228	137	365
ECC	95	40	135
S-ECC	153	65	218
Total	476	242	718
p=0.09			

Table 2. Distribution of Gestational Birth and Hyperbilirubinemia Diagnosis

Hyperbilrubinemia Diagnosis	Premature birth: Term Birth	29-36 weeks	28 weeks or less	Total
No	413	56	6	475
Yes	130	64	48	242
Total	543	120	54	717
p<0.0001, phi=0.41				

Table 3. The FREQ Procedure: Hyperbilirubinemia vs. ECC

ECC	Hyperbilrubinemia Diagnosis: No	Yes	Total
No	228	137	365
Yes	248	105	353
Total	476	242	718
p=0.03, phi=-0.08			

DISCUSSION

Hyperbilirubinemia can occur in up to 60% of term births and 80% of preterm births. However, receiving a diagnosis of hyperbilirubinemia varies based on diagnostic parameters utilized, and risk factors for developing worsening or severe hyperbilirubinemia present. Diagnostic parameters for the diagnosis tend to vary significantly between both researchers and clinicians/healthcare facilities.

There are limitations of this study and a need for further examination. Avenues for future research include analyzing the age at which these patients completed their first dental visit and recommendations made by the patient's pediatrician to establish a dental home at an earlier age. It also would be beneficial to conduct a survey among parents of these patients to inquire if there was a conversation with their pediatrician, where they were informed of their child's potentially higher risk for the development of early childhood caries. It may also be of note to gather more demographic information and determine if children with early childhood caries without a hyperbilirubinemia diagnosis had any environmental factors or medical history associated with an increased caries risk. The Medical University of South Carolina Pediatric Dentistry Clinic cares for a large number of children and adolescents with complex medical histories that may influence caries risk. In addition, there are more infants born at the Medical University of South Carolina than are noted in this research study. Not all of these infants may establish their dental home with the Pediatric Dentistry Clinic at the Medical University of South Carolina. This sample size of patients is a glimpse into the greater number of children who are born at this hospital who may have a diagnosis of hyperbilirubinemia, as well as a diagnosis of early childhood caries.

CONCLUSIONS

Hyperbilirubinemia is common in infancy, but there is significant variation in severity, duration, risk, and treatment. High levels of bilirubin have been shown to negatively affect dentinogenesis and may be implicated in the development of tooth defects that place the dentition at a higher risk for caries. A relationship was determined between the week of gestational age and a diagnosis of hyperbilirubinemia. There also was a high association between phototherapy treatment and pre-term birth (less than 36 weeks gestational age). In the patient population evaluated in this study, there is a very weak association between hyperbilirubinemia in infancy and a diagnosis of early childhood caries under 6 years of age. Further investigation into potential confounding factors, including the age of the first dental visit and the establishment of a dental home, is warranted to supplement this research.

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