Biomarker Levels and Enamel Defects Associated with Chronic Kidney Disease

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Introduction

Children with chronic kidney disease (CKD) can pose challenges for dental health care providers, not only due to their complex medical history, but also due to common dental anomalies present within this population. Dental findings associated with the enamel can include discoloration, pitting, and reduced hardness leading to extensive tooth wear with normal function (Velan & Sheller, 2021). According to the CDC, roughly 10,000 children and adolescents are living with kidney failure treated by dialysis or kidney transplant (CDC, 2017). It is important for dental professionals to understand the normal tooth formation and occurrences that have altered the natural formation, leading to malformations in children with CKD.

Purpose

Previous literature has substantiated claims that children and adolescents with chronic kidney disease (CKD) often present with dental anomalies such as enamel defects, caries experience, and calculus accumulation. Some studies have theorized that there are biological markers associated with CKD; however, not much is known about this topic. The aim of this observational correlation pilot study is to determine if levels of BUN, creatinine, phosphorus, and calcium correlate with enamel defects such as demarcated opacity, diffuse opacity, hypoplasia or other defects.

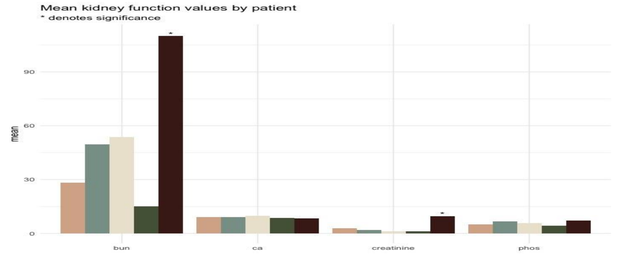
Methods

Patients undergoing hemodialysis at SSM Health Cardinal Glennon Children's Hospital were selected for this pilot study. Inclusion criteria were patients ages 6-17 years old, with a diagnosis of CKD. Exclusion criteria included: under the age of 6 or over the age of 17, no permanent dentition, or edentulous. Patients meeting inclusion criteria were preselected by the dialysis staff. The sample population was 5 individuals. A visual oral evaluation with a disposable mouth mirror was conducted during the patient's dialysis appointment. No tissue manipulation or explorer was used. Two teeth were selected based on the permanent dentition present and the visibility of the tooth. Molars and/or premolars were visually assessed for demarcated opacity, diffuse opacity, hypoplasia, or other defects. The modified developmental defects of enamel index [DDEI]) as cited by the World Health Organization (2020) was used to assess and categorize enamel defects. Patients' EHR were reviewed to record at least 3 readings from CBC results for BUN, creatinine, phosphorus, and calcium levels as close as possible to the calcification timeline of the assessed molar or premolar.

Results

A one-way ANOVA was performed to compare the differences of BUN levels between the individuals in study.

The one-way ANOVA revealed that there was a statistically significant difference in BUN and creatinine levels between at least two patients ($F(4, 10) = 5.778$, $p = 0.011$) and ($F(4,10) = 13.083$, $p = 0.001$), respectively (Table 7). Tukey's HSD Test for multiple comparisons found that the mean value of BUN was significantly different between patient 5 and patient 1 ($p = 0.022$, 95% CI = [11.23,152.036]). The mean value of BUN was also significantly different between patient 5 and patient 4 ($p = 0.009$, 95% CI = [24.5, 165]). The mean value of creatinine was significantly different for patients 5 and 1 ($p = 0.005$, 95% CI= [2.08-11.3]). The mean value of creatinine was also significantly different for patients 5 and 2 ($p = 0.002$, 95% CI = [3.05, 12.3]).



Patient	Age	Gender	Tooth	Enamel Defect
1	6	F	#19/ #30	Hypoplasia
2	13	F	#4/#20	Normal/Diffused Opacity
3	7	M	#14/#19	Diffused Opacity
4	15	M	#18/#31	Normal
5	11	M	#19/#28	Normal/Diffused Opacity

Conclusion

The study described oral DDE findings in 5 patients on hemodialysis to determine if there was a correlation with periodic changes of BUN, creatinine, phosphorus, or calcium levels during or around the time of enamel calcification. Previous literature has supported evidence that phosphorus and calcium imbalance directly affect enamel. This study could not conclude that levels of BUN and creatinine directly contributed to enamel changes in any patient.

References

Center for Disease Control and Prevention. (2017). Kidney Disease Surveillance System. https://nccd.cdc.gov/ckd/AreYouAware.aspx?emailDate=July_2017

Velan, E., & Sheller, B. (2021). Oral health in children with chronic kidney disease. Pediatric nephrology (Berlin, Germany), 36(10), 3067–3075. https://doi.org/10.1007/s00467-020-04913-9