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Health disparities in infants with hypertrophic pyloric stenosis

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Abstract

BACKGROUND: This study investigates whether health disparities exist in infants with hypertrophic pyloric stenosis (HPS), to identify factors affecting definitive treatment, and if more morbidity occurs.

METHODS: A 6-year retrospective analysis was performed on infants with HPS. Analysis of variance was used to evaluate the impact of socioeconomic factors on disease severity and hospitalization. General linear models were used to assess the impact of risk factors on the outcomes.

RESULTS: There were a total of 584 infants. African-American's had lower serum chloride ($P < .001$), higher bicarbonate ($P = .001$), and sodium levels ($P = .006$), adding to longer hospitalization than whites ($P = .03$). Uninsured infants had lower sodium and chloride ($P < .001$) and higher bicarbonate ($P < .001$), resulting in a longer time to operation ($P = .05$) than privately insured infants. In multivariable analyses, African-American's were associated with chloride ($P = .002$) and higher bicarbonate ($P = .009$), and uninsured status remained significantly associated with all electrolyte abnormalities.

CONCLUSIONS: African-American and poorly insured infants with HPS had greater risk of metabolic derangements. This required more time to correct dehydration and electrolytes, adding to longer hospitalizations.

One of the original Healthy People initiatives, and "overarching goals" of Healthy People 2020,[1] is "Maternal, Infant, and Child Health" which focuses on achieving health equity, eliminating disparities, and improving the health of all groups in the United States. Social determinants have great influence on infant health. Racial and ethnic disparities in infant mortality exist, particularly for African-American infants. Understanding how social determinant factors contribute to risk of illness and mortality is often complicated, due to the high correlation between many of these factors. Studying how these factors affect diseases of infancy may help add clarity to the care of infants at risk.

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Dr. Feliz supervised the conceptualization and design of the study, drafting of the manuscript, and approved the final manuscript as submitted. Dr. Holub conceptualized and designed the study, drafted the initial manuscript, and approved the final manuscript as submitted. Dr. Azaraksh designed the data collection instruments, coordinated and supervised data collection, critically reviewed the manuscript, and approved the final manuscript as submitted. Dr. Bachier-Rodriguez assisted in the drafting, editing, and approval of the final manuscript. Dr. Savoie assisted in the drafting, editing, and approval of the final manuscript.

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Currently, there is a paucity of work examining whether social determinants affect care in infants with hypertrophic pyloric stenosis (HPS), and few studies in the literature focus on the presenting factors and resultant potential morbidity for pediatric surgical diseases.[2,3] It has been suggested that disease models for the assessment of barriers to access to health care should have no or few clear modifiable risk factors and be fairly uniform across race, ethnicity, and socioeconomic status.[4,5]

HPS represents an excellent model to evaluate disparities in infant health, care utilization, and outcomes due to its relative frequency, natural disease progression, and standardized treatment. The prevalence of HPS ranges from 1.5 to 4.0 per 1,000 live births in white infants, with less prevalence in African-American and Asian children, making it one of the most common surgical diseases in infancy.[6–9] Although a male predominance has been well reported, no clear modifiable risk factor has been identified.[10,11]

Infants with HPS present with progressive, projectile emesis from gastric outlet obstruction due to hypertrophy of the pyloric musculature. Operative treatment is curative; however, surgical intervention is preceded by correction of acid-base and fluid derangements present at the time of diagnosis. Delays in presentation lead to greater metabolic derangements, placing these infants at risk for requiring higher acuity of care and longer hospitalizations. Once stabilized, pyloromyotomy allows for complete resolution of the obstruction, and most infants are discharged 24 to 48 hours after their operation.[12]

The present study seeks to determine if health disparities exist in the presentation of infants with HPS and to identify factors that may delay definitive surgical treatment. We hypothesize that socioeconomic determinants of health, such as race/ethnicity and insurance status, affect the presentation of infants with HPS, resulting in a subset of infants presenting more acutely ill, requiring greater care, and longer hospitalization before definitive surgical intervention.

Methods

This is a retrospective cohort study performed after Institutional Review Board approval by the University of Tennessee Health Science Center. A chart review of the medical records of infants who underwent pyloromyotomy for HPS (International Classification of Diseases - version 9 [ICD-9]: 750.5, 537.0) during a 5-year period (2007 to 2012), at Le Bonheur Children's Hospital, a tertiary free-standing pediatric hospital, was performed; all infants with a confirmed intraoperative diagnosis of HPS were included in the final analysis.

The primary outcome of illness acuity at time of admission was assessed by the presence of electrolyte abnormalities (specifically, serum chloride, bicarbonate, sodium, and potassium levels) and time to operation (ie, length of hospitalization before definitive surgical treatment). Increased morbidity was defined as an increased total length of hospital stay, compared with the control group.

The diagnosis of pyloric stenosis is made with the assistance of ultrasonography, which has been readily available at our institution, in most infants. Infants are taken for operative intervention once they are appropriately resuscitated, which is defined as having adequate urine output and normalized electrolytes, according to institutional standard reference values: chloride greater than 100 meq/L and serum bicarbonate level less than 30 mmol/L. At our institution, volume resuscitation is based on a standardized protocol. The infants receive 1 or 2 10 mL/kg boluses of isotonic fluid in the emergency department to establish urine output. They then receive a standard resuscitative fluid at a rate of 150 mL/kg/day. Laboratory values are checked each morning, and operative plan is decided depending on these values. Hence, greater volume requirements require greater time length of stay before their definitive operative therapy.

Patient demographic information included gender, race/ethnicity, and insurance status. Patient illness characteristics included days of symptomatic emesis before index hospitalization and admission weight.

Descriptive statistics including mean ± standard deviation were computed to summarize continuous data. Categorical data were analyzed using the Fisher's exact test. Some data were missing on the following variables: weight (1), serum bicarbonate (11), serum chloride (9), serum potassium (9), serum sodium (12), and duration of symptoms (4). One-way analysis of variance models, using the Tukey–Kramer method to adjust for multiple comparisons, were employed to test differences in means of each outcome for the race/ethnicity groups and insurance status. A P value less than .05 was considered to be statistically significant. A generalized linear model was performed to assess the impact of risk factors (patient demographics and illness characteristics as defined previously) on the outcomes electrolyte abnormalities, time to operation, and total length of hospital stay. Variables with a P value less than .05 were retained in the final model based on the stepwise model selection procedure. Statistical analyses were performed using SAS, version 9.3 (SAS Institute, Cary, NC).

Results

A total of 584 patients with HPS were identified during the study period (Table 1). The mean age and weight were 6.9 ± 8.6 weeks and 3.9 ± .8 kg, respectively. There were 339 (58.1%) white, 188 (32.2%) African-American, and 57 (9.8%) Latino infants. There were 199 (34.1%) infants with private insurance, 362 (62.0%) with public insurance, and 23 (3.9%) with no insurance. Of white infants, 142 (41.8%) had private insurance, 190 (56%) had public insurance, and only 7 (2%) were uninsured. In contrast, only 41