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Racial Variation In Timing Of Pyeloplasty: Prenatal Versus Postnatal Diagnosis

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Abstract

Purpose—We have previously shown that non-white patients with UPJ obstruction undergo pyeloplasty at a younger age than do whites. The mechanisms behind this are unclear, as there is no known racial variation in the natural history of UPJ obstruction. We sought to use a detailed clinical database to explain this phenomenon.

Methods—We performed a retrospective review of all patients undergoing primary pyeloplasty at our institution between 1992 and 2008. Over 360 data points were abstracted for each patient, including self-reported patient race, socioeconomic status, symptom duration, and presentation.

Results—Of 847 patients undergoing pyeloplasty during the study period, 741 met inclusion criteria. Non-white patients underwent surgery younger than did whites (non-white 0.6 v. white 2.6 years, $p < 0.0001$). When stratified by timing of clinical presentation (prenatal versus postnatal), there was no significant difference by race among patients presenting prenatally (0.37 v. 0.36 years, $p = 0.22$). Non-white patients presenting postnatally were significantly younger than white patients (6.3 v. 8.2 years, $p = 0.03$). This appeared to be due to differences in both the age at initial clinical presentation (5.4 v. 7.0 years, $p = 0.03$) and in time from initial clinical presentation to urology evaluation (0.6 v. 3.2 months, $p = 0.03$). These differences persisted after correcting for other factors, including markers of socioeconomic status.

Conclusions—Consistent with previous studies, we found that non-white patients underwent primary pyeloplasty at a younger age than whites. This difference is limited to patients presenting after birth. Prenatally diagnosed patients underwent surgery at similar ages regardless of race.

Keywords

Ureteropelvic Junction; Obstruction; Disparities; Surgery; Hydronephrosis

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Introduction

Antenatal hydronephrosis is the single most common abnormality identified during prenatal sonography, and in recent years an increasing proportion of patients with congenital ureteropelvic junction obstruction (UPJO) are being identified through prenatal screening. Although the indications for surgical intervention in these children have evolved over time,^{1, 2} pyeloplasty for correction of obstruction remains one of the most common major surgical procedures in urology.

As part of previous studies using national administrative databases to characterize trends in the management of congenital UPJO, we observed a **significant** difference in the timing of surgery between whites and nonwhites, with nonwhites undergoing surgery significantly earlier than whites.^{3, 4} The reasons for the apparent disparity are unknown.

The aim of this study is to use a detailed clinical database to elucidate racial disparities in the timing of pyeloplasty in patients with UPJO.

Patients and Methods

Patient Population

We retrospectively identified all children with UPJO undergoing primary pyeloplasty at our institution between 1992 and 2008. For each patient we abstracted their initial clinical presentation, history (including prenatal findings), and preoperative imaging studies. Self- or parent-identified race/ethnicity data were gathered from hospital and departmental records to check for any discrepancies. To further elucidate the sequence of care that might impact surgical timing, we determined the timing of key benchmarks in the clinical pathway leading to surgery. These benchmarks included (in sequential order): initial clinical presentation (point at which symptoms developed or initial tests identified a problem); institutional presentation (if seen by a department other than urology); departmental presentation; and the procedure itself.

We estimated patient socioeconomic status (SES) using multiple methods. Based on billing records, we determined patient insurance status at the time of departmental presentation and at the time of surgery. We used the patient's address to assess block-level data from the United States Census Bureau.⁵ We abstracted local median household and per-capita income; percentage of English-speaking households; of single-parent households; of residents with high school and college-level education; and of households with families living below the poverty level.

Statistical Analysis

We performed bivariate tests of association between predictor variables and our primary outcome (age at pyeloplasty) using Wilcoxon rank-sum or Fisher's exact test as appropriate. We then created linear regression models to assess the relationships between predictor variables and age at pyeloplasty. Model covariates were determined based on our conceptual model⁶ and a bivariate p-value of 0.2 or less. The covariates entered into our final model included patient race/ethnicity (white/non-white), insurance payer (private/public), median local per capita income, percentage of households speaking English only, percentage of single-parent households, percentage of residents with high school education, timing of diagnosis (prenatal/postnatal), patient gender, etiology of UPJO, and year of surgery. Generalized estimating equations were used to control for clustering of similar patients or care patterns among the 15 surgeons performing pyeloplasty at our institution during the study period. Model diagnostics revealed no significant violations of regression

assumptions. All analyses were performed using SAS version 9.2 (SAS Institute Inc., Cary, NC). All tests were two-sided and p-values of 0.05 or less were considered significant.

Institutional review board approval was obtained from Children's Hospital Boston prior to data collection and analysis.

Results

During the study period, 847 patients underwent primary pyeloplasty for UPJO at our institution. We excluded 106 (13%) patients due to lack of adequate racial information; excluded patients did not differ from those included in terms of age at pyeloplasty ($p=0.25$). Demographic data of the remaining 741 patients is presented in Table 1. Most patients were white (84%), privately-insured (83%) males (68%) without significant co-morbidity (68%). Prenatal (49%) and postnatal (51%) diagnoses were evenly distributed. Obstructions were typically left-sided (59%) and due to intrinsic (73%) obstruction. Few patients required a translator during their office visit or hospital stay (3%). Most patients (89%) underwent open pyeloplasty. Median and mean age at the time of surgery were 1.9 and 4.8 years, respectively.

Non-white patients underwent surgery at a younger age than did whites (median 0.6 v. 2.6 years, $p<0.0001$). When stratified by timing of clinical presentation (prenatal v. postnatal), however, there was no significant difference by race among patients presenting with prenatal hydronephrosis (PNH) (median 0.37 v. 0.36 years, **mean 1.4 v. 1.2 years**, $p=0.22$). Among postnatal non-white and white patients, however, the difference in age at surgery persisted (median 6.3 v. 8.2 years, **mean 7.1 v. 9.0 years**, $p=0.03$). Both surgical indication (Table 2) and UPJO etiology (Table 3) differed by presentation timing and by race. Among postnatal patients, whites were more likely to be initially diagnosed at another institution than non-whites (33% v. 16%, $p=0.03$), and were less likely to be initially seen in our institution's emergency room (13 v. 26%, $p=0.03$).

Among the postnatally diagnosed group, examination of clinical timing benchmarks identified two distinct factors that appeared to contribute to the later surgery among white patients (Table 4). First, the age at initial clinical presentation was different between non-whites and whites (non-white 5.4 v. white 7.0 years, $p=0.03$). Second, there was a significant difference in the time from initial presentation until surgery (3.0 months v. 5.4 months, $p=0.04$). This second difference was not due to variation in time from urologic evaluation until surgery, which was similar between non-white and white patients (1.9 v. 1.4 months, $p=0.3$). Instead, the delay appeared to be due to variation in time from a patient's initial clinical presentation to their urology evaluation (0.6 v. 3.2 months, $p=0.03$).

Additionally, multiple SES factors differed between racial groups (Table 5), raising the possibility that these factors could at least partially explain the differences in surgical timing between racial groups. After adjusting for SES, for other clinical factors, and for surgeon-level clustering of similar patients and practice preferences, patient race/ethnicity remained a significant predictor of age at surgery only among patients diagnosed after birth ($p=0.006$ among postnatal diagnosed patients, $p=0.07$ among prenatal diagnoses).

As expected, after multivariate adjustment for SES, race, and surgeon, prenatally diagnosed patients underwent surgery at a significantly younger age than did postnatally diagnosed patients ($p=0.007$). Among all patients (prenatal and postnatal), timing of surgery also varied by year of surgery, with patients presenting in the early 1990s undergoing surgery earlier in life than patients presenting in the early 2000s ($p=0.02$). Census data on household educational level ($p=0.87$), presence of a father in the household ($p=0.86$), primary spoken

language at home ($p=0.79$), and per-capita median household income ($p=0.43$), in addition to patient gender ($p=0.41$) and insurance status ($p=0.07$), were not significant predictors of a patient's age at the time of pyeloplasty. On subset analysis of the white cohort, these SES factors remained insignificant.

Discussion

It is widely acknowledged that clinical decision-making may be influenced by a variety of non-clinical factors on the part of both patient and physician, including race and ethnicity.⁶ Countless studies have documented disparities in health care access and outcomes for non-whites compared to whites for a wide range of conditions, including many pediatric and urologic conditions.^{7, 8} In previous studies of congenital UPJO using nationwide databases, we observed a **significant** difference in the timing of surgery between whites and non-whites, with non-whites undergoing surgery at a significantly younger age than whites.^{3, 4} In the first of these studies, we examined 5,858 pyeloplasties from the Nationwide Inpatient Sample, specifically analyzing factors associated with the timing of surgery. In that nationally-representative sample we found that non-white patients underwent surgery an average of 26 months earlier than white patients ($p<0.001$). Importantly, this difference persisted even after adjusting for patient SES, insurance, and hospital factors.³

To further explore these findings, we used a designated pediatric database, the Kids' Inpatient Database. We again observed **significant** variation by race in the timing of surgery: non-whites underwent surgery 29 months earlier than whites ($p<0.001$). Non-whites were also 52% more likely to undergo surgery during the first year of life ($p<0.001$), and these effects again persisted after adjusting for other factors. Taken together, these studies demonstrate that non-white children have surgery at significantly younger ages than do their white peers. However, they were limited in their ability to elucidate factors underlying the discrepancy due to the relative lack of clinical detail in administrative data. In particular, it is unclear if the findings were due to biological differences (*e.g.*, UPJO may progress more rapidly in nonwhite children), provider differences (*e.g.*, concern over possible loss to follow-up may lead to earlier surgery in non-whites), or to other factors. The current study takes advantage of a detailed clinical database which has allowed us to examine clinical and other factors that might influence racial variations in timing of surgery.

The racial differences we have observed in the timing of pyeloplasty are curious, as they differ from the pattern typically seen in disparities research. Non-white populations in the United States often have healthcare access problems, which may be attributable to economic barriers, cultural differences, and patient or provider bias. In this instance, however, the typically underserved population (non-whites) undergoes surgery significantly earlier than the population usually identified with better access (whites). On the one hand, this suggests that the disparity is not simply an access issue, and may reflect other complex cultural and/or socioeconomic factors that may affect decision-making. It is well-documented that clinical decision-making may be influenced by a variety of non-clinical factors including social, cultural, and economic concerns, on the part of both the patient and the physician.⁶ On the other hand, the persistence of the disparity among the patients presenting after birth, even after controlling for factors such as SES and insurance status – and particularly the fact that the age at clinical presentation appears to vary between groups – raises the possibility that these findings reflect a true biological variation between whites and nonwhites in the natural history of UPJO.

We noted that the clinical presentation – that is, the initial manifestation of signs or symptoms that led to the diagnosis of UPJO – was significantly different between whites and non-whites. Post-natal patients with UPJO presented earlier in the non-white population,

by a wide margin. There is no known biological explanation for this, and there has not been any description of a racial variation in the natural history of UPJO. However, racial variations in prevalence clearly exist for certain urological conditions, such as vesicoureteral reflux,⁹⁻¹¹ so it is certainly possible that such differences exist for UPJO. Social, cultural, or economic factors may also play a role in determining when patients first present with a clinical illness, so it is unlikely that that biological factors alone determine UPJO discrepancies.

One possible explanation for the discrepancy in timing of clinical presentation is that many of the early-presenting non-white children may actually be “missed” patients with PNH. It has been shown that non-white populations have decreased access to, and utilization of, prenatal care.¹²⁻¹⁵ It is thus plausible that a higher proportion of non-white patients who presented postnatally might, had they had received equivalent prenatal care compared to the white population, have been diagnosed prenatally. This hypothesis is supported by the fact that the proportion of older children (>12 years) among whites was nearly double that among nonwhites (15% vs. 9%), which would be expected if more “missed” nonwhites present early in childhood. Conversely, however, PNH was actually more prevalent among the non-white cohort (64% vs. 49%), which would seem to make it less likely that a lack of prenatal screening underlies the difference. This question deserves further study.

Other access and referral pattern differences were seen in this sample which may have contributed to the variation in timing of surgery, specifically time from clinical presentation to arrival in the urology department for consultation. Again, the discrepancy is reversed from what one might expect based on typical disparity patterns, in that white patients had a significantly longer time from presentation to specialist consultation. There could be a number of possible explanations for this, including primary physicians for underserved populations being more likely to refer sooner (due perhaps to workload, financial factors, lack of comfort with hydronephrosis management, etc), or the greater reliance of the non-white population on the emergency department for initial care, thus potentially speeding subspecialty consultation due to simple proximity.

There are also encouraging findings in these data. Among those patients diagnosed prenatally, the age at surgery (and, by inference, the referral and surgical decision-making processes) did not differ by race/ethnicity, suggesting that we equitably manage this population without reference to non-biological parameters. Similarly, among those presenting postnatally, there was no difference in time to surgery once the patient entered our department as a referral or consultation. This, too, suggests an encouraging uniformity of care within the “walls” of pediatric urology.

The findings of this study should be interpreted in light of its limitations. We focus exclusively on patients who actually underwent pyeloplasty, and we do not have an equivalent control population who did *not* undergo pyeloplasty. Thus, our findings may be biased by the fact that pyeloplasty patients may not represent all UPJO patients. Similarly, this study is a retrospective review of medical records, and thus is subject to the inherent limitations of this design, including missing data and selection bias. These problems are mitigated somewhat by the fact that, by design, this study focused on events prior to the surgical procedure, which means that missing data and loss-to-follow-up are less of an issue than in many retrospective studies. As a single-institution study, these data reflect the experience at our site and may not be generalizable to all children's hospitals, or to hospitals in other communities or health care systems. Similarly, there is general agreement on the broad indications for surgical pyeloplasty in the setting of UPJO, different surgeons and institutions may have widely varying thresholds for determining when a patient meets those criteria. Thus, our surgical sample may not be reflective of those at other institutions.

However, generalizability is enhanced by the fact that a large number of surgeons contributed cases to this cohort, which should limit the effects of any particular surgeon's practice patterns on surgical timing. Additionally, other recent reports of UPJO are similar to ours in terms of surgical age and indication.¹⁶ Furthermore, we adjusted for clustering of similar patients among each surgeon using a mixed model. Lastly, it should be remembered that the impetus for the current study was the findings from two large, national, stratified samples of pyeloplasty patients, derived from data at hundreds of hospitals. The surgical timing discrepancies seen in those databases were strikingly similar to those observed within our local cohort, suggesting that our cohort may be more representative of wider trends than might otherwise be expected.

Conclusions

Consistent with previous studies, we found that non-white patients with UPJO underwent primary pyeloplasty at a younger age than whites. This difference appears to be limited to patients who present after birth; patients with PNH underwent surgery at similar ages regardless of race. Our findings suggest that the racial variation among patients with UPJO may be due either to biological differences in the age at which children present with UPJO or to variations in practice patterns, or to a combination thereof.

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Key To Abbreviations

UPJO	ureteropelvic junction obstruction
PNH	prenatal hydronephrosis
SES	socioeconomic status

Table 1
Patient Demographic Data

	# Non-White (%)	# White (%)	P-Value*
Total Number of Patients	120 (16%)	621 (84%)	-
Median (Mean) Age at Surgery	0.6 (3.2)	2.6 (5.2)	<0.0001 [†]
Age at surgery by category:			
< 1 year	73 (61%)	240 (39%)	0.001
1-3 years	9 (8%)	82 (13%)	
4-6 years	11 (9%)	82 (13%)	
7-12 years	18 (15%)	125 (20%)	
13-18 years	7 (6%)	63 (10%)	
> 18 years	2 (2%)	29 (5%)	
Gender			
Male	91 (76%)	414 (67%)	0.05
Female	29 (24%)	207 (33%)	
Race/Ethnicity:			
White/Caucasian	-	621 (100%)	-
Black/African American	37 (30.8%)	-	
Asian	23 (19.2%)	-	
Hispanic	50 (41.7%)	-	
Other	10 (8.3%)	-	
Interpreter Use During MD Visits?			
Yes	19 (16%)	5 (1%)	<0.0001
No	101 (84%)	615 (99%)	
Insurance Payer at Surgery			
Private	68 (57%)	540 (88%)	<0.0001
Public	52 (43%)	72 (12%)	
Presentation			
Prenatal	76 (64%)	301 (49%)	0.004
Postnatal	43 (36%)	315 (51%)	
Surgical Technique			
Open	105 (89%)	535 (89%)	0.36
Robotic	13 (11%)	56 (9%)	
Laparoscopic	0 (0%)	9 (2%)	
Laterality			
Right	43 (36%)	228 (37%)	0.56
Left	71 (59%)	374 (60%)	
Bilateral	6 (5%)	19 (3%)	

* Fisher's exact test

[†]Wilcoxon rank-sum test

Table 2
Comparison of Surgical Indications, by Timing of Diagnosis and Race

Surgical Indication	Timing of Diagnosis		Race	
	Postnatal	Prenatal	Non-white	White
Worrisome Radiologic Study (<i>e.g.</i> , poor function, worsening hydronephrosis)	59 (16%)	168 (45%)	38 (32%)	189 (31%)
Symptomatic UPJO	188 (52%)	22 (6%)	21 (18%)	189 (31%)
Social Concerns (<i>e.g.</i> , Insurance concerns, multiple missed appointments)	1 (0.3%)	3 (0.8%)	3 (3%)	1 (0.2%)
Other Medical Concerns (<i>e.g.</i> , infection, solitary kidney, presence of concomitant reflux or stones)	29 (8%)	24 (6%)	10 (8%)	43 (7%)
Family desire	9 (3%)	22 (6%)	8 (7%)	23 (4%)
No reason given	71 (20%)	134 (36%)	40 (32%)	176 (27%)
P-Value	<0.0001		0.001	

*
 Fisher's exact test

Table 3
Comparison of Etiology of UPJO, by Timing of Diagnosis and Race

Etiology of Obstruction	Timing of Diagnosis		Race	
	Postnatal	Prenatal	Non-white	White
Intrinsic	209 (60%)	327 (89%)	93 (82%)	443 (73%)
Crossing Vessel/Extrinsic	126 (36%)	19 (5%)	11 (10%)	136 (23%)
Unknown	13 (4%)	22 (6%)	10 (8%)	25 (4%)
P-Value *	<0.0001		0.002	

* Fisher's exact test

Table 4
Key Benchmarks for Surgical Timing Among Postnatal Patients Only

	Median age at initial clinical presentation (months)	Median time from initial clinical presentation until institutional presentation (months)	Median time from institutional presentation to urology presentation (months)	Median time from urology presentation until surgery (months)	Median age at surgery (months)
White	84.0	3.2	2.0	1.4	98.4
Non-White	64.8	0.6	2.0	1.9	75.6
P-value *	0.03	0.04	0.7	0.3	0.03

* Wilcoxon rank-sum test

Table 5
Markers of Socioeconomic Status among the Cohort

	Non-White	White	P-Value*
Median # of single-mother households per census block	161.5	82.0	<0.0001
Median % high-school graduates per census block	80.5	90.3	<0.0001
Median % college graduates per census block	23.0	33.9	<0.0001
Median % English-only households per census block	69.4	91.3	<0.0001
Median % families with children below poverty level per census block	15.4	4.1	<0.0001
Median family income per census block	\$48,488	\$68,484	<0.0001
Median per- capita income per census block	\$19,688	\$26,314	<0.0001

* Wilcoxon rank-sum test