Operative Versus Nonoperative Management of Ureteropelvic Junction Obstruction in Children

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OBJECTIVES To describe and validate our strategy for treating patients with ureteropelvic junction obstruction operatively or nonoperatively according to ultrasonography and nuclear renal scan findings.

METHODS A retrospective analysis of 243 patients from 1999 to 2006 with grade 3-4 hydronephrosis was performed. Depending on the grade of hydronephrosis with parenchymal thinning on ultrasonography and renal function on the nuclear renal scan, patients were treated with immediate pyeloplasty, pyeloplasty after a period of observation, or observation only.

RESULTS Of 243 patients, 116 were found to have UPJO as determined by a half-life >20 minutes. The mean follow-up was 24.0 months (range 3-69). Immediate pyeloplasty was performed in 32 children, and 84 were treated conservatively. Crossover from observation to surgery occurred in 47 children. In the immediate pyeloplasty group, the mean pre- and postoperative differential function was 30.4% and 38.8%, respectively ($P < .0001$). In the observation-only group (n = 37), the initial mean renal function was 41.4% and stayed stable throughout the follow-up period, at a mean of 43.2% ($P = .2764$). In the delayed pyeloplasty group (n = 47), the initial mean renal function was 35.9% and increased to a mean of 41.6% after intervention ($P = .0003$). The median improvement of hydronephrosis on ultrasonography for those who underwent immediate surgery from before to after the intervention was from grade 4 to grade 3 ($P < .0001$). For those not undergoing surgery, it improved from grade 4 to grade 2.25 ($P = .0026$) and for those who underwent delayed surgery, from grade 4 to 3 ($P = .0003$).

CONCLUSIONS According to our findings, the serial ultrasonography findings and initial renal function on nuclear renal scan are better indicators than the half-life alone for determining whether pyeloplasty is indicated. UROLOGY 73: 521–525, 2009. © 2009 Elsevier Inc.

Ureteropelvic junction obstruction (UPJO) is a principal cause of renal damage in young children and can lead to early, permanent loss of renal function. The widespread use of antenatal renal ultrasonography starting in the mid-1980s caused an increase in the incidence of infantile hydronephrosis. This instigated the need for a standard of care for asymptomatic hydronephrosis.

For those with suspected UPJO, debate is ongoing regarding the optimal management. Historically, most children with high-grade hydronephrosis were treated surgically. Surgical management with open pyeloplasty is safe, with a high success rate of 90%-95%.[1] Studies have indicated that conservative management is appropriate for children who might not have complete UPJO.[2-4] The difficulty is the determination of which patients have significant obstruction and require early corrective surgery.[5,6]

The development of diuretic renography has shown promise for assisting in the diagnosis and management of UPJO. Calculation of the glomerular filtration rate (GFR) is well established for the diagnosis of obstruction. Many sources use the half-life ($T_{½}$) value—the time to clear 50% of the diethylene triamine pentaacetic acid contrast medium after the administration of furosemide—as the chief indicator of obstruction. A $T_{½}$ time of <10 minutes is generally considered benign, and values >20 minutes indicate obstruction. Values between 10 and 20 minutes are thought to be equivocal.[7-9] The use of this particular measurement has not yet been shown to affect outcomes when used to direct the management of UPJO.

In this study, we evaluated the adequacy of the currently accepted standards for managing suspected UPJO according to an elevated $T_{½}$ value on nuclear renal scan (NRS) in correlation with decreased renal function.

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Table 1. Demographics

Demographic	Immediate Pyeloplasty (Group 1)	Observation (Group 2)	Delayed Pyeloplasty (Group 3)	Total
Patients (n)	32	37	47	116
Sex (n)				
Male	22	32	30	84
Female	10	5	17	32
Affected kidney				
Left	15	26	30	71
Right	16	11	17	45
Age at presentation (d)				
Mean	1092	224	780	762
Minimum	14	4	3	3
Maximum	7749	3051	5444	7749
Mean follow-up (mo)	28.38	18.12	25.24	23.98

MATERIAL AND METHODS

The institutional review board of the University of Oklahoma Health Sciences Center approved the study, and a review was conducted to identify all patients with unilateral or bilateral grade 3 or greater hydronephrosis on renal ultrasonography from 1999 to 2006. Cases of UPJO were determined when the NRS showed a delayed $T_{½}$ of >20 minutes after furosemide administration. Retrospective data concerning age, sex, laterality, and surgical repair or observational protocol were collected. The long-term outcomes concerning changes in hydronephrosis and/or renal function were noted.

Hydronephrosis was assessed by renal ultrasonography and graded according to the Society for Fetal Urology standards from grade 0 to 3. Intergrades (2-3 or 3-4) were recorded as grade 2.5 or 3.5, respectively. Small changes in the ultrasound findings that did not deserve a change in grade were recorded as positive or negative and later converted to one half the amount between a full grade and an intergrade (ie, 3.75 for slightly improved grade 4). These distinctions were made so that slight improvements or degradations could be reflected in the quantitative analysis.

After assessment with ultrasonography, the renal function was estimated using diuretic technetium-99m-diethylenetriaminepentacetic acid renogram NRS. This technique is commonly used to estimate the GFR by measuring the uptake of radioisotope by the kidneys compared with the background signal. The percentage of differential renal function was calculated according to the estimated GFR in each kidney. Furosemide was administered after infusion of the radiopharmaceutical, and images were acquired according to the Society for Nuclear Medicine protocol.[8]

According to a consensus between the Society for Fetal Urology and the Society for Nuclear Medicine, drainage of the renal pelvis into the ureter can be characterized by the renogram curve. Different categories of curve structure have been proposed as normal, immature, stasis, obstruction, and poor function.[9,10] Renogram curves or "drainage patterns" were used in making the management decisions for the patients, as detailed below.

For the purposes of this retrospective study, the ultrasound and NRS results were obtained by visualization of the studies by the managing surgeon. In equivocal cases, the results were discussed with the pediatric radiologist. The differential function on the NRS, signs of obstruction before and after furosemide administration, renal parenchymal blood flow, visualization of the ureter on the drainage films, and the $T_{½}$ values were obtained from the studies themselves. All measurements of renal function in the present study are reflected as the percentage of contribution of the affected kidney to the total renal function.

Patients were identified either by the prenatal ultrasound findings or postnatally because of symptoms. The symptoms included pain, hematuria, flank mass, and/or recurrent febrile infection. All patients underwent voiding cystourethrography. Patients with vesicoureteral reflux were excluded from the study. Those patients with grade 3 or greater hydronephrosis underwent NRS after the first month of age.

The pre- and postintervention NRS changes were subjected to a paired *t* test, and the 95% confidence intervals around the change in percentage were calculated. The pre- and postintervention hydronephrosis changes were subjected to a paired sign test. An analysis of variance procedure was performed to determine whether a difference in occurred in the change in NRS function across the study groups. All statistical tests were evaluated at a .05 significance level.

RESULTS

A total of 243 cases of hydronephrosis of grade 3 or greater in a 7-year period were evaluated. Of the 243 patients, 11 had no function in the affected kidney on NRS and were excluded. A $T_{½}$ of <20 minutes was found in 71 patients, 34 of whom had a value of 5-20 minutes. For 45 patients, all of the studies could not be obtained or they were lost to follow-up; these patients were excluded from the study.

Of the 187 remaining patients, the $T_{½}$ time was >20 minutes in 116. None of these patients had any other abnormalities of the upper or lower urinary tract. Appropriate studies and follow-up (range 2-80 months, mean 24.2) were available for all 116 patients included for review. Additional demographic data are listed in Table 1.

Depending on the results of the initial workup, the patients were divided into 3 groups: group 1, immediate surgery; group 2, observation protocol; and group 3, delayed pyeloplasty. Immediate standard open dismembered pyeloplasty was performed in 32 patients (group 1). The remaining 84 patients were placed in the observational