The Magnitude of Fetal Renal Pelvic Dilatation can Identify Obstructive Postnatal Hydronephrosis, and Direct Postnatal Evaluation and Management

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Purpose: Up to 1% of prenatal ultrasounds will detect fetal renal pelvic dilatation. We sought to evaluate and determine whether fetal renal pelvic measurements may appropriately direct prenatal counseling and postnatal evaluation and management.

Materials and Methods: We performed a retrospective analysis of prospectively collected measurements of anteroposterior renal pelvic dilatation obtained at a single fetal maternal medicine center between 1990 and 2003. Fetuses with renal pelvic dilatation 4 mm or greater at less than 33 weeks of gestation, or 7 mm or greater at more than 33 weeks of gestation were evaluated postnatally at a single pediatric urology center. Infants with renal pelvic dilatation were evaluated with ultrasound, voiding cystourethrograms and renal scintigraphy. Renal obstruction was the main outcome measure assessed. Obstruction was defined as the need for surgery and was not based on the renal scan drainage time. Indications for surgery included declining function and increasing hydronephrosis.

Results: There were 257 neonates with prenatally detected renal pelvic dilatation. A mean maximum prenatal renal pelvic dilatation of 11.8 mm was seen in 195 patients with nonobstructive dilatation. In the 62 patients with obstruction there was a nearly 2-fold increase in the mean renal pelvic dilatation (22.3 mm), which was statistically significant. Receiver operating characteristic analysis revealed that when 15 mm renal pelvic dilatation is used as a threshold it correctly discriminates obstruction in at least 80% of fetuses with a sensitivity of 73% and a specificity of 82%.

Conclusions: The magnitude of fetal renal pelvic dilatation is predictive of obstruction. Our results suggest that 15 mm renal pelvic dilatation represents a significant threshold. Receiver operating characteristic analysis provides a useful guide for prenatal counseling and may help to direct the postnatal evaluation.

Key Words: prenatal diagnosis; ultrasonography, prenatal; dilatation, pathologic

Fetal renal pelvic dilatation is the most frequently detected abnormality on prenatal ultrasound.[1] Repeat ultrasounds are often obtained during pregnancy to follow RPD, although the likelihood of progression or alteration in the timing or mode of delivery is small.[2] The anteroposterior diameter of the renal pelvis is the most reproducible measurement of RPD.[3] The commonly accepted anteroposterior diameter cutoffs for RPD of 4 mm or greater at less than 33 weeks of gestation and 7 mm or greater at more than 33 weeks of gestation for postnatal referral were described at our institution in 1991, with nearly 100% sensitivity but poor specificity for predicting postnatal obstruction. Renal pelvic dilatation may also be an indication of vesicoureteral reflux, although the clinical significance of this reflux is uncertain.[4–7]

Despite potential postnatal pathology, the majority of patients with prenatally detected RPD have no significant findings during infancy. Therefore, there is considerable debate regarding the necessity and extent of the postnatal evaluation in these asymptomatic newborns. To discriminate between upper urinary tract obstruction and benign transient dilatation, we performed a more detailed evaluation of the sensitivity and specificity of RPD detected on prenatal ultrasound with regard to postnatal outcomes.

METHODS

Maternal fetal medicine specialists prospectively recorded fetal RPD at our tertiary care center between 1990 and 2003. Fetuses with RPD of 4 mm or greater at less than 33 weeks of gestation and 7 mm or greater at 33 weeks of gestation were followed every 4 to 8 weeks during gestation. The maximum anteroposterior prenatal RPD measurement was used in the data and outcome analysis.

The study population received postnatal evaluation and management at St. Louis Children's Hospital. Infants were placed on amoxicillin prophylaxis (20 mg/kg daily) and evaluated with ultrasound at age 3 to 4 weeks. Voiding cystourethrograms and renal scintigraphy (^{99m}technetium mercaptoacetyltriglycine with furosemide) were subsequently obtained in most infants. Renal scans were not routinely obtained in infants with Society for Fetal Urology grades 0, 1 and 2 dilatation.[8] If the ultrasound revealed no dilatation

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at age 1 month and the voiding cystourethrogram was negative for reflux, the patient was classified as normal. Infants with duplication anomalies and multicystic dysplasia were excluded from this analysis. Routine urine samples were not obtained, but urinalysis and urine culture were obtained for fever greater than 38.5C or other localizing symptoms in older children.

All infants were initially treated conservatively. Postnatal obstruction was assessed as an outcome variable. For the purposes of this analysis obstruction was defined as the need for surgery and was not based on the drainage time on the renal scan. Surgery for obstruction was performed for declining renal function on serial renal scans (decrease of greater than 10% and a differential split of less than 40%) and/or increasing hydronephrosis on serial ultrasounds. Additionally, some older children underwent surgery for symptomatic intermittent renal colic. Cases were followed until the RPD resolved (or remained stable), and those not requiring surgery were classified as nonobstructive dilatation.

Statistical analysis included graphic comparison of distribution of maximum anteroposterior diameters between obstructive and nonobstructive groups with a 2-sample t test since the data were reasonably normally distributed (fig. 1). Overall diagnostic accuracy of the maximum diameter for discriminating between infants with and without obstruction was characterized by receiver operating characteristic curve (fig. 2). The area quantified under the curve is interpreted as the probability that a randomly selected newborn with obstruction has a larger maximum diameter than a randomly selected newborn without obstruction. To describe the clinical usefulness of the maximum diameter, we calculated sensitivity, specificity, and positive and negative predictive values for given cutoffs. These positive and negative predictive values are applicable in clinical settings, with an obstruction prevalence rate similar to ours (24%).

RESULTS

We identified 257 infants with RPD who received prenatal and postnatal evaluation and management at our institution. The prenatal measurements and postnatal findings are detailed in table 1. Distal ureteral dilatation was identified postnatally in 27 of the infants. Inclusion of these patients in the series did not change the statistical analysis. No patient had significant bilateral findings.

A total of 62 children (24%) underwent surgery for obstruction. There was a statistically significant difference in the mean prenatal RPD in the obstructed group in comparison to those without obstruction (fig. 1). Mean and median followup were 24 and 12 months, respectively. Dismembered pyeloplasty was performed in 55 infants and children with UPJ obstruction. Tapered ureteral reimplantation was performed in 7 infants with an obstructed megaureter.

Receiver operating characteristic analysis revealed that an RPD threshold of 15 mm discriminates obstruction in 80% of fetuses with a sensitivity of 73% and a specificity of 82% (fig. 2). Figure 3 shows the timing of surgical intervention in the obstructed group of infants. Nearly half of the patients underwent surgery before age 6 months. Only 3 children underwent surgery after age 18 months. Of these patients 1 had increasing hydronephrosis at age 2.5 years and 2 had symptomatic renal colic at age 6 years.

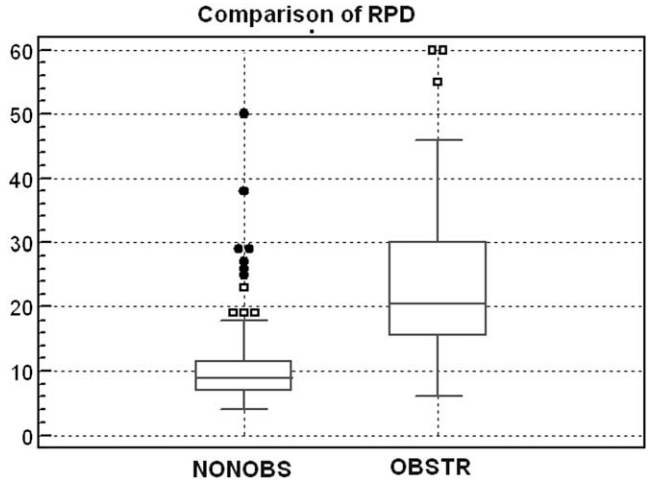

FIG. 1. Graphic comparison of maximum prenatal diameters between obstructive (*OBSTR*) and nonobstructive (*NONOBS*) groups. Box has several lines—median, upper quartile, lower quartile, 1.5 × IQR. Filled circles indicate data points beyond 1.5 IQR, values which are more extreme. *RPD*, renal pelvic dilatation.

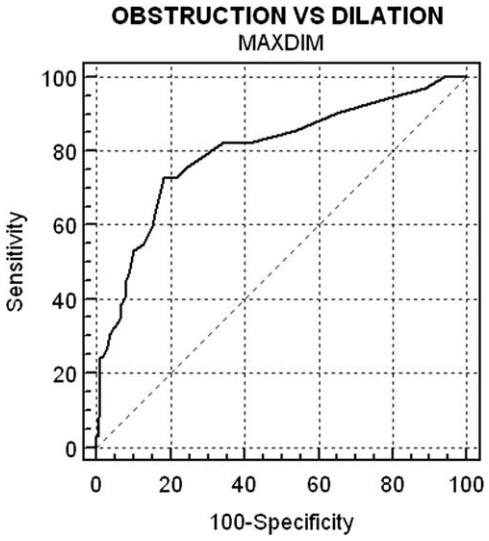

FIG. 2. Receiver operating characteristic curve characterizes overall diagnostic accuracy of maximum diameter (*MAXDIM*) for discriminating between infants with and without obstruction.

DISCUSSION

There has been extensive debate regarding the prenatal RPD threshold that triggers postnatal evaluation. Early thresholds were directed at 100% sensitivity for obstruction.[3] However, these levels resulted in lower RPD thresholds, which give a high false-positive rate. Consequently a

TABLE 1

Diagnosis	No. Children	Mean ± SD Max Prenatal RPD (mm)	p Value
Normal	11	8.2 ± 2.2	NS
Nonobstructive hydronephrosis	138	11.4 ± 6.6	NS
Vesicoureteral reflux	26	12.9 ± 6.8	NS
Obstruction	62	22.3 ± 12.1	p <0.0001