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# The Type and Frequency of Fetal Renal Disorders and Management of Renal Pelvis Dilatation

Jeffrey M. Dicke, MD, Valerie M. Blanco, Yan Yan, MD, Douglas E. Coplen, MD

**Objective.** This study describes the frequency of sonographically detected fetal renal disorders, the correlation of fetal renal pelvis dilatation (RPD) with the need for postnatal surgery, and proposed management of RPD. **Methods.** The study population consisted of 342 fetuses with prospectively identified isolated renal abnormalities and known follow-up. Fetuses with RPD were considered separately with respect to underlying renal disease, postnatal testing, and the need for surgical correction. Obstructive RPD was defined as the need for surgical treatment. Nonobstructive RPD included those cases that required no therapy. The correlation between prenatal RPD and the need for postnatal evaluation was examined. **Results.** Renal pelvis dilatation was the primary postnatal sonographic finding in 66.4% of cases. The remainder were distributed between multicystic dysplastic kidney, duplication malformations, and reflux, with a smaller number of other diagnoses. Renal pelvis dilatation in the obstructive group was significantly greater than in the nonobstructive group. However, 10% of fetuses with maximum RPD of 10 mm or less had an obstructive process, whereas 58% of fetuses with RPD of greater than 10 mm did not have obstruction. There were no cases in which preterm delivery was necessitated by RPD. **Conclusions.** Renal pelvis dilatation is the most common fetal renal abnormality. The greater the RPD, the more likely it is due to obstruction. However, the overlap between obstruction and no obstruction dictates postnatal evaluation. In that RPD, regardless of degree, did not change the timing of delivery, a single follow-up sonographic examination either late in pregnancy or after delivery is considered adequate for follow-up of RPD detected earlier in pregnancy. **Key words:** fetal; nonobstructive; obstructive; renal pelvis dilatation.

## Abbreviations

NMU, nonobstructed megaureter; NOH, nonobstructive hydronephrosis; NOR, normal; OMU, obstructed megaureter; RPD, renal pelvis dilatation; UPJ, uretero-pelvic junction; VCUG, voiding cystourethrogram

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Renal disorders are among the most common sonographically detected fetal abnormalities.<sup>1,2</sup> Commonly accepted thresholds for pathologic renal pelvis dilatation (RPD) requiring further prenatal or postnatal evaluation are an anteroposterior measurement of the renal pelvis of 4 mm or greater at less than 33 weeks' gestation or 7 mm or greater at more than 33 weeks' gestation.<sup>3</sup> The appropriate prenatal and postnatal follow-up of fetuses exceeding these thresholds is not standardized. This report describes the types and frequencies of isolated fetal renal abnormalities, the utility of renal pelvis measurements in the discrimination of obstructive versus nonobstructive disorders, proposed prenatal management, and postnatal evaluation.

**Materials and Methods**

The study population consisted of all fetuses examined in the ultrasound unit at this institution with isolated renal abnormalities and known postnatal follow-up in the Department of Urology at St Louis Children's Hospital. The parameters evaluated during the sonographic examination were those recommended by the *AIUM Practice Guideline for the Performance of an Antepartum Obstetric Ultrasound Examination*.<sup>4</sup> In addition, fetuses were routinely evaluated for the presence of sonographic markers for fetal aneuploidy (nuchal skin fold thickness, hyperechoic bowel, echogenic intracardiac focus, biparietal diameter–femur length ratio, and pyelectasis). Imaging of the cardiac outflow tracts, upper lip, and digits was also performed when possible. All prenatal data were prospectively collected and retrospectively identified from our obstetric sonography database. The study period was from 1990 to 2004. Renal pelvis dilatation was defined as a renal pelvis measurement of 4 mm or greater in the anteroposterior diameter at less than 33 weeks' gestation or 7 mm or greater at more than 33 weeks' gestation. Statistical analysis of the differences in RPD between obstructive and nonobstructive RPD has been described in a prior publication.<sup>5</sup> Postnatal follow-up ranged from 3 months to 10 years.

For purposes of this analysis, nonobstructive disorders were those that either resolved spontaneously postnatally or remained stable and did not require surgical correction. These included nonobstructive hydronephrosis (NOH), nonobstructed megaureter (NMU), and those cases in which the postnatal sonographic findings were deemed normal (NOR). Obstructive lesions were those requiring surgical treatment because of decreasing renal function, increasing hydronephrosis, or symptomatic renal colic and consisted of ureteropelvic junction (UPJ) obstruction and obstructed megaureter (OMU).

**Results**

The study population consisted of 342 fetuses between 18 and 41 weeks' gestation. The types and frequencies of postnatal diagnoses are listed in Table 1. In total, 66.4% of cases involved RPD as the primary sonographic finding. The total number of fetuses in the nonobstructive group was 167. There were 60 fetuses in the obstructive

**Table 1.** Postnatal Diagnoses of Sonographically Detected Fetal Renal Abnormalities (n = 342)

Abnormality	n (%)
Nonobstructive RPD	
NOH	139 (40.6)
NMU	21 (6.1)
NOR	7 (2.0)
Obstructive RPD	
UPJ obstruction	54 (15.8)
OMU	6 (1.8)
Multicystic dysplastic kidney	36 (10.5)
Duplication malformations	32 (9.4)
Reflux	28 (8.2)
Other	19 (5.6)

group. The remaining cases were fairly evenly distributed between multicystic dysplastic kidney, urinary tract duplication malformations, and reflux. The Other category included cases of bladder outlet obstruction, prune belly, pelvic kidney, horseshoe kidney, and bladder exstrophy. The mean RPD ± SD in nonobstructive diagnoses was 11.4 ± 6.6 mm versus 23.2 ± 12.1 mm in obstructive processes (*P* < .0001). The area under the receiver operating characteristic curve was 0.800, reflecting the probability that a given magnitude of RPD is indicative of obstruction.<sup>5</sup> All fetuses with RPD identified prenatally had postnatal sonography as their initial evaluation. A voiding cystourethrogram (VCUG) and renal scintigraphy were performed at the discretion of the pediatric urologists. The results of such testing are depicted in Tables 2 and 3. Voiding cystourethrogram and renal scintigraphy testing were performed in 95.0% and 91.7%, respectively, of fetuses with obstructive RPD. The VCUG revealed vesicoureteral reflux in 22.8%, and the renal perfusion scan revealed urinary stasis (*t*<sub>1/2</sub> > 10 minutes) in 96.4%. In fetuses with nonobstructive RPD, a VCUG was obtained in 74.3% and

**Table 2.** VCUG Testing and Results in Obstructive and Nonobstructive Fetal RPD (n = 227)

RPD		VCUG, n (%)
Obstructive (n = 60)	<b>No</b>	3/60 (5.0)
UPJ obstruction (n = 54)	<b>Yes</b>	57/60 (95.0)
OMU (n = 6)	Normal	44/57 (77.2)
	Abnormal	13/57 (22.8)
Nonobstructive (n = 167)	<b>No</b>	43/167 (25.7)
NOH (n = 139)	<b>Yes</b>	124/167 (74.3)
NMU (n = 21)	Normal	119/124 (96.0)
NOR (n = 7)	Abnormal	5/124 (4.0)

revealed reflux in only 4%. In the 29.3% that had renal scintigraphy, urinary stasis was present in 49.0%. Function of the affected moiety was reduced in less than 5% of infants.

Fetal sex was male in 76.6% of cases in the nonobstructive group and 70.0% in the obstructive group. The fetal left kidney was slightly more commonly affected (53.3% in the nonobstructive group and 58.3% in the obstructive group).

The relationship between maximum RPD and likelihood of an obstructive versus a nonobstructive process is indicated in Table 4. Of the 227 fetuses with RPD as the primary renal finding, nearly half had measurements between 4 and 10 mm. Of these, approximately 10% were secondary to an obstructive process. In fetuses with an RPD of 11 to 20 mm, 26.7% ultimately required surgery. The need for surgical correction increased to nearly 70% when the RPD was greater than 20 mm. Collectively, the ratio of obstructive to nonobstructive disorders was approximately 1:3.

The maximum RPD in obstructive and nonobstructive processes is indicated in Table 5. Although there was generally a direct relationship between RPD and renal obstruction, there was considerable overlap with the nonobstructive group, especially when the RPD was less than 20 mm. The numbers of fetuses requiring surgery with mild, moderate, and severe RPD are depicted in Table 6. No fetus with a maximum RPD of less than 6 mm required postnatal surgery. Eleven fetuses (18% of cases requiring surgery) with RPD between 6 and 10 mm had surgery.

## Discussion

The finding of any fetal abnormality on prenatal sonography often generates parental anxiety.<sup>6</sup> Fetal renal disorders are among the most common malformations detected sonographically.<sup>1,2</sup>

**Table 3.** Renal Scintigraphy Testing and Results in Obstructive and Nonobstructive Fetal RPD (n = 227)

RPD		Renal Scan, n (%)	
Obstructive (n = 60)	<b>No</b>	5/60 (8.3)	
	<b>Yes</b>	UPJ obstruction (n = 54)	
		Normal	2/55 (3.6)
		Abnormal	53/55 (96.4)
Nonobstructive (n = 167)	<b>No</b>	118/167 (70.7)	
	<b>Yes</b>	NOH (n = 139)	
		Normal	25/49 (51.0)
		NMU (n = 21)	
		NOR (n = 7)	Abnormal 24/49 (49.0)

The fetal renal pelves are readily visualized sonographically. The structure of the fetal kidneys and measurement of the renal pelves are able to be reliably assessed.<sup>7,8</sup> This report describes the spectrum of fetal renal disorders encountered in a tertiary care facility and examines the utility of thresholds for RPD sufficient to warrant postnatal evaluation. The classification of the postnatal diagnoses as obstructive or nonobstructive was chosen because this reflects the need for surgical correction, an important distinction when counseling parents regarding postnatal prognosis and management.<sup>9</sup>

Although the definition of obstruction is widely debated,<sup>10,11</sup> we tried, to the best of our ability, to treat all infants in the same fashion and use the same indications for surgery in all cases. We chose to define renal obstruction as a serial increase in hydronephrosis on postnatal sonography, declining function on renal scintigraphy, or symptomatic renal colic. We specifically did not base this on renal drainage times or the magnitude of dilatation because some infants had prolonged drainage times on renal scintigraphy ( $t_{1/2} > 20$  minutes), but dilatation resolved with follow-up, indicating that substantial obstruction was not present. Our results and conclusions may not be directly transferable to other institutions. For example, if a surgeon has a more aggressive approach that is based on sonographic appearance alone or on renal scan drainage time, then a lower magnitude of maximum RPD would be indicative of obstruction.

The patient whose fetus has isolated RPD may be reasonably counseled prenatally that the likelihood of an obstructive uropathy requiring correction is low (10%) with mild RPD (4–10 mm). This represented half of our cases. This risk increases to nearly 70% when RPD is greater than 20 mm. The importance of postnatal follow-up for definitive determination of clinical importance is shown by the postnatal finding that 40.7% of what were found to be nonobstructive

**Table 4.** Maximum Prenatal RPD and Likelihood of a Postnatal Obstructive or Nonobstructive Process

Maximum RPD	Obstructive, n (%)	Nonobstructive, n (%)	Total, n (%)
4–10 mm (n = 110)	11/110 (10.0)	99/110 (90.0)	110/227 (48.5)
11–20 mm (n = 75)	20/75 (26.7)	55/75 (73.3)	75/227 (33.0)
>20 mm (n = 42)	29/42 (69.0)	13/42 (31.0)	42/227 (18.5)
∑ 227	60/227 (26.4)	167/227 (73.6)	

**Table 5.** Fetal RPD in Postnatal Obstructive and Nonobstructive Processes

RPD Diagnosis	4–10 mm	11–20 mm	>20 mm
Nonobstructive (n = 167), n (%)			
NOH (n = 139)	84 (60.4)	44 (31.7)	11 (8.0)
NMU (n = 21)	9 (42.9)	10 (47.6)	2 (9.5)
NOR (n = 7)	6 (85.7)	1 (14.3)	0
Σ	99/167 (59.3)	55/167 (32.3)	13/167 (7.8)
Obstructive (n = 60), n (%)			
UPJ (n = 54)	10/54 (18.5)	19/54 (35.2)	25/54 (46.3)
OMU (n = 6)	1/6 (14.3)	1/6 (14.3)	4/6 (66.7)
Σ	11/60 (18.3)	20/60 (33.3)	29/60 (48.3)

processes had RPD of greater than 10 mm, whereas 18% of obstructive lesions had prenatal maximum RPD of 4 to 10 mm.

Renal dilatation may also be indicative of vesicoureteral reflux. We identified reflux in nearly 10% of the tested children. Although there does not appear to be a relationship between the magnitude of RPD and the presence of reflux, there was a trend that infants with obstruction had a higher incidence of reflux (22% vs 4%). The clinical relevance of this reflux is unknown. Much of this reflux is coexisting and is not thought to be the primary disease in these children. Most of this reflux resolves without need for surgical intervention or development of infectious complications while the patient receives prophylaxis.<sup>5</sup>

Regardless of the maximum RPD, there were no cases in which isolated RPD necessitated preterm delivery. This information is useful in counseling parents and guiding prenatal management. Once RPD is detected, serial prenatal sonographic monitoring is probably unnecessary. A single follow-up sonographic examination late in pregnancy will allow determination of

**Table 6.** Maximum RPD in Fetuses Requiring Postnatal Surgery (n = 60)

RPD, mm	Fetuses Requiring Surgery
4	0
5	0
6	2
7	2
8	2
9	3
10	2
Σ, n (%)	11 (18.3)
11–20, n (%)	20 (33.3)
>20, n (%)	29 (48.3)

the need for postnatal follow-up. Alternatively, postnatal sonography could be performed rather than additional prenatal studies. This would allow definitive renal assessment, and if the findings are normal, the total number of sonographic examinations would be no different than if a third-trimester sonographic examination was performed.

Conclusive recommendations regarding appropriate postnatal follow-up cannot be determined from this study. We recommend prophylactic antibiotics in all female infants with RPD, in male infants with bilateral RPD that is suggestive of reflux or bladder outlet obstruction, and in infants with duplication anomalies pending the initial urologic evaluation at 1 month of age. Because obstruction is very unlikely when RPD is less than 10 mm, we do not obtain scintigraphy unless there is diffuse calycectasis or cortical thinning on the postnatal sonography.

A small number of these children had vesicoureteral reflux, and much of the detected reflux may be clinically unimportant. The magnitude of RPD is not predictive of reflux. Because the incidence of infection is much higher in female infants, we currently recommend a VCUG in all female infants with RPD but limit testing in male infants to those with poor corticomedullary differentiation and the appearance of dysplasia because pelvic dilatation, calyceal dilatation, and ureterectasis do not increase the chance of high-grade reflux.<sup>12</sup> A prospective trial is indicated to evaluate the incidence and importance of this reflux. Hopefully this will allow us to better define a subset that should have a VCUG.

In summary, this report describes the types and frequencies of isolated renal abnormalities detected in a referral prenatal ultrasound unit. Two thirds of cases involved RPD as the primary sonographic finding. The degree of RPD can be useful in prenatal counseling, although postnatal evaluation is warranted to accurately assess the presence or absence of obstruction. The absence of an effect on the timing or route of delivery suggests that a conservative approach to prenatal sonographic monitoring is appropriate.

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