Prenatal Anteroposterior Pelvic Diameter Cutoffs for Postnatal Referral for Isolated Pyelectasis and Hydronephrosis: More is Not Always Better

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Abbreviations and Acronyms

APPD = anteroposterior pelvic diameter

GA = gestational age

MAG3 = mercaptoacetyltriglycine

US = ultrasound

UTI = urinary tract infection

VUR = vesicoureteral reflux

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Purpose: Congenital hydronephrosis and isolated pyelectasis are frequently diagnosed by prenatal ultrasound. About 80% of cases resolve spontaneously in early childhood. Currently there is no agreed on protocol for prenatal followup. Most clinicians use a renal pelvis anteroposterior diameter of greater than 4 mm as a threshold for identifying isolated pyelectasis and hydronephrosis at 33 weeks of gestation or anteroposterior diameter greater than 7 mm at 40 weeks of gestation. We sought to determine a fetal renal pelvis diameter cutoff at 20 and 30 weeks of gestation that would be able to predict significant nephron uropathy requiring surgery.

Materials and Methods: Our protocol included 2 prenatal ultrasounds at 20 and 30 weeks of gestation and 3 postnatal ultrasounds at ages 1, 6 and 12 months. Between January 2009 and December 2011 we evaluated 149 prenatal cases (130 males, 19 females) of isolated pyelectasis and 41 cases (28 males, 13 females) of hydronephrosis with a renal pelvis anteroposterior diameter of greater than 4 mm at 20 weeks of gestation.

Results: For isolated pyelectasis we identified cutoffs of 6 mm at 20 weeks of gestation (100% sensitivity, 84.3% specificity) and 10 mm at 30 weeks of gestation (100% sensitivity, 91.9% specificity). For hydronephrosis we identified cutoffs of 10 mm at 20 weeks of gestation (100% sensitivity, 86.1% specificity) and 12 mm at 30 weeks of gestation (100% sensitivity, 66.7% specificity).

Conclusions: Using these thresholds, we could avoid a significant number of followup ultrasounds in the prenatal and postnatal periods, as well as invasive postnatal tests (ie voiding cystourethrography and mercaptoacetyltriglycine scintigraphy) without missing even a single case of obstructive nephropathy requiring surgery.

Key Words: hydronephrosis; prenatal diagnosis; postnatal care; pyelectasis; ultrasonography, prenatal

HYDRONEPHROSIS and isolated pyelectasis are the most common prenatal urinary tract anomalies detected by ultrasonography.[1–6] These fetal abnormalities have been observed in 1% to 5% of pregnancies and are frequently caused by a transient or chronic obstruction of the urinary tract, which can be functional or anatomical.[6–11] They are often localized at the ureteropelvic junction and less frequently at the ureterovesical junction, or caused by posterior urethral valves in males.[12] Prenatal

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hydronephrosis and isolated pyelectasis can also be caused by the presence of a nondynamic segment of ureter, or by a crossing of the lower pole vessels or vesicoureteral reflux. The terms "hydronephrosis" and "isolated pyelectasis" are too often used synonymously in the medical literature because of the lack of consensus on the definition of prenatal hydronephrosis.[13]

Since the 1990s, several authors have assessed the prenatal renal pelvis threshold to identify those patients whose renal function is at risk, and at the same time to avoid ineffective tests and parental anxiety in the high percentage of patients who are not at risk for renal damage.[6,14] Considering that almost 80% of newborns with a prenatal diagnosis of isolated pyelectasis or mild hydronephrosis present as completely normal on ultrasound at birth, some abnormal findings are probably normal variants with minimal or uncertain clinical significance.[7]

The most common method of diagnosing prenatal uropathy is by measuring the anteroposterior diameter of the renal pelvis via US.[1] The currently accepted standard for a clinically significant APPD is based on the original work of Corteville et al, who proposed an APPD cutoff of 4 mm at 33 weeks of GA or 7 mm at 40 weeks of GA.[15] Using these cutoffs, they obtained 100% sensitivity for identification of renal pelves that would require postnatal evaluation or surgery. Other studies have described different renal pelvis cutoffs as predictors of obstructive uropathy. Adra et al in 1995 proposed an APPD of 8 mm or greater after 28 weeks of GA,[14] while Mandell et al noted persistent postnatal uropathy when APPDs were larger than 6 mm before 20 weeks, larger than 8 mm at 20 to 30 weeks and 8 to 10 mm after 30 weeks of GA.[16] Currently there are no international guidelines to identify kidneys that will need postnatal surgery or protocols for prenatal evaluation once isolated pyelectasis or hydronephrosis is identified.[17,18]

We used the following definitions for isolated pyelectasis and hydronephrosis. Isolated pyelectasis indicates isolated renal pelvis dilatation without associated calyceal dilatation. Hydronephrosis indicates the associated dilatation of the renal pelvis and the calyceal structures. We sought to determine APPD cutoffs at 20 and 30 weeks of GA that are able to predict significant obstructive uropathy requiring surgery in newborns. Our goal was to maximize the detection of significant abnormalities while minimizing unnecessary evaluations that can result in a waste of resources and cause anxiety in the parents.[14,19,20]

MATERIALS AND METHODS

This prospective study was performed at our institute in collaboration with the pediatric nephrology and prenatal diagnosis services, and received institutional review board approval. During routine prenatal ultrasonography we detected 149 isolated pyelectasis and 41 hydronephrosis cases with an APPD of 4 mm or greater at 20 weeks of GA, using the criteria of Corteville et al,[15] between January 2009 and December 2011. All mothers with a fetus with an APPD of 4 mm or larger at 20 weeks of GA were included in the study independently of age, ethnic origin or social status. Fetuses with other associated anomalies were excluded. All fetuses enrolled were otherwise healthy. To avoid bias, the same trained gynecologist, supported by a pediatric nephrologist, performed ultrasounds and diameter acquisitions. Transabdominal ultrasound was performed with 4 to 8 MHz 3-dimensional array using a Voluson™ E8 Expert ultrasound system. Differentiation between unilateral and bilateral uropathy is not reported because in the statistical analysis we considered single renal units whose development was independent of the contralateral kidney.

Our monitoring protocol included 2 prenatal US evaluations at 20 and 30 weeks of GA and 3 postnatal followup examinations consisting of US and nephrology evaluation performed at ages 1, 6 and 12 months (fig. 1). Patients with isolated pyelectasis or hydronephrosis suspected to be caused by obstructive uropathy (pelvis dilatation greater than 15 mm or poor parenchyma quality) underwent MAG3 scintigraphy. Two parameters were evaluated by MAG3 scintigraphy, ie split renal function (less than 40% differential) and half-time greater than 20 minutes.[21] Both parameters were considered equally when assessing the degree of obstruction and need for surgery.

In patients with unilateral isolated pyelectasis or hydronephrosis renal scan data were compared to the normal contralateral kidney. In those presenting with bilateral dilatation we considered only half-time as an indication for surgery. In these patients VUR was excluded by cystourethrography. VUR evaluation was also performed in those children who presented with a postnatal UTI, irrespective of the degree of dilatation. Renal isolated pyelectasis and hydronephrosis detected by prenatal ultrasound were classified as mild (4 to 7 mm), moderate (7.1 to 9 mm) or severe (greater than 9 mm). Postnatal outcomes were defined as resolved, improving or worsened.

All 149 isolated pyelectasis and 41 hydronephrosis cases diagnosed prenatally were included in the analysis. No patient was lost to followup. Sensitivity and specificity values, ROC curves and cutoff values were calculated and identified through bivariate logistic regressions. All analyses were carried out with Stata/IC™, version 11.2 for Windows®.

RESULTS

We collected 149 isolated pyelectasis and 41 hydronephrosis cases by prenatal US with an APPD of 4 mm or greater at 20 weeks of GA. The male-to-female ratio was 7:1 (87% males, 13% females) for isolated pyelectasis and 3:1 (68% males, 32% females) for hydronephrosis. Only 3 children presented with a single episode of UTI, of whom 2 had