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Validation of "urinary tract dilation" classification system

Correlation between fetal hydronephrosis and postnatal urological abnormalities

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Abstract

Aim to illuminate the correlation between fetal hydronephrosis and postnatal urological abnormalities by a new classification system—"urinary tract dilation (UTD)" grade.

Of 659 pregnancies screened by ultrasound, 34 cases were found with isolated fetal hydronephrosis, and enrolled in our study from 2017 to 2019. These 34 infants had been prospectively followed up to 6 months after birth by 3 times of urinary tract ultrasound. Hydronephrosis was graded in accordance with the UTD classification system.

Among 34 infants with isolated fetal hydronephrosis. Twenty-four (70.6%) were classified as UTD A1 grade (mild hydronephrosis), and the other 10 (29.4%) were UTD A2–3 grade (moderate to severe hydronephrosis) by antenatal evaluation. After birth, all of the 24 infants (70.6%) with UTD A1 grade had normal ultrasonic findings of urinary tract; while the other 10 cases with UTD A2–3 grade had persistent abnormalities of urinary tract by postnatal assessment, sorted as UTD P1 grade (mild hydronephrosis) in 6 cases (17.6%), UTD P2 grade (moderate hydronephrosis) in 2 cases (5.9%) and UTD P3 grade (severe hydronephrosis) in 2 cases (5.9%). The most common postnatal urological abnormality of isolated fetal hydronephrosis was vesicoureteral reflux. During the follow-up period, 7 infants (20.6%) had urinary tract infection episodes and very few obtained positive cultures of the urine. Only 2 infants (5.9%) with the diagnosis of ureterovesical junction obstruction required surgery intervention, who were both classified as UTD P3 grade. None of the children with UTD P1 and P2 grades needed operation.

The UTD classification system described the urinary tract both antenatally and postnatally, which could point out the correlation between fetal hydronephrosis and postnatal urological abnormalities. This new classification system is expected to be a good prognostic marker for fetal hydronephrosis.

Abbreviations: APRPD = anterior-posterior renal pelvic diameter, PUV = posterior urethral valves, UPJO = uretero-pelvic junction obstruction, UTD = urinary tract dilation, UTI = urinary tract infection, UVJO = ureterovesical junction obstruction, VUR = primary vesicoureteral reflux.

Keywords: fetal hydronephrosis, prognosis, urinary tract dilation classification system, urological abnormalities

1. Introduction

Fetal hydronephrosis is the most common structural fetal abnormality detected by ultrasound in 2% to 3% of all pregnancies.[1] This condition may be a physiologic or transient process which could recover spontaneously in 36% to 80% of cases.[2–4] Indeed, antenatal structural abnormalities of the kidneys may or may not be associated with postnatal renal problems.[3] However, if these urological abnormalities have not been found by prenatal ultrasound and subsequently managed, these abnormalities may manifest later in life as pyelonephritis, hypertension, and even renal failure.[1,3,5] In approximately 14% to 21% of neonates with fetal hydronephrosis, the most frequently discovered pathologies of the urinary system after birth include uretero-pelvic junction obstruction (UPJO), ureterovesical junction obstruction (UVJO), primary vesicoureteral reflux (VUR), and posterior urethral valves (PUV).[3,6,7]

Factually, assessing the degree of antenatal hydronephrosis is able to contribute to better postnatal diagnosis, management, and prognosis at short and longer term. Ultrasound is the first choice of examination for hydronephrosis, thanks to its safety,

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excellent anatomical resolution, and wide feasibility.[3,8] In the past, the correlation between antenatal and postnatal urological findings had been problematic, partly due to the lack of uniformity in describing and grading urinary tract dilation.[9] In 2014, a standard scheme for follow-up evaluation based on the severity of the urinary tract dilation grade and other ultrasound findings was proposed, which had been named "urinary tract dilation (UTD)" classification system to define the appearance of the urinary tract both antenatally and postnatally. Moreover, recommendations for further management for these patients were made depending on the UTD grade.[10]Currently, there was few clinical data regarding to UTD classification system used for evaluation and management of fetal hydronephrosis. In our study, we aimed to illuminate the correlation between the fetal hydronephrosis and postnatal urological abnormalities by this new classification system.

2. Methods

The study group enrolled 34 infants with unilateral or bilateral isolated fetal hydronephrosis by screening 659 pregnancies from 2017 to 2019. Exclusion criteria were as follows:

(1) patients associated with other congenital anomalies including renal agenesis, renal cyst, renal hypoplasia, or polycystic kidney disease;
(2) patients who did not come for follow-up visits.

The hydronephrosis was graded in accordance with the UTD classification system that is based on six ultrasound findings:

(1) anterior-posterior renal pelvic diameter (APRPD),
(2) calyceal dilation with distinction between central and peripheral calyceal dilation postnatally,
(3) renal parenchymal thickness,
(4) renal parenchymal appearance,
(5) bladder abnormalities,
(6) ureteral abnormalities.[10]

This classification system distinguishes whether the ultrasonic findings were antenatal (normal, A1, A2–3) or postnatal (normal, P1, P2, P3). The higher the number was, the more severe the finding was. Grading was based upon the most severe finding.[10]

These 34 infants were followed up prospectively at 5 to 7 days, 1-month, and 6-month by means of ultrasound. The ultrasound scan was performed by the same radiologist using a Siemens scanner (Sonoline G40, transducer P8–4 MHz, Germany). Additionally, the incidence of urinary tract infection (UTI), renal dynamic radionuclide imaging, initiation of prophylactic antibiotics, and requirements of surgical intervention were evaluated. The ethics committee of West China Second University Hospital approved this study, and informed consents were obtained from all of their parents.

3. Statistical analysis

Results were expressed as median, mean, percentage, minimum and maximum. Statistical analyses were done with Microsoft Excel and SPSS software (version 18.0, SPSS). The measured parameters between 2 groups were compared by χ^2 –test for categorical data. All reported P value $<.05$ was considered statistical significant.

4. Results

A total of 659 pregnancies were screened by ultrasound, only to find 34 cases (5.2%) with unilateral (19/34, 55.9%) or bilateral (15/34, 44.1%) isolated fetal hydronephrosis. These 34 infants were enrolled in this study, consisting of 21 boys (61.8%) and 13 girls (38.2%). Most of fetal hydronephrosis had been found in the late second and third trimester of pregnancy. Among 34 infants, 24 cases (70.6%) were classified as UTD A1 grade (mild hydronephrosis), the other 10 cases (29.4%) were UTD A2–3 grade (moderate to severe hydronephrosis) by antenatal evaluation.

After birth, all of the 24 infants (70.6%) with UTD A1 grade had normal ultrasonic findings of urinary tract, indicating fetal hydronephrosis may be a transient or physiological condition; while the other 10 infants with UTD A2–3 grade had persistent abnormalities of urinary tract, sorted as UTD P1 grade (mild hydronephrosis) in 6 cases (17.6%), UTD P2 grade (moderate hydronephrosis) in 2 cases (5.9%) and UTD P3 grade (severe hydronephrosis) in 2 cases (5.9%) by postnatal assessment. The most common postnatal urological abnormality of isolated fetal hydronephrosis was VUR grade I-II, found in 7 (20.6%) infants (5 unilateral VUR, 2 bilateral VUR). UVJO and UPJO without kidney damage were found in 3 (8.8%) infants.

During the follow-up period, 7 infants (20.6%) had UTI episodes and very few obtained positive cultures of the urine. Maybe these patients had been treated in other hospitals. Only 2 infants (5.9%) with the diagnosis of UVJO required surgery intervention, who were both classified as UTD P3 grade. None of the children with UTD P1 and P2 grades needed operation. The clinical characteristics of 34 infants were showed in Table 1.

5. Discussion

With the availability of the antenatal ultrasound, there has been an increase in the number of neonates detected with fetal hydronephrosis.[1] However, the underlying pathology or etiology remains unclear, and what about the connection between fetal hydronephrosis and postnatal urological abnormalities is a great challenge for pediatricians. Therefore, multidisciplinary consensus on the classification of antenatal and postnatal urinary tract dilation becomes more and more essential to standardize the etiological diagnosis and care of children with fetal hydronephrosis.[5,11]

In our study, we reported on the clinical outcome in a group of infants with isolated fetal hydronephrosis assessed by a new classification system—UTD grade. We observed that the majority of infants with fetal hydronephrosis were male (61.8%) who were more vulnerable to moderate or severe fetal hydronephrosis (UTD A2–3 grade). As expected, patients with UTD A2–3 grade were definitely associated with higher risk of postnatal urological abnormalities.[12,13,14] In our study, all of the 10 infants with UTD A2–3 grade had abnormal ultrasonic findings of urinary tract after birth, including 6 cases (17.6%)classified as UTD P1 grade (mild hydronephrosis), 2 cases (5.9%) with UTD P2 grade (moderate hydronephrosis) and 2 cases (5.9%) with UTD P3 grade (severe hydronephrosis). Moreover, the underlying etiologies of these 10 patients had been verified as VUR grade I-II, UVJO and UPJO without kidney damage, suggesting that the UTD classification system could explicitly define the correlation between the fetal hydronephrosis and postnatal urological abnormalities.[10] Thus, we recommended that fetuses with

Table 1

The clinical characteristics of 34 infants.

Case	Gender	Age of mother at pregnancy (year)	Maternal complication during pregnancy	Similar family history	Time of found antenatal hydronephrosis (week of pregnancy)	Unilateral or bilateral hydronephrosis	Antenatal UTD grade	Postnatal UTD grade	Etiology of fetal hydronephrosis	Incidence of UTI	renal dynamic radionuclide imaging	initiation of prophylactic antibiotics	surgical intervention
1	Male	29	No	No	28th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
2	Male	27	No	No	27th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
3	Male	31	No	No	29th	Unilateral	A2–3	P1	VUR grade I	None	Yes	No	No
4	Female	33	Hypertention	No	31th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
5	Male	24	No	No	25th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
6	Female	26	No	No	29th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
7	Male	32	Hypertension	No	30th	Unilateral	A2–3	P2	VUR grade II	1 times	Yes	No	No
8	Male	29	No	Yes	26th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
9	Female	27	No	No	28th	Unilateral	A2–3	P1	VUR grade I	None	Yes	No	No
10	Female	34	Diabetes	No	27th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
11	Male	26	No	No	31th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
12	Male	32	No	No	28th	Bilateral	A2–3	P3	UVJO	2 time	Yes	Yes (Cefixime)	Yes
13	Male	23	No	No	29th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
14	Male	27	No	No	28th	Unilateral	A2–3	P1	VUR grade I	1 time	Yes	No	No
15	Male	33	No	No	28th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
16	Female	25	No	No	29th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
17	Female	26	No	No	26th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
18	Male	27	No	No	27th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
19	Male	22	No	No	25th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
20	Male	31	No	No	29th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
21	Female	35	Hypertension	No	30th	Unilateral	A2–3	P1	VUR grade I	1 time	Yes	No	No
22	Male	34	Diabetes	No	26th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
23	Female	30	No	No	29th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
24	Male	31	No	No	30th	Unilateral	A2–3	P2	UPJO	2 times	Yes	No	No
25	Male	28	No	Yes	28th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
26	Female	25	No	No	28th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
27	Female	31	No	No	27th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
28	Male	28	No	No	30th	Unilateral	A2–3	P1	VUR grade II	2 times	Yes	No	No
29	Male	32	No	No	26th	Bilateral	A2–3	P3	UVJO	3 time	Yes	Yes (Cefixime)	Yes
30	Male	33	Diabetes	No	29th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
31	Male	31	No	No	29th	Unilateral	A2–3	P1	VUR grade I	None	Yes	No	No
32	Female	28	No	No	28th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
33	Female	25	No	No	25th	Bilateral	A1	Normal	Transient hydronephrosis	None	No	No	No
34	Female	37	Diabetes, hypertension, anemia	No	26th	Unilateral	A1	Normal	Transient hydronephrosis	None	No	No	No

UTD = urinary tract dilation; UTI = urinary tract infection; UVJO = ureterovesical junction obstruction; VUR = primary vesicoureteral reflux.

UTD A2–3 grade (moderate to severe hydronephrosis) needed postnatal ultrasound before discharge from the hospital.[1,8,14]

Our study also demonstrated that the severity of the condition was likely to be relieved or even recovered completely (24/34, 70.6%) during the postnatal period; but the condition may deteriorate in few cases (4/34, 11.8%). Obviously, we should not underestimate the severity of mild fetal hydronephrosis which could be recognized as low risk of surgical intervention.[12,13] As to infants with UTD A1 grade (mild hydronephrosis), these babies had better perform postnatal ultrasound scan within the first month of life. Although the risk of structural abnormality of urinary tract is lower for this population, we ought to keep in mind that the dynamic follow-up is much important and necessary.[15]

6. Conclusions

As a unified system, the UTD classification system described the urinary tract both antenatally and postnatally, which could point out the correlation between fetal hydronephrosis and postnatal urological abnormalities. This new classification system is expected to be a good prognostic marker for fetal hydronephrosis. As such, the UTD classification system is warranted to be validated with further clinical experience and future research.

Author contributions

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References

[1] Woodward M, Frank D. Postnatal management of antenatal hydronephrosis. Bju Int 2015;89:149–56.
[2] Persutte WH, Hussey M, Chyu J, et al. Striking findings concerning the variability in the measurement of the fetal renal collecting system. Ultrasound Obstet Gynecol 2000;15:186–90.
[3] Ismaili K, Avni FE, Wissing KM, et al. Long-term clinical outcome of infants with mild and moderate fetal pyelectasis: validation of neonatal ultrasound as a screening tool to detect significant nephro-uropathies. J Pediatr 2004;144:759–65.
[4] Sairam S, Al-Habib A, Sasson S, et al. Natural history of fetal hydronephrosis diagnosed on mid-trimester ultrasound. Ultrasound Obstet Gynecol 2001;17:191–6.
[5] Shapiro E. Antenatal hydronephrosis: Here today, gone tomorrow-one way or another: NYU Case of the Month, May 2017. Rev Urol 2017; 19:138–41.
[6] Coplen DE, Austin PF, Yan Y, et al. The magnitude of fetal renal pelvic dilatation can identify obstructive postnatal hydronephrosis, and direct postnatal evaluation and management. J Urol 2006;176:724–7.
[7] Orabi M, Abozaid S, Sallout B, et al. Outcomes of isolated antenatal hydronephrosis at first year of life. Oman Med J 2018;33:126–32.
[8] Sinha A, Bagga A, Krishna A, et al. Revised guidelines on management of antenatal hydronephrosis. Indian Pediatr 2013;50:215–31.
[9] Nguyen HT, Herndon CD, Cooper C, et al. The Society for Fetal Urology consensus statement on the evaluation and management of antenatal hydronephrosis. J Pediatr Urol 2010;6:212–31.
[10] Chow JS, Darge K. Multidisciplinary consensus on the classification of antenatal and postnatal urinary tract dilation (UTD classification system). Pediatr Radiol 2015;45:787–9.
[11] Christodoulou M. Paediatrics: Guidelines for UTI and antenatal hydronephrosis should be gender specific. Nat Rev Urol 2015;12:476.
[12] İsa Kıllı , Avlan D, Taşkınlar H, et al. Effective predictors for surgical decision in antenatal hydronephrosis: a prospective multiparameter analysis. Turk J Urol 2017;43:361.
[13] Braga LHP, Ruzhynsky V, Pemberton J, et al. Evaluating practice patterns in postnatal management of antenatal hydronephrosis: a national survey of canadian pediatric urologists and nephrologists. Urology 2014;83:909–14.
[14] Darwish HS, Habash YH, Almardawi EA, et al. Postnatal outcome of isolated antenatal hydronephrosis. Saudi Med J 2014;35:477–81.
[15] Vemulakonda V, Yiee J, Wilcox DT. Prenatal hydronephrosis: postnatal evaluation and management. Curr Urol Rep 2014;15:430.