POSTNATAL EVALUATION AND OUTCOME OF INFANTS WITH ANTENATAL HYDRONEPHROSIS

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SUMMARY – This study was aimed at evaluating the clinical outcome of infants with antenatally diagnosed hydronephrosis. Our objective was also to determine whether there is a significant correlation between anterior posterior pelvic diameter (APPD) and urinary tract abnormalities detected. We retrospectively analyzed data of 145 infants collected between January 2000 and May 2010. Inclusion criteria were the presence of APPD ≥5 mm on prenatal US scan after 20 weeks of gestation, at least 6-month follow-up and at least two postnatal US scans. Most patients underwent renal scintigraphy (n=140, 96.6%) and micturating cystourethrography (n=141, 97.2%). Of 145 infants, 77 (53.1%) had idiopathic or transient hydronephrosis. The second most common diagnosis was vesicoureteral reflux found in 21 (14.4%) infants, followed by ureteropelvic junction obstruction without significant kidney damage found in 18 (12.4%) infants. The relative risk of significant urologic abnormality according to the degree of antenatal hydronephrosis (ANH) was 21.25 (95% CI: 2.95-156.49) for severe ANH, 1.57 (95% CI: 0.94-2.62) for moderate ANH and 0.47 (95% CI: 0.33-0.66) for mild ANH. There was a significant increase in the risk *per* increasing degree of hydronephrosis. In 19 out of 145 (13.2%) infants, immediate surgery was required. These data support the need of antenatal detection and long term postnatal follow-up of infants with ANH.

Key words: *Hydronephrosis; Infant; Prenatal diagnosis; Postnatal diagnosis*

Introduction

With the increasing use of antenatal sonography, fetal hydronephrosis has been reported more frequently. It is well known that antenatal hydronephrosis (ANH) affects ≈1% to 5% of all pregnancies and is one of the most common birth defects[1-4]. If these anomalies are not detected by prenatal ultrasonography (US) and subsequently managed, many of these urologic abnormalities would manifest later in life as pyelonephritis, hypertension, or even renal failure.

The major limitation of the antenatal identification of urinary tract dilatation is that hydronephrosis does not necessarily imply obstruction, nor give any indication of the function of an affected kidney. In addition, it has become apparent that some cases of antenatally detected hydronephrosis will spontaneously improve or resolve with no surgical intervention. Because of the lack of consensus regarding assessment of these infants, the postnatal approach to fetal renal pelvis enlargement remains controversial[5].

This study was aimed at evaluating the clinical outcome of infants with antenatally diagnosed hydronephrosis. Our objective was also to determine whether there is a significant correlation between the anterior posterior pelvic diameter (APPD) and the urinary tract abnormalities detected.

Patients and Methods

We retrospectively analyzed data of 145 infants collected between January 2000 and May 2010. Prenatal US was performed by gynecologists from different medical institutions. All postnatal US scans were performed by pediatric nephrologists using a Siemens

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machine (Sonoline G 40, transducer P 8-4 MHz, Germany).

Inclusion criteria were the presence of APPD ≥5 mm on prenatal US scan after 20 weeks of gestation, at least 6 months of follow-up and at least two postnatal US scans. The infants prenatally diagnosed as having multicystic dysplastic kidney, polycystic kidneys, kidney agenesis or abdominal cysts were excluded from the study.

Hydronephrosis was classified into three groups according to antenatal US measurement of renal pelvis diameter: mild (APPD 5-9.9 mm), moderate (APPD 10-14.9 mm) and severe (APPD ≥15 mm).

The probability of significant urologic anomaly according to the degree of ANH was expressed as the relative risk ratio. Data were calculated using calculator for confidence intervals of relative risk, a program written by DJR Hutchon.

The first postnatal US scan was performed on days 2-3 (for infants born at our University Hospital) or when first seen (for infants born at other medical institutions). After the initial US, 140 (96.6%) patients underwent renal scintigraphy (technetium-99m diethylene triamine penta-acetic acid (^{99m}Tc-DTPA)) during or soon after the first month, whereas micturating cystourethrography (MCUG) was done in 141 (97.2%) patients within 3 months of life. In four children who were first seen at age four to nine months and who had 2 consecutive normal US scans, renal scintigraphy and MCUG were not performed. If needed according to the results of US as well as the results of renal scintigraphy and MCUG, in a few cases i.v. pyelography and magnetic resonance imaging were performed.

Results

A total of 145 infants were included in the analysis (104 (71.7%) boys and 41 (28.3%) girls). Most of the abnormalities were detected in the late second and third trimester of pregnancy (18 (12.4%) in 20th week of gestation, 20 (13.8%) in 28th week, 30 (20.7%) in 30th week, 12 (8.3%) between 34th and 36th week, and 27 (18.6%) between 37th and 38th week). In 38 (26.2%) cases, the gestational age at which the diagnosis of ANH was established was unknown. Among 145 infants, 82 (56.6%) had mild dilatation, 43 (29.6%) had moderate and 20 (13.8%) had severe dilatation on antenatal US scan. Ninety-four (64.8%) infants presented unilateral and 51 (35.2%) infants bilateral ANH.

Table 1. Etiology of antenatal hydronephrosis

Urological abnormality	Total 145
Idiopathic or transient hydronephrosis	77 (53.1%)
VUR grade I-V	21 (14.4%)
UPJO without significant kidney damage (≥40% RKF)	18 (12.4 %)
UPJO with significant kidney damage (0%-39% RKF)	12 (8.3%)
Hypoplastic and hypofunctional kidney	10 (6.9%)
Extrarenal pelvis	3 (2.1%)
Ureterocele with 1 hypofunctional kidney	1 (0.7%)
UVJO with contralateral UPJO	1 (0.7%)
PUV	1 (0.7%)
Ren duplex with ureterocele	1 (0.7%)

VUR = vesicoureteric reflux; UPJO = ureteropelvic junction obstruction; UVJO = ureterovesical junction obstruction; PUV = posterior urethral valve; RKF = residual kidney function

The etiology of antenatal hydronephrosis is shown in Table 1. Of 145 infants, 77 (53.1%) had idiopathic or transient hydronephrosis. The second most common diagnosis was vesicoureteral reflux (VUR) grade I-V, found in 21 (14.4%) infants (11 unilateral and 10 bilateral VUR). Ureteropelvic junction obstruction (UPJO) without significant kidney damage (≥40% residual kidney function) was found in 18 (12.4%) and UPJO with significant kidney damage (0%-39% residual kidney function) in 12 (8.3%) infants. The diagnosis of hypoplastic and hypofunctional kidney was established in 10 (6.9%) children. Extrarenal pelvis was found in 3 (2.1%) children. One (0.7%) child was diagnosed with vesicoureteral junction obstruction with contralateral UPJO, ureterocele with one hypofunctional kidney, posterior urethral valve, and ren duplex with ureterocele each.

Table 2 shows postnatal diagnosis in infants with antenatal hydronephrosis according to the degree of fetal renal pelvic dilatation. Of 82 patients with mild dilatation, in 58 (70.7%) no anomaly was detected and diagnosis of idiopathic or transient dilatation was established. In infants with moderate ANH, 18 of 43 (41.8%) had no anomaly, whereas only 1 out of

Table 2. Postnatal diagnosis in infants with antenatal hydronephrosis according to the degree of fetal renal pelvic dilatation

	Degree of antenatal hydronephrosis			
Postnatal diagnosis	Mild hydronephrosis	Moderate hydronephrosis	Severe hydronephrosis	Total children
No anomaly detected (idiopathic or transient dilatation)	58	18	1	77 (53.1%)
Extrarenal pelvis	1	2		3 (2.1%)
UPJO (≥40% RKF)	12	6		18 (12.4%)
UPJO (0%-39% RKF)	2	3	7	12 (8.3%)
VUR grade I	1	1		2 (1.4%)
VUR grade II-III	5	6	3	14 (9.6%)
VUR grade IV-V	1	2	2	5 (3.4%)
Ureterocele + hypofunction of 1 kidney			1	1 (0.7%)
Ureterocele + ren duplex			1	1 (0.7%)
UVJO + contralateral UPJO		1		1 (0.7%)
PUV			1	1 (0.7%)
Hypoplasia + hypofunction of 1 kidney	2	4	4	10 (6.9%)
Total	82 (56.6%)	43 (29.6%)	20 (13.8%)	145

VUR = vesicoureteric reflux; UPJO = ureteropelvic junction obstruction; UVJO = ureterovesical junction obstruction; PUV = posterior urethral valve; RKF = residual kidney function

20 (5%) with severe ANH had idiopathic dilatation. The relative risk of significant urinary tract anomaly according to the degree of antenatal hydronephrosis was 21.25 (95% CI: 2.95-156.49) for severe ANH, 1.57 (95% CI: 0.94-2.62) for moderate ANH and 0.47 (95% CI: 0.33-0.66) for mild ANH.

Table 3. Infants with antenatal hydronephrosis requiring surgical intervention

Urological abnormality requiring surgical intervention	Total 19
UPJO with hypofunction of 1 kidney	5 (26.3%)
VUR III-V with hypofunction of 1 kidney	5 (26.3%)
UPJO with 1 afunctional kidney	3 (15.7%)
Ureterocele with 1 afunctional kidney	1 (5.3%)
Hypoplasia and hypofunction of 1 kidney with megaureter	2 (10.5%)
UVJO with contralateral UPJO	1 (5.3%)
PUV	1 (5.3%)
Ren duplex with ureterocele	1 (5.3%)

VUR = vesicoureteric reflux; UPJO = ureteropelvic junction obstruction; UVJO = ureterovesical junction obstruction; PUV = posterior urethral valve

During the follow-up period, 19 (13.2%) of 145 infants required immediate surgery (Table 3). Fifteen of them had severe and four moderate ANH. None of the children with mild ANH required surgical intervention. After 6-12 month follow-up, 13 (8.9%) infants had progression of hydronephrosis without the need of surgery. In 46 (31.7%) infants, the US results were stable, while 67 (46.2%) had normal US scans.

Discussion

In recent years, there has been an increase in the number of patients diagnosed with hydronephrosis on fetal US scan. Prenatal sonography enables recognition of urological abnormalities that otherwise would not be identified until later in life, when usually the symptoms of pyelonephritis occur[6,7].

We report on the clinical outcome in a group of infants with ANH. Our study has confirmed that chil-

dren with moderate and severe ANH are at a greater risk of postnatal urinary tract anomaly, as pointed out by other investigators[8]. Unlike some authors, we did not find a significant risk of anomaly in the group with mild hydronephrosis[9-11].

The risk of pathologic postnatal outcome of ANH may be quantified by the measurement of APPD. As expected, this analysis confirmed that severe ANH carried a significant risk of postnatal pathologic outcome (21.25 (95% CI: 2.95-156.49)). We also demonstrated a significant risk of pathology in moderate ANH group (1.57 (95% CI: 0.94-2.62)). The relative risk of urologic abnormality was not significant in the group with mild ANH (0.47 (95% CI: 0.33-0.66)).

These data indicate that thorough postnatal diagnostic management should be considered when encountering an infant with moderate and severe ANH. Nevertheless, an infant with mild ANH should not be considered clinically insignificant, but can be categorized as carrying a low risk of surgical intervention. We would like to point out that among 82 infants with mild ANH, 24 (29.3%) had urinary tract anomaly (among them there were 5 infants with VUR grade II-III, 1 infant with VUR grade IV-V, 2 with UPJO with significant kidney damage, and 2 with hypoplastic and hypofunctional kidney).

The probability of detecting urinary abnormalities depends solely on the experience and skill of the sonographer and is usually better late in gestation, when the fetus is larger and an anomaly is easier to image[12]. In our study, most of the abnormalities on fetal US scans were detected in the late second and third trimester of pregnancy.

It has been reported that most structural abnormalities of urinary tract are characterized by hydronephrosis, which is generally assumed to be obstructive. Often, however, hydronephrosis is not caused by obstruction; examples include VUR, abnormalities of ureteropelvic and ureterovesical junction, and multicystic dysplastic kidney. The underlying diseases in our study are presented in Table 1. Vesicoureteral reflux and UPJO were the most common diagnoses, as reported in the literature[9,13,14].

As expected, patients with moderate and severe ANH presented a higher risk of surgical intervention. In our study group, 19 (13.2%) infants required immediate surgery: 15 presented with severe and 4 with moderate ANH. These results are similar to those found in the literature[9,15,16].

According to our findings, the risk of uropathy and associated morbidity was remarkably correlated with the magnitude of fetal APPD. We therefore suggest that infants with severe ANH should undergo postnatal US scan before discharge from the hospital. The initial postpartum US examination should be performed several days after delivery in order to avoid a falsely normal-appearing kidney during the first 24 hours of life[17]. In this group, a comprehensive diagnostic treatment should be administered as soon as possible. Infants with moderate and mild hydronephrosis should undergo postnatal US within the first month of life. Although the risk of urologic abnormality is lower in moderate group compared to severe ANH group, it should be kept in mind that in our study 58.2% of infants with moderate ANH presented uropathy. Taken together, these findings suggest that invasive diagnostic procedures might be necessary for both severe and moderate groups. Primary debate is focused on diagnostic approach in infants with mild ANH[16,18,19]. Based on our results, invasive diagnostic procedures are not required in all infants with mild ANH; we propose a follow-up protocol consisting of US investigations every 1 to 3 months during the first 6 months of life. If dilatation persists or progresses past 6 months, renal scintigraphy and/or MCUG should be performed. If US scan is normal after 6 months, prolonged follow-up is not justified.

All infants with ANH with or without significant urologic abnormality need strict clinical surveillance for urinary tract infection and US surveillance for possible progression of APPD during infancy.

Finally, we would like to stress the importance of quantification of fetal renal pelvis dilatation (in millimeters) since some of the US findings (not included in our investigation) were just descriptive. Despite the degree of ANH, the gynecologist should refer all infants with ANH to pediatric nephrologist, preferably during the first month of life or during the first week in case of severe ANH.

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Sažetak

POSTNATALNA PROCJENA I ISHOD U DOJENČADI S ANTENATALNOM HIDRONEFROZOM

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Cilj rada bio je istražiti ishod u dojenčadi kod kojih je na fetalnom ultrazvuku (UZ) nađena hidronefroza. Cilj nam je, također, bio ustanoviti postoji li značajna korelacija između anteriorno-posteriornog promjera bubrežne nakapnice (*anterior posterior pelvic diameter*, APPD) i nađenih anomalija mokraćnog sustava. Retrospektivno smo analizirali podatke za 145 dojenčadi prikupljene od siječnja 2000. do svibnja 2010. godine. Kriteriji za uključivanje u studiju bili su: APPD ≥5 mm na prenatalnom UZ nakon 20. tjedna gestacije, najmanje 6 mjeseci praćenja i najmanje 2 postnatalna UZ. U većine dojenčadi načinjena je dinamička scintigrafija bubrega (n=140; 96,6%) i mikcijska cistouretrografija (n=141; 97,2%). Od 145 dojenčadi, 77 (53,1%) ih je imalo idiopatsku ili prolaznu hidronefrozu. Druga najčešća dijagnoza bila je vezikoureteralni refluks nađen u 21 (14,4%) dojenčeta, a treća stenoza pijeloureteralnog ušća bez značajnog oštećenja bubrežne funkcije ustanovljena u 18 (12,4%) djece. Relativni rizik za značajnu urološku anomaliju prema stupnju antenatalne hidronefroze (ANH) bio je 21,25 (95% CI: 2,95-156,49) za tešku ANH, 1,57 (95% CI: 0,94-2,62) za umjerenu ANH i 0,47 (95% CI: 0,33-0,66) za blagu ANH. Rizik za anomaliju mokraćnih putova bio je proporcionalan rastućem stupnju hidronefroze. U 19 od 145 (13,2%) dojenčadi bio je potreban hitan kirurški zahvat. Ovi podaci podupiru važnost otkrivanja antenatalne hidronefroze, kao i potrebu kontinuiranog postnatalnog praćenja ove dojenčadi.

Ključne riječi: *Hidronefroza; Dojenče; Prenatalna dijagnoza; Postnatalna dijagnoza*