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Clinical Characteristics and Outcome of Hydronephrosis Detected by Prenatal Ultrasonography

The widespread use of prenatal ultrasound results in an increased recognition of fetal hydronephrosis. To determine clinical characteristics and postnatal outcome of fetal hydronephrosis, we performed a retrospective study in children diagnosed as having fetal hydronephrosis between 1990 and 2001. 341 children with 427 dilated kidneys were included. Dilatation of the renal pelvis was caused by primary ureteropelvic junction obstruction in 65.6%, multicystic kidney in 9.4%, vesicoureteral reflux in 7.0%, duplex system in 5.4%, ureterovesical junction obstruction in 4.0%, and posterior urethral valves in 3.0%. Hydronephrosis resolved spontaneously in 126 (29.5%) kidneys, with 52.7% of mild hydronephrosis, and 2.6% of severe hydronephrosis. Mean interval to spontaneous resolution was 1.39 (±1.41, SD) yr. Surgery was performed in 174 kidneys, including pyeloplasty in 105, ureteroneocystostomy in 23, transurethral incision in 11 and nephrectomy in 9. Most patients had initially high-grade hydronephrosis (p<0.05). Mild hydronephrosis appears to be relatively benign, and in most cases, dilatation improves with time, and thus surgical intervention is not required. On the other hand, moderate or severe hydronephrosis often results in a significantly poor outcome and requires surgical intervention, and therefore, requires closer follow-up both antenatally and postnatally.

Key Words : *Hydronephrosis; Natural History; Ultrasonography, Prenatal*

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INTRODUCTION

Hydronephrosis is the most common congenital condition that is detected by prenatal ultrasonography. Moreover, the widespread use of prenatal ultrasonography results in an increased recognition of fetal hydronephrosis. Prenatal hydronephrosis is diagnosed at an incidence of 1:100 to 1:500 by ultrasonographic studies (1). Prenatal ultrasonography enables us to detect the correctable cause of hydronephrosis, such as ureteropelvic junction obstruction as early as prenatally, and to preserve renal function by adequate work-up and management. Shokeir et al. (2) reported that 2-9 neonates per 1,000 births have urogenital anomaly and 50-87% of these have hydronephrosis. Sairam et al. (3) reported that fetal hydronephrosis was identified in 2.3% of women who underwent an anomaly scan after 18-23 weeks of gestation.

The detection of fetal hydronephrosis presents a diagnostic and therapeutic dilemma. Despite previous studies on this issue, there is an insufficiency of knowledge concerning the pathophysiology of fetal hydronephrosis and of its natural history in the infants, and there is no consensus on how to manage an infant with prenatally detected hydronephrosis. Also, racial differences had been reported (4). To our knowledge, no study has been conducted on this issue, in Korean children. Herein, we describe our experiences in order to guide the physicians caring for the fetus and infants and include a review of the literature.

MATERIALS AND METHODS

The medical records and imaging studies of 393 children that registered between January 1990 and June 2001 were retrospectively evaluated. The children were diagnosed as fetal hydronephrosis after 17-40 weeks of gestation, and were further followed up by postnatal ultrasonography. Children not confirmed to have hydronephrosis by postnatal ultrasonography were excluded from the study.

Postnatal ultrasonography was followed up at one to four days, one month and at one year. If hydronephrosis persisted for a month, a 99mTechnetium-diethylene-triaminepentaacetic acid renal scan and additional ultrasonography was performed at three months postnatally. Voiding cystourethrography was performed in selected cases with lower ureteral dilatation. Urinalysis, urine culture, serum creatinine, and leukocyte count were performed at the first visit, and repeated when necessary. All postnatal ultrasonography was graded according to the guidelines issued by the Society for Fetal Urology (5).

Surgery was performed in cases with symptoms or signs such as urinary tract infection, palpable mass and flank pain, and if there was evidence of obstructive injury, which was defined as a reduction in differential renal function to below 40%, ultrasonographic progression of hydronephrosis with renal cortical atrophy, and in cases with a half-time of more than 20 min by diuretic renography.

Clinical characteristics and outcome were evaluated and compared to the degree of hydronephrosis. Data were analyzed statistically using the chi square test where appropriate. A p value of <0.05 was considered significant.

RESULTS

Of 393 children that registered, 341 children (262 males and 79 females) with 427 dilated kidneys were included in this study. Fifty-two children were excluded because of lacking data or loss at follow up. The mean follow-up was 33.6 months (range, one month-14 yr).

The left kidney was more commonly involved (left 256, right 171). Grade 1 hydronephrosis was present in 93 (21.8%), and grades 2, 3, and 4 in 162 (37.9%), 96 (22.5%), and 76 (17.8%), respectively. Dilatation of the renal pelvis was caused by primary ureteropelvic junction obstruction in 280 (65.6%), multicystic kidney in 40 (9.4%), vesicoureteral reflux in 30 (7.0%), duplex system in 23 (5.4%), ureterovesical junction obstruction in 17 (4.0%), posterior urethral valves in 13 (3.0%), ureteroceles in 5 (1.2%), and primary megaureter in 2 (0.4%).

In 126 (29.5%) kidneys, the hydronephrosis resolved spontaneously during the follow-up period. Mean interval to spontaneous resolution was 16.5 months (range, one week to 6.74 yr). In grade 1 hydronephrosis, 49 (52.7%) resolved spontaneously, and in grades 2, 3, and 4 hydronephrosis, 59 (36.4%), 16 (16.7%), and 2 (2.6%) resolved, respectively.

Surgery was performed in 174 kidneys (40.7%) of 154 children (45.2%), including pyeloplasty in 105 kidneys, ureteroneocystostomy in 23, transurethral incision in 11, nephrectomy in 9, and partial nephrectomy in 7. Mean age at operation was 6.3 months (range, one day-5.2 yr). Most children in that received surgery had initially high grade hydronephrosis. Eight (8.6%) of 93 kidneys had grade 1 hydronephrosis, 39 (24.0%) of 162 had grade 2 hydronephrosis, 62 (64.6%) of 96 had grade 3, and 65 (85.5%) of 76 had grade 4 hydronephrosis warranted surgical intervention, respectively (Fig. 1). The rate of surgery increased as the degree of hydronephrosis increased (p<0.05).

In children with ureteropelvic junction obstruction, the grade of hydronephrosis was 1 in 63 (22.5%), 2 in 77 (27.5%), 3 in 74 (26.4%), and 4 in 66 (23.6%). Pyeloplasty was performed in a total of 109 kidneys (six of grade 2, 46 of grade 3, and 57 of grade 4 hydronephrosis). The rate of surgery increased as the degree of hydronephrosis increased (p<0.05). Mean age at pyeloplasty was 5.1 months (range, one week-3.2 yr), 13 (11.9%) kidneys were operated upon within one month, 48 (44%) from one to three months, 37 (34%) within one year, and 11 (10.1%) from one to three years.

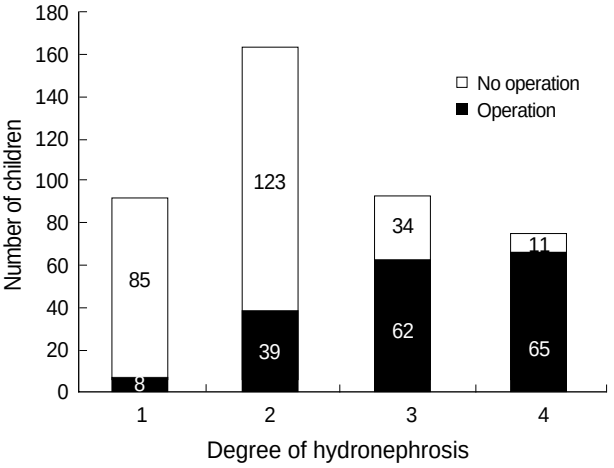

Fig. 1. Management versus degree of hydronephrosis.

Vesicoureteral reflux was identified in 24 infants (bilateral in 6 cases) giving a total of 30 refluxing renal units, including 21 males and three females. Reflux was found in the left kidney in 17 cases, and in the right in 13 cases. The grade of reflux was grade 1 in 2 (6.7%), grade 2 in 2 (6.7%), grade 3 in 9 (30.0%), grade 4 in 9 (30.0%), and grade 5 in 8 (26.7%), and the percentages of males in each group were 50.0%, 100%, 88.9%, 88.9%, and 87.5%, respectively. All infants diagnosed as having vesicoureteral reflux were placed on antibiotic prophylaxis. In the majority (58.3%) of cases, reflux resolved with conservative management. Ten children underwent surgical intervention due to breakthrough infection, renal deterioration, persistent high-grade reflux. The mean age at operation was 10.1 months with a range of 3.9 to 20.5 months.

DISCUSSION

The purpose of prenatal ultrasonography has changed from the simple detection of hydronephrosis to selection for specific diagnosis-based management. It is important to determine which infants with hydronephrosis will deteriorate, and which will stabilize or improve. However, the significance of hydronephrosis in infants is often difficult to define, and current techniques cannot reliably diagnose obstruction without an observation period. Thus, the evaluation and management of hydronephrosis are issues that are rapidly evolving, which is generating enormous controversy.

Koff et al. (6, 7) have proposed plotting serial measurements on a renal growth chart to identify infants with obstruction as evidence by accelerated contralateral renal growth. Mallek et al. (8) and Palmer and DiSandro (9) suggested the use of diuretic Doppler ultrasonography to differentiate obstruction from dilatation. However, current techniques cannot reliably

differentiate obstruction from non-obstruction, and neither the initial grade of hydronephrosis on prenatal ultrasonography nor the drainage-functional pattern on initial diuretic renography is a predictor of the subsequent need for surgery (10, 11). Therefore, it is important to identify better techniques for the assessment of the hydronephrotic kidney.

Conflicting data exist concerning the optimal timing of postnatal ultrasonography in neonates with prenatal hydronephrosis. Published reports suggest the need to delay renal ultrasonography for at least 1 week after birth to avoid a false-negative study due to oliguria. It has been recommended that when ultrasonography is negative within 48 hr of birth, the study should be repeated after 1 week of life (12). On the other hand, Wiener and O'Hara (13) reported that although ultrasonography within 48 hr of birth more commonly underestimated the degree of hydronephrosis, the difference was not clinically significant at further follow-up. Docimo and Silver (14) reported that among the children with no or mild hydronephrosis by ultrasonography within 48 hr of birth, no child developed any significant obstructive renal lesion within the first year of life, and suggested that there is no contraindication to early neonatal ultrasonography. In the present study, ultrasonography was performed at 1-4 days after birth, repeated after 1 month and graded according to the grading system of the Society for Fetal Urology. No significant difference was observed in the grade of hydronephrosis or postnatal outcome between children who had initial ultrasonography within 48 hr and those that did not.

The management of prenatally detected hydronephrosis has changed dramatically in the last decade, from early surgery to close observation until renal deterioration, or progression of hydronephrosis occurs. This strategy is based on the observations that most mild hydronephrosis resolves spontaneously and renal function then recovers to the level of the normal kidney. Koff (15) reported that 85% of patients, in whom prenatal hydronephrosis was detected, proved to have transient, physiologic dilatation of the renal pelvis, and these hydronephroses resolved spontaneously without surgical intervention. Harding et al. (16) reported that in patients with mild hydronephrosis of the anteroposterior diameter of the renal pelvis of less than 10 mm, 43.1% of the hydronephroses resolved spontaneously postnatally, and they suggested the necessity that parental concerns be addressed and minimized. Ransley et al. (17) also reported that most hydronephroses, with a differential renal function exceeding 40% and an anteroposterior diameter of less than 1.2 cm, disappeared spontaneously on the follow-up without surgical intervention. As many previous studies have indicated, mild fetal hydronephrosis is known to be clinically insignificant, and to carry a low likelihood of surgical intervention.

At a first glance, the results of our study suggest that the rate of spontaneous resolution (29.5%) may seem lower, and the rate of surgery (40.7%) higher than those reported by other studies. This difference can be explained as follows. In our study, many infants, who had an initial diagnosis of prenatal hydronephrosis, but without evidence of hydronephrosis on postnatal ultrasonography, were excluded. Most cases of mild hydronephrosis are known to resolve spontaneously before delivery (18). Sairam et al. (3) reported that hydronephrosis resolved in the antenatal or early neonatal period in 88% of fetuses. If this patient type has been included in our study, the rate of spontaneous resolution would have been much higher. Moreover, children with multicystic dysplastic kidney, posterior urethral valve, duplication, or ureterocele were included in our study, which led to an increased rate of surgical intervention. Our institute is tertiary hospital to which the most severe cases are referred nationwide for further management, naturally, this also causes the selection bias. In addition, the patients who were lost to follow-up were excluded from this study, and most of these, we suppose, may be doing well without any symptoms and with spontaneously resolved hydronephrosiss. And finally, ethnic differences may influence the nature of prenatal hydronephrosis. This aspect requires further investigation.

Regarding the duration of follow-up period, Ulman et al. (10) recommended nonoperative treatment with a close follow-up, especially during the first 2 yr, and that the follow-up protocol should maintain a maximum interval between diagnostic tests of no longer than 3 months for the first 2 yr of life. In our study, most surgeries (91%) except some nephrectomies performed in multicystic dysplastic kidneys were performed before the age of one, and mean time to spontaneous resolution was 16.5 months, which supports the recommendation made by Ulman et al. (10).

The limitations of our study are that it was not a planned prospective study. Many children were excluded because their medical records were incomplete or because they had been lost to follow-up. In addition, the study population included children in whom the specific cause of hydronephrosis had been verified, such as multicystic dysplastic kidney, vesicoureteral reflux, and posterior urethral valve. This heterogeneity of the study population may have led to the underestimation or the overestimation of the rate of spontaneous resolution. However, the overall data suggests that mild hydronephrosis is relatively benign and does not require surgical intervention, which is in-line with the report of previous studies (19-21).

In conclusion, our study demonstrates that mild fetal hydronephrosis is relatively benign and does not require surgical intervention in most cases. Moderate or severe fetal hydronephrosis often results in a poor outcome requiring surgical intervention. Fetal hydronephrosis needs closer follow-up both antenatally and postnatally, and surgery should be performed if renal compromise occurs.

The natural history of prenatally detected hydronephrosis continues to be defined. Only the collaborative efforts of obstetricians, neonatologists, geneticists, radiologists, and pediatric urologists can provide answers to the many questions regarding prenatally diagnosed hydronephrosis.

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