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PRENATAL HYDRONEPHROSIS

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ABSTRACT

Objective: To report the experience of the Fetal Medicine Group of the State University of Campinas Medical School with the diagnosis and management of intrauterine hydronephrosis.

Patients and Methods: From January 1997 to April 1999, forty-five women, whose fetuses were diagnosed with prenatal hydronephrosis were treated by the Fetal Medicine Group.

Results: Thirty-one fetuses were male, eleven were female and three had undetermined gender. Nineteen fetuses (42.2%) had additional malformations. Prenatal intervention was performed in 18 fetuses, being 18 urine aspirations and three shunt placement. Mean birth weight was 2,778 g. There were eleven deaths that occurred either intrauterine (# 4) or in the immediate postnatal period (# 7). Thirty-four neonates were followed, whose final diagnoses was transitory hydronephrosis in three neonates (8.82%), ureteropelvic junction obstruction in nine (26.5%), non-obstructive hydronephrosis in four (11.8%), vesicoureteral reflux in seven (20.6%), ureterovesical junction obstruction in five (14.7%) and posterior urethral valve in six (17.6%). The 31 with non-transitory hydronephrosis were closely monitored after birth for a mean follow-up of 16.8 months (6 to 37 months). Seventeen children (54.8%) in whom renal function remained within normal limits were treated non-operatively. The remaining 14, whose renal function was either initially poor or deteriorated during follow-up, underwent surgical correction of their anomalies.

Conclusions: Antenatal diagnosis of hydronephrosis allows early follow-up by a multidisciplinary team, improving the management of these infants and eventually providing the rationale for early intervention.

Key words: kidney; hydronephrosis; prenatal diagnosis; fetus; ultrasonography
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INTRODUCTION

The routine use and improvement of prenatal ultrasonography allowed early diagnosis and therapeutic planning of pregnant women carrying fetuses with congenital anomalies, such as urinary anomalies (1). Fetuses with prenatal disgnosis of hydronephrosis can present normal renal growth and function, independent of the fetal intervention. However, non-treated fetuses with obstructive bilateral uropathies can develop progressive renal function deterioration, oligohydramnios and prenatal death (2).

Prenatal diagnosis of hydronephrosis enables either the follow-up of urinary anomalies as fetal interventions, mainly in bilateral cases. The ultimate aim is to preserve postnatal renal function and change the development of obstructive uropathies (2).

The present study reports the experience of Unicamp Fetal Medicine Group in the management of prenatally diagnosed hydronephrosis and its postnatal follow-up.

PATIENTS AND METHODS

From January 1997 to April 1999, 45 pregnant women whose fetuses suffered from uni- or bilateral hydro-

nephrosis were treated. The anomalies were diagnosed through prenatal ultrasonography performed by the physicians from the Center of Integrated Attention to Women Health - Unicamp. Unicamp Fetal Medicine group, responsible for pregnant women entire follow-up, is formed by a multiprofessional team with obstetricians, neonatologists, pediatricians, neurosurgeons, geneticists and pediatric cardiologists, besides psycologists, social assistants and nurses.

Medical register data in the present study were: 1)- prenatal ultrasonography information, such as gestational age at the moment of the diagnosis of hydronephrosis; fetal gender; presence of associate malformation; amniotic liquid measured through the amniotic liquid index, which indicates the normal amount of liquid for each gestational age; presence of cysts or alterations in renal echogenicity; performance of fetal urinary tract puncture and evaluation of fetal urinary function through electrolytes determination; indication of fetal urinary diversion and pregnancy outcome, and 2)- neonatal information; birth weight; gender; ultrasonography and voiding urethrocystography and scintigraphic tests of DTPA and DMSA for renal function quantification and posterior neonatal diagnostic confirmation; clinical or surgical treatment and total follow-up duration.

Prenatal ultrasonography has allowed the routine measurement of the amniotic liquid in all pregnant woman. It has also guided the urinary tract puncture. Puncture to collect fetal urine was indicated in the following conditions: bilateral hydronephrosis and presence of oligohydramnio or progressive reduction of amniotic liquid. Intrauterine derivation (vesicoamniotic) was indicated to fetuses with favorable prognosis, defined by Harrison et al. (2) as: pregnancy between 20 and 30 weeks without associate malformations and with normal karyotype, urinary levels of sodium < 100mEq/ml, of chlorine < 90mEq/ml, b2-microglobulin < 2 mg/dl and osmolarity < 210mOsm.

During the first month after birth, the cause of hydronephrosis was investigated through ultrasonography and voiding urethrocystography. Newborns with normal ultrasonography and voiding urethrocystography were re-evaluated by the age of 3 months, to confirm the transitory hydronephrosis diagnosis or to identify any urinary deviation which could have been incorrectly diagnosed. The initial approach was conservative and included urinary tract cyntilographic evaluation with DMSA and/or DTPA one month after birth. All newborns were initially treated with antibiotic prophylaxis until diagnostic definition. Antibiotics were continued in cases of confirmed hydronephrosis.

Surgical treatment was indicated when bilateral ureteropelvic junction obstruction, superior tract obstruction on DTPA and renal tubular function deterioration on DMSA, and superior urinary tract infection, independently of the use of antifioticprophylaxis, were observed.

RESULTS

The mean gestational age at the time of the intrauterine diagnosis was 28.2 weeks (16 - 38). In 20 patients the hydronephrosis was identified before 26 weeks. Nineteen fetuses (42.2%) presented with associate malformation. Cordocentesis was performed in 15 to identify chromosopaties. Gender was identified in 42 fetuses, being 31 males, 11 females and 3 not-determined. Initial echographic evaluation reveled normal amniotic liquid in 35 (77.8%), lower in 7 (15.5%) and higher in 3 (6.7%) fetuses. Most fetal kidneys did not present renal parenchima ecogenicity alterations (75.6%) and only 9 presented renal cysts (20.9%).

Fetal urine collection was performed in 18 women, being 15 from the fetal bladder and 3 from the renal pelvis. Six of the punctured fetuses died. Four of them presented severe oligohydramnios, elevated β_2- microglobulin (mean of 26.4 mg/dl) and sodium and chlorine higher than 100 mEq/ml. The 12 punctured fetuses who survived presented urinary sodium and chlorine levels below 100 mEq/dl. β_2 microglobulin was performed in only 6 of the latter (mean of 3.5 mg/dl).

Vesicoamniotic deversion was performed in 3 fetuses to diminish the urinary tract pressure. One diversion was successful and resulted in hydronephrosis alleviation. The other 2 fetuses were born prematurely, one after the migration of the amniotic liquid catheter to the fetal peritoneum.

Thirty-four fetuses survived and 11 died. Four or the latter died intrauterus (36.3%) and 7 in the immediate postnatal period (63.7%). From the ones who died, 10 presented other associate malformations, 7 confirmed by necropsy (4 congenital cardiopaties and 3 central nervous system malformations). There was no relation between fetal or neonatal death with fetal puncture or deversion. Mean birth weight of the 34 newborns who survived was 2,778 g (1,140 g – 4,390 g).

Neonatal confirmation of the diagnosis reveled 3 cases of transitory hydronephrosis (8.8%), 6 cases of ureteropyelic junction anomalies (17.6%), 3 cases of ureteropyelic junction anomalies associated with contralateral non-obstructive hydronephrosis (8.8%), 4 cases of non-obstructive hydronephrosis (11.8%), 7 cases of primary vericoureteral reflux (20.6%), 5 cases of megaureter without reflux (14.7%), 5 cases of posterior urethral valve (14.7%) and 1 urethral stenosis (3%).

Prenatal ultrasound diagnosis was not in accordance with the neonatal ultrasound diagnosis in 6 out of the 21 patients (87% of sensibility), whose prenatal ultrasonography showed bilateral hydronephrosis. The neonatal ultrasound was normal in 3 of these children and showed unilateral hydronephrosis in the others (Table-1).

From the 9 neonates with final diagnosis of ureteropyelic junction anomaly, 7 (77.8%) were male, and 8 (88.9%) presented unilateral impairment of the renal function. There was an association with contralateral non-obstructive hydronephrosis in 3 neonates (33.3%). From the 7 neonates with primary vesicoureteral reflux, 4 (57.1%) were male and 5 (71.4%) presented unilateral impairment of the renal function. Among the patients with infravesical obstruction (posterior urethral valve or urethral stenosis), 3 presented vesicoureteral reflux and significant unilateral renal deterioration. One of them had patent urachus at birth.

After diagnosis confirmation, 17 newborns (50%) with normal renal function were clinically treated, with no need of surgical intervention. During the entire clinical follow-up, the renal function did not present any alteration. In contrast, 14 newborns (41.2%) were operated due to abnormal renal function (Table-2).

Table 1 *- Correlation between pre- and postnatal ultrasound diagnosis as to hydronephrosis side and final etiologic diagnosis.*

Prenatal US	**Postnatal US**	**Final Diagnosis**
13 Unilateral	13 Unilateral	5 UPJ 4 PUV 2 Non-refluxive Megaureter 2 HNO
21 Bilateral	15 Bilateral	5 PUV 4 UPJ: 1 bilateral; 3 NOH contralateral 2 PUV 2 Non-refluxive Megaureter 1 NOH 1 Urethral Stenosis
	3 Unilateral	1 PUV 1 Non-refluxive Megaureter 1 NOH
	3 Normal	

UPJ = ureteropelvic junction; VUR = vesicoureteral reflux; NOH = non-obstructive hydronephrosis; PUV = posterior urethral valve

Table 2 - *Hydronephrosis treatment according to the postnatal diagnosis.*

Diagnosis	Clinical Treatment	Surgical Treatment	No. de Patients
UPJ Anomaly	4	5	9
Isolated Non-Obstructive Hydronephrosis	4	-	4
Vesicoureteral Reflux	5	2	7
Non-Refluxive Megaureter	4	1	5
Posterior Urethral Valve	-	5	5
Urethral Stenosis	-	1	1
Total	17	14	31

The initial presentation of six out of 14 patients who were operated was low unilateral renal function, which was secondary to the ureteropyelic junction anomaly in 5 of them, and secondary to the obstructive megaureter in one. From these, 4 were submitted to nephrectomy due to renal exclusion and 2 were submitted to pyeloplasty, at 2 and 8 months of life, respectively. As for the 2 patients operated with bilateral ureteropyelic junction obstruction, one had no problems during follow-up while the other, with low renal function since diagnosis, presented deterioration of the renal function and recidive of obstruction. He was submitted to endopyelotomy without any sign of obstruction after 6 months. However, the renal function remained low.

Two patients with vesicoureteral reflux and unfavorable outcome in the clinical treatment were operated. The first, with recurrent urinary tract infection, had the ureter reimplantated by Politano technique at the age of 9 months, with no incidents. The second, with cloaca extrophy, was submitted to a step-by-step treatment , with vesicostomy at birth and ureteral reimplantation afterwards, dying at the age of 12 months due to urinary sepsis.

The results of the 6 patients with infravesical obstruction are as follows: the initial postnatal treatment were vesicostomy followed by posterior urethral valve ablation in 5 and early valve resection in one. All patients with infravesical obstruction had preserved renal function. This group includes the 3 patients who were submitted to intrauterine vesicoamniotic diversion.

The mean follow-up of the 31 patients with neonatal urinary abnormality was 16.8 months (6 - 37 months).

DISCUSSION

Hydronephrosis is the most frequent alteration detected by prenatal ultrasonography, with a global incidence of 1% in the fetal diagnosis. It corresponds to approximately 50% of all anomalies detected intrauterus. Prenatal identification has significantly increased with the advent of detailed fetal ultrasonography as from 18 - 20 weeks of pregnancy and with the improvement of its resolution (1).

Early hydronephrosis identification allows the screening of fetuses with indication of prenatal intervention, delivery anticipation, or anticipated removal to a specialized medical service. Besides being important to family counseling, it allows better parents' orientation and preparation to the diagnosis and eventual pre- or postnatal intervention.

Early perinatal medical follow-up of patients with hydronephrosis avoid urinary tract infections in newborns at risk, decrease hospitalizations due to infections or electrolytic dysfunction, and enable the substitution of urgent for elective surgeries. However, there are still some doubts regarding the significant improvement in the incidence of chronic renal failure at adult age (3).

Many parameters aid in the ultrasonographic diagnosis of fetal hydronephrosis. The anteroposterior diameter of the renal pelvis is considered the most

simple and sensitive. Corteville et al. (4) believe that a pelvis diameter ≥ 4 mm and ≥ 7 mm before and after the 30th week of pregnancy, respectively, are associated with high diagnostic sensitivity. Even though their data are consistent, it is still controversial if the dilation degree at birth can predict postnatal hydronephrosis development.

Antenatal intervention is still not a consensus in fetal hydronephrosis approach, especially regarding nephro- and vesicoamniotic diversions with the purpose of preserving postnatal renal function.

The last 10 years are characterized by the refinement in fetal therapy. The treatment philosophy defined the prevention of lung hypoplasia as the primary purpose, being secondary the effects on renal and vesical function.

In order to identify the fetuses who will really benefit from intrauterine urinary deversions, the selection criteria was refined. This is based on amniotic liquid quantification (amniotic liquid index measured by ultrasonography), karyotype study and fetal urine electrolytes and protein dosage (5).

The serial evaluation of fetal urine has been postulated for allowing a better accurate selection of fetus who will benefit from urinary diversion (6). The addition of new fetal renal function prognostic markers has aided urinary investigation. The α_1-microglobulin, the growth transformation-β1 factor and the epidermic growth factor are some of them (5). In the present study, we observed that proteinuria as demonstrated by β2 microglobulin dosage has been a bad prognosis indicator, mainly when associated with elevated concentration of sodium and chlorine in the fetal urine.

Advances in the techniques for fetal urinary diversion have allowed safer procedures with low complication rates. The most frequent complications are the migration of the diversion catheter to a site outside the bladder, with fetal urinary ascites formation or intestinal herniation, and the subsequent obstetric complications (5,7). Freedman et al. compared fetuses in similar circumstances with or without vesicoamniotic diversion. They showed significant decrease in the number of intrauterus deaths, even though there was an increase in the incidence of early labor (5).

In the present study, two out of three diversions resulted in early labor. One of them occurred after catheter migration and formation of urinary ascites.

In our experience, the best criteria to indicate fetal urine collection has been the progressive decrease in the amniotic liquid index or severe oligohydramnios.

The most common causes of fetal hydronephrosis are transitory non-obstructive factors such as the physiologic dilation (8). The low incidence of transitory hydronephrosis is noticeable in our casuistics. This is possibly due to the fact that, as a tertiary service, we follow a high number of pregnant women with high risk of significant fetal anomalies. This fact can equally explain the high mortality rate in the immediate antenatal or neonatal period (24.4%), because almost all patients (90.9%) presented with associate malformations.

The ureteopyelic junction anomaly is the main cause of neonatal hydronephrosis. It occurs mainly because of abnormal distribution of collagenous and musculary fibers in this region (9). It is more common in males, being bilateral in 21 to 36% of the cases (10).

The prenatal diagnosis of ureteropyelic junction anomaly has motivated the creation of 2 therapeutic approaches: one that advocates early surgical correction, and another that advocates close surveillance with surgery being indicated only in cases of renal function deterioration. The initial renal damage is smaller in cases detected in the prenatal period; however, there is no consensus in the literature if there will be a renal function improvement after early pyeloplasty when compared to children with later diagnosis and surgery (11,12).

In our study, the surgical intervention was performed only in those patients who presented obstructive DTPA with low initial relative tubular renal function (< 40%), significant decrease (≥ 10%) during follow-up, outbreak of new scars or recurrent urinary tract infection. The 2 children submitted to pyeloplasty in this series presented bilateral ureteropyelic junction anomaly and low initial tubular function.

Vesicoureteral reflux develops in 10 to 25% of the prenatal hydronephrosis. Normal postnatal ul-

trasonography is seen in 18 to 30% of them. It is more common in boys, there is higher incidence of bilateral onset, and the reflux grade is more severe (13). It is possible that such characteristics are secondary to high intravesical pressures, due to late maturation of the striate urethral sphincter in boys, as described by Kokoua et al. (14). In spite of controversial, the performance of postnatal voiding ureterocystography is advocated in all cases of ante- or postnatal hydronephrosis to diagnose vesicoureteral reflux (8,15).

The impact of prenatal diagnosis in the vesicoureteral reflux outcome is still not known. Due to the frequent spontaneous resolution of early diagnosed reflux, our approach has been conservative, with clinical surveillance, antibiotics prophylaxis and selected tests for renal evaluation.

Ureterovesical junction anomalies characterize the megaureter in its different forms as follows: non-refluxive / non-obstructive, obstructive and refluxive different forms. Spontaneous improvement of the megaureter is a common event. Prenatal diagnosis allows early follow-up and identification of some patients who can develop renal function deterioration, despite the absence of symptoms (9). In the present study, 4 out of 5 newborns with non-refluxive megaureter diagnosis were conservatively treated.

The posterior ureteral valve is the most common cause of infravesical obstruction in boys, with an incidence of 1 in 4,000 to 25,000 children born alive (9). The presence of a fetus with thick bladder wall, bilateral hydronephrosis, with or without renal dysplasia, and oligoamnio strongly suggests the prenatal diagnosis of posterior ureteral valve.

There are three anatomic variables associated with the posterior urethral valve in fetuses which acts as a escape valve mechanism reducing high urinary system pressure and preserving renal function. They are the posterior urethral valve syndrome, characterized by unilateral vesicoureteral reflux and renal dysplasia, congenital vesical diverticulum, and urine leakage, for example, secondary to uracus patency. Rittenberg et al. (16) have shown differences in the serum creatinine among boys with or without escape valve. Among the 6 fetuses with infravesical obstruction in our casuistics, 4 presented escape mechanisms (3 with posterior valve syndrome and dysplasia, and one with uracus patency).

In order to preserve bilateral renal function secondary to urethral obstruction, the main indication of fetal urinary diversion has been the progressive decrease in the amniotic liquid index or oligodramnio, associated with preserved fetal renal function as measured by urinary biochemistry, absence of other significant abnormalities and normal fetal karyotype. Although the diversion is a therapeutic maneuver to preserve the fetus renal function, its long-term benefit is not completely known (17). In this series, 3 out of 6 fetuses with infravesical obstruction were submitted to intervention.

The neonatal treatment of choice for posterior urethral valve is the endoscopic ablation of the valve (18). After the acquisition of endoscopic instruments for posterior urethral valve resection, we have also adopted such approach (19).

The development of the fetal surgery by uterine laparoscopy and fetal cystoscopy with laser-assisted posterior ureteral valve ablation has been described as a promising technique (20). Such procedure could avoid intrauterus diversion, as well as offer earlier obstruction relief (18).

We can conclude that the prenatal diagnosis of hydronephrosis allows perinatal follow-up which results in an appropriate posnatal management, especially in patients with hydronephrosis. As a consequence, it helps in the selection of patients who will eventually need early surgical intervention.

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