Ultrasonographic findings in genitourinary tract malformations: a pictorial essay

Achados ultrassonográficos nas malformações do trato geniturinário: ensaio pictórico

Martha Hanemann Kim¹, Yoshino Tamaki Sameshima², Miguel José Francisco Neto³, Marcelo Buarque de Gusmão Funari⁴

ABSTRACT

Objective: To demonstrate didactically the different ultrasound findings of various congenital malformations of the genitourinary system.

Methods: Twelve cases were retrospectively studied, comprising patients who presented with genitourinary tract malformations (with or without related symptoms), detected by ultrasound testing carried out with Phillips ATL / HDI – 5000 ultrasound equipment, during the period of August 2007 to June 2009 at the Imaging Department of the Hospital Israelita Albert Einstein.

Results: Six patients were females and six were males, and ages varied from a few hours of life to 15 years and 9 months. All individuals were evaluated and accompanied by the Pediatric Radiology sector of the Hospital Israelita Albert Einstein. The study was carried out as follows: two cases of hydrocolpos, one of them a result of imperforate hymen and one a case of congenital stenosis of the ureteropelvic junction, one case of ureterocele, one case of bilateral double collection system, one case of horseshoe kidney, one case of Hutch’s diverticulum, two cases of pelvic kidney, one of them with hydronephrosis, one case of multicystic dysplastic kidney, one case of polycystic kidney (adult form), and one case of congenital megaureter.

Conclusions: The ultrasonographic study is a valuable method for the early identification, often in the uterus, of these and several other treatable anomalies of the genitourinary tract. Additionally, it also presents the advantage of not using ionizing radiation, which is very significant, especially in the pediatric age group.

Keywords: Urinary tract/ultrasonography; Urinary tract/abnormalities; Urogenital system

INTRODUCTION

Congenital urinary tract anomalies are relatively frequent and may be found in about 3% to 4% of the population⁴. The incidence of urinary tract anomalies detected in routine prenatal ultrasound studies varies at different institutions from 1 for every 154 gestations to 1 for every 1200⁴.
Many cases of renal insufficiency in childhood are attributed to congenital anomalies of the kidneys and urinary tract.

Anomalies of the genital and urinary tracts may occur simultaneously due to the interrelations in embryonic development of both systems.

Ultrasound tracking is important for the detection of other associated anomalies, which may indicate the presence of a syndrome or chromosomal anomaly.

One should also point out the importance of the ultrasound study of family members of the fetuses or children who present renal anomalies in order to aid in the diagnosis and to detect possible asymptomatic renal disorders in parents or siblings. The early diagnosis of these malformations is essential for the treatment and prevention of renal function deterioration. Ultrasound study has a fundamental role in this investigation, since it is an accessible method of real-time diagnosis without the use of ionizing radiation, which is an important factor, especially in this pediatric age bracket.

**OBJECTIVE**

To demonstrate in a didactic manner the different ultrasound findings of various congenital malformations of the genitourinary system for a precise and early diagnosis, thus aiding in clinical procedures.

**METHODS**

This paper brings a retrospective study, carried out at the Imaging Department of the Hospital Israelita Albert Einstein, of patients presenting with genitourinary tract malformations detected in ultrasound tests performed on Phillips ATL / HDI – 5000 equipment, in the period comprising August 2007 to June 2009. Patients were of both genders, with ages that varied between a few hours of life to 15 years and 9 months of age, with or without related symptoms. These cases were selected due to their typical alterations of each disorder, thus being of didactic interest.

**RESULTS**

Six patients were females and six were males. All individuals were assessed and accompanied by the pediatric radiology sector of the Hospital Israelita Albert Einstein. The cases studied were: two cases of hydrocolpos, one of them as consequence of an imperforate hymen, one case of congenital stenosis of the ureteropyelic junction, one case of ureterocele, one case of bilateral collection system duplicity, one case of horseshoe kidney, one case of Hutch’s diverticulum, two cases of pelvic kidney, one of them presenting with hydronephrosis, one case of multicystic dysplastic kidney, one case of polycystic kidney (adult form), and one case of congenital megaureter.

**Case 1: hydrocolpos**

P.M., female, 15 years and 9 months old, with cerebral palsy, went through a routine ultrasound test which revealed liquid distension of the vaginal cavity with no other associated findings (Figure 1A-D).
Case 2: imperforate hymen

D.M.’s, female newborn, 20 hours of life, with fetal ultrasound test performed at another institution showing a cystic formation interpreted as an ovarian cyst. An abdominal ultrasound was performed soon after birth for the diagnosis, which revealed a large elongated formation containing thick fluid content with fine debris, measuring 13.7 x 5.9 x 4.9 cm, occupying the median region of the abdomen, extending from the pelvic region in the vaginal topography to the mesogastric region, pushing and compressing the adjacent abdominal organs (the uterus was pushed towards the mesogastric region), causing moderate bilateral uretero hydronephrosis (Figure 2A-D).

Figures 3 to 6 show the child’s clinical aspect before and after hymenotomy, and Figures 7 and 8 present the ultrasonographic control after hymenotomy.

---

**Figure 3.** Imperforate hymen

**Figure 4.** Hymenotomy

**Figure 5.** Hymenotomy with mucoid material discharge

**Figure 6.** Hymenoplasty for the treatment of imperforate hymen
the right with predominance of pyelic dilation, with a thinning of the renal parenchyma and no evidence of ureteral dilation (Figures 9A-B and 10).

**Case 3: congenital stenosis of the ureteropyelic junction (UPJ)**

A.M.M., male, 6 years and 4 months old, was submitted to ultrasound study for control of congenital stenosis of the ureteropyelic junction on the right, which displayed accentuated dilation of the pyelocaliceal system on

![Figure 7. Ultrasonographic control after hymenotomy](image1)

**Figure 7. Ultrasonographic control after hymenotomy**

![Figure 8. Ultrasonographic control after hymenotomy; bilaterally collecting system dilatation has not been observed](image2)

**Figure 8. Ultrasonographic control after hymenotomy; bilaterally collecting system dilatation has not been observed**

**Case 4: ureterocele**

I.M.I’s male newborn, one day old, showed in a fetal ultrasound conducted at another institution showed ureterohydronephrosis on the right. The postnatal follow-up study revealed bilateral obstructive ureterocele on the right with hydronephrosis upstream and non-obstructive on the left (Figure 11).
Case 5: collection system duplication
M.G.F.C.S., female, 1 month old, with an ultrasound study performed for follow-up of hydronephrosis that showed complete duplication of the pyelocaliceal system of both kidneys, with bilateral obstructive ectopic ureterocele, causing accentuated upper grouping of both kidneys (Figure 12A-C).

Case 6: renal fusion anomalies
Horseshoe kidney
M.A.O.S., female, 4 years and 4 months old, history of repeated urinary tract infections. An ultrasound test was requested to investigate a renal scar that revealed a fusion of the kidneys by the lower poles (horseshoe kidney) (Figure 13A-C).

Case 7: bladder diverticula
Hutch’s congenital diverticulum
P.G.P.R., male, 4 years and 9 months old, with a history of repeated urinary tract infections. An ultrasound study was requested for follow-up, and revealed the presence of a diverticulum adjacent to the ureterovesical junction with urinary reflux into the bladder (Figures 14A-B).

Case 8: renal ectopia
Pelvic kidney
M.C.S.R.P.’s, female newborn, one day old. Left kidney not characterized on fetal ultrasound performed at another institution. A postnatal follow-up ultrasound was requested and showed the left kidney in a pelvic location (Figure 15A-B).
Case 9: renal ectopia

Pelvic kidney with hydronephrosis
K.R.S.S., male, 3 months of life. The left kidney was not characterized upon fetal ultrasound performed at another institution. Postnatal follow-up ultrasound was requested, showing the left kidney in pelvic location with accentuated hydronephrosis (Figure 16A-C).

Case 10: multicystic dysplastic kidney
D.A.S., male, 3 months of life, with fetal ultrasound performed at another institution showing renal masses. The follow-up ultrasound demonstrated a left kidney with multiple cysts with anechoic content and thin walls of various dimensions, with no evidence of normal renal parenchyma among them (Figure 17A-B).

Case 11: adult renal polycystic disease
S.S.L., female, 6 years and 9 months old, patient with sickle-cell anemia, with hepatomegaly and ultrasound, performed at another institution, showing bilateral renal cysts. A follow-up ultrasound was requested and revealed cysts of various dimensions involving the renal cortex and medulla bilaterally with areas of normal parenchyma (Figure 18A-B).

Case 12: congenital megaureter
G.T., male, 8 months old, with a history of urinary tract infections; an ultrasound test was requested for diagnostic investigation, showing bilateral ureteral dilation upstream of a distal ureteral segment with reduced caliber and normal kidneys (Figure 19A-B).
Figure 16A-C. Left kidney localized in the pelvis with marked hydronephrosis

Figure 17A and B. Infundibular pelvic shape of the multicystic kidney presenting simple multiple cysts of several dimensions without renal parenchyma

Figure 18A and B. Cysts of several dimensions involving bilaterally the cortex and renal spinal cord with areas of normal parenchyma

Figure 19. (A) Bilateral urethral dilatation to amount of distal urethral segment of reduced gauge (B) Normal kidneys

DISCUSSION

Many cases of renal insufficiency in childhood are attributed to congenital anomalies of the kidneys and urinary tract. Anomalies of the genital and urinary tracts may occur simultaneously due to the interrelationship during embryonic development of these two systems. The early diagnosis of these malformations is essential for the treatment and prevention of renal function deterioration. Therefore, it is vitally important that the radiologist recognize the primary ultrasonographic findings of each case for a precise diagnosis, enabling correct clinical procedures and treatment.

Hydrocolpos is a vaginal distension by fluid content due to vaginal obstructions, generally caused by an imperforate hymen or vaginal atresia with an accumulation of mucoid secretion, and more rarely, due to vaginal septation or Gartner’s duct cyst. It may be associated with malformations of other organs and systems, such as the urinary, gastrointestinal and cardiovascular systems.
Imperforate hymen is the most frequent congenital malformation of the female genital tract. Its isolated occurrence is the most common presentation, and the incidence is estimated at 0.1% of women born alive\(^{(4-6)}\). The manifestation of imperforate hymen as an abdominal mass during the fetal period or in neonates is extremely rare, with an estimated incidence of 0.006% of liveborns\(^{(5,7)}\). Most cases remain asymptomatic until puberty. Associated malformations are rare\(^{(5,7)}\) and include polydactyly, malformations of the urinary tract, gastrointestinal malformations, skeletal malformations, rare familial syndromes (McKusick-Kaufman). Prenatal ultrasound study is important for the diagnosis of associated malformations and for a correct treatment planning.

Congenital stenosis of the ureteropyelic junction (UPJ) is the most common urinary tract anomaly, estimated at 1 for every 1000 cases\(^{(8)}\). It implies obstruction of the urinary flow from the renal pelvis to the ureter, and it is the primary cause of hydronephrosis in children; when bilateral, it can lead to renal insufficiency. The prenatal diagnosis can easily be made by ultrasound\(^{(8)}\).

Ureterocele is the cystic dilation of the intramural portion of the distal ureter, which may be uni- or bilateral\(^{(9)}\), occurring in normal or duplicated ureters, or ureters with ectopic implantation. Ureteral duplication is present in about 75% of patients with ureteroceles\(^{(9-10)}\), and is most frequent in the ureter that drains the upper unit, generally with ectopic implantation. They are usually associated with significant hydronephrosis of this unit. Voluminous ureteroceles may obstruct the contralateral ureteral orifice and/or the urethral orifice in the bladder neck region. They may be asymptomatic or lead to obstruction, causing recurring or persistent urinary infections. Duplication of the collection system is a frequent, often asymptomatic, alteration of the urinary tract\(^{(8)}\). It may be complete or incomplete, the latter being more common (1 in every 500 persons)\(^{(10)}\). When it is complete, there may be obstruction of the upper grouping by an ectopic insertion of the ureter or by the presence of ectopic ureterocele and reflow to the lower group. The ureter that drains the upper group is inserted inferior-medially to its habitual insertion and the ureter that drains the lower group is inserted superior-laterally to its habitual insertion site.

The horseshoe kidney is the most common of the fusion renal anomalies. In more than 90% of cases, the fusion occurs along the lower poles. The primary complications involved are nephrolithiasis and recurring infections due to vesicoureteral reflux.

There may be associations with UPJ stenosis and an increased risk of tumor development. Sometimes, the ultrasound diagnosis may be limited\(^{(11)}\).

Bladder diverticula (Hutch’s congenital diverticulum) are herniations of the mucosa through the muscular bladder wall. Hutch’s congenital diverticulum is classified as primarily of the bladder, occurring at the ureterovesical junction\(^{(12)}\). It is associated with vesicoureteral reflux and other complications such as the formation of calculi in its interior and epithelial dysplasia with an increased risk of neoplastic development.

Renal ectopia is the kidney abnormally positioned, and its most frequent location is the iliac or pelvic position. Incidence varies from 1 in 500 to 1 in every 1,200 children. It is most frequent in boys, and more common on the left side\(^{(13)}\). It may be associated with poor renal rotation. The kidney may be dysplastic and subject to reflux due to incompetence of the ureterovesical junction.

The multicystic dysplastic kidney is not a hereditary disease. It is caused by ureteropelvic atresia during intrauterine development. In the hydronephrotic form of the multicystic kidney, only the ureter is atresic and the cysts represent the pyelocaliceal system. In the pelvoinfundibular form of multicystic kidney, the atresia involves the ureter and renal pelvis, and the multiple cysts represent the dilated calyces. It is generally diagnosed in the intrauterine period or during the first days of life. Bilateral involvement is incompatible with life. It is the second most frequent cause of abdominal masses in newborns\(^{(13)}\). Treatment is conservative.

Renal polycystic disease of the adult is a dominant autosomal disease. It can affect kidneys and the liver, and be uni- or bilateral. It is characterized by cysts of various dimensions that involve the renal cortex and medulla with areas of normal parenchyma.

It may manifest in the newborn (as a uni- or bilateral abdominal mass) or only in the adult phase (hypertension, hematuria, renal insufficiency)\(^{(13)}\). The family history is an important and contributing factor in the diagnosis.

Congenital megareter is the upstream ureteral dilation of a distal segment that is juxtavesical and aperistaltic, with a normal or reduced caliber\(^{(9,14)}\). It is usually congenital and diagnosed in childhood; treatment is conservative in 49% of the cases\(^{(9)}\). It is more frequent in males, on the left side, and may be bilateral in 20% of cases. It may also be associated with other anomalies.

**CONCLUSIONS**

The ultrasonography is a valuable method for early identification, often in the intrauterine period, of these and several other treatable anomalies of the genitourinary tract. Additionally, it has the advantage of not using ionizing radiation, which is tremendously important especially in the pediatric age group.
REFERENCES


