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MINI REVIEW

Scintigraphy in Children with Urinary Tract Dilatation (Antenatally Detected Hydronephrosis)

Boris Ajdinović*, Marija Radulović and Biljana Bazić-Đorović

Institute of Nuclear Medicine, Military Medical Academy, Belgrade, Serbia

Abstract

The causes of Antenatal Hydronephrosis/Urinary Tract Dilatation (ANH/UTD) vary from transient benign conditions-transit hydronephrosis, (resolves by birth or during infancy) to conditions that can significantly affect renal function. The outcome depends on the underlying etiology, so it is very important to determine these causes. The definition and grading of ANH is based on the Anteroposterior Pelvic Diameter (APD) of the fetal renal pelvis.

Antenatal management includes antenatal ultrasound monitoring, which is usually repeated every 4-6 weeks. It is recommended that the assessment of the severity of postnatal hydronephrosis is based on the APD of the renal pelvis. Extensive postnatal investigation was proposed to be limited to those with moderate or severe dilatation. Voiding cystourethrography and scintigraphy are usually preserved for children with postnatal APD <15 mm and/or abnormal kidney parenchyma, severe calyx dilatation ureteral dilatation and bladder pathology.

Diuretic renal scintigraphy is important in the postnatal evaluation of infants with ANH, particularly in distinguishing kidneys with poor drainage from nonobstructive hydronephrosis with good drainage. According to our diuretic renography results, we conclude that in the presence of partial or no drainage, the separate renal function may not be significantly impaired. The finding of poor renal emptying is significantly more common among children with increasing renal pelvis APD.

Technetium 99m-dimercaptosuccinic acid renal scintigraphy (^{99m}Tc-DMSA) has been used in renal imaging to estimate the functional renal mass (damage to the kidney) and relative renal function, especially in pediatric patients. A statistically significant correlation between the degree of hydronephrosis (APD) and DMSA scan finding and between the degree of the VUR and DMSA scan finding was established. Other than VUR, CAKUT (pelvic ureteric junction obstruction, pylon et ureter duplex, megaureter, posterior urethra valves) were not statistically correlated with pathological findings on the DMSA scan.

Introduction

Antenatal Hydronephrosis (ANH) is one of the most common fetal anomalies detected in pregnancy. Previously, this condition was referred to as congenital, antenatal, or prenatal hydronephrosis, but urinary tract dilatation UTD is now the preferred term [1]. The introduction of routine fetal Ultrasound (US) screening in the 1990s has resulted in increasing recognition of Antenatal Hydronephrosis (ANH) [2]. Depending on the diagnostic criteria and gestation, the prevalence of antenatally detected hydronephrosis ranges from 0.6% to 5.4% [3].

*Corresponding author(s)

Boris Ajdinović, Institute of Nuclear Medicine, Military Medical Academy, Belgrade, Serbia

Email: ajdinovicboris@gmail.com

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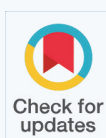
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The causes of ANH/UTD vary from transient benign conditions-transit hydronephrosis, (resolves by birth or during infancy) to conditions that can significantly affect renal function. The outcome depends on the underlying etiology, so it is very important to determine these causes [4].

The definition and grading of ANH is based on the Anteroposterior Pelvic Diameter (APD) of the fetal renal pelvis [5]. It is an objective parameter, although it varies with gestation, maternal hydration and bladder distension.

ANH is present if the APD is ≥ 4 mm in the second trimester and ≥ 7 mm in the third trimester [4]. ANH is further graded as mild, moderate and severe depending on the size of the measured APD. While fetuses with minimal pelvic dilatation (5–9 mm) have a low risk of postnatal pathology, the APD ≥ 15 mm at any gestation represents severe hydronephrosis and requires close follow-up [6–9].

Antenatal management includes antenatal ultrasound monitoring, which is usually repeated every 4–6 weeks, but its frequency depends on the gestation at which ANH was detected, as well as its severity and the presence of oligohydramnios. Almost 80% of the fetuses diagnosed in the second trimester show resolution or improvement of findings with a low likelihood of postnatal pathology [10]. Patients with persistent or worsening hydronephrosis in the third trimester show higher rates of postnatal pathology and require more frequent monitoring. Also, more frequent monitoring is required for fetuses with findings that suggest lower urinary tract obstruction. It is recommended that additional prenatal ultrasound evaluation is done at 16–20 weeks of pregnancy in fetuses with the ANH/UTD detected [5]. It includes evaluation of lower urinary tract obstruction, renal dysplasia, and extrarenal structural malformations (CAKUT).

The controversy about the postnatal management of infants with ANH still exists. It is emphasized that an ultrasound in the first few days of life underestimates the degree of pelvic dilatation due to dehydration and a relatively low urine output. Despite this limitation, an early ultrasound, (24–48 hours after birth), is necessary in neonates with suspected lower urinary tract obstruction, oligohydramnios, bilateral severe hydronephrosis, and severe hydronephrosis in a solitary kidney [4]. In others, the first ultrasound examination should ideally be delayed until the end

of the first week. An ultrasound at 6 weeks is more sensitive and specific for obstruction.

It is recommended that the assessment of the severity of postnatal hydronephrosis is based on the Anteroposterior Diameter (APD) of the renal pelvis. Extensive postnatal investigation was proposed to be limited to those with moderate or severe dilatation. The ANH/UTD classification has been evaluated in several studies and has shown accurate precision in detecting postnatal CAKUT, the need for surgery [11] and chronic kidney disease [12]. Voiding cystourethrography and scintigraphy are usually preserved for children with postnatal APD ≥ 15 mm and/or abnormal renal parenchyma, severe calix dilatation, ureteral dilatation, and bladder pathology. The presence of the two normal postnatal renal ultrasounds excludes the presence of the significant renal disease including dilating Vesicoureteral Reflux (VUR) [13].

Diuretic renography is much more applied than DMSA renal scintigraphy in these children. Diuretic renal scintigraphy is important in the postnatal evaluation of these infants, particularly in distinguishing kidneys with poor drainage from nonobstructive hydronephrosis with good drainage [14,15].

The examination methods currently used cannot identify obstruction but only reflect the consequences (decreased renal function, compromised drainage, or increased pelvic dilatation). The only useful definition of obstruction is retrospective, defined as “any restriction to urinary outflow that left untreated will damage the kidney,” or defined as “a condition of impaired urinary drainage that if uncorrected will limit the ultimate functional potential of a developing kidney” [16]. Diuretic renography is a cornerstone method for guiding the clinical management of asymptomatic congenital hydronephrosis [17].

Material, Methods and Results

The aim of one of our previous studies was to assess the renal function determined by the pattern of drainage and Split Renal Function (SRF) on diuretic renography and to correlate these findings with the APD estimated by ultrasonography. According to the results of the study, we could conclude that in the presence of partial or no drainage, the SRF may not be significantly impaired. The finding of poor renal emptying is significantly more common among children with increasing renal pelvis APD [18].

Technetium ^{99m}Tc-dimercaptosuccinic acid renal scintigraphy (^{99m}Tc-DMSA) has been used in renal imaging to estimate the functional renal mass (damage to the kidney) and relative renal function, especially in pediatric patients.

The purpose of our other study was to assess kidney damage by using Tc^{99m}-DMSA scintigraphy in children with ANH and the influence of CAKUT on abnormal DMSA findings. In 40 of 66 renal units ^{99m}Tc-DMSA findings were pathological, (60.6%). A statistically significant correlation between the degree of hydronephrosis (APD) and DMSA scan finding ($p < 0.001$) and between the degree of the VUR and DMSA scan finding ($p = 0.002$) was established. Other, except VUR, CAKUT (pelvic ureteric junction obstruction, pylon et ureter duplex, megaureter, posterior urethra valves) were not statistically correlated with pathological findings on DMSA scan.

On the basis of these results, we recommend DMSA scintigraphy in the evaluation of renal pathology in children with ANH. A greater number of patients is needed for the estimation of the associated diagnosis (other than VUR) influence on renal parenchymal damage in children with ANH [19].

Roughly, one-third of antenatally diagnosed UTD, defined as an APD of ≥ 4 mm in the second trimester and/or ≥ 7 mm in the third trimester, will resolve before birth, another third will resolve within the first years of life, and in the remaining cases, UTD will persist or a Congenital Abnormality of Kidney and Urinary Tract (CAKUT) will be diagnosed postnatally [1].

Conclusion

The contribution of nuclear medicine methods in investigating children with ANH/UTD is proved by our studies. Diuretic dynamic scintigraphy and DMSA scintigraphy have important roles in the evaluation and management of these children.

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