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The role of micturating cystourethrography in antenatally detected mild hydronephrosis

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Abstract *Background.* The postnatal imaging of infants with antenatally detected mild hydronephrosis remains controversial.
Objective. Our aim was to establish the role and timing of micturating cystourethrography (MCUG) in mild hydronephrosis.
Materials and methods. We performed a retrospective study of 61 infants (122 kidneys) referred with an antenatal diagnosis of hydronephrosis who showed persistent postnatal dilatation. All had follow-up postnatal ultrasound (US) and MCUG performed. The degree of dilatation at each follow-up scan was recorded.
Results. Of the 122 kidneys, 65 showed mild hydronephrosis.
A substantial proportion of these (21.5 %) demonstrated reflux.
Serial US of these infants showed that the 6-week scan was the most informative and that any changes that warranted further investigation had occurred by this time.
Conclusion. We recommend that all infants with mild hydronephrosis should undergo MCUG. MCUG need not be delayed until 3 months but could be performed following a 6-week US scan.

Introduction

Antenatal hydronephrosis may be transient or a manifestation of vesicoureteric reflux (VUR) [1] or obstruction [2, 3]. Mild hydronephrosis poses particular problems as there is little consensus as to the extent of investigation and duration of follow-up that is needed. Strategies for follow-up have been suggested for moderate and severe hydronephrosis [4, 5] but the procedure is less clear for postnatal imaging of mild hydronephrosis. In order to determine the indications for, and optimal timing of, micturating cystourethrography (MCUG) in infants with mild hydronephrosis, we have retrospectively analysed the postnatal imaging performed in these children at our centre.

Materials and methods

All postnatal imaging performed on neonates diagnosed as having hydronephrosis on antenatal ultrasound (US) in the period between January 1989 and October 1993 was reviewed. At our centre, an AP renal pelvic diameter of > 5 mm detected antenatally was considered abnormal, warranting further investigation. The initial postnatal US scans were grouped according to a modification of the classification used by Homsy et a1. [2]: mild hydronephrosis was defined as an AP renal pelvic diameter 5–15 mm; moderate, > 15 mm without cortical atrophy; severe, > 15 mm with cortical atrophy. The majority of postnatal scans were performed by one of the authors (D. R. M. L.) using an Acuson 128 scanner with a 5- or 7.5-MHz sector or curvilinear transducer.

The study included infants with an antenatal diagnosis of hydronephrosis who had mild to severe hydronephrosis on serial postnatal US and had been investigated with MCUG. Additionally, one infant with normal kidneys but bilateral hydroureters was included. Infants with complex urogenital problems, bladder outflow obstruction or renal dysplasia were excluded from the study. Infants with two consecutive normal US investigations did not undergo MCUG and were also excluded.

During the study period, the postnatal US were performed in the following sequence: the first postnatal ultrasound scan was carried

Table 1 Summary of results showing severity of dilatation at each US scan (122 kidneys)

Scan	Severity of dilatation				
	Normal	Mild	Moderate	Severe	No record
Neonatal scan	55	40	11	4	12
Second scan	41	65	15	1	0
Third scan	45	56	6	1	14

Table 2 MCUG results against severity of dilatation at second US scan

Severity of dilatation	Grade of reflux					
	0	I	II	III	IV	V
Normal	30	2	2	7	0	0
Mild	51	2	2	7	3	0
Moderate	12	0	0	2	1	0
Severe	1	0	0	0	0	0

Table 3 Progression from normal neonatal US scan

Neonatal scan		Second scan		Third scan	
Normal	55			Normal	25
				Mild	0
		Normal	27	Moderate	0
				Severe	0
				No third scan	2
				Normal	6
				Mild	20
		Mild	26	Moderate	0
				Severe	0
				Normal	1
				Mild	1
		Moderate	2	Moderate	0
				Severe	0
				Normal	0
				Mild	0
		Severe	0	Moderate	0
				Severe	0

out within 1 week of birth; follow-up US was scheduled for 1 month (actually performed at a median of 1.5 months) and 3 months (median 4.6 months) for mild hydronephrosis. The follow-up period ranged from 0.4 to 53.1 months (median 12.1 months).

All infants in the study group had an MCUG performed at 3 months of age if postnatal US showed mild hydronephrosis. MCUG was carried out at 1 month for moderate dilatation and within the first week if dilatation was severe. MCUG was performed using a standard radiological technique [6]. The degree of VUR was graded from 0 to V according to the classification recommended by the International Reflux Committee Study [7]. Further investigations to exclude obstruction were performed if VUR was not demonstrated. Intravenous urography (IVU) and technetium-99 m 2,3-dimercaptosuccinic acid (DMSA) and mercaptoacetyltriglycine (MAG3) scintigraphy were used where appropriate.

Results

During the study period, 61 infants (122 kidneys) fulfilled the criteria for inclusion. All 61 had been investigated with US and MCUG. There was a preponderance of boys (43 boys, 18 girls). Postnatal US showed that 29 infants had bilateral hydronephrosis; 1 had bilateral hydroureters but normal kidneys; 31 had unilateral hydronephrosis with the left kidney (25) being more commonly affected than the right (6). For the purpose of this paper, any kidney with a renal pelvic diameter of < 5 mm has been designated normal. Normal kidneys were only investigated because of contralateral dilatation or associated hydroureters. Table 1 summarises the degree of dilatation seen at each of the three postnatal scans. Results were not available for the neonatal scans of six infants and the third scans of seven.

Of the 122 kidneys investigated with MCUG, 28 (23.0 %) had VUR ranging from grade I to grade IV. In 20/28 of these kidneys (71.4 %) VUR was bilateral. Table 2 correlates the degree of VUR with the presence and severity of dilatation detected on the more informative second postnatal US.

Of the kidneys that were normal on the second US 11/41 (26.8 %) had VUR. Among these, 8/11 (72.7 %) had bilateral VUR with reflux into both the normal and contralateral dilated kidneys. In 3/11 (27.3 %), VUR occurred only on the normal side and not on the side of the US-detected dilatation. VUR was present in 8 (57.1 %) of 14 kidneys with hydroureter and in 20 (18.5 %) of 108 kidneys not associated with hydroureter.

In those with mild hydronephrosis, 14/65 kidneys (21.5 %) had VUR varying between grades I and IV. Of the mild group, 19/65 (29.2 %) had AP renal pelvic diameters between 5–10 mm and 3 of these had VUR of grade III or IV.

Of the moderately dilated kidneys, 3/15 (20 %) had VUR. Among the remainder, 6/15 (40 %) were obstructed: two showed extrarenal pelves and one had a malrotated kidney. In 3/15 (20 %) no cause was demonstrated. None of the severely dilated kidneys had VUR as a cause for the hydronephrosis. All five were obstructed and required intervention.

Table 3 shows that of the 55 kidneys diagnosed as being normal on the first postnatal scan, 27 kidneys were normal at the second scan. Most of those that were normal at the second scan had a third scan performed (25),

Table 4 Progression from mildly dilated neonatal US scan

Neonatal scan		Second scan		Third scan	
Mild	40			Normal	4
				Mild	0
		Normal	5	Moderate	0
				Severe	0
				No third scan	1
				Normal	3
				Mild	25
		Mild	33	Moderate	1
				Severe	0
				No third scan	4
				Normal	1
				Mild	1
		Moderate	2	Moderate	0
				Severe	0
				Normal	0
				Mild	0
		Severe	0	Moderate	0
				Severe	0

and all remained normal. Twenty-six showed mild dilatation at the second scan which at the third US either persisted unchanged (20) or became normal (6). Two kidneys in the same infant which appeared normal on the first scan showed moderate dilatation by the second scan. These two kidneys were later diagnosed as having extrarenal pelves on IVU with no evidence of obstruction.

Table 4 shows that of 40 kidneys with mild dilatation at the neonatal US, 5 became normal; 33 persisted unchanged, with 1 of these showing progressive dilatation by the third scan. The latter was subsequently diagnosed as having ureterovesical junction (UVJ) obstruction. Two became moderate at 1 month: both had pelviureteric junction (PUJ) obstruction.

In the absence of obstruction, no kidney showed further increase in dilatation between the second and third scans.

Discussion

Sterile VUR has been shown to be associated with renal damage in studies investigating congenital uropathies [8, 9]. Many infants with antenatal hydronephrosis confirmed postnatally remain asymptomatic, but a proportion of these will have occult VUR and some will go on to develop reflux nephropathy [10,11]. Early detection of VUR is therefore essential to minimise this. The incidence of VUR in the general paediatric population has been estimated between 0.4 % and 1.8 % [1]. We have shown that VUR occurs in a substantial proportion of kidneys with mild hydronephrosis (21.5 %) and that VUR also occurs in normal kidneys (26.8 %) investigated because of contralateral dilatation. Other studies have shown a similar incidence of reflux in these groups [1, 11]. Reflux was more common in kidneys associated with hydroureter (57.1 %) than in those without hydroureter (18.5 %).

The incidence of VUR in our study may still represent an underestimate, as not only is VUR known to be an intermittent phenomenon [12], but it has been shown that variations in techniques for performing MCUG may influence the demonstration of reflux. Paltiel et al. have shown that detection of VUR may be enhanced by a second voiding cycle [13].

The degree of hydronephrosis did not correlate with the presence or grade of VUR, confirming that US is a poor screening test for VUR in the neonate [14]. We have shown that the initial postnatal US can underestimate the degree of potential dilatation; 50.9 % of kidneys that were normal on the first US showed changes from mild to moderate hydronephrosis on the second. The purpose of the immediate postnatal US scan is to detect severe hydronephrosis requiring urgent investigation. The second scan was the most informative examination. We have found the third scan to be unnecessary, as any changes that warranted further investigation occurred by the second US.

The importance of the US examination at 6 weeks (equivalent to our second US) has been emphasised by other groups investigating obstruction rather than reflux as a cause for hydronephrosis [15,16]. Follow-up with US may have an important role in indicating the presence of obstruction by the degree and change in pelvic dilatation [15]. In our study, all of the severely dilated kidneys and the two kidneys with increasing dilatation on consecutive scans had PUJ or UVJ obstruction as a cause for the hydronephrosis.

The lower limit of renal pelvic dilatation warranting investigation varies between centres [1,17]. If 10 mm had been used as the lower limit in our study rather than 5 mm, 18 kidneys would not have had an MCUG performed and 3/18 kidneys (16.7 %) with VUR (1 grade III, 2 grade IV) would have been missed. Marra et al., investigating patients with mild hydronephrosis with an AP renal pelvic diameter between 5 and 10 mm, found that 29.7 % had VUR [1].

Forty-one normal kidneys were investigated with MCUG in this study because of contralaterally dilated kidneys. Of these, 11/41 (26.8 %) showed reflux, similar to the incidence in mildly dilated kidneys (21.5 %). Kidneys which were bilaterally normal on consecutive US examinations did not have MCUG performed and so the incidence of VUR in this group is not known. Zerin et al. have demonstrated significant VUR (25 %) in this bilaterally normal group but have shown that the VUR runs a more benign course and that the majority resolve spontaneously within 2 years [11]. As MCUG is an invasive test involving exposure to ionising radiation, further

studies are required to evaluate the significance of VUR and clinical course in this persistently normal group before screening all cases of antenatally detected hydronephrosis with MCUG can be justified. However, the substantial VUR demonstrated in the mild and normal kidneys suggests that it would be prudent to prescribe antibiotic prophylaxis to all infants with an antenatal diagnosis of hydronephrosis until reflux has been excluded.

In conclusion, we recommend that all infants with mild hydronephrosis (AP diameter 5–15 mm) on the more significant second US scan should be investigated with MCUG which need not be delayed until 3 months. If reflux is not demonstrated at this time, then further investigations to exclude obstruction may be indicated if the dilatation persists or increases on serial US scans.

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