

ROLE OF RENAL ULTRASONOGRAPHY (RUS) AND MICTURATING CYSTOURETHROGRAM (MCU) IN THE ASSESSMENT OF VESICO-URETERIC REFLUX (VUR) IN CHILDREN AND INFANTS WITH URINARY TRACT INFECTION (UTI)

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SYNOPSIS

From Aug 1985 to Jun 1986, 100 children whose ages ranged from 1 month to 11 years, admitted to the Paediatrics Dept TTSH for suspected UTI, were evaluated by ultrasound examination of the kidneys.

Of these 100 children, 55 subsequently had MCU. From our study, 9 of 16 patients with abnormal renal ultrasound, subsequently had an MCU. We found that 3 of the 9 patients had UV reflux of one or both sides. Similarly, of the 17 patients with UV reflux confirmed on MCU, 14 had renal ultrasonography which were normal.

Our study illustrates the point that US was insufficiently accurate to exclude the presence of a UV reflux. We believe therefore that an MCU still has a role in the radiological investigation of children with UTI.

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INTRODUCTION

Urinary tract infection is one of the commonest disease of childhood, 3-5% of girls and 1-2% of boys having at least one episode during childhood.(1)(2)

Underlying abnormalities of the genito-urinary tract occur in about 40-50% of boys and 30-40% of girls with UTI, so that once infection is confirmed, further investigation of the urinary tract is mandatory.(2)

The most common abnormality found is vesico-ureteral reflux. Renal ultrasonography has begun to play an increasingly important role in the evaluation of urinary tract diseases in children. The intravenous urogram has, as a result, now largely vacated its position as the initial screening investigation in diagnostic imaging.

METHODS

100 patients were referred to us by our colleagues in the Department of Paediatrics, TTSH between August 1985 and June 1986 with confirmed or strongly suspected UTI.

UTI was considered present when 2 consecutive cultures of midstream clear voided urine revealed 10 organisms/ml of a single species.

Only children clinically presenting with UTI alone were accepted for our study.

Renal Ultrasonography (RUS) was the first radiological investigation that was carried out.

The renal sonograms were obtained by radiographers, radiology medical officers and radiologists. However, all films were reviewed at the end of each day by at least one of four radiologists.(3)

We used real-time sector scanning with either a 3.5 or 5.0MHz transducer. Our machine was the Technicare EDP 1200. Supine oblique and prone scans were obtained in both longitudinal and transverse planes.

The younger children were sedated with syrup chloral by the Paediatricians half to an hour before RUS was commenced.

The MCU was done by infusing dilute contrast into the bladder via an indwelling per-urethral catheter in a similarly sedated child if sedation was required.

Under fluoroscopic screening, reflux was looked for in both ureters before, during and after micturition.

The classification of severity of uretero-vesical reflux adopted by us in this study was the SMELLIE GRADING(4):

- | | |
|-----------|--|
| GRADE I | Reflux not extending above the pelvic brim. |
| GRADE II | Reflux up to kidney on micturition. |
| GRADE III | Reflux in a normal sized ureter up to the kidney, both at rest and on micturition. |
| GRADE IV | Reflux extending up to the kidney with dilatation of the renal pelvis and ureter. |

RESULTS

66 of the 100 children in this study, were confirmed to have UTI. The organisms cultured from the urine are listed in Table 1.

The remaining 34 children presented with a clinical picture highly suspicious of UTI, even though we failed to confirm it with a positive urine culture.

It was found that the mean age of presentation was 1.76 (i.e. in the 1-2 year age group) with a variance of 5.8.

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The ratio of males to females in our 100 children was approximately 2:1 (Table 1)

The children were grouped into categories according to age of presentation ie 0–1 years, 1–2 years, 2–3 years etc., and it was discovered that 67% were between the ages of 0–1, 17% in the age group 1–2 years and the rest distributed in the remaining age groups. 16 of the 100 children who were ultrasonographically examined were reported to have an 'abnormal' RUS, their abnormality mainly being splaying of the central renal echoes either in one or both kidneys.

Of these 100 children, 55 subsequently kept their MCU appointment and all 55 MCUs were satisfactorily obtained.

Out of the 55 children that were examined by both RUS and MCU, 32 were found to have a normal RUS and MCU, hence no further diagnostic procedures were performed.

TABLE 1 ORGANISMS CULTURED FROM URINE

E Coli	57
Klebsiella	3
Proteus Mirabilis	3
Citrobacter Diversus	1
Group D Strep	1
Morganella Morganii	1

**TABLE 2
TABLE OF MEAN AGE**

Age Group	Frequency	x	xf	x ² f
0–1	67	0.5	33.5	16.75
1–2	17	1.5	25.5	36.25
2–3	0	2.5	00.0	0.0
3–4	3	3.5	10.5	36.75
4–5	1	4.5	4.5	0.0
5–6	2	5.5	11.0	60.5
6–7	1	6.5	6.5	42.25
7–8	2	7.5	15.0	112.5
8–9	1	8.5	8.5	0.0
9–10	2	9.5	19.0	180.5
10–11	4	10.5	42.0	441.0
Total			176.0	928.5

$$\begin{aligned} \text{MEAN } \bar{x} &= \frac{\sum xf}{n} & n &= \sum f \\ &= \frac{176}{100} \\ &= 1.76 \end{aligned}$$

ie. Within the 1–2 years age group

$$\begin{aligned} \text{VARIANCE } s^2 &= \frac{n(\sum x^2f) - (\sum xf)^2}{n(n-1)} \\ &= \frac{100(928.5) - (176)^2}{100(99)} \\ &= 6.25 \end{aligned}$$

TABLE 3

No. of Patients	Grades of Reflex	
	Right	Left
3	4	3
2	3	3
1	3	2
1	2	2
1	1	4
2	4	–
2	–	3
1	3	–
1	–	2
Total:	14	

TABLE 4

No. of Patients	Grades of Reflex	
	Right	Left
1	4	4
1	4	3
1	–	4

Of the remaining 23 children, 14 were reported to have 'normal' and 9 'abnormal' RUS examinations. Surprisingly, all 14 patients reported to have 'normal' RUS were subsequently proven by MCU to have either unilateral or bilateral reflux — 4 with unilateral and 10 with bilateral. (Table 3) Of these 14 children, 11 were in the 0–1 age group; 2 in the 1–2 age group and 1 in the 9–10 age group.

Of the remaining 9 patients that were reported to have an 'abnormal' RUS, only 3 were subsequently proven to have vesico-ureteric reflux (Table 4). Their age distribution were 2 in the 0–1 age group and 1 in the 1–2 age group.

Conversely, of the 17 patients that were proven to have either unilateral or bilateral U-V reflux by an MCU, only 3 were reported to have an 'abnormal' RUS earlier. Of these 3:

1 reported to have an abnormal RUS on the left side had unilateral grade 4 reflux on the left side at MCU.

1 with abnormal RUS on both sides had bilateral reflux (Grade 4 on the right and Grade 3 on the left)

1 reported to have an abnormal RUS on the right side had bilateral Grade 4 reflux at MCU.

Of the remaining 6 children reported to have an 'abnormal' RUS, all 6 showed no reflux subsequently in the MCU. Only 1 of these 6 were subsequently followed up with an Intravenous Urogram which proved to be normal anyway.

DISCUSSION

The principal aim of imaging the urinary tract in children with UTI is to look for developmental anomalies which may predispose the child to persistent infection.(5)

The ultimate goal of this being the prevention of progressive renal damage.

It is also widely accepted that VUR is a result of incompetence of the vesico-ureteric junction, usually seen as an abnormally short intramural length of ureter, and is not secondary to either obstruction or infection.(6)

RUS was the first radiological investigation carried out in those infants and children who presented to us with UTI. We then attempted to follow this up with an MCU.

Various methods of grading UV Reflux have been used in the past.(7) Examples include:

International Study Classification

Dwoskin-Perlmutter

Rolleston

Smellie — this last method being the one we adopted.

Of the 100 children who were ultrasounded, 55 subsequently returned for an MCU. Of these 55, 17 had in fact VUR proven on MCU.

Remarkably, 14 of these 17 were ultrasonographically normal.

Conversely, of the remaining 38 with normal MCU, 6 of these children's RUS examinations were reported as "abnormal". This was manifested mainly as separation of the central echoes.

All these figures highlight the inadequacies of the Renal Ultrasound in detecting and assessing VUR.

There are a few reasons which we feel may explain the cause for this.

Firstly, the VUR has to be severe enough to result in dilatation of the upper ureter and/or renal pelvis, if not at least the calyces, for RUS to detect VUR.

Secondly, it must be sufficiently longstanding to allow the deleterious effects on the renal pelvi-calyceal system and renal parenchyma, such as renal growth

retardation, renal scarring from repeated infection, and cortical thinning to manifest itself.(8)

There is a clear association between renal scarring and reflux and about 20% of patients with VUR have scarred kidneys at presentation.

Thirdly, timing of the examination is important as well. It is sometimes fortuitous that VUR is detected at all.

VUR is notorious for its intermittency. It may be said that micturating sometimes help in eliciting VUR. Therefore a normal MCU does not unfailingly exclude a VUR.

Together, these factors limit the detection of VUR. Added to all these points, RUS is not able to assess the entire ureter.

Consequently, the less severe VUR will go undetected ultrasonographically.

Mindful of these points, our study supports the impression that, at present, RUS is deficient in accurately excluding VUR.

We therefore, conclude that MCU continues to have a significant role in the radiological assessment of children with UTI and should still be carried out even if RUS is normal.

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