Is omitting post urinary-tract-infection renal ultrasound safe after normal antenatal ultrasound? An observational study

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Arch Dis Child 2007;**92**:502–504. doi: 10.1136/adc.2006.108662

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Accepted 24 December 2006
Published Online First
16 January 2007

Background: Guidelines recommend obtaining a renal ultrasonogram (RUS) for young children after a first urinary tract infection (UTI).

Objective: The aim of the current study was to assess the concordance of prenatal and post-UTI RUS findings in children with a first simple UTI.

Methods: This was a prospective study and included all children aged 5 years or younger who were hospitalised with a first simple UTI (determined as clinical response and normalisation of temperature within 48 h on initiation of antibacterial therapy with no complications). Data were collected from each child regarding the results of prenatal and post-UTI RUS.

Results: Overall, 250 children were included in the study and the results of late-pregnancy and post-UTI RUS were available for 84% (n=209). Complete concordance between the two RUS was demonstrated in 96% (n=201). The predictive value of normal antenatal to normal post-UTI RUS was 96% (95% CI: 93% to 99%). These results include four children with mild transient pelvic dilatation. In eight children in whom renal anomalies were demonstrated only in post-UTI RUS, the influence of these anomalies on the children's management was negligible.

Conclusions: Prenatal-RUS have been performed in most children <5 years old hospitalised with a first simple UTI. Concordance with post-infection tests is very high. Findings which appear only in post-infectious RUS usually have negligible effects on children's management. Thus, in such children with normal antenatal RUS omitting post-UTI RUS could be considered.

Urinary tract infection (UTI) is relatively prevalent in children, affecting 3–5% of females and 1.5% of males. Imaging studies are the standard of care for young children after a first UTI, the primary purpose being to identify possible urinary tract abnormalities such as vesicourethral reflux (VUR), obstruction of the urinary tract, ureterocele and renal scarring that may predispose the child to recurrent infections or adverse long-term outcomes.^{1–3} In a recent paper, Alon argued that the vast majority of major anatomic abnormalities in the urinary tract are detected by antenatal urinary tract ultrasonogram, suggesting that this imaging (which is performed in industrialised countries on almost all pregnant women during late pregnancy) may replace the post-UTI test in children with a first simple UTI.³ This is also supported by two observational studies.^{4,5} However, satisfactory data based on a systematic study supporting this argument are lacking.

The aim of the present study was to assess the concordance of late pregnancy and post-UTI renal ultrasonogram (RUS) in children with first proven simple UTI.

PATIENTS AND METHODS

The study was prospective and included all children aged 5 years or less hospitalised with first proven simple UTI. Simple UTI was determined if clinical improvement and subsidence of fever were documented within 48 h of initiation of antibacterial therapy without later complications. The routine approach to these children in our institution is to perform RUS and voiding cystourethrography (VCUG) within 6 weeks of discharge. In children who do not fulfil the definition of simple UTI, RUS is performed during admission. Detailed data regarding the results of late pregnancy fetal RUS (if performed) were obtained from mothers on admission. Antenatal RUS results were read by experienced perinatologists and post-UTI imaging studies were read by an expert in paediatric radiology who was unaware of the purpose of the study and blinded to the results of the antenatal RUS. For

convenience, grading of ultrasonographic renal findings was divided into normal, mild, moderate and severe (hydronephrosis) pelvic dilatation and according to other specified findings.⁶ The study was approved by the local Helsinki committee, and informed consent was obtained from parents or guardians.

Statistical analysis

The 95% confidence intervals (95% CI) calculated for the predictive value of normal prenatal to normal post-UTI RUS were calculated using the SPSS 11.5 statistical package tests.

RESULTS

During the study period, 250 children with proven first simple UTI (96% of all children with UTI) were hospitalised and included in the study. The results of prenatal and post-UTI RUS were available for 209 (84%) children (median age 10 months, range 9 days to 5 years, 23% males) (tables 1 and 2). During the study period, only 10 children suffered from non-simple UTI and had immediate RUS which was normal in all cases, as was the prenatal sonogram.

Overall, kidney anomalies were demonstrated by RUS during pregnancy in only three children (1.4%). In one of these three,

Table 1 Prenatal and post-UTI RUS findings

	Normal post-UTI RUS	Abnormal post-UTI RUS
Abnormal prenatal-RUS	1	2
Normal prenatal RUS	199	7

Abbreviations: RUS, renal ultrasonogram; UTI, urinary tract infection; VCUG, voiding cystourethrography; VUR, vesicourethral reflux

Table 2 Imaging details of children with prenatal and/or post-UTI RUS abnormal findings

No.	Results of prenatal RUS	Results of post-UTI RUS	Results of VCUG
1	Normal	Moderate dilatation of both renal pelvises	Bilateral VUR grade 4
2	Normal	Bilateral hydronephrosis	Bilateral VUR grade 5
3	Right hydronephrosis	Right hydronephrosis	Right VUR grade 2
4	Normal	Moderate dilatation of left renal pelvis	Left VUR grade 3
5	Normal	Moderate dilatation of right renal pelvis	Normal
6	Normal	Right double collecting system	Normal
7	Polycystic kidneys, right hydronephrosis	Polycystic kidneys, right hydronephrosis	Right VUR grade 3
8	Normal	Left hydronephrosis	Right VUR grade 1, left VUR grade 3
9	Mild dilatation of right renal pelvis	Normal	Normal
10	Normal	Left severe hydronephrosis	Normal

RUS, renal ultrasonogram; UTI, urinary tract infection; VCUG, voiding cystourethrogram; VUR, vesicourethral reflux.

the anomaly was not found after UTI (no. 9, table 2). Complete concordance between pre- and postnatal RUS was documented in 201 (96%) of the children. In 199 (97%) of 206 children with normal prenatal RUS, the post-infection imaging was also normal or revealed only mild pelvic dilatation in four kidneys. Altogether, the predictive value of normal prenatal to normal or near normal postnatal RUS was 96% (95% CI: 93% to 99%). Children with normal antenatal RUS were 17.24 times (95% CI: 5 to 50) more likely to have normal post-UTI RUS than children with abnormal RUS in late pregnancy. In 11 children who did not fulfil the definition of simple UTI, RUS was performed during admission and found to be normal in all cases.

VUR was documented in 78 kidneys in 57 children, in 97% of whom the prenatal and in 90% of whom the post-UTI RUS were normal. The predictive value of normal prenatal RUS to normal VCUG was 73.3% (95% CI: 67% to 95%).

In nine children, the post-UTI RUS was abnormal after the UTI, including two of the three children in whom the same anomaly was documented during pregnancy and who had VUR (table 2). In only one child (no. 10) was the anomaly found only after UTI and affected his management. There was a suspicion of ureteropelvic junction obstruction, but this was not confirmed by other tests, and the symptoms later improved.

DISCUSSION

In Israel, routine expanded fetal organ screening (in which anomalies of the urinary tract may be revealed) is not recommended by health authorities; however, pregnant women may undergo this procedure semi-privately at 12 and 22–24 weeks of gestation. Our study documents a very high rate of late pregnancy urinary tract ultrasonogram, a very low rate of significant renal anomalies revealed by this imaging and a very high concordance between its results and those of the routine post first simple UTI RUS. In all children with new post-UTI RUS findings, the impact of these later images on the approach and management of the children was negligible. To our knowledge, this is the first study which systematically assesses the relationship between pre- and postnatal RUS in children with UTI. Our study confirms the poor association between the results of the RUS and the voiding cystourethrogram, as reported in other studies.^{7–9}

In only eight of 206 children in whom the prenatal RUS was normal, did the RUS reveal new findings after the UTI and all had a negligible effect on child management. Mucci *et al*⁸ found abnormalities in only six of 193 children (3%) in whom RUS was performed after a first or recurrent UTI RUS. The authors also reviewed all other RUS performed during the study period in their centre and found five children with a dilated collecting system. In three of the five children, hydronephrosis had been detected antenatally. None of these children experienced a UTI. Alon *et al*⁵ reviewed the results of RUS performed on 124 children after a first febrile UTI. In 10 children (8%), the sonogram showed hydronephrosis and/or hydroureter. In eight of these children the voiding

cystourethrogram showed VUR, in one posterior urethral valve, and in one with a non-obstructed dilated system it was normal. The authors also followed 63 children with hydronephrosis as documented by RUS which was performed without relation to previous UTI. In 45 children (71%), the renal anomaly was found during pregnancy, and 14 of these 45 children (31%) later required surgery. Combining the results of our and these two studies, it is suggested that RUS after UTI in children shows a low rate of significant renal anomaly and obstructive uropathies not previously detected by routine prenatal fetal organ ultrasonography screening. Also, these data show that important anomalies may be missed even if RUS is performed only after a first UTI.

Several issues need to be clarified before post-UTI RUS is to be abandoned in children who have had a late pregnancy renal sonogram. Firstly, is it safe to rely on parental reports regarding the results of RUS during pregnancy? We found parental reports to be highly reliable, as we compared them to the official medical reports, which must be done in case of uncertainty. Secondly, there is operator variability in evaluating and interpreting pregnancy RUS. In Israel, such measures are taken and interpreted in registered centres or by very experienced gynaecologists, so there is a high detection rate of renal anomalies. Thirdly, UTI beyond 5 years of age is very infrequent, and RUS or other studies are not routinely recommended in our hospital. Therefore, we do not have data to compare post-UTI and prenatal US for this age group. Lastly, our study included over 200 children in 5% ($n = 10$) of whom renal anomalies were documented. A study which included a larger number of children with possibly a higher number including rare

What is already known on this topic?

- A renal sonogram is recommended in young children after a first UTI.
- Most renal anatomic abnormalities are detected by antenatal sonogram.
- In industrialised countries, a fetal renal sonogram is performed in almost all pregnant women.

What this study adds

- Prenatal-RUS has been performed in most children hospitalised with a first simple UTI and the concordance of prenatal with post-UTI RUS is very high.
- RUS abnormal findings found only after UTI have a negligible effect on children's management.
- In children <5 years of age, following a first simple UTI, renal ultrasound can be omitted if the antenatal ultrasound was normal.

anomalies such as ureteropelvic junction obstruction would possibly confirm our results.

In conclusion, the present study suggests that in young children with a first simple UTI, RUS is generally not necessary if data from a late pregnancy RUS are available. In Israel, a change in the guidelines would mean that about 85% of all post-UTI RUS may not need to be carried out.

ACKNOWLEDGEMENTS

We thank Ms Sylvia Walters for her most valuable assistance in preparing this manuscript.

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Competing interests: None.

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