The Role of Renal Ultrasound on the Management of Children with First Uncomplicated Urinary Tract Infection

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Abstract

Aims: Urinary tract infections (UTI) are a common cause of acute illness in infants and children. Renal ultrasound (RUS) should be performed in febrile infants and young children with UTI. The aim of this study was to evaluate the impact of routine RUS on the care of children admitted with first uncomplicated UTI.

Methods: A Retrospective review of the medical charts of all children under 14 years of age who were admitted to the pediatric ward at Prince Ali Bin Al-Hussein Hospital (PAH) -Jordan, with a discharge diagnosis of first uncomplicated UTI. Children with known underlying genitourinary abnormalities or previous history of UTI were excluded. The medical record were reviewed regarding (RUS) and voiding cystourethrogram (VCUG) results during the patients follow up at the pediatric nephrology clinic. The yield of RUS was measured by its ability to detect renal abnormalities, and by its sensitivity and specificity, positive and negative predictive value for detecting vesicoureteral reflux (VUR), and by its impact on the care of UTI.

Results: Of the 117 children that were included in the study, their median age was 16 months, 74 (63%) were female. The prevalence of VUR was 24%. Renal ultrasound (RUS) results were positive for VUR in 10 of 28 patients (36%) with confirmed VUR on VCUG, and were positive in 25 of 89 patients (28%) without VUR on VCUG. Of 18 patients who had a normal RUS but showed VUR on VCUG, four had grade 1 VUR, ten patients had grade 2, two with grade 3, one with grade 4, and one with grade 5. The sensitivity, specificity, positive and negative predictive value of RUS for detecting VUR were (52%), (75%), (53%), and (78%) respectively. The results of abnormal RUS did not cause any change on the care of our patients except two patients who were referred to the pediatric surgeon.

Conclusion: The result of our study show similarity to most previous studies regarding the low impact of RUS on the care of UTI. We still encourage performing RUS for children with first uncomplicated UTI, since it is non invasive procedure in comparison to the VCUG.

Keywords: Urinary tract infection; Routine renal ultrasound; Voiding cystourethrogram; Vesicoureteral reflux

Introduction

Urinary tract infections (UTI) are one of the commonest bacterial infections in the pediatric population. It is estimated that 8% girls and 2% boys will acquire UTI during childhood [1]. 5-12% of children ages between 2 months to two years with high grade fever, are having a diagnosis of UTI. 20-30% of the children will develop another episodes between 6-12 months after the first episode of UTI [2]. UTI is one of the most important risk factors in the development of renal insufficiency or end stage renal disease [3], so early diagnosis and intervention is needed to preserve renal function of the growing kidney. However, contraversy and lack of consensus have been encountered in the management of UTI, including its diagnosis, radiological investigations and the use of antibiotic therapy [4]. The assessment and follow-up of children with UTI have been revised in the recent years, and the new guidelines recommends limitation of invasive radiological procedures and encourages performing investigations only in children at risk [5,6]. On the other hand, in recent years the clinical value of routine renal ultrasound (RUS) in the management of children with first UTI has been questioned [7]. The purpose of our study was to evaluate the role of routine RUS in the management of children with first uncomplicated UTI who were admitted at Prince Ali Bin Al-Hussein Hospital (PAH)-Jordan.

Methods

All pediatric patients admitted to the Prince Ali Bin Al-Hussein Hospital- Jordan from Jan 2015 - May 2017, with a discharge diagnosis of first uncomplicated UTI were identified and followed at the Pediatric Nephrology Clinic. The study population included all children up to 14 years of age. UTI was defined as growth of more than 100.000CFU/ml in a mid-stream urine sample, more than 10.000CFU/ml in urine obtained by

bladder catheterization, or any growth observed in suprapubic bladder aspirate.

Uncomplicated UTI was determined as a child with febrile UTI who became afebrile within 48hrs of initiation of treatment and responded well. Children with previously known genitourinary abnormalities or those who had a history of UTI were excluded from the study.

All included children had routine RUS during their admission and VCUG was done within 1-3 months. RUS was considered suggestive of VUR if renal pelvic diameter greater than 5mm or if there is dilatation of the ureter or dilatation of collecting system of one or both kidney. VUR was classified according to the international VUR classification [7]. All imaging studies were read by radiologists who were unaware of the study.

The yield of RUS was assessed by its ability to detect renal abnormalities, and by its sensitivity, specificity and positive and negative predictive value for detecting VUR, and by its influence on the care of UTI. Impact on UTI care was defined if there is a change in treatment, investigation, or follow up based on RUS findings, that would not be done otherwise.

The statistical analysis for determining the sensitivity, specificity, positive and negative predictive value were based on the patients with both RUS and VCUG. Data were analyzed using Epi info version 6.04d.

Results

A total of 120 patients met all the inclusion criteria and were enrolled in our study. Three patients who were booked for VCUG as outpatients did not return for their appointment and were excluded from the study, leaving 117 patients with a first uncomplicated UTI who had VCUG done.

The median age of the 117 patients was 16 months; 43(37%) were boys and 74 (63%) girls. The median age for males was significantly lower than for female (6 vs 36 months, respectively, p less than 0.05).

Table 1: Demonstrate findings of RUS , grade of VUR by VCUG.

VCUG	RUS		Total
	Abnormal	Normal	
G1	1	4	5
G2	0	10	10
G3	4	2	6
G4	3	1	4
G5	2	1	3
Total	10	18	28

The age range for males was (6 days -110 months), and for female (3 days -140). The prevalence of VUR in our study was 24%. The main causative agents were *Escherichia coli* in 100 patients (85%), *Klebsiella sp.* in 6 patients (5%), and *Pseudomonas aeruginosa* in 4 patients (3%), *Enterococcus fecalis*

and *Morganella morgani* were responsible for the remaining seven infections. Fever was the most common symptoms. Twenty eight patients were found to have VUR on VCUG. Of these 28 patients, five had grade 1 reflux, ten had grade 2 reflux, six had grade 3, four with grade 4 reflux and three patients with grade 5 VUR. RUS findings suggested the presence of VUR in 10 of these 28 patients, and in 25 of 89 patients without VUR on VCUG. Table 1: demonstrate the distribution of VUR in 28 patients by its grade and RUS findings.

The RUS results of the 25 patients with no VUR included 16 patients with mild hydronephrosis, six patients with moderate hydronephrosis, one patient with uretrocele , one patient with unilateral double collecting system and severe hydronephrosis, one had small renal cyst .

The sensitivity of RUS for detection of VUR was 52% (95% CI: 35% to 66%); The specificity was 75% (95% CI: 66%- 83%). The positive predictive value for RUS was 53% (95% CI: 36%- 68%) and the negative predictive value was 78% (95% CI: 65% to 88%).

In the majority of patients, RUS was done between 2-7 days from admission .RUS findings did not cause any change on the care of most of our patients included in the study regarding antimicrobial agents used or its duration of treatment. Two patients referred to pediatric surgeon for further management, one with uretrocele and the other with unilateral double collecting system and unilateral severe hydronephrosis.

Discussion

Although imaging studies are routinely performed in children with UTI to identify those at risk for renal damage and to preserve renal function, evidence of their value in affecting the management or improving the outcome is questionable.

In recent years, the clinical value of RUS for young children with first UTI had been assessed, and several studies evaluated the role of RUS on the UTI care [7-10]. Our study shows that RUS findings are neither sensitive, nor specific for VUR detection and are of little value, it is also has no major influence on changing UTI care in children who were admitted with first uncomplicated UTI except in two patients one had ureterocele and the other with unilateral double collecting system and unilateral severe hydronephrosis, who were referred to pediatric surgeon for further evaluation.

VUR is the most common anomaly of the urinary tract system and it is one of the most important risk factor of UTI [11,12]. It was thought that early detection and management of VUR, either by prophylactic antibiotic or by surgery will help in preventing subsequent renal damage and scarring. This however, had led to over diagnosis and over management of most insignificant VUR.

In our study, VUR was detected by VCUG in 28 children, among them, only 10 patients had abnormal RUS findings and 25 patients had no VUR by VCUG inspite of abnormal RUS results.

in addition to that some children with higher grade VUR (grade 4-5) were not detected by any findings during their routine RUS, one with grade 4 and another one with grade 5 VUR. However, the numbers of high grade reflux (3-5) was more in children with abnormal RUS. Inspite of that, Asanuma H and his colleagues [13] considered abnormal RUS findings like dilatation of ureter and pelvis as useful for predicting VUR, in contrary, others retrospective and prospective studies indicates that RUS is of little benefit in VUR diagnosis [14-16].

Several studies published and showed similar findings to our study regarding the low yield of RUS findings to the UTI care. DiPietro et al. [17] reported 70 children above the age of 5 years, five of 70 children had an abnormal RUS, while 2 of the 5 had reflux on VCUG. Of the other 65 children with normal RUS, 19(29%) had VUR on VCUG. They found that RUS was unreliable in VUR detection in children aged 5 years or older.

Mahant et al. [9] studied retrospectively 162 children below the age of 5 years with first UTI who had RUS and VCUG. They concluded that RUS are neither sensitive nor specific for VUR, and clinicians should not use RUS results to influence their decision to proceed for VCUG. Zamir et al. [10], studied 255 children prospectively, 35 children had abnormal RUS, of whom only 9 had VUR on VCUG. The sensitivity, specificity, positive and predictive value of abnormal RUS for VUR were 17.7%, 87.6%, 23.5% and 83.25% respectively. In our study our values were 52%, 75%, 53%, 78%.

Hoberman et al. [17] published a prospective trial on children aged 1-24 months and assess the role RUS, DMSA at the time of acute UTI. And reported that abnormal RUS results and DMSA findings during acute illness did not modify any change on UTI care.

The impact of RUS on the management of hospitalized patients with first UTI has been assessed. Both Mucci and Mauire [18] and Alon and Ganapathy [19] and Alshamsan L et al. [20] found that RUS had no effect on the clinical care of the children with first simple UTI. Our study shows the same conclusion as previous studies regarding the contribution of RUS on UTI care. The role of DMSA scan in the management of UTI was not assessed in our study and need to be explored in the further study.

The median age of the children in our study was 16 months, and the prevalence of VUR was 24%, an estimate similar to that previously reported in other studies [9,20]. The compliance rate for completing VCUG after RUS was very excellent.

Most of the published data is for younger children below 5 years, but we included all the pediatric population seen in our hospital to compare our data to the previous ones if the wide age of distribution will make any changes.

Our study, being retrospective in design, which generates possible selection bias. In addition to the small number of patients included in our study since our hospital is not a tertiary hospital, so we included all the children hospitalized to our hospital with UTI. Other limitation to the study was RUS variability in detecting anomalies as it is operator dependent and our findings was reported by four radiologist.

Conclusion

In accordance with previous reported studies RUS is of little value on the UTI care, and of low sensitivity and specificity. We still encourage performing RUS in children with first uncomplicated UTI since it is not invasive procedure compared to the VCUG.

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