

Value Of Ultrasound In Children With Urinary Tract Infection And Vesicouretric Reflux

أهمية الفحص بالموجات فوق الصوتية في الاطفال المصابين بالتهابات المجاري البولية والارتجاع البولي من المثانة الى الحالب

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الخلاصة:

الغرض من الدراسة : تهدف هذه الدراسة لمعرفة أهمية الفحص بالموجات فوق الصوتية (السونار) لمعرفة كافة الآفات التي تصيب الجهاز البولي عند الأطفال المشخصين سريريًا ومختبريًا بالإصابة بالتهابات المجاري البولية وكذلك أهميته في تشخيص الارتجاع البولي من المثانة إلى الحالب والكلى .

المرضى والطريقة : أجريت الدراسة على 80 مريضاً من الأطفال تحت سن الخمس سنوات تم تشخيص إصابتهم بالتهابات المجاري البولية سريرياً ومختبرياً للمرة الأولى . استمرت الدراسة لمدة سنتين . تم اخذ السونار أولاً ثم اجري فحص تلوين المثانة والاحليل لكل مريض . واجري فحص تلوين الكلى والمجاري البولية في 30 مريض . تم تشخيص معظم الآفات التي تصاحب الأطفال المصابين بالتهابات المجاري البولية وكذلك اعتبر وجود الارتجاع البولي من المثانة إلى الحالب إذا كان هنالك توسع في حوض او حويضات الكلى أو توسع الحالب أو توسع الجهاز التجميعي للكلى.

النتائج : وجد أن هنالك آفات تصيب الجهاز البولي في الأطفال وتتصاحب مع التهابات المجاري البولية فيهم . وقد تمكن فحص السونار من تحديد معظمها . وكان أكثرها هو توسع حوض وحويضات الكلى (28.7%) وتتخذ جدار المثانة الكلى الذي يعكس وجود الالتهاب فيها (28.7%) . ويأتي بعده حصى الكلى والمثانة بنسبة (11.2% و 6.2%) على التوالي ويأتي بعده تشوهات الجهاز البولي الوراثية بنسبة (10%). أثبتت الدراسة وجود ارتجاع بولي من المثانة إلى الحالب في (25%) (20 مريض) من الحالات . وكان السونار ايجابى في (8) حالات فقط من (20) حالة المثبتة بواسطة فحص تلوين المثانة والاحليل وايجابى أيضا في (15) حالة من باقى الحالات (60) التي لم يثبت فحص تلوين المثانة والحالب وجود الارتجاع البولي فيها . من (12) حالة (التي كان فيها السونار سلبى) اثبت فحص تلوين المثانة والاحليل وجود (7) حالات ارتجاع بولي من الدرجة الثانية و(3) حالات من الدرجة الثالثة و (2) حالة من الدرجة الرابعة . كانت نسبة حساسية تشخيص السونار للارتجاع البولي من المثانة الى الحالب (40%) ونسبة تخصيص السونار لها (80%) وكانت نسبة التنبؤ الايجابية للسونار (34%) ونسبة التنبؤ السلبية (83%) .

الاستنتاج: وجدت الدراسة أن السونار مفيد في تعيين آفات الجهاز البولي التي تصاحب التهابات المجاري البولية عند الأطفال ولكنه غير حساس وغير قادر على التنبؤ للارتجاع البولي من المثانة إلى الحالب عندهم .

Abstract;

Aims of the study: To assess different urological abnormalities associated with UTI in children & to determine the value of ultrasound in vesicoureteral reflux (VUR).

Patients and Methods: Retrospective study of the ultrasound and micturating cystourethrogram (MCUG) results of 80 children under 5 years of age with clinically labelled cases of first time urinary tract infection (UTI) over a 2 years period . Thirty cases had excretory urography tailored according to the case. The study assesses different renal, uretric and urinary bladder abnormalities associated with first time UTI in children. Ultrasound findings were also assess VUR and suggest its presence if dilatation of the pelvi-calyces, dilatation of the ureters, or dilatation of the collecting system of one or both kidneys was reported. Statistical analysis used include sensitivity, specificity, positive predictive value and negative predictive value.

Results: A total of 80 patients (20days – 5years) (median age 18months, 42 (52% were female), 38 (48% were males) . In analysis of US findings: hydronephrosis and urinary bladder mucosa thickenings (cystitis) each 28.7 % were the commonest, renal stones and congenital anomalies :11.2 % and 10% respectively .The urinary bladder stones were 6.2% . The prevalence of VUR was 25%. Ultrasound findings were positive for VUR in 8 of 20 patients with confirmed VUR on MCUG, and positive in 15 of 60 patients without VUR on MCUG. of 12 patients who had a normal ultrasound but showed VUR on MCUG, 7 had grade II reflux, 3 grade III reflux, and two grade IV reflux. The sensitivity and specificity of ultrasound in suggesting VUR were 40% and 80%, respectively. The positive predictive value of ultrasound in suggesting VUR was 34%; the negative predictive value was 83%.

Conclusions: Ultrasound useful to evaluate children with different urological abnormalities associated with UTI in children but its neither sensitive nor specific for VUR in children with UTI. Clinician should not depend on ultrasound only for diagnosis of VUR and must proceed to other like voiding colour Doppler US with echo enhancement or MCUG

Keywords: VUR, ultrasound, UTI, MCUG

INTRODUCTION:

Urinary tract infection (UTI) is the inflammatory response of urothelium to the bacterial invasion that is usually associated with bacteriuria and pyuria. ⁽¹⁾ The incidence of UTI in girls is estimated to be 3% and in boys around 1%. ⁽²⁾

Hydronephrosis literally "water inside the kidney" refers to distension and dilation of the renal pelvis and calyces, usually caused by obstruction of the free flow of urine from the kidney. It may be nonobstructed. Untreated, it leads to progressive atrophy of the kidney. ⁽³⁾



Figure (1) Ultrasound, patient with hydronephrosis

Vesicoureteral reflux (VUR), the retrograde flow of urine from the bladder to the ureter and renal pelvis, has been identified as a risk factor for the development of UTI, one study found that it was present in 18–40% of children investigated for first time UTI. ⁽⁴⁾ The familial nature of vesicoureteral reflux is well recognized. Screening siblings for reflux is controversial. We identified a group of siblings of index patients with vesicoureteral reflux who are most likely to be affected. ⁽⁵⁾ The magnitude of fetal renal pelvic dilatation is not reliably predictive of reflux and this measure alone cannot be used to direct postnatal cystography. ⁽⁶⁾

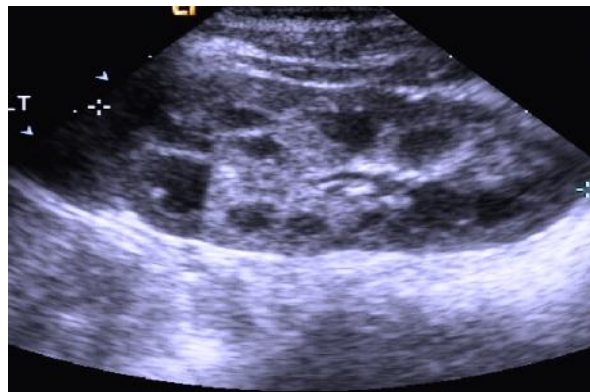


Figure (2); Longitudinal sonogram corresponding to a voiding cystourethrogram (VCUG) of a grade III vesicoureteral reflux. There is the mild pelviectasis. The degree of pelviectasis or caliectasis does not correlate with the degree of reflux seen on the VCUG

Reflux was graded using the international system of radiographic grading of VUR. ⁽⁷⁾

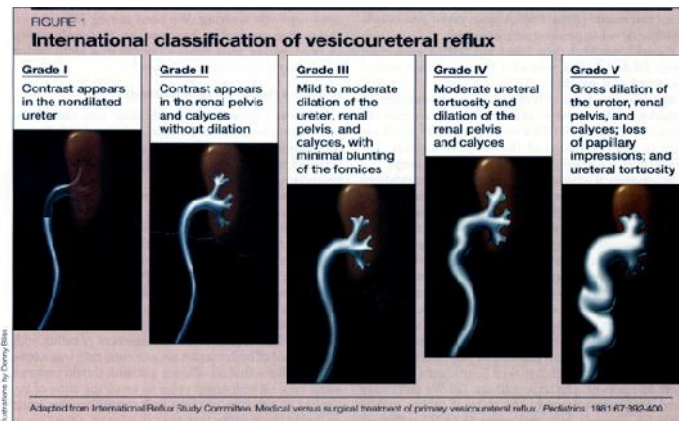


Figure (3) grading of VUR

In children with vesicoureteral reflux as the cause of chronic kidney disease older age, higher chronic kidney disease stage and history of urinary tract infection are significantly associated with the risk of progression to end stage renal disease ⁽⁸⁾ Practice guidelines from American Academy of Pediatrics recommend micturating cystourethrogram (MCUG) and renal ultrasonogram after a first time UTI in children between 2-24 months of age. ⁽⁹⁾



Figure (4): Unilateral grade V vesicoureteral reflux secondary to a posterior urethral valve. There is gross dilatation of the renal pelvis and calyces. Papillary impressions are not visible

Up to 30% of children, presenting with a UTI will have underlying vesicoureteric reflux (VUR) ^(10, 11)

The purpose of the imaging studies is to detect anatomical abnormalities of the urinary tract system as well as VUR.

METHODS:

A retrospective study done for 2 years for children with UTI under age of 5 years were identified by searching the records for urinary tract infection. In this study, a renal ultrasound was considered suggestive of VUR if dilatation of the pelvi-calyces, dilatation of the ureters, or dilatation of the collecting system of one or both kidneys was reported. All ultrasound scans and MCUGs were performed at the hospital and the results reported radiologists. The urinary bladder is catheterised with a 8 French catheter without a balloon and taped into position. Omenipaque contrast material is then instilled under fluoroscopy guide with the patient in a supine position.

Intermittent fluoroscopy was performed during the filling phase to detect VUR or other abnormality. A spot image of the filled bladder is normally obtained. Once the bladder is sufficiently filled, infants and young toddlers will spontaneously void, older children are instructed to void when they feel full, girls lying supine on a bedpan and boys in a left anterior oblique position over a urinal. Spot images are obtained of bladder and urethra during voiding, the catheter having either been pulled out or fallen out. A post-void image of the bladder is obtained to assess post-void volume and reflux.

Thirty patients had done excretory urography tailored according to the case clinical, laboratory and other radiological findings.

Ultrasound scans were performed with Medison Sonoace 8000 and HG 11 XE Philips ultrasound system. All studies were performed with sector, curved array, and linear high resolution transducers.

Statistical analysis for the entire group included age, sex, and prevalence of VUR. The statistical indices were sensitivity, specificity, and predictive values (positive and negative). Sensitivity is defined as the proportion of those with the disorder (VUR) in whom the test (ultrasound) is positive. Specificity is the proportion of those without the disorder in whom the test is negative. These two indices are not as helpful as predictive values. The positive predictive value is the probability of VUR in children with dilatation observed on the ultrasound scan; the negative predictive value is the probability of no reflux in children with no dilatation noted on ultrasound.

RESULTS

A total of 80 charts of patients less than 5 years of age with a diagnosis of UTI were identified. The median age of the 80 subjects was 18 months, 42 (52%) were females and 38 (48%) were males

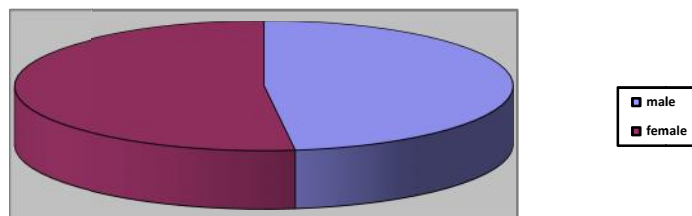


Figure (5) sex distribution

The age range for males was 20days –5 years. In the analysis of US findings, hydronephrosis and bladder wall mucosal thickening (cystitis) were the commonest (each 28.7%). Nephrolethiasis and congenital anomalies were the next. Congenital anomalies include (ectopic kidney 1, duplicating system 3, PUJ obstruction 2, congenital single Kidney 1& uretrocele 1 case)

Table (1) incidence of urinary congenital anomalies

Ectpoic kidney	1(1.2%)
Duplicating system	3(3.7%)
PUJ obstruction	2(2.5%)
Single kidney	1(1.2%)
Uretrocele	1(1.2%)

Table (2) the percentage of US findings

Hydronephrosis	23 (28.7%)
Cystitis	23 (28.7%)
Normal	20 (25%)
Renal stones	9 (11.2%)
Urinary system congenital anomalies	8 (10%)
Urinary bladder stones	5 (6.2%)

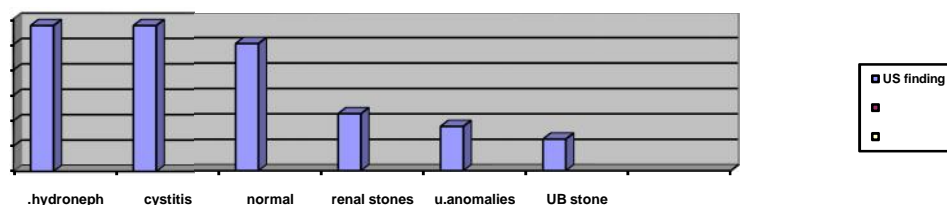


Figure (6) showing percentage of US findings in the urinary tract

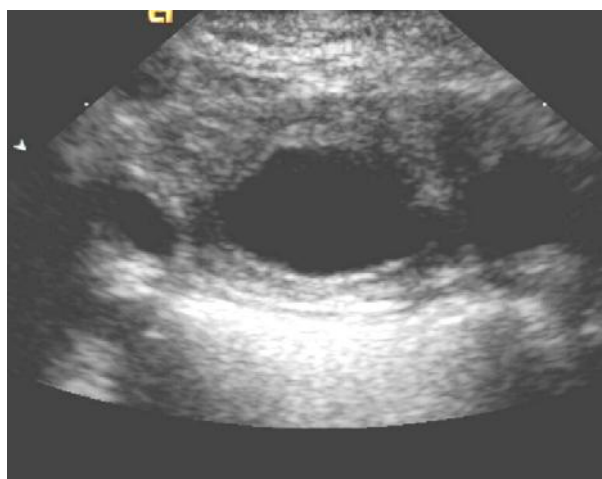


Figure (7) Renal sonogram in a patient with high-grade vesicoureteral reflux demonstrates moderate hydronephrosis and cortical thinning

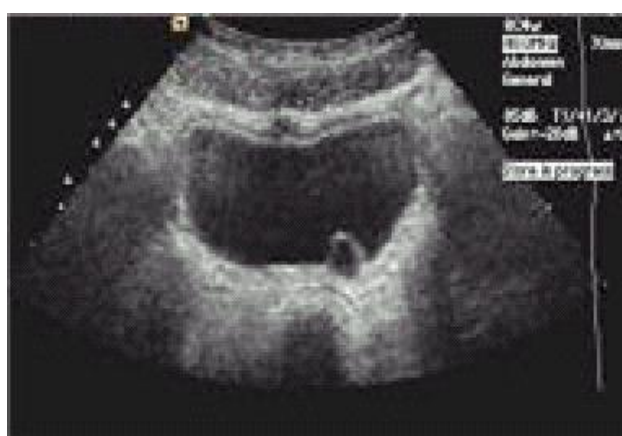


Figure (8) Transverse gray-scale sonogram demonstrates a small left ureterocele in a patient with a low-grade vesicoureteral reflux

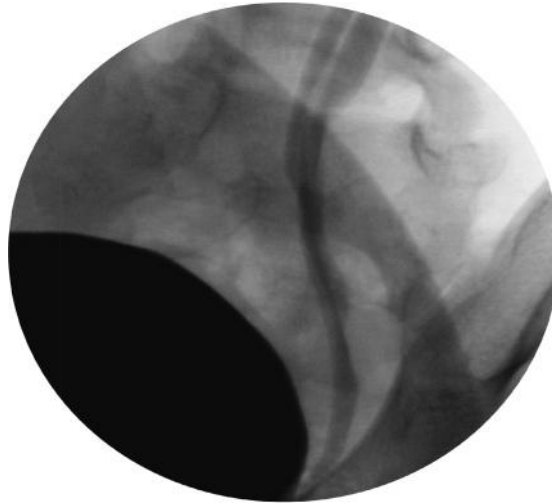


Figure (9): Grade II vesicoureteral reflux in a patient with ureteral duplication

Twenty patients were found to have VUR on MCUG, giving a prevalence of 25%. Of these 20 patients, 1 had grade I reflux, 10 had grade II reflux, 5 had grade III reflux, 4 had grade IV reflux. Ultrasound results suggested the presence of VUR in 8 of these 20 patients, and in 15 of 60 patients without VUR on MCUG.

Table (3) shows the distribution of the 20 patients with VUR on MCUG by grade and ultrasound result.

Grades of VUR on VCUG	Ultrasound +	Ultrasound -	total
I	1	0	1 (5%)
II	3	7	10 (50%)
III	2	3	5 (25%)
IV	2	2	4 (20%)
V	0	0	0
Total	8	12	20 (100%)

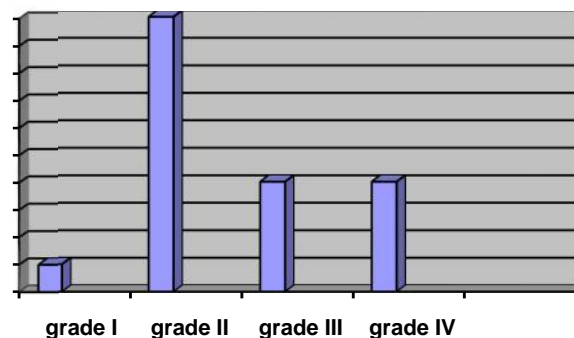


Figure (10) the percentage of VUR grades on MCUG

The sensitivity of ultrasound for detection of VUR was 40% specificity was 80%. The positive predictive value of ultrasound for VUR was 34% and the negative predictive value was 83%.

DISCUSSION:

Hydronephrosis describe the dilatation of the renal pelvis and calices, in association with backpressure changes in renal parenchyma. ⁽¹²⁾ It is the most common abnormality seen (28.7%).It correlates well with studies reported by other , it was

22% and higher than those reported by other series (Barry B et al and Al-Kazzaz D , Al-Nasiri U)^(13,14)

Cystitis was manifested by a diffuse mucosal wall thickening of the bladder in 23 (28.7%) patients, the majority were female patients above 1.5 years. Because of differences in anatomy, girls are at a higher risk of UTI than boys beyond the first year of life. In girls, the moist periurethral and vaginal areas promote the growth of uropathogens. The shorter urethral length increases the chance for ascending infection into the urinary tract.⁽¹⁵⁾ This percentage is greater than obtained by other studies like that obtained by Mitra Naseri & Ali Alamdaran, which show (18%). Renal stones seen in (11.2%) and vesical stones in (6.2%) of the cases. This percent is higher than that obtained by Mitra Naseri & Ali Alamdaran, which is (9.7%).⁽¹⁶⁾

This study demonstrate 1.2% ectopic kidney and 1.2% single kidney which approach that obtained by other studies and PUJ obstruction is lower (2.5% by this study compare with 5% by other studies)⁽¹⁶⁾.

Urethral duplication by this study is 3.7%, which is lower than that obtained by other studies, estimated to be 10% in children with UTI⁽¹⁷⁾.

Overall incidence of VUR by this study is (25%) this agree with other studies obtained by other which shows incidence of (26-53%)⁽¹⁸⁻²⁰⁾

Various degrees of dilatation of the collecting system of the kidney seen on renal ultrasound are often reported. Three studies that examined significance of these findings in children.

Di Pietro and colleagues⁽²¹⁾ found that ultrasound was unreliable in excluding VUR in children aged 5 years or older who were being evaluated for a UTI. Only two of 21 children with VUR on MCUG had abnormal renal ultrasound scans.

Blane and colleagues⁽²²⁾ analysed MCUG and ultrasound results of 493 children. All children who had a MCUG within eight hours of a renal ultrasound scan were included, except for children with myelomeningocele or renal surgery. The mean age of their study population was 4.9 years. They found that ultrasound was not sensitive for VUR. Of the kidneys with VUR, 74% had normal ultrasound scans.

Studies have reported on the reliability of colour flow Doppler sonography in the diagnosis of VUR in children.^(23, 24) The real breakthrough in the US diagnostic option has come with the availability of stable US contrast media that can be administered intravesically. Comparison between contrast-enhanced sonographic reflux examination (voiding urosonography, VUS) and MCUG/RNC has revealed the high concordance between these imaging modalities regarding the diagnosis or exclusion of VUR⁽²⁵⁾

Voiding colour Doppler US with echo enhancement is useful for the diagnosis or exclusion of VUR, being as good as VCUG. Therefore, it may reduce the number of patients exposed to ionizing radiation.⁽²⁶⁾ Radiologists reading the MCUG results were not blinded to the ultrasound results. Any bias, however, would have been expected to be towards reporting more VUR in patients with suggestive ultrasound findings, a bias not evident in the study results.

CONCLUSION:

Renal ultrasound useful to evaluate children with different urinary system abnormalities but neither sensitive nor specific for VUR in children with a UTI. Therefore,

RECOMMENDATIONS:

Clinicians should not use renal ultrasound results to influence the decision on whether or not to proceed with a MCUG in the investigation of a UTI in young children.

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