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Renal ultrasound and voiding cystourethrogram in children with recurrent urinary tract infection

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ABSTRACT

Introductions: Urinary tract infection (UTI) is common in children and vesicoureteric reflux (VUR) is a risk factor for the UTI. Renal ultrasound, voiding cystourethrogram (VCUG) and nuclear renal scanning are used to confirm VUR. Recent studies show that ultrasound has a low sensitivity and specificity for VUR. Aim of the study was to assess the findings of renal ultrasound and VCUG in recurrent urinary tract infection and presence of VUR.

Methods: This cross-sectional study retrospectively reviewed 208 cases of children with recurrent UTI who had ultrasound and VCUG in at Patan Hospital during 2010 to 2015. Sensitivity and specificity of both tests were analysed. Amount of contrast required for VCUG with or without VUR was analysed.

Results: Among the 209 patients with recurrent UTI, 51 (24.51%) had VUR and 157 (75.48%) were normal. In ultrasound, 196 cases (94.2%) were normal, 11 cases (5.3%) had mild hydronephrosis and 1 (0.5%) had moderate hydronephrosis. VUR cases needed more amount of contrast medium than normal patients while performing VCUG.

Conclusions: Ultrasound alone is not diagnostic of VUR and VCUG is required to confirm diagnosis. Mire amount of contrast volume is required in VUR cases than no VUR.

Keywords: recurrent UTI in children, renal ultrasound, voiding cystourethrogram VCUG, vesicoureteral reflux VUR

INTRODUCTIONS

Urinary tract infection (UTI) is common in paediatric group; and vesicoureteric reflux (VUR) has been identified as a risk factor for the development of UTI. Standard imaging tests are renal ultrasound, voiding cystourethrogram (VCUG) and nuclear renal scanning. As Nepal is a resource limited country, many patients may not be able to afford nuclear scanning. We only consider renal ultrasound and VCUG, and nuclear scanning only if indicated. Many recent articles show that renal ultrasound has a low sensitivity and specificity for predicting VUR.[1] This study was done to detect VUR by renal ultrasound and VCUG in recurrent UTI in children at Patan Hospital.

METHODS

This was a cross-sectional study of children up to age 18 years (1.5 months to 208 months) treated at Patan Hospital, Patan Academy of Health Sciences, Lalitpur, Nepal during five years period from 2010 to 2015, for recurrent UTI of at least two times.

Ultrasound finding was divided into normal, mild hydronephrosis and moderate hydronephrosis. All ultrasounds were performed in Radiology Department of Patan Hospital using Medison, Sonosite and Aloka machines.

The VUR were graded based on VCUG findings- Grade I (reflux limited to the ureter), II (reflux up to the renal pelvis), III (mild dilatation of ureter and pelvicalyceal system), IV (tortuous ureter with moderate dilatation) and V (tortuous ureter with severe dilatation of ureter and pelvicalyceal system).[2]

The VUR was taken as a dependent variable and characteristics of ultrasound findings and VCUG as independent variables. A p-value less than 5% (<0.05) was taken as statistically significant. SPSS Version 20 was used for data analysis.

RESULTS

There were total 208 children, mean age 20.94 months, female 101 (48.6%) and male 107 (51.4%). Eleven (5.3%) had mild hydronephrosis, one moderate hydronephrosis (0.5%) and 196 (94.2%) normal ultrasound. On VCUG, 51 (24.52%) had VUR and 157 (75%) normal findings.

Among 51 VUR, 44 (86.27%) had normal ultrasound and 7 mild (13.72%) hydronephrosis. Of 51 VUR, 31 (60.78%) were unilateral and 20 (39.21%) bilateral. In unilateral VUR, grade I was 11 (35.48%), grade II was 14 (45.16%), grade III was 14 (45.16%), grade IV was 2 (6.45%) and grade V was 2 (6.45%), (Table 1).

The Fisher's exact test (value 12.628) was statistical not significant, $p > 0.05$. The sensitivity of ultrasound suggesting VUR was 13.7% (6.81%-25.72%) and specificity 96.8% (92.76%–98.63%) with 95% confidence interval. The Positive Predictive Value was 58.33% and Negative Predictive Value 77.55%, and Cohen's kappa Landis[3] was 14.2% with 95% confidence interval of (4.28%-24.14%), (Table 2).

The independent t-test showed that mean amount of contrast used was higher among VUR group compared to Normal group, $p<0.001$, (Table 3).

DISCUSSIONS

This study shows children with recurrent UTI, ultrasound findings alone are not predictive of VUR and VCUG is required to rule out VUR. In 51 cases of VUR, 41 had normal ultrasound. Practice guidelines from American Academy of Pediatrics (AAP) recommended a VCUG and a renal ultrasonogram for first UTI incidence.[4] Recent study questions the value of routine renal ultrasound for young children in whom first UTI is diagnosed because of a limited effect on clinical management.[1] Our study confirms that renal ultrasound USG has little role in diagnosis of VUR and VCUG must be

performed because renal ultrasound is a poor screening test for genitourinary abnormalities, as suggested by Celeb et al.[1] Both tests complement each other as they provide important but different information. They found that ultrasound had sensitivity of 18% to 55% and specificity 77% to 97%, which is comparable to our study with USG sensitivity of 13.7% and specificity 96.8% with Cohen's kappa with 14.2%, suggesting a slight agreement among USG and VCUG.[3]

Table 1. The voiding cystourethrogram (VCUG) and ultrasonogram (USG) findings in children with vesicoureteric reflux (VUR) (n=51)

VCUG Grade		USG Finding		Total
		Normal	Mild Hydronephrosis	
Unilateral cases of VUR	Grade I VUR	9	2	11
	Grade II VUR	13	1	14
	Grade III VUR	13	1	14
	Grade IV VUR	2	0	2
	Grade V VUR	0	2	2
Bilateral cases of VUR	Rt-II, Lt-III VUR	2	0	2
	Rt IV, Lt III VUR	2	0	2
	Rt II, Lt II VUR	1	0	1
	Rt-IV, Lt-I VUR	1	0	1
	Rt-III, Lt-IV VUR	1	1	2
Total		**44**	**7**	**51**

Table 2. Sensitivity and specificity of VCUG and USG findings in children with VUR (n=51)

USG findings	VCUG Findings		Total
	VUR	Normal	
Hydronephrosis	7	5	12
Normal	44	152	196
Total	51	157	208

Table 3. Amount of contrast required during VCUG in children with VUR (n=51) and normal findings

Amount	VCUG	N	Contrast Mean (ml)	SD	SEM	p-value (1-tailed test)
Contrast	Normal	157	129.39	64.95	5.18	<0.001
	VUR	51	172.55	69.74	9.77	

Layla et al reports 50% sensitivity and 76.9% specificity.[5] In our study VUR was identified in 24.5% whereas in a larger series[3] VUR was identified in 41.7%. Other study reports 22% prevalence, 40% sensitivity, 76% specificity, 32% positive and 82% negative predictive value.[6] Our study had positive predictive value of 58.33%, and negative predictive value of 77.55%, which could be due to small sample size.

Patients with VUR in our study had normal ultrasound in 86.27% and mild hydronephrosis in 13.72%. However, patients with no VUR did have moderate hydronephrosis. This is similar to the study done on 70 patients in which only 5 patients had abnormal ultrasound and 2 out of 5 had reflux on VCUG.[7] In 21 VUR, 19 (90%) had normal ultrasound and the study concluded that an abnormal ultrasound does not reliably exclude VUR in children.[7] Alon and

Ganapathy studied 124 patients with UTI where 38 patients were found to have VUR but only 10 patients had abnormal ultrasound similar to our study where out of 51 cases of VUR only 7 had abnormal ultrasound.[8] Hoberman and colleagues in 255 children, 36 had VUR on VCUG but normal on ultrasound.[9] They concluded that ultrasound results were normal in 88% of VUR, similar to our study with 86.27% normal ultrasound in VUR.[9] On further analysis of ultrasound findings in 33 children with mild to moderate renal pelvis dilatation, they reported only 9 had VUR on VCUG, similar to our study where out of 11 mild hydronephrosis, 7 had VUR and 1 with moderate hydronephrosis did not have VUR.

Our findings along with published studies supports that ultrasonography alone is not a choice of investigation for VUR and should be combined with VCUG. Our study also confirms that VCUG requires more contrast in VUR than normal cases.

The possible limitation of our study could we did not include patients less than 1.5 months and we assessed the outcome using only one machine rather than three different machines to ensure the reliability of the finding.

CONCLUSIONS

This study suggests that ultrasound alone is not diagnostic of VUR in patients of recurrent UTI and VCUG is required to rule out VUR. The suspected VUR patients need more amount of contrast (ml) during VCUG than normal patient.

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