International Surgery Journal
Ainippully AM et al. Int Surg J. 2018 May;5(5):1847-1851
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20181595

Original Research Article

Utility of urethral ratio in voiding cystourethrogram to identify milder variants of posterior urethral valves

Arun M. Ainippully, Anoop P. V.*, Arun Preeth V., Prathap S.

Department of Paediatric Surgery, Government Medical College, Kozhikode, Kerala, India

Received: 01 March 2018
Accepted: 31 March 2018

***Correspondence:**
Dr. Anoop P.V,
E-mail: pvanup28@gmail.com

ABSTRACT

Background: Majority of patients with posterior urethral valves are diagnosed antenatally. Few patients present later in childhood with milder variants of the disease where the radiological findings are not very apparent. In this study, we aim to evaluate the role of urethral ratio beyond which here is higher probability of finding a mild variant of urethral valve thereby identifying patients who need to undergo a cystoscopic evaluation.
Methods: This study was conducted in the Department of Paediatric Surgery between 2016 and 2017. 48 male patients who presented with either urinary tract infection or other lower urinary tract symptoms were included in the study. The candidates were examined and evaluated with an ultrasound followed by a voiding cystourethrogram (VCUG). The Urethral ratio was calculated. All patients then underwent a cystoscopy to rule out the presence of valve. We analyzed the data in Stata IC 15 statistical software and R statistical computing environment.
Results: Of the 48 children recruited to the study, the median age of those with posterior urethral valve on cystoscopy was 8(IQ 3-18) and those without valves was 9(IQ 6.5-21) months. There was a statistically significant difference in the quality of urinary stream, straining on micturition, presence or absence of palpable bladder between the two groups (p value <0.05). The mean urethral ratio in the first group with PUV was 2.25(CI 2.02 to 2.48) and that in the second group with no urethral valve was 1.48(CI 1.32 to 1.65). with cut-off point of Urethral ratio at 2 the specificity and positive predictive value for the presence of PUV reached 100%.
Conclusions: The present study indicates the calculation of urethral ratio on VCUG is an objective method for assessment of milder variants of PUV. In the present study, a Urethral ratio greater than 2 had a positive predictive value of 100% and would mandate a cystoscopic evaluation.

Keywords: Adenocarcinoma, Colorectal, Carcinoma, Colonoscopy, Retrospective

INTRODUCTION

Posterior urethral valves affects 1 in 5000 live births.[1] A significant number from this cohort will require renal replacement therapy due to end stage renal disease within the first two decades of life.[2] Though majority of patients are now diagnosed in the antenatal period many children do present later on in early childhood and may represent milder variants of the disease, in whom radiological findings in voiding cystourethrogram (VCUG) may not be very apparent.[3]

Initially described by Hugh Hampton Young posterior urethral valves are currently classified into 3 types of which type 1 forms 90% of the cases.[4,5] The disease process presents with a wide spectrum of symptoms from severe forms presenting with renal compromise or milder forms presenting with lower urinary tract symptoms

only.[3] VCUG remains the gold standard in diagnosing posterior urethral valves because it delineates the anatomy of the bladder, bladder neck, and urethra.[6]

The proximal urethra is quite dilated and the actual valve structure is often visible. Secondary changes in the urinary bladder may be demonstrable. Vesicoureteral reflux is present in at least 50% of valve patients at the time of diagnosis. Though VCUG remains the gold standard for diagnosis, the accurate diagnosis of urethral valves needs an endoscopic evaluation.[7]

Severe varieties of PUV are easily diagnosed by VCUG where the urethral ratio is greater than 4. Urethral ratio (UR), calculated by dividing the posterior urethral diameter by the anterior urethral diameter as seen on VCUG, gives an objective measurement of adequacy of valve ablation.8 Studies have shown a reduction of UR to a postoperative value of 2.5 to 3.5 is acceptable.[8,9]

The amount of posterior urethral dilatation that mandates a cystoscopic evaluation to rule our milder variants of PUV is still arbitrary and has a lot of individual variations based on the surgeon's experience. This is because the posterior urethral dilatation is not so extreme and the secondary bladder changes and vesicoureteric reflux are not seen. Studies on urethral ratio in controls have varying values which range from 1.73 to 2.6.[8,9] Post-operative values of urethral ratio greater than 3 should be evaluated for incomplete fulguration.[10]

This study aims to evaluate the role of urethral ratio beyond which here is higher probability of finding a mild variant of urethral valve thereby identifying patients who need to undergo a cystoscopic evaluation.

METHODS

This study was conducted in the Department of Paediatric surgery, Government Medical Collage, Kozhikode, Kerala from February 2016 to December 2017. Ethical committee clearance was taken and informed consent from parents of all patients was taken. A prior sample size calculation was done.

Forty eighty male children who presented consecutively to the Outpatient department with either urinary tract infection or poor stream of urine or other lower urinary tract symptoms were included in the study. Children who were previously evaluated and diagnosed with VCUG or patients who underwent surgical intervention previously related to the present symptoms were excluded from the study. The candidates were examined and evaluated with an ultrasound followed by a voiding cystourethrogram (VCUG).

VCUG was done under aseptic precautions and antibiotic cover. From the VCUG the urethral ratio (UR) was calculated. We defined urethral ratio as the diameter of the posterior urethra divided by the diameter of the anterior urethra, measured during the voiding phase, on an oblique film. The diameter of the posterior urethra was measured transversely at a point halfway between the bladder neck and the distal end of the membranous urethra.

The diameter of the anterior urethra was taken as the transverse diameter at the point of maximum distension in the bulbar urethra. We aimed to measure these diameters on a voiding film without a catheter. Both measurements were taken on the same film. Children with secondary effects of bladder outlet obstruction or raised UR greater than 4 were excluded from the study.

All patients then underwent a cystoscopy to rule out the presence of Posterior urethral valves. If valves were present they were simultaneously fulgurated at the same sitting. We used a 10 Fr cystoscope with resectoscope and a cutting diathermy current. When the urethra was too small for this instrument, a #7.5 cystoscope with bugbee electrode was used for fulguration.

Apart from the basic demographic variables, we collected anterior urethral, posterior urethral measurement and symptoms and signs suggestive of posterior urethral valve. The outcome was defined as presence or absence of posterior urethral valve as documented by cystoscopy. Data were collected in a pretested data collection form, later abstracted into an excel database.

We analyzed the data in StataI C 15 statistical software and R statistical computing environment. Categorical variables were summarized as numbers and frequency. Continuous data was summarized as mean and standard deviation or median and interquartile range. Sensitivity, specificity, positive and negative predictive values were calculated for relevant variables. ROC curves were plotted for anterior urethral, posterior urethral measurements and urethral ratio. ROC curves were compared for these variables and area under the curves were calculated.

RESULTS

In this study, there were 48 patients. The median age was 8.5 (IQ 4.5-19) months. Out of these patients, posterior urethral valve was present in 33 (68.8%) patients. Baseline line features were comparable across both groups. The median age of those with posterior urethral valve on cystoscopy was 8 (IQ 3-18) and those without valves was 9 (IQ 6.5-21) months.

As far as evaluation of clinical features of these patients there were a statistically significant difference in the quality of urinary stream, straining on micturition, presence or absence of palpable bladder between the two groups (p value <0.05).

Comparison of various clinical features across both groups is given in Table 1. On sonological examination,

14(29.2%) showed features suggestive of posterior urethral valve. The sensitivity of sonological examination was 42.4%(25.5 to 60.8) and specificity 100%(69.8 to 100).

Table 1: Baseline comparison of the clinical features across both groups.

	[ALL] N=48	PUV present N=33	PUV absent N=15	P. overall
Urinary tract infection				0.556
Present	21 (43.8%)	13 (39.4%)	8 (53.3%)	
Absent	27 (56.2%)	20 (60.6%)	7 (46.7%)	
Urinary stream				0.007
Wide	33 (68.8%)	27 (81.8%)	6 (40.0%)	
Narrow	15 (31.2%)	6 (18.2%)	9 (60.0%)	
Dribbling				0.238
Present	17 (35.4%)	14 (42.4%)	3 (20.0%)	
Absent	31 (64.6%)	19 (57.6%)	12 (80.0%)	
Frequency				0.936
Increased	18 (37.5%)	13 (39.4%)	5 (33.3%)	
Normal	30 (62.5%)	20 (60.6%)	10 (66.7%)	
Straining				0.021
Present	16 (33.3%)	15 (45.5%)	1 (6.67%)	
Absent	32 (66.7%)	18 (54.5%)	14 (93.3%)	
Urinary bladder				0.020
Palpable	10 (20.8%)	10 (30.3%)	0 (0.00%)	
Not palpable	38 (79.2%)	23 (69.7%)	15 (100%)	
Phimosis				0.636
Present	28 (58.3%)	18 (54.5%)	10 (66.7%)	
Absent	20 (41.7%)	15 (45.5%)	5 (33.3%)	

Table 2: Sensitivity, specificity, PPV and NPV for different clinic-sonological findings.

		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Phimosis	33.3	11.8	61.6	54.5	36.4	71.9	25	8.7	49.1	64.3	44.1	81.4
Frequency	66.7	38.4	88.2	39.4	22.9	57.9	33.3	17.3	52.8	72.2	46.5	90.3
Straining	93.3	68.1	99.8	45.5	28.1	63.6	43.8	26.4	62.3	93.8	69.8	99.8
Dribbling	80	51.9	95.7	42.4	25.5	60.8	38.7	21.8	57.8	82.4	56.6	96.2
UTI	46.7	21.3	73.4	39.4	22.9	57.9	25.9	11.1	46.3	61.9	38.4	81.9
Stream	81.8	64.5	93	60	32.2	83.6	81.8	70.3	89.5	60	39.4	77.5
Palpable bladder	30.3	15.5	48.7	100	78.1	100	100			39.4	34.2	44.9
USG	100	76.8	100	44.1	27.1	62.1	42.4	35.3	49.8	100		

findings sensitivity CI 95% for PLR specificity CI 95% for NLR PPV (%) CI = 95% for PPV NPV(%) CI= 95% for NPV UTI: Urinary tract infection, USG: Ultrasound

The positive predictive value was 100% (68.1 to 100) and negative predictive value 44.1% (27.2 to 62.1). The sensitivity and specificity and other diagnostic tests of various clinical features are given in Table 2. The mean urethral ratio in the first group with PUV was 2.25 (CI 2.02 to 2.48) and that in the second group with no urethral valve was 1.48 (CI 1.32 to 1.65). We found a statistically significant difference in the posterior urethral size and urethral ratio between the two groups (p value 0.0001) (Figure 1). There was no statistically significant difference between the anterior urethra between the two groups. We plotted the ROC curves for urethral ratio, for posterior urethra and anterior urethra. ROC curves for the measurements and ratio is shown in figure 2-4. The area under the curve (AUC) for urethral ratio was 83.3 and that for posterior urethra was 75.6. Comparison of AUC and ROC with confidence levels for these variables are given in Figure 5. The cut off point for ROC for the urethral ratio was 1.5 based on Youden index. The sensitivity of urethral ratio at differentiating the presence or absence of posterior urethral valve was 84.85% and specificity 80% at this cut off value. However, we fixed the cut off at 2 based on the clinical grounds in view of the objective of correctly identifying the cases. With a

UR value of greater than 2, the specificity and positive predictive value reach 100 percent.

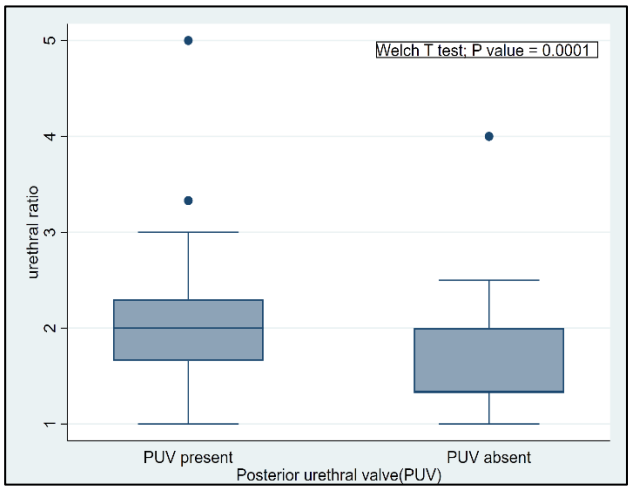

Figure 1: Comparison of urethral ratio between patients who had valve and those who did not.

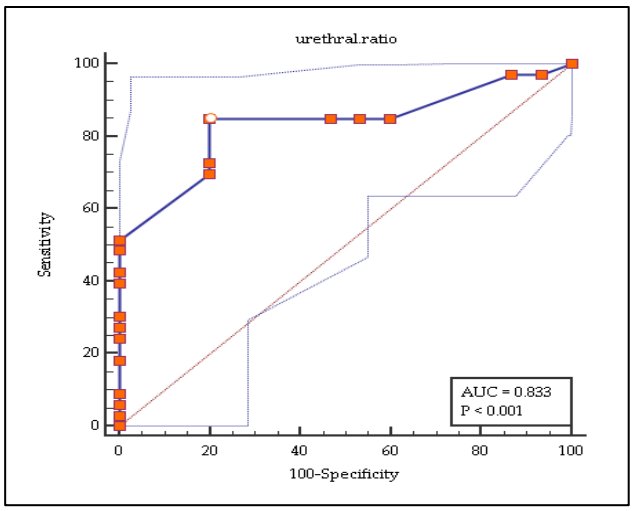

Figure 2: ROC curve for urethral ratio.

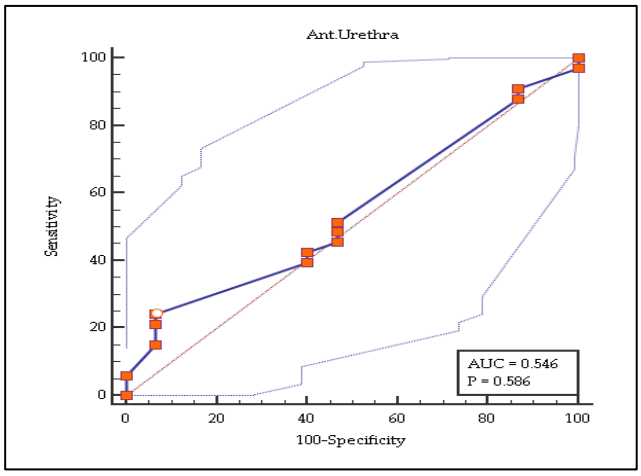

Figure 3: ROC curve for anterior urethra.

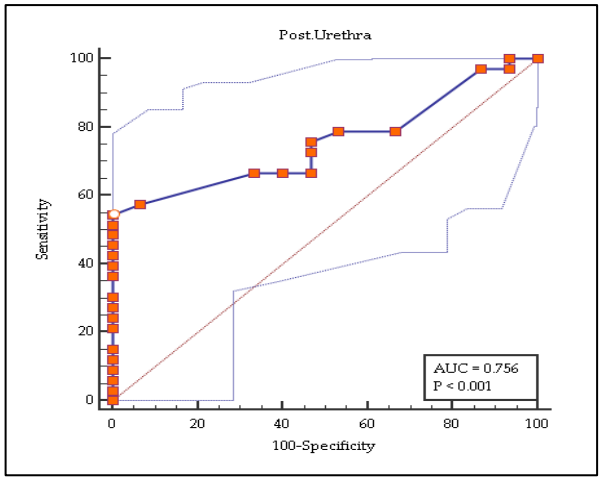

Figure 4: ROC curve for posterior urethra.

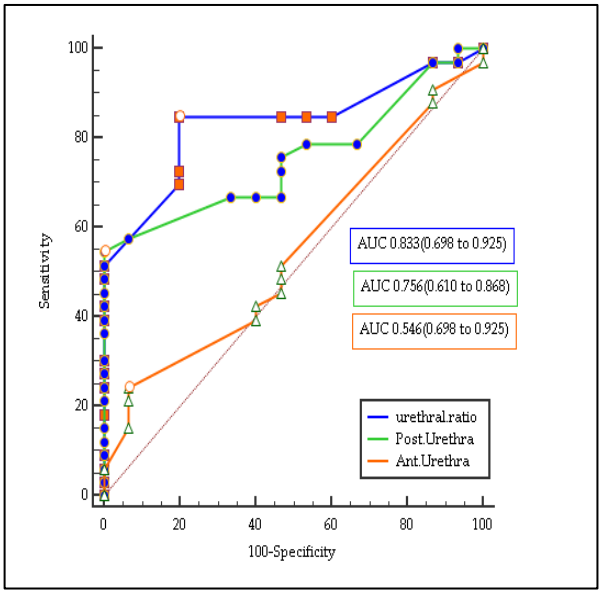

Figure 5: Comparison of AUC and ROC with confidence levels.

DISCUSSION

In the present study, we assessed the diagnostic accuracy of voiding cystourethrogram in diagnosing mild variants of posterior urethral valve in paediatric patients who presented to the Paediatric Surgery Department of Government Medical College, Kozhikode.

The present study has shown that urethral ratio has higher diagnostic accuracy in correctly classifying the groups as shown by the higher AUC in the ROC curve analysis. Using a cut off value of more than 2, the specificity and positive predictive value reach 100 percent. We opted for a clinical cut off for the ROC curve in view of our objective of picking of those cases with highest probability of PUV so that a cystoscopy can be performed at the earliest.

There are multiple studies in the literature describing various cut off points for ROC for diagnostic VCUG. Studies comparing the pre and post fulguration values of urethral ratios has been done. A clinically relevant cut of value for initial diagnosis of PUV will be helpful in identifying milder variants in the initial VCUG.

Naima et al in their study Using a cut-off value of 3.5, all boys with a UR >3.5 had residual valves requiring further resection at check endoscopy. In fact, a second fulguration was done in all patients with a UR > 3. Conversely, however, of the 23 patients with a UR < 3, nine boys (39%) required further valve resection. This prompted assessment of the UR also on the initial diagnostic VCUG. Interestingly, the median UR on the initial diagnostic VCUG was 3.0, with 14 values below the 3.5 cut-off suggested by Bani Hani et al. to indicate bladder outflow obstruction.[11]

Bani Hani et al. found the urethral ratio measured in 23 infants with PUV (1-12 months) and in controls (1-11 months) with a normal VCUG to investigate possible urinary tract pathology.[11] Control URs ranged from 1.3 to 5.5 (median 2.6), and PUV URs on the diagnostic VCUG ranged from 4 to 14.7 (median 8.6). They suggested a post fulguration UR of 3.5 to be acceptable criteria of adequate ablation. Rahul Gupta et al, in another study foud a post fulguration urethral ratio of 2.5- 3 was acceptable postoperatively.[12]

One of the limitations of the present study is the lack of sufficient observations at different criterion points for the ROC analysis. Selective reporting of cases in the Tertiary care setting like ours limits wider application of the diagnostic cut off we selected in this study.

One of the interesting findings we came across was the diagnostic differentiation of the patients into two groups by posterior urethral ROC. Further studies are needed to test the usefulness of this measurement in clinical practice

The calculation of urethral ratio on VCUG is an objective method of assessment of PUV, is reproducible, and allows preoperative and postoperative VCUG from different facilities to be compared. In the present study, a Urethral ratio greater than 2 had a positive predictive value of 100% mandating a cystoscopic evaluation.

ACKNOWLEDGEMENTS

Our sincere thanks to Dr Jeo Tharakan and Dr Sarath KN for support of the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Zderic SA, Canning DA. Posterior urethral valves. In: Docimo SG, Canning DA, Khoury AEA, editors. The Kelalis-King-Belman Textbook of Clinical Pediatric Urology. 5th ed.. Thompson Publishing Services; Chapter 63, 1, 2007. 1059-81.
2. Mouriquand PD. [Posterior urethral valve: determining factors of long-term results]. Arch Pediatr. 1997;4(1):31s-6s.
3. Baunin C, Puget C, Gafsi R. [Urination disorders revealing posterior urethral valve: radiological aspects]. Arch Pediatr. 1997;4(1):14s-8s.
4. Hennus PM, van der Heijden GJ, Bosch JL, de Jong TP, de Kort LM. A systematic review on renal and bladder dysfunction after endoscopic treatment of infravesical obstruction in boys. PLoS One. 2012;7(9):e44663.
5. Young HH, Frontz WA, Baldwin JC. Congenital obstruction of the posterior urethra. J Urol. 1919;3(5):289-365.
6. Caione P, Nappo S. Posterior urethral valve. Pediatric surgery: diagnosis and management Springer Verlag Publishing, Berlin Heidelberg. 2009:863-79.
7. Sauvage P. Endoscopic aspects of posterior urethral valve. Arch Pediatr. 1997;4(1):23s-6s.
8. Bani Hani O, Prelog K, Smith GH. A method to assess posterior urethral valve ablation. J Urol. 2006;176(1):303-5.
9. Gupta RK, Shah HS, Jadhav V, Gupta A, Prakash A, Sanghvi B, et al. Urethral ratio on voiding cystourethrogram: a comparative method to assess success of posterior urethral valve ablation. J Pediatr Urol. 2010;6(1):32-6.
10. Menon P, Rao KL, Vijaymahantesh S, Kanojia RP, Samujh R, Batra YK, et al. Posterior urethral valves: Morphological normalization of posterior urethra after fulguration is a significant factor in prognosis. J Indian Assoc Pediatr Surg. 2010;15(3):80-6.
11. Hani OB, Prelog K, Smith GHH. A Method to Assess Posterior Urethral Valve Ablation. The J Urol. 2006;176(1):303-5.
12. Gupta RK, Shah HS, Jadhav V, Gupta A, Prakash A, Sanghvi B, et al. Urethral ratio on voiding cystourethrogram: A comparative method to assess success of posterior urethral valve ablation. J Pediatr Urol. 2010;6(1):32-6.

Cite this article as: Ainippully AM, Anoop PV, Preeth VA, Prathap S. Utility of urethral ratio in voiding cystourethrogram to identify milder variants of posterior urethral valves. Int Surg J 2018;5:1847-51.