ORIGINAL ARTICLES

SONO-URETHROGRAPHY IN THE EVALUATION OF MALE ANTERIOR URETHRAL STRICTURES

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Abstract:

Objective*: To evaluate the accurate length, site, number of male anterior urethral stricture and to determine the extent of spongiofibrosis by sonourethrography and comparing it with retrograde urethrogam and operative findings.*

Methods: *This cross sectional study was conducted to evaluate 60 patients with anterior urethral stricture. All patients underwent retrograde urethrography (RGU) followed by sonourethrography (SUG) to evaluate abnormalities of male anterior urethra. All sonographic studies were performed with a standard ultrasound scanner (Just Vision 400, Toshiba) using a 7.5 MHz linear array transducer. With the patients in supine position anterior urethra was filled with saline and multiple longitudinal and transverse scans were taken. All cases underwent operative treatment. During operation all patients observed for length of stricture and degree of spongiofibrosis of stricture and correlated it with RGU & SUG findings.*

Results: *The Mean (± SD) age of the patients of this study was 30.75 ±8.70 years and the age range of the subjects was 50 to 18 years. Sensitivity of SUG to diagnose urethral stricture length at cut off level 10 mm was 94.1%, specificity 97.7%, positive predictive value 94.1%, negative predictive value 97.7% and accuracy 96.7% (Kappa value = 0.918; p value <0.001). Sensitivity of RGU to diagnose urethral stricture length at cut off level 10 mm was 88.2%, specificity 86.0%, positive predictive value 71.4%, negative predictive value 94.9% and accuracy 86.7% (Kappa value = 0.693; p value <0.001). Diagnostic accuracy was determined as receiver operating characteristic (ROC) curve, suggesting that the area under the curve (AUC) of SUG and RUG was 0.959 and 0.871, respectively in the diagnosis of length of stricture (Fig.-1).*

Conclusion: *Retrograde urethrography and sonourethrography are equally efficacious in detection of anterior urethral strictures.*

Key words: *Anterior urethral stricture, retrograde urethrography, sonourethrography, spongiofibrosis.*

Introduction:

Standard radiographic retrograde urethrography remains an important study for the planning of urethral reconstruction[1]. However because conventional retrograde urethrography produces static images, variation in the penile stretch, urethral distension and patient positioning may produce variable results [1,2]. Voiding cystourethrography offers a valuable complement to retrograde urethrography, but again variation in positioning may produce an incorrect axis of assessment and thus imprecise results. Extravasation of contrast, sepsis and hypersensitivity may also occurs [1, 3, 5].To overcome these problems in 1988 MC Aninch et al reported a new technique for imaging the male anterior urethra with high resolution ultrasound (Sonourethrography)[1].

As a dynamic 3 dimensional study which can be repeated without radiation exposure, sonourethropgrahy offers important technical advantages by estimating length of strictures, degree of spongiofibrosis which would be more informative in making decisions about the management [3, 20]. This study was undertaken to explore the uses of high-resolution ultrasound in evaluating abnormalities of male anterior urethra and comparing with Retrograde Urethrography. Recently sonourethrography and MR imaging have been proposed, distending the lumen with simple saline solution instead of iodinated contrast media [5, 7]. They are being used to study the urethral mucosa and the periurethral spongy tissue which can be involved in the urethral pathologies such as strictures, diverticula, trauma, and tumors [1, 7, 9]. A significant reduction in the incidence of recurrent stricture may be obtained by selecting patients for treatment on the basis of the findings of sonourethrography [16, 18].

The present study is designed to determine the length, site, number of male anterior urethral stricture, extend of spongiofibrosis by sonourethrography and comparing it with retrograde urethrogam and operative findings.

Materials & Methods:

This hospital based cross sectional study was conducted from January 2007 to October 2008 in the department of Urology, Radiology and Imaging, Bangabandu Sheikh Mujib Medical University, Dhaka to evaluate male anterior urethra by sonourethrography. A total of 60 patients out of 100 by defined criteria were evaluated in this study. Male patients with the complaints of poor stream of urine were selected from the out patients Urology Dept. of Bangabandhu Sheik Mujib Medical University. A detailed history was elicited which included a past history of reaction to contrast media, penile or urethral trauma, infections, urethral surgery, prolonged urethral catheterization or urethral dilatation. Clinical examination was performed for specific relevant findings of meatal stenosis, epispadias, hypospadias, fistulae, diverticula or purulent urethral discharge. All patients under went RGU followed by sonourethrography. The patients who were diagnosed as primary anterior urethral strictures were invited to participate in the study. After anaesthetic evaluations all cases underwent operative treatment. During operation all patients observed for length and degree of spongiofibrosis and correlated with RGU & SUG findings.

All sonographic studies were performed with a standard ultrasound scanner (Just Vision 400, Toshiba) using a 7.5 MHz linar array transducer. With the patients in supine, glans was cleansed with antiseptic solution, a 12 Fr Foley's catheter introduced such that the bulb of the catheter laid in the fossa navicularis. The bulb was distended gently using 2 ml normal saline. The penis was then cranially extended over the lower abdomen and ultrasonic gel was applied liberally to the ventral surface of the penis. Twenty ml to 100 ml of sterile normal saline was infused after taking care of to exclude air bubbles. The penile urethra was visualized to the peno-scrotal junction with multiple longitudinal and transverse scan by placing the transducer on the ventral penile surface. Subsequently, the transducer was repositioned to visualize the proximal penile and distal bulbar urethra transscrotaly. Transperineal scans were performed to visualize the proximal bulbar urethra and external sphincter (Figure-2).

During sonourethrography, the urethra became distended by saline infusion and appeared as a homogenous echo free band, 8-10 mm in diameter. Below the urethra an echogenic band was visualized, which was produced by dorsal acoustic enhancement and reflection from tunica albuginea. Strictures were located as segments of reduced dispensability on infusion of saline. The stricture length and diameter were determined using electronic scale measurements. Strictures were graded as mild encroachment on less than one third of normal lumen, moderate encroachment on less than one third of normal lumen. Periurethral fibrosis was identified as regions of greater echogenicity in corpus spongiosum thickness, moderate involvement of one third to a half, and severe involvement of over one half (Fig.-3). The duration of the procedure varied from 10 – 20 min.

Results:

A total of 60 patients with symptoms of lower urinary tract obstruction underwent retrograde urethrography (RGU) followed by sonourethrography. The outcome variables studied were compared with peroperative findings of stricture urethra and sensitivity, specificity and overall accuracy for the procedures were calculated. The findings of the study obtained from data analyses are given in different tables.

Evaluation of stricture by RGU shows that 51 (85.0%) had single stricture and only 9 (15.0%) patients had multiple strictures. In thirty three (55.0%) patients, the strictures were located at bulbous part and 27 (45.0%) at penile part of the urethra. Over 96.7% of the subjects had strictures of <10 mm length (Table-1).

Table-I

Distribution of the respondents by the evaluation of stricture by SUG and RGU.

Evaluation of stricture	Frequency SUG-RGU		SUG-RGU Percent	
Number of stricture				
• Single	52	51	86.7	85.0
• Multiple	8	9	13.3	15.0
Location of stricture				
• Bulbar	36	33	60.0	55.0
• Penile	24	27	40.0	45.0
Anterior urethral stricture length (mm)				
• <10	18	58	30.0	96.7
• >10	42	2	70.0	3.3
Periurethral fibrosis				
• Mild	5		8.3	
• Moderate	51		85.0	
• Severe	4		6.7	

Evaluation of stricture by sonourethrography shows that 52 (86.7%) had single stricture and only 8 (13.3%) patients had multiple strictures. In thirty six (60.0.0%) patients, the strictures were located at bulbous part and 24 (40.0%) at penile part of the urethra. About 70.0% (42) of the subjects had strictures of >10 mm length and 30.0% (18) had stricture of d”10 mm length. Most of the patients, 85.0% (51) had moderate, 8.3% (5) had mild, and only 6.7% (4) had severe periurethral fibrosis (Table-I).

Evaluation of stricture preoperative shows that 83.3% had single stricture and only 16.7% patients had multiple strictures. In thirty six (60.0.0%) patients, the strictures were located at bulbous part and 40.0% at penile part of the urethra. About 70.0% of the subjects had strictures of >10 mm length and 30.0% had stricture of <10 mm length. Most of the patients, 80.0% had moderate, 15% had mild, and only 5% had severe periurethral fibrosis (Table-II).

Table-II

Distribution of the respondents by per operative evaluation of stricture

Per operative evaluation of stricture	Frequency	Percent
Number of stricture		
• Single	52	83.3
• Multiple	08	16.7
Location of stricture		
• Bulbar	36	55.0
• Penile	24	45.0
Anterior urethral stricture length (mm)		
• <10	18	30.0
• >10	42	70.0
Periurethral fibrosis		
• Mild	9	15.0
• Moderate	48	80.0
• Severe	3	5.0
Colour of urethral mucosa		
• Pink	11	18.3
• Gray	46	76.7
• White	3	5.0
Resistance to incision		
• Mild	8	13.3
• Moderate	48	80.0
• Severe	4	6.7

SUG evaluation of fibrosis was correlated well with per operative findings (r=0.569; p <0.001). Kappa value= 0.671; p value <0.001. 67.1% agreement was also observed between SUG and per operative findings in the evaluation of fibrosis.

Out of all patients 16 cases were diagnosed as having urethral stricture length d<10 mm by SUG and confirmed by peroperative evaluation. They were true positive. One case was diagnosed as having urethral stricture length dˆ10 mm by SUG and not confirmed by peroperative findings. So, it was false positive case. Of 43 patient having urethral stricture >10mm, which were confirmed by SUG, one was confirmed as having urethral stricture d<10mm and 42 were >10 mm length by peroperative evaluation. They were false negative and true negative respectively. Kappa value 0.918 revealed that statistically highly significant agreement (total agreement) between these two tests in the diagnosis length of urethral stricture at 10 mm cut off point.

On the other hand considering correlation between RGU and operative findings 15 cases were true positive, 6 were false positive 37 cases were false negative and two were true negative at a cut off level of 10 mm.

Sensitivity of SUG to diagnose urethral stricture length at cut off level 10 mm was 94.1%, specificity 97.7%, positive predictive value 94.1%, negative predictive value 97.7% and accuracy 96.7%. Sensitivity of RGU to diagnose urethral stricture length at cut off level 10 mm was 88.2%, specificity 86.0%, positive predictive value 71.4%, negative predictive value 94.9% and accuracy 86.7% (Table-III).

Table-III

Sensitivity, specificity, accuracy, positive and negative predictive values of the SUG and RGU in the diagnosis of urethral stricture length at cut off level 10 mm

	SUG	RGU
Sensitivity	94.1	88.2
Specificity	97.7	86.0
PPV	94.1	71.4
NPV	97.7	94.9
Accuracy	96.7	86.7

Diagnostic accuracy was determined as receiver operating characteristic (ROC) curve, suggesting that the area under the curve (AUC) of SUG and RUG was 0.959 and 0.871, respectively (Figure 1).

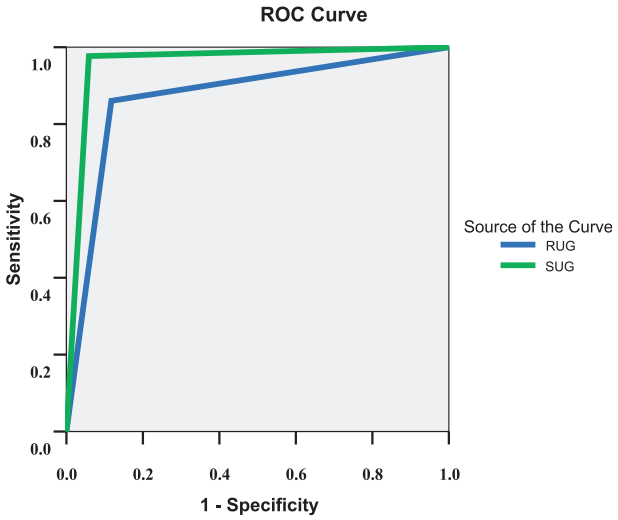

Fig.-1: *Receiver operating characteristic curve (ROC curve) analysis*

Test Result Variable(s)	Area under the Curve
RUG	0.871
SUG	0.959

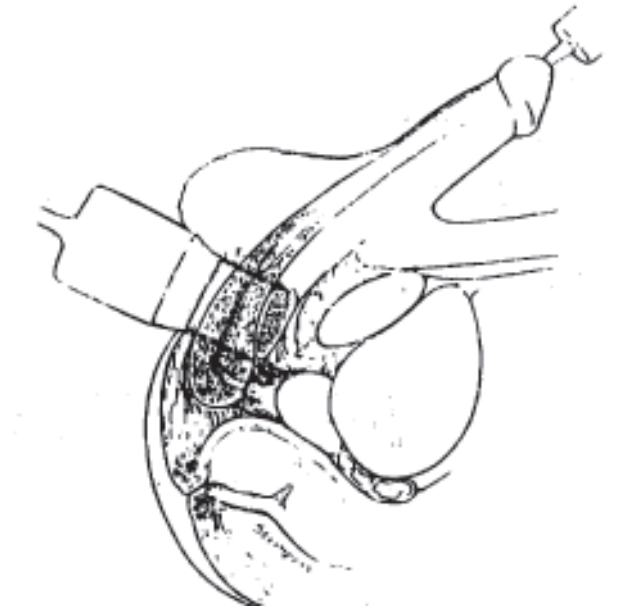

Fig.-2: *Sonourethrography*

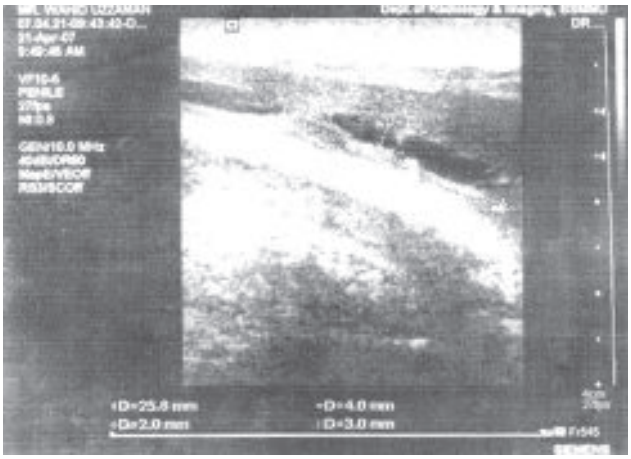

Fig.-3: *Sonourethrography showing location and length of urethral stricture*

Discussion:

Urethral stricture is one of the most important causes of bladder outflow obstruction and become one of the most important workload of the urological centres in developing countries [3]. Although radiographic retrograde urethrography (RGU) has long been the gold standard for imaging the anterior urethra, inherent limitation persist [7]. Limitations of RGU include variation in the appearance of strictures with positions of the patients and the degree of stretch of the penis during the study, limited information about periurethral fibrosis and it has hazards of radiation exposure to testes [3, 11]. Contrast material may extravasate into other areas of the penis. In addition venous and lymphatic intravasation may occur [2, 3]. McAninch et al began using ultrasonography to image the male urethra in the mid 1980s at San Francisco General Hospital to evaluate complex urethral strictures more precisely (McAninch et al 1988). Since then it has been routinely used urethral ultrasound to evaluate anterior urethral strictures.

Among the 60 subjects 21 (35.0%) were 25 or below 25 years of age, 25 (41.7%) between 25-35 years and the rest 14 (21.3%) were above 35 years of age. The Mean ± SD was 30.75 ±8.70 years and the age range of the subjects was 50 to 18 years.

The sites of stricture in this series were penile and bulbar. Evaluation of stricture shows that 45.0% of the stricture was located at bulbous part followed by 55% at penile part. Site of stricture detected by sonourethrography was similar as detected by RGU, 60.0% at bulbous part and 40.0% at penile part. Walther et al. (1980) studied 52 patients with anterior uretheral stricture and

found that 55% of strictures were bulbar, 35% at penile and 10% at penobulbar part which was similar to this study. Lipsky et al. (1977) found similar results. Among the 60 subjects of our series, all had complaints of poor stream and straining during micturition. About Ninety seven percent subjects had the burning sensation during micturition. In the study of Khan (2007), Singh et al (2004) and Peter A. Nash et al (1995) similar number of patients complaints as this study.

Sensitivity of SUG to diagnose urethral stricture length at cut off level 10 mm was 94.1%, specificity 97.7%, positive predictive value 94.1%, negative predictive value 97.7% and accuracy 96.7%. Sensitivity of RGU to diagnose urethral stricture length at cut off level 10 mm was 88.2%, specificity 86.0%, positive predictive value 71.4%, negative predictive value 94.9% and accuracy 86.7%. In Khan (2007) series the overall accuracy was a bit lower in case RGU (97.3%) than that in sonourethrography (100%).

In the present study when strictures were grouped according to anatomical sites both techniques were equally sensitive in length estimation in the penile urethra. But sonourethrography showed a greater sensitivity in estimating strictures length over all and correlated better with operative findings than RGU. Diagnostic accuracy was determined as receiver operating characteristic (ROC) curve, suggesting that the area under the curve (AUC) of SUG and RUG was 0.959 and 0.871, respectively, which also reflect SUG is the better diagnostic modality than RUG in comparison with peroperative finding.

Gupta et al. (2006) in a study including 30 patients reported poor correlation between the two techniques in estimating of stricture length, RGU underestimating the length in most cases. The accurate estimation of strictures length is important because it is one of the factors that determine the suitable operative procedure.

Periurethral fibrosis (spongiofibrosis) is a critical determinant of appropriate therapy and ultimate prognosis. Excessive fIbrosis is said to be responsible for high recurrence rates. Peroperative evaluation of strictures shows 18.3% were pink coloured, 76.7% gray coloured and 5.0% white coloured. In 13.3% of the cases mild resistance was felt during incision, in 80.0% cases moderate and in 6.7% cases severe resistance was felt. In our series SUG evaluation of fibrosis was correlated well with per operative findings of fibrosis ($r=0.569$; $p<0.001$). 67.1% agreement was also observed between SUG and per operative findings in the evaluation of fibrosis. The findings of present study are also similar with Nash et al. (1995).

Conclusion:

Retrograde urethrography and sonourethrography are equally efficacious in detection of anterior urethral strictures. Further evaluation of strictures in terms of length and periurethral pathologies, like spongiofibrosis, is better evaluated by using sonourethrography as compared with retrograde urethrography.

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