Original Research Paper

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Urology

ROLE OF SONOURETHROGRAM IN EVALUATION OF SHORT SEGMENT ANTERIOR URETHRAL STRICTURE

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ABSTRACT **INTRODUCTION:** Retrograde urethrography (RGU) is the standard imaging study for the evaluation of anterior male urethra. Sonourethrography(SUG) offers comparable information with added advantages. **MATERIAL AND METHODS:** 196 males with anterior urethral stricture studied. RGU/MCU, sonourethrogram and urethroscopy done in all and information regarding urethral stricture was compared keeping urethroscopy as gold standard. Strictures > 4 cm were excluded. Chiou et al classification used to classify urethral stricture on SUG. **RESULTS & DISCUSSION:** Bulbar urethra was the most common site for urethral stricture. Sensitivity of sonourethrography for location of stricture was >98%. Strength of agreement between SUG and urethroscopy for location of stricture was very good. Number of the strictures were diagnosed with higher accuracy on urethroscopy than SUG and RGU respectively. Kappa value for number of strictures was suggestive of very good agreement between SUG & urethroscopy. Length of stricture in urethroscopy was better correlating with SUG. Both RGU and SUG were equally sensitive in location and number of stricture while RGU correlated poorly in the bulbar urethra, older studies also showing RGU underestimating the length of stricture in bulbar urethra. Sonourethrography also providing additional information regarding periurethral pathologies. The complications encountered during RGU were contrast intravasation, pain during the procedure, urethral bleeding and UTI after the procedure. During sonourethrography no significant complication noted. **CONCLUSIONS:** Sonourethrography is a multiplanar, easily available and cost-effective technique for evaluating anterior urethra without radiation exposure. When compared with RGU, sonourethrography is equally efficacious with added important technical advantages which help surgeons to plan surgical procedure.

KEYWORDS : sonourethrography, urethral stricture, retrograde urethrography, SUG

INTRODUCTION

Urethral stricture is one of the common problems in young males and a major cause of morbidity. The male urethral imaging has an important role to play in the study of the stricture diseases[1]. Retrograde urethrography (RGU) is the standard imaging study for the evaluation of anterior male urethra. RGU involves the use of radiation and intra-urethral injection of contrast medium to visualize luminal anatomy. Limitations of RGU in evaluation of anterior urethral stricture diseases include variation in the appearance of strictures with position of the patient and the degree of stretch of the penis during the study. It also provides limited information about periurethral structures[2].

An ideal study should be able to indicate the type of surgical procedure suitable for the patient. This includes accurate determination of the site, length and diameter of strictures. Complete preoperative knowledge of complicating conditions like urethral calculi, fistulae, false tracts, diverticula and polyps facilitate favourable outcome of surgical procedure[3].

McAninch et al. popularized sonourethrography in 1988 for imaging the anterior urethra in males with high-resolution ultrasound probe. The initial technique utilized a 5 MHz linear array transducer which was applied to the dorsal surface of the penis. As the normal urethral wall and spongiosum are elastic they are compressible by SUG probe. The corpus spongiosum loses its elasticity in stricture disease due to higher collagen content and is not compressible. As a dynamic, three-dimensional study, which can be repeated without radiation exposure, sonourethrography (SUG) offers important technical advantages compared with RGU[4]. This study was done to explore the uses of sonourethrogram in evaluating stricture disease of the male anterior urethra and comparing it with RGU and correlation with findings in urethroscopy.

MATERIAL AND METHODS

All patients who were clinically diagnosed as urethral stricture from November 2016 to May 2018 were selected. In all patients apart from clinical examination and RGU/MCU, sonourethrogram was done 3-4 days after RGU/MCU by using Bk pro USG machine (FOCUS 2202) with high frequency linear probe (10-12.5 MHz) and findings regarding the urethral stricture were correlated with urethroscopy (done at the time of DVIU).

For SUG, a standard ultrasound scanner with a linear-array transducer (7.5 to 12 MHz) was used. Patient kept in supine position and ultrasound scanning was done through the ventral surface of the penis, trans-scrotal and transperineal surfaces to assess the whole anterior urethra up to the bulbo-membranous junction. After cleaning the glans and external urethral meatus, sterile 2% lignocaine jelly instilled into the urethra through a nozzle in the fossa navicularis, and compression applied over the glans to prevent the spillage of the jelly. During the procedure, penis kept straight by gentle traction. After jelly insertion, the urethra distended and appeared as a homogenous echo-free tubular structure along with spongiosum and of 8 to 10 mm in diameter. Strictures were identified as the segments with reduced distensibility upon lignocaine jelly insertion. In cases where the proximal extent of the stricture was unclear, the patients were asked to strain with a full bladder, which helped to delineate the proximal limit of a stricture. Stricture length was measured with electronic callipers, and periurethral structures were evaluated for spongiofibrosis and the presence of false tracts, filling defects, or diverticula. The procedure

was well tolerated by the patients, and there were no complications. Chiou's classification (fig.1) used to classify urethral stricture/ spongiofibrosis on sonourethrogram.

Urethroscopy done at the time of DVIU (20.5 Fr Richard wolf DVIU sheath, 0-degree endoscope, straight VIU knife) and nature of stricture fibrosis classified on the basis grittiness during the DVIU and number (2 or more) and site (single vs multiple) of cuts required during DVIU to adequately opening the urethral lumen (20.5 Fr sheath passing freely). During surgery, ureteric catheters determined stricture length. The different parameters assessed by SUG and RGU were compared with each other and with urethroscopy, which was considered as gold standard.

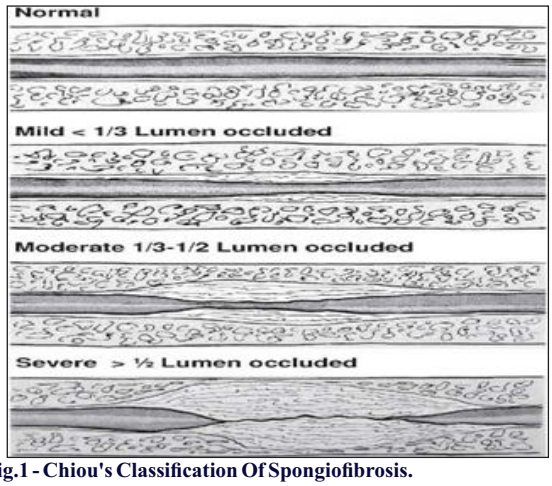

Fig.1 - Chiou's Classification Of Spongiofibrosis.

Figure 2: Showing Patient In Position For Sonourethrogram Procedure

RESULTS & OBSERVATIONS

A total of 234 clinically diagnosed anterior urethral stricture patients were recruited for the study from 1st November 2016 to 31st may 2018 (all patients were operated on or before 30th November 2017). Out of which 34 patients lost follow-up during the study, no stricture found in 2 patients during urethroscopy and in 2 patients, long segment anterior urethral stricture found on urethroscopy hence plan changed to urethroplasty instead of DVIU, remaining 196 patients followed and studied.

The mean age of our study population was 45.6 years (range 15-81 years).

Maximum number of patients belonged to 2nd and 4th decade.

Strictures were further characterized as per location, number, length, periurethral fibrosis and other findings.

Table 1: Distribution Of Patients According To Location Of Strictures

	RGU	SUG	URETHROSCOPY
Penile	3	3	3
Bulbar	193	191	191
Normal	0	2	2
Total	196	196	196

In our study we found that bulbar urethra is the most common site for urethral stricture. Two apparent bulbar strictures on RGU found normal on SUG & urethroscopy. Total three penile strictures were diagnosed on RGU/MCU, SUG and urethroscopy.

Table 2: Distribution Of Patients According To Number Of Strictures

	RGU	SUG	URETHROSCOPY
Single	196	194	188
Multiple	0	2	6
No Stricture	0	0	2
Total	196	196	196

196 patients with single stricture on RGU/MCU when evaluated with SUG and urethroscopy found to have multiple strictures in 2 and 6 patients respectively, while in 2 patients showing bulbar urethral stricture on RGU/MCU found normal on urethroscopy. Complex strictures were diagnosed with higher accuracy on urethroscopy than SUG and RGU.

On the basis of etiology strictures were categorized as traumatic (19), inflammatory/infective (20) and idiopathic (157) urethral stricture

Aetiology	No. of patients
Traumatic	19(9.6%)
Infective/ inflammation	20 (10.20%)
Idiopathic	157 (80.10%)
Total	196

Some patients had received treatment for urethral stricture previously in the form of urethral dilation or DVIU or had history of catheterization. 39 patients had history of previous DVIU along with catheterization while 35 patients had history of previous urethral dilation± urethral catheterization.

STRICTURE LENGTH

Stricture length assessed with RGU/MCU, Sonourethrogram and classified into 3 categories having stricture length <1 cm. 1-2 cm and 2-4 cm. 62 patients had stricture of < 1 cm length while 96 and 38 patients had strictures of 1-2 cm and > 2 cm respectively. Length of stricture during urethroscopy measured after DVIU with the help of ureteric catheter.

Grade Of Spongiofibrosis On Sonourethrogram

Grading of spongiofibrosis was assessed with sonourethrogram apart from other urethral stricture characteristics. Chiou classification is used to grade spongiofibrosis Out of 196 patients, sonourethrography revealed mild spongiofibrosis in 108 (55.10%) patients, moderate spongiofibrosis in 73(37.24%) and severe fibrosis was seen in 15 (7.65%) patients.

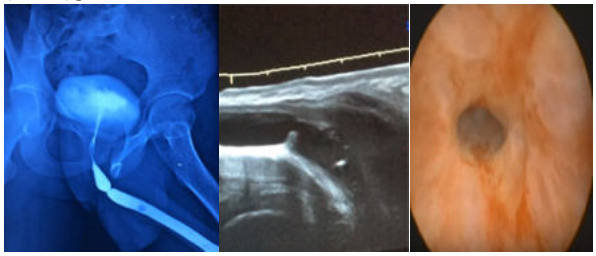

Figure 3: Showing Short Segment Flimsy Flap Like Stricture With Minimal Spongiofibrosis On RGU, Sonourethrogram And Urethroscopy.

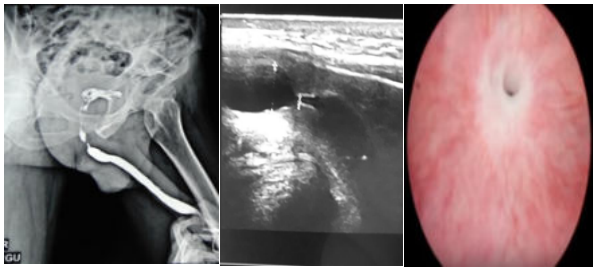

Fig. 4: Showing short segment bulbar urethral stricture with moderate spongiofibrosis on RGU, sonourethrogram and urethroscopy.

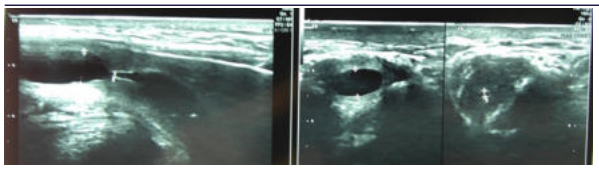

Fig.5 – Showing Restricted Distensibility And Luminal Narrowing Of Strictured Segment Of Bulbar Urethra Stricture.

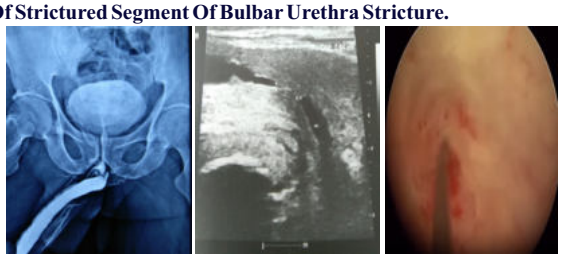

Figure 6: Showing Severe Spongiofibrosis On Sonourethrogram And Urethroscopy

Other Findings

One patient with bulbar urethral stricture was also having false tract, which was better delineated by SUG and urethroscopy.

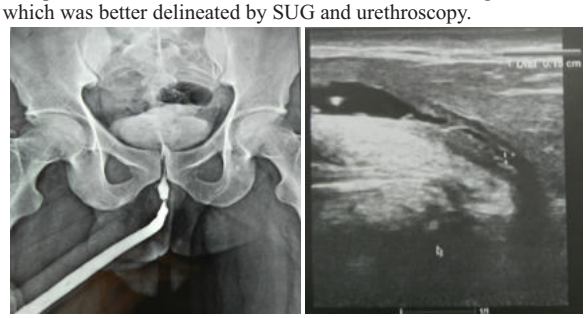

Fig 7 . Retrograde Urethrography And Sonourethrographic Appearance Of Stricture Bulbar Urethra, Presence Of False Passage Is Clearly Visible In Sonourethrogram.

Comparison Between Successful And Failed Patients

Patients divided into 2 groups on the basis of duration of follow up. Group A –patients having more than 12 months follow up (120 patients) and Group B – patients with 6 to 12 months of follow up (76 patients).

Table 3 – Successful And Failed Patients In Group A And Group B

Group	No. of patients	Successful	Failed	P value
Group A	120	68 (56.67%)	52 (43.33%)	0.001
Group B	76	60 (78.94%)	16 (21.05%)	

Grade of spongiofibrosis on sonourethrogram in successful and failed patients of group A and group B.

On sonourethrogram 53 patients of successful subgroup in group A had mild spongiofibrosis, 15 had moderate spongiofibrosis while in failed subgroup only one patient had mild spongiofibrosis, 39 had moderate and 12 had severe spongiofibrosis.

On sonourethrogram 54 patients of successful subgroup in group B had mild spongiofibrosis, 6 had moderate spongiofibrosis while in failed subgroup only no patient had mild spongiofibrosis, 13 had moderate and 3 had severe spongiofibrosis.

Table 4. Results And Comparison Between Two Groups

Group A Grade of spongiofibrosis	**Successful**	**Failed**	**Total**	**P value**
Mild	53 (77.9%)	1 (1.9%)	54 (45%)	<0.001
Moderate	15 (22.1%)	39 (75%)	54 (45%)	
Severe	0 (0%)	12 (23.1%)	12 (10%)	
Group B Grade of spongiofibrosis	**Successful**	**Failed**	**Total**	**P value**
Mild	54 (90%)	0 (0%)	54 (71.1%)	<0.001
Moderate	6 (10%)	13 (81.2%)	19 (25%)	
Severe	0 (0%)	3 (18.8%)	3 (3.9%)	

For RGU, taking urethroscopy as gold standard, the sensitivity for location and number of strictures is >98% while positive predictive value is >98%. When compared to SUG which is also having sensitivity and positive predictive value of > 98% regarding stricture location and number, RGU has lower sensitivity regarding length of the bulbar urethral stricture than SUG and tends to underestimates the length of the stricture.

The complications encountered during RGU were contrast intravasation in 2 patients, pain during the procedure in 8 patients, and urethral bleeding in four patients. 6 patients had chills during the procedure. No patients with contrast intravasation had adverse systemic reactions. Local burning pain occurred during retrograde injection of contrast medium. This subsided in all cases a few hours after the procedure. During SUG minor bleeding per urethra in one patient due to jelly tip trauma at meatus with no other significant complication noted.

DISCUSSION

RGU has been the standard imaging technique for the evaluation of male anterior urethra, which involves the use of radiation and contrast medium. It gives very limited information about periurethral structures. Radiation is harmful especially to the gonads which are frequently exposed during these examinations. An ideal study should be able to indicate the type of surgical procedure suitable for the patient. This includes accurate determination of the site, length and diameter of strictures. Complete preoperative knowledge of complicating conditions like urethral calculi, fistulae, false tracts, diverticula and polyps facilitate favorable urethroplasty outcomes. For this study, the SUG imaging was performed with the urethra distended by xylocaine jelly as a negative contrast agent.

Bearcroft P.W.P. and Berman L.H[7] used radiographic contrast medium/ normal saline as negative contrast agent. Initial studies described dorsal scanning approach to the penile urethra moving ventrally for subscrotal and perineal views of the bulbar urethra. These studies however used 5 MHz transducer and near-field artifact was a problem. Despite the penile urethra appearing in the extreme near field, we found that ventral approach was preferable with the penis extended along the lower abdomen. This enabled the longitudinal scans to be accomplished in a single rapid sweep. Near field artifact was abolished by using a high frequency probe (10 MHz). In our study mean age of the patients was 45.6 years (range 15- 81 years) **James Osoro et al also found urethral strictures have a peak between the ages of twenty to fifty years.** Greenwell. T. J et al and Mandhani et al also found similar findings in their studies[8,9].

In our study bulbar urethral strictures are the most common. **These findings were similar to those found in Senegal whereby the anterior urethra's bulbar region was the commonest site for strictures accounting for 72.7%.** The two bulbar urethral strictures on RGU/MCU were found normal on SUG & urethroscopy, considered as false positive for RGU. In the rest of the patients, location of stricture perfectly matches on all the modalities. Sensitivity of SUG for location of stricture was 98.3%.

6 complex/multiple strictures were missed by RGU/MCU while 2 missed by SUG hence complex or multiple strictures were more accurately detected by urethroscopy followed by SUG. Sensitivity and positive predictive value of SUG was 98.30%. There was good correlation of the complex strictures SUG with urethroscopy. All the previous studies showed good correlation of both the modalities regarding stricture number or multiplicity.

In our study, we found that SUG diagnosed length of stricture with higher accuracy and Positive predictive value was also 98.30%. When strictures were grouped according to anatomical sites, both techniques were equally sensitive in length estimation in the penile urethra. However, RGU correlated poorly with length of strictures in the bulbar urethra, underestimating the length in spite of radiographic magnification. Most previous studies show consistently poor correlation between RGU in estimating stricture length, especially for bulbar urethral strictures[11]. The information gained using SUG in the bulbar urethra was as helpful in clinical decision making as it was correlated closely with urethroscopic findings in this area. Gupta et al in the study reported that RGU underestimates the length in most cases[10].

S. Choudhary et al, P. Singh et al[11]. in their study reported similar

findings. Samaiyar S.S. et al. found that contrast urethrography underestimated the length by 50% or by 0.6 mm, mainly in the bulbar region[12]. The accurate estimation of stricture length is important, as it is one of the factors that determine the suitable operative procedure. Earlier investigators, using standard radiographic imaging alone, proposed that only strictures 1 cm or less be selected for excision therapy. Because sonographic measurements are often longer, new ultrasonic criteria proposed indicate resection and end-to-end anastomosis for adult bulbar stricture measuring up to 25 mm[13]. Comparing this with the study by Heidenreich A. et al[14]. showed sensitivity of 98% and specificity of 96% with positive and negative predictive values 98% and 96% respectively. Samaiyar S.S. et al. had sonourethrographic accuracy of 96.44%[12]. Additional information was available about the periurethral region on sonourethrography like periurethral fibrosis.

Periurethral fibrosis is a critical determinant of appropriate therapy and ultimate prognosis. Excessive fibrosis is said to be responsible for high recurrence rates. Spongiofibrosis surrounding the urethral stricture leads to luminal narrowing or poor distensibility of urethra. SUG can assess the distensibility of urethra or luminal narrowing in comparison to normal urethra and can give information regarding grade of spongiofibrosis which may be helpful in planning of the procedure.

Other findings such as periurethral hematoma, periurethral abscesses, diverticula and false passages are well visible on SUG. SUG detected a false passage in one patient which was not clearly visible in RGU of the patient. So, our experience with sonourethrography shows certain added advantages of SUG with lesser degree of complications but further study with larger sample size is needed to conclude firmly.

CONCLUSIONS

In the present study we have found sonourethrography to be helpful technique for evaluating the male anterior urethra without radiation exposure. Characterization of strictures in terms of length, periurethral pathologies like periurethral fibrosis, diverticula, abscesses, fistulas and false tracts can be performed with relatively greater sensitivity using the sonourethrography. Ability of sonourethrography to diagnose periurethral pathologies, periurethral fibrosis and length of stricture especially in bulbar urethra helps surgeon to plan proper surgical procedure.

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