UIJ UroToday International Journal®

The Role of Sonourethrography In the Evaluation of Anterior Urethral Strictures: A Correlation with Retrograde Urethrography

Vinod Priyadarshi, Mahendra Singh, Vijoy Kumar, Rajesh Tiwari, Sanjay Kumar Gupta, Nidhi Sehgal

Submitted May 7, 2012 - Accepted for Publication June 27, 2012

ABSTRACT

Objective: Retrograde urethrography (RGU) is the most commonly used imaging modality for the evaluation of the anterior urethra. Sonourethrography (SUG) is another modality that is not so frequently used, though several studies have suggested its higher degree of sensitivity and specificity in anterior urethral stricture evaluation. The present prospective study has been done to compare the results of SUG with that of RGU and to probe its effect in decision making.

Patients and Methods: A total of 50 patients with anterior urethral stricture disease were evaluated with both SUG and RGU for stricture length, site location, and associated urethral pathologies. Collected information was used as a guide for the choice of surgery, and it was compared with operative findings.

Results: The mean lengths of strictures on SUG, RGU, and surgery were 20.46 cm, 17.14 cm, and 20.35 cm, respectively. Overall sensitivity and accuracy of SUG in predicting correct stricture length was 95.55 and 97.33%, respectively, and overall sensitivity and accuracy of RGU in predicting correct stricture length was 77.22 and 85.33%, respectively. Spongiofibrosis was noted only with SUG in 78 to 88% accuracy. In 32% of cases, the surgical plan changed when SUG results were taken into consideration along with RGU.

Conclusion: SUG is more accurate in measuring stricture length, especially that of the bulbar urethra. It simultaneously provides a better assessment of a diseased urethra. It should be used as an extension of the physical examination by the treating urologist as it helps in better preoperative surgical planning of anterior urethral strictures.

INTRODUCTION

Although radiographic retrograde urethrography (RGU) has traditionally been the most preferred imaging modality for the anterior urethra, it has some inherent limitations. Apart from radiation exposure to the testis [1], inadequate patient positioning and penile traction during contrast injection greatly alters the appearance and lengths of strictures [2]. Sonourethrography (SUG) is an infrequent method of imaging the urethra. Since its introduction in the mid-1980s [3] several studies have suggested its higher degree of sensitivity and specificity in anterior urethral stricture evaluation [4-7]. The inadequate evaluation of posterior urethra, the need of technical expertise, and operator dependence are its major limitations [8]. In the present study, we evaluated the estimation of SUG for anterior urethral stricture in comparison to RGU estimation, findings during surgery, and its effect on surgical decision making, in general.

PATIENTS AND METHODS

The present prospective study was conducted between March

KEYWORDS: Sonourethrography, retrograde urethrography, anterior urethral stricture

CORRESPONDENCE: Vinod Priyadarshi, MBBS, MS, Senior Resident, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India (vinod_priyadarshi@yahoo.com)

CITATION: *UroToday Int J*. 2012 October;5(5):art 46. http://dx.doi.org/10.3834/uij.1944-5784.2012.10.05

2009 and February 2010 in the Department of Urology in collaboration with the Department of Radiodiagnosis at Indira Gandhi Institute of Medical Sciences, Patna. After informed consent, 57 patients presenting with features suggestive of urethral stricture disease without any history of previous surgery for the same disease underwent both sonographic and roentgenographic urethrograms before cystoscopy and corrective surgery. Four patients who were found to have stricture in the posterior urethra and 3 patients having normal urethra in both the study and cystoscopy were excluded from the study. SUG was done in all patients before conventional urethrography (RGU and MCU) to avoid operator bias.

For SUG, a standard ultrasound scanner with a linear-array, small-parts transducer (7.5 to 10 MHz) was used. In the supine and dorsal positions, ultrasound scanning was done through the ventral surface of the penis, and subsequently the trans-scrotal and transperitoneal surfaces, to completely map the anterior urethra up to the extent of external urethral sphincter. After disinfecting the glans and external urethral meatus, the urethra was dilated by retrograde instillation of sterile 2% lignocaine jelly through a nozzle in the fossa navicularis, and a digital compressor was applied over the tip of the penis. Multiple longitudinal and transverse sections were obtained from the level of corona glandis to posterior visibility. During the procedure, moderate traction was applied to the pendular part of penis until taut. Upon jelly insertion, the urethra distended and appeared as a homogenous echo-free band of 8 to 10 mm in diameter, with posterior acoustic enhancement and reflection from the tunica albuginea. Strictures were identified as 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 calipers, 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. Spongiofibrosis was graded as mild (encroachment on less than 1/3 of the lumen), moderate (encroachment on 1/3 to 1/2 of the lumen), and severe (encroachment on more than half of the lumen or the lumen measured less than 3 mm in diameter during maximal retrograde distension), as suggested by McAninch et al. [3,9].

Each patient underwent both retrograde (RGU) and voiding cystourethrography (VCU). Standard RGU was done in the supine, 450-oblique position using 10 to 12 F Foley catheters, with a bulb distended with 2 ml of saline seated in the fossa navicularis; 10 to 15 ml of 76% Urografin was infused under fluoroscopy, and spot films were taken. Stricture lengths were measured directly from films without correcting for magnification from variations in the tube-film distance. For a better analysis, stricture length was classified as a short segment (a length of 15 mm or less), an intermediate segment (a length 16 mm to 25 mm), and a long segment (a length of more than 25 mm).

Figure 1. A normal sonourethrographic appearance of the anterior urethra.

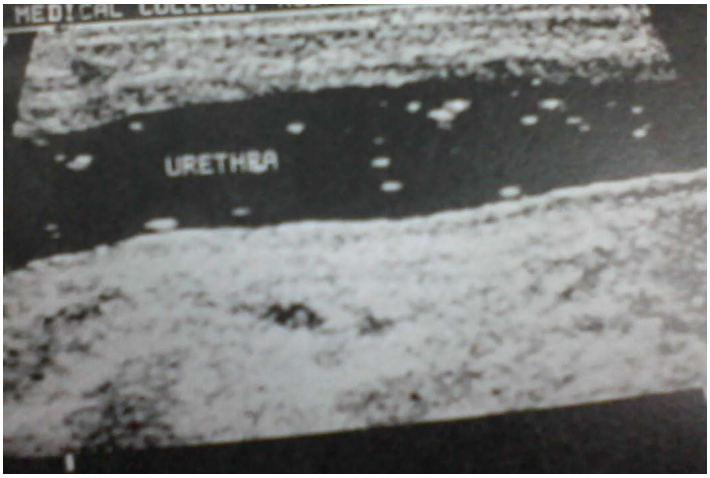

Figure 2. RGU of a patient with a suprapubic catheter *in situ*.

The different parameters assessed by sonourethrography and RGU were compared with each other and with intraoperative findings as a gold standard. During surgery, ureteric catheters determined stricture length, and spongiofibrosis were assessed by the color of the urethral mucosa, and by the grittiness and

Table 1. Location of strictures.

Method of Diagnosis	Location of Strictures		
	bulbar	penile	bulbar + penile
RGU	30	19	1
SUG	29	18	3
operative	29	18	3

Table 2. Lengths of strictures.

Method of Diagnosis	Lengths of Strictures		
	short segment	intermediate segment	long segment
RGU	16	27	7
SUG	15	22	13
operative	15	20	15

Table 3. Diagnostic accuracy of SUG in comparison to RGU in the diagnosis of different stricture categories (according to length).

	RGU			SUG		
	short	inter.	long	short	inter.	long
total no.	18	25	7	15	22	13
true positive	15	17	7	15	20	13
false positive	3	8	0	0	2	0
false negative	0	3	8	0	0	2
sensitivity	100	85	46.66	100	100	86.67
specificity	91.42	73.34	100	100	93.34	100
accuracy	94	78	84	100	96	96

inter. = intermediate

Table 4. Spongiofibrosis.

	Spongiofibrosis		
	mild	moderate	severe
SUG assessment	24	15	11
operative assessment	19	27	14
accuracy of SUG	78%	66%	88%

resistance felt during the incision, as described by Gupta et al. [7]. The accuracy of each method for the prediction of stricture length and spongiofibrosis was calculated, and the significance of their difference was tested.

RESULTS

Altogether, 50 male patients with anterior urethral stricture disease were evaluated. Strain to void (80%, 40 patients) and poor urinary stream (72%, 36 patients) were the most common symptoms at presentation while the mean duration of symptoms was 11.5 months. Of our patients, 72% were between 21 to 40 years of age, and the mean age was 36 years (range: 15 to 61 years). The majority (62%) of strictures were post-traumatic (including iatrogenic) while the rest were infective and idiopathic. The majority was in the bulbar urethra and of intermediate length (16 to 25 mm) (Table 1 and Table 2). The mean lengths of strictures on SUG, RGU, and surgery were 20.46 mm, 17.14 mm, and 20.35 mm, respectively. The mean length calculated on SUG was closer to that of surgery. Overall sensitivity and accuracy of SUG in predicting correct stricture length were 95.55% and 97.33%, while these were 77.22% and 85.33%, respectively, on RGU (Table 3). These diagnostic gains were found statistically significant (p value: 0.025 and 0.035, respectively).

With SUG, associated urethral and periurethral abnormalities were detected. Periurethral spongiofibrosis could be noted in every case, and they were graded and compared with operative findings. The accuracy of this assessment was 78%, 66%, and 88% for mild, moderate, and severe spongiofibrosis, respectively (Table 4).

SUG was also able to detect mucosal abnormality in 30% of cases while it was noted in only 14% cases on RGU. Two periurethral sinuses and 1 urethral diverticulum were also seen by SUG, which were missed on RGU. False tracts were seen in 2 cases and none were missed with either method, and it was again delineated by SUG. In 2 cases on RGU, associated proximal urethral strictures were also noted, which could not be noted on SUG.

Surgical planning was done first with RGU considering the length and location of the stricture and the presence of false tracts, sinuses, and other associated findings. The planning

UIJ / Vol 5 / Iss 5 / October / http://dx.doi.org/10.3834/uij.1944-5784.2012.10.05
ISSN 1944-5792 (print), ISSN 1944-5784 (online)

Table 5. Impact of SUG in surgical decision making.

Surgical	OIU	Resection and anastomosis	Local substitution/ augmentation	BMG	Stage Procedure
Only with RGU	14	17	14	3	2
With both RGU and SUG	8	18	17	4	3

Figure 4. RGU of the same patient with 2 strictures in the anterior urethra just distal to the bulbar urethra.

revised again when findings of SUG were considered along with that of RGU. In 16 cases (32%) the surgical plan changed when SUG results were taken into consideration along with RGU, and 12 of these were of short or intermediate stricture length on RGU (Table 5).

DISCUSSION

Although RGU has long been the gold standard for imaging the anterior urethra, it has some inherent limitations. Variations in patient positioning and penile traction during the injection of a contrast medium can greatly alter the radiographic appearance of stenotic areas [2]. RGU is done while keeping the patient in

Figure 3. Sonourethrography showing 2 different strictures at the anterior urethra just distal to the bulbar urethra, with acoustic shadowing due to severe spongiofibrosis.

a steep oblique position, and the bulbar urethra typically lies in an oblique position relative to the axis of the X-ray beam, resulting in a shorter appearance of strictures at the bulbar urethra [2]. It simply delineates the primary stricture with no accurate determination of site, length, or diameter of the stricture, or the presence of associated complications like stones, fistulae, false tracts, or diverticula [7]. It also does not outline the periurethral tissues besides having added a disadvantage of radiation exposure to the testes [1,2].

The use of ultrasonography to evaluate anterior urethral strictures was first reported in 1988 by McAninch et al. who found it to be a more accurate tool for diagnosis and the characterization of anterior urethral strictures, particularly of the bulbar urethra [3]. As the scanning probe is aligned directly over the ventral of the penis in the midsagittal plane, and oriented along the course of the penile and bulbar urethra, the axis of measurement is precisely perpendicular to the urethra that measures stricture length, with a higher degree of accuracy [3,8]. In the present study, SUG shows better overall sensitivity and accuracy in predicting stricture length, and the mean stricture length calculated on SUG was found closer to that of surgery than RGU, which is in accordance with previous studies.

As the cross-sectional images are obtained, SUG provides a 3-dimensional, real-time study of questionable areas, with exact narrowing information [9]. SUG is particularly useful for a high-grade stenosis when the entire stricture segment cannot be

filled adequately for standard radiographic techniques. In such a case, the patient can be advised to strain with a full bladder at the time of SUG, which would also distend the urethra proximal to the stricture and thus define the full extent of the stricture [7]. In the present study, the proximal segment was not well opacified on RGU due to high-grade stenosis in 3 cases, and the urethroscope was also not negotiable, so SUG proved definitive in providing stricture length before the surgery and changed surgical planning.

SUG not only identifies intraurethral abnormalities like urethral stones and diverticula but can also visualize associated periurethral pathology like hematomas, abscesses, spongiofibrosis, fibrous scars, and tumor invasion [3,7,8,10]. In the present study, 2 periurethral sinuses and 1 urethral diverticulum were visualized by SUG, which were missed on RGU.

Spongiofibrosis, due to high collagen content, produces areas of hyperechogenicity of the tissues of the spongiosa surrounding the urethra on SUG, and they are a critical determinant of treatment and the ultimate prognosis [6,7,9]. The standard RGU does not show morphological periurethral changes, and so it is not supposed to provide a good assessment of spongiofibrosis. In the present study, SUG revealed severe spongiofibrosis in 11 cases with an accuracy of 88%, and this added information guided excision and repair instead of OIU.

SUG has been found to have a marked impact on surgical decision making. In the present study itself, our surgical plan changed in 32% of cases when SUG assessment was considered. Better assessment of length, spongiofibrosis, and periurethral pathology all help in decision making. It can be repeatable pre- and postoperatively in doubtful conditions, without any risk of radiation exposure. In the present study, this favorable impact was found in 34.86% (12 out of 35) cases of short- and intermediate-segment stricture while in 26.67% cases of long-segment strictures. Strictures on sonography shorter than 25 mm can be treated by anastomotic urethroplasty, whereas those longer than 25 mm typically require a graft or flap for reconstruction. The advantage of sonography here is the determination of true stricture length and luminal diameter preoperatively, which guides whether to go for excision or tissue transfer. If the latter is planned, then sufficient graft or flap mobilization can be done in the supine position before definitive surgery in the lithotomy position, thus decreasing the total lithotomy position time and complications related to this [8,9]. Likewise in complex strictures, the presence of periurethral abscesses or fistulae on SUG may help to determine whether to do graft repair or a procedure.

SUG is not as helpful in guiding procedure selection in the pendulous urethra as in the bulbar urethra [9]. Pendulous strictures are usually diffuse and post-inflammatory, and not focal or post-traumatic. As a result, most distal strictures are not amenable to excision and will generally require some form of onlay urethroplasty, regardless of length [11]. Furthermore, because the pendulous urethra resides in a lateral, dependent position during retrograde urethrography, radiographic and ultrasonic images provide roughly equivalent information [2,9].

A major drawback with SUG is its limited ability to evaluate the posterior urethra [7,11]. In this study, concurrent proximal urethral strictures were missed on SUG in 2 cases, although a few authors have suggested transrectal voiding cystourethrosonography for the evaluation of the posterior urethra and the bladder neck [12]. They claim the bladder-neck opening and funneling can be studied with a good depiction of the bladder neck and posterior urethra up to the prostatic apex. However, it offers a smaller field of view and poses difficulty to patients who must void in the lateral position with a probe introduced in the rectum.

Another significant limitation is interobserver variation that lies within all ultrasonographic studies. Thus it can't replace conventional urethrography in a total evaluation of the urethra and posterior urethral strictures, but it can work as a decisive adjunct in anterior urethral stricture disease. Inherent observer bias can be decreased if SUG is done by the treating urologist [7].

SUG is a safe procedure and it has no added complications. In this study, no complications were noted, and the mean procedure time was 10 minutes.

CONCLUSION

SUG is a simple, rapid, safe, and effective technique that provides a reliable, real-time, 3-dimensional assessment of anterior urethral strictures. It is more accurate in measuring stricture length, especially that of the bulbar urethra. It simultaneously provides a better assessment of a diseased urethra such as the presence of spongiofibrosis, diverticula, fistulae, or abscesses. It provides more accurate preoperative surgical planning of anterior urethral strictures, and, as such, it should be used as an adjunct to conventional urethrography and as an extension of physical examination by the treating urologist.

REFERENCES

1. Merkle, E., A. J. Aschoff, et al. (1996). "Computer assisted determination of the dose-area product in retrograde urethrography." *Br J Radiol* 69(819): 262-265. PubMed ; CrossRef

2. Rosen, M. A., and J. W. McAninch. (1996). "Preoperative staging of the anterior urethral stricture." In: *Traumatic and Reconstructive Urology*. J. W. McAninch, ed. W. B. Saunders; Philadelphia, PA: 551–564.

3. McAninch, J. W., F. C. Laing, et al. (1988). "Sonourethrography in the evaluation of urethral strictures: a preliminary report." *J Urol* 139(2): 294-297. PubMed

4. Morey, A. F. and J. W. McAninch (1997). "Role of preoperative sonourethrography in bulbar urethral reconstruction." *J Urol* 158(4): 1376-1379. PubMed ; CrossRef

5. Merkle, W. and W. Wagner (1988). "Sonography of the distal male urethra--a new diagnostic procedure for urethral strictures: results of a retrospective study." *J Urol* 140(6): 1409-1411. PubMed

6. Choudhary, S., P. Singh, et al. (2004). "A comparison of sonourethrography and retrograde urethrography in evaluation of anterior urethral strictures." *Clin Radiol* 59(8): 736-742. PubMed ; CrossRef

7. Gupta, N., D. Dubey, et al. (2006). "Urethral stricture assessment: a prospective study evaluating urethral ultrasonography and conventional radiological studies." *BJU Int* 98(1): 149-153. PubMed ; CrossRef

8. Peterson, C. M., C. O. Menias, et al. (2008). "Imaging of the male urethra." In: *Urethral reconstructive surgery*. S. B. Brandes, ed. Humana Press; Totowa, NJ: 29-42.

9. Morey, A. F. and J. W. McAninch (2000). "Sonographic staging of anterior urethral strictures." J Urol 163(4): 1070-1075. PubMed ; CrossRef

10. Kawashima, A., C. M. Sandler, et al. (2004). "Imaging of urethral disease: a pictorial review." *Radiographics* 24 Suppl 1: S195-216. PubMed ; CrossRef

11. Morey, A. F., C. P. Duckett, et al. (1997). "Failed anterior urethroplasty: guidelines for reconstruction." *J Urol* 158(4): 1383-1387. PubMed ; CrossRef

12. Pavlica, P., L. Barozzi, et al. (2003). "Imaging of male urethra." *Eur Radiol* 13(7): 1583-1596. PubMed ; CrossRef