Review Article

SONOGRAPHIC EVALUATION OF MALE ANTERIOR URETHRAL STRICTURES: CORRELATION WITH RETROGRADE URETHROGRAPHY AT UNIVERSITY OF NIGERIA TEACHING HOSPITAL, ENUGU, NIGERIA

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ABSTRACT

BACKGROUND: Urethral stricture is a common urological problem affecting the male gender. There is currently a progressive increase in its incidence in South-East, Nigeria. Retrograde urethrography has traditionally been the gold standard for imaging the anterior urethra. However, sonourethrography has evolved as a precise and effective imaging method for evaluating anterior urethral strictures.

AIMS/OBJECTIVES: The aim of this study was to determine the efficacy of ultrasonography in diagnosing male anterior urethral stricture and to compare the findings with those on retrograde urethrography.

METHODOLOGY: This was a prospective cross-sectional descriptive study. Fifty male patients with anterior urethral stricture had sonographic examination with a 7.5-10 MHz annular-array transducer on a mobile 'ALOKA' ultrasound machine and the findings were compared with the concomitant retrograde urethrographic findings. The findings on both modalities were correlated with the intraoperative findings in five of the patients who had urethral surgery.

RESULT: There was a good relationship between the length and diameter of anterior urethral strictures on Sonourethrography and Retrograde urethrography. The length and diameter of anterior urethral stricture on sonourethrography showed a strong positive correlation with intraoperative measurements while Retrograde urethrography showed a poor correlation with intraoperative measurements.

CONCLUSION: Sonourethrography is as effective as Retrograde urethrography in detecting anterior urethral strictures. In addition, periurethral pathologies can be better delineated using SUG.

KEYWORDS: Anterior urethral stricture, Direct Vision Internal Urethrotomy, Periurethral spongiofibrosis, Retrograde urethrography, Sonourethrography.

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INTRODUCTION

Radiographic retrograde urethrography (RUG) has traditionally been the gold standard for imaging the anterior urethra in males while voiding cystourethrography (VCUG) is the most commonly used imaging method in the evaluation of the male posterior urethra. The history of retrograde urethrocystography dates back to the early 20th century. In 1905, the techniques of retrograde cystourethrography using kollargol, a silver-containing preparation, were introduced by Volecker and Von Lichentberg.[1] Since then, these techniques have become widely available aided, in part, by the development of newer and safer iodinated contrast agents.[1] Originally, RUG was performed using penile clamps and other devices but McCallum and Colapinto popularized the use of Foley catheter in the distal urethra to help retain contrast material after urethral filling.[2]

Radiographic RUG is a static two-dimensional study which underestimates the length of urethral strictures as its ability to precisely define stricture length is limited.[3] Variation in patient position and traction on the penis during injection of the contrast medium can also greatly alter the radiographic appearance of a stricture.[3] Retrograde urethrography (RUG) also involves the use of ionizing radiation which provides unnecessary radiation exposure to the testis. Apart from using contrast medium with its attendant side-effects, RUG also provides limited information about periurethral structures.[3]

Rifkin[4] first described the use of sonourethrography (SUG) in evaluating the prostatic urethra. In 1988, McAninch et al[5] reported the usefulness of sonourethrography in evaluating stricture disease of the anterior urethra. The initial technique used by them

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involved the use of a 5MHz linear array transducer applied to the dorsal surface of the penis with images obtained during retrograde instillation of normal saline.

Unlike RUG, sonourethrography is a dynamic, three-dimensional study.[3] It is a procedure used for assessment of urethral abnormality, specifically strictures of the anterior urethra. It has evolved into a powerful and clinically useful imaging tool in accurate delineation of anterior urethral pathology.[6-11] It has proven to be more accurate than RUG in measuring the length of stricture involving the anterior urethra which is important in determining the appropriate surgical procedure for the patient. SUG can also provide information about luminal and extraluminal structures of the anterior urethra in particular, periurethral spongiofibrosis(PUS) with a view to guiding surgery.[12, 13] SUG is relatively non-invasive, readily available and avoids exposure to ionising radiation.[3] There is also no need for the use of contrast medium and its attendant side-effects in SUG[3]. Recent advances in sonographic techniques such as extended-field-of-view imaging further add to the utility of this technique[14].

The purpose of this study was to compare the efficacy of sonourethrography with retrograde urethrography in detection and characterisation of anterior urethral strictures in male patients at UNTH, Enugu. Findings from both modalities in five of the fifty patients in the study were correlated with the intraoperative findings. This study represented the first study, to my knowledge, to provide a detailed correlative assessment of anterior urethral stricture using these two imaging modalities among the Igbo population and will serve as a guide to clinicians in the appropriate assessment of urethral stricture in the study population and Nigeria at large.

MATERIALS AND METHODS

This was a prospective cross-sectional descriptive study. The study was conducted at UNTH, Ituku-Ozalla in Enugu metropolis of Enugu state in South-East Nigeria. The study was conducted in adult males. The subject's age, occupation, marital status, weight and height were documented in the Study Data Sheet. Patients diagnosed with anterior urethral stricture by a physician or urologist at UNTH, Enugu and referred to the radiology suite for RUG were recruited. Hence RUG was done first. Sonourethrography (SUG) was performed 3 days later on their subsequent visit to collect the RUG report. Five of these patients had surgical repair of the urethra during the period of the study. The findings from both RUG and SUG in five of these patients were compared with their intraoperative findings. The study duration was six months.

STUDY POPULATION

Sample Size Determination:

The minimum sample size per group (n / group) will be determined using the following formula for determination of minimum sample size in comparison of two independent proportions.

$$? = \frac{?(Za + ??)^{?} \times (p \times ? - p)}{??}^{15}$$

Where:

n = minimum sample size

Za = standard normal deviate corresponding to the probability a (which is 1.96 at 95% confidence limit for a two tailed test)

Z? = standard normal deviate corresponding to the probability β (which is 0.84 at β = 0.20, or 80% power)

p = prevalence of urethral stricture. This is taken as 0.6%7.

d = amount of error to accommodate which will be considered significant at the set confidence limit (95% C.L.). This is taken as 5%.

Therefore,

$$n = \frac{?(?.96 + 0.84)^{?} \times (?.006 \times ?.994)}{?.05^{?}} = 37.4$$

This approximates to a total of 38 patients.

Expected attrition rate of 10% when accounted for gives a sample size of 42 patients.

N was calculated to be approximately 42. But a sample size of 50 was chosen to have a more representative number of the population.

STATISTICAL ANALYSIS

Statistical Package for the Social Sciences (SPSS) 17.0 for windows software was used for analysis of the data. The quantitative data were summarized using mean ± standard deviation (SD). The student t-test was used to measure and compare mean of quantitative data. Computation of the correlation values of the variables was done for relationship between the quantitative data. The chi-square test was used to measure association and independence of categorical variables. A p-value of <0.05 was considered as statistically significant.

RESULTS

- Anterior urethral stricture was detected in all the 50 male patients on SUG and RUG and 5 of these patients had intraoperative repair of the urethra. The subjects' ages ranged between 19

and 72 years. The mean age was 51.44±14.28 years. Only 1(2%) case was below 20 years. Majority of the cases were above 40 years (76%). Forty-one(82%) were married, seven(14%) were single and two were widower. Majority of the participants had primary education(44%). The predominant occupational group seen in this study was businessmen(Table1).

- Thirty-four of the patients (68%) had strictures in the bulbar urethra and sixteen (32%) of the patients had strictures in the penile urethra. None of the participants had multiple urethral strictures(Table 2).

- Aetiology of anterior urethral stricture were post-traumatic in 21 (42%) patients, iatrogenic in 13 (26%) patients and infective in 16 (32%) cases. Of the 21 patients with post-traumatic stricture, 13(62%) were due to road traffic accidents, 3(14%) cases were due to fall from trees in patients whose occupation was palm wine tapping and 5(24%) of the cases were due to fall from high-rise buildings at construction sites. There is associated history of pelvic fracture in 3(14%) patients with post-traumatic stricture. The cases of iatrogenic urethral strictures were due to urethral catheterization. All the cases due to infection had a past history of purulent urethral discharge(Table 2).

- The presenting complaints were poor stream of urine in 44 (88%) patients, and straining at micturition in 41 (82%) patients. Urinary retention was seen in 14 (28%) and dysuria was seen in 22 (44%). Past history of urethritis was present in 16 (32%) patients and hematuria in 18 (36%) patients(Table 2). The mean duration of symptoms at the time of presentation was 22 months. Twenty-three (46%) patients presented in less than one year from the onset of symptoms while 27(54%) presented after one year from onset of symptoms(Table 2).

- The overall mean length of anterior urethral strictures on RUG was 19.05±11.36 and on SUG was 24.48±11.58mm (Table 3). The Pearson correlation coefficients(r) for urethral stricture length on RUG and SUG was 0.811 and which was statistically significant (p =0.000). The overall mean diameter of residual lumen of anterior urethral strictures on RUG was 0.708±1.20mm and on SUG was 0.61±0.99 mm(Table 4). The Pearson correlation coefficients(r) for urethral stricture diameter on RUG and SUG was 0.779 which was statistically significant (p =0.000)(Table 5a).

- The mean length of anterior urethral strictures in the penile urethra on RUG was 24.71±14.47mm and on SUG was 23.37±13.55mm(Table 3). The mean diameter of anterior urethral strictures in the penile urethra on RUG was 0.98±1.45mm and on SUG was 0.76±1.09 mm(Table 4). The Pearson correlation coefficients(r) for penile urethral stricture length on RUG and SUG was 0.89 which was statistically significant (p =0.000). The Pearson correlation coefficients(r) for penile urethral stricture diameter on RUG and SUG was 0.84 which was statistically significant (p =0.000)(Table 5c).

- The mean length of anterior urethral strictures in the bulbar urethra on RUG was 16.38±8.5mm, while on SUG was 23.59±10.64mm (Table 3). The mean diameter of anterior urethral strictures in the bulbar urethra on RUG was 0.57±1.06mm, while on SUG was 0.53±0.95mm(Table 4). The Pearson correlation coefficients(r) for bulbar urethral stricture length on RUG and SUG was 0.78 which was statistically significant (p =0.000). The Pearson correlation coefficients(r) for bulbar urethral stricture diameter on RUG and SUG was 0.73 respectively which was statistically significant (p =0.000) (Table 5d).

- Five of the participants with urethral strictures in the bulbar urethra had open urethroplasty. The mean intraoperative length(IOL) and diameter were 21.04±10.95mm and 0.560±0.817mm respectively, while they were 13.24±8.30mm and 1.44±1.16mm respectively on RUG. The mean length and diameter on SUG were 20.88±10.82mm and 0.600±0.894mm respectively. The Pearson correlation coefficient(r) for urethral stricture length and diameter on RUG and surgery were 0.785 and 0.694 respectively, which were not statistically significant (p >0.05), while correlation for SUG and intraoperative values were 0.999 which were statistically significant (p<0.001) (Table 5b).

- The mean length of stricture in the overall anterior urethra was significant on the t-test (p =0.02). The mean length of urethral stricture in the bulbar urethra was also significant on the t-test (p=0.03). A significant difference (t=2.269,p = 0.02) was seen when the mean RUG stricture length was compared with intraoperative stricture length(Table 3). The

mean diameters of anterior urethral stricture on RUG and surgery show no significant difference on the t-test (p >0.05) (Table 4).

- Bleeding, pain and contrast intravasation were encountered during retrograde urethrography while bleeding and pain were encountered at sonourethrography. Contrast intravasation was seen in 13(26%) patients on RUG, but none of them had adverse systemic reactions. Local burning pain occurred in 41(82%) of patients during retrograde injection of contrast medium. This subsided in all cases a few hours after the procedure. During sonourethrography, pain was experienced by 7(14%) of patients during inflation of the balloon of the Foley's catheter in the fossa navicularis. The frequency of pain during RUG was greater (p<0.001). Bleeding occurred in 6(12%) of patients on RUG and in 5(10%) of patients on SUG. Bleeding subsided within few minutes of the procedures. However, the difference in the frequency of bleeding after the two procedures was not significant (p=0.749)(Table 6).

- Periurethral spongiofibrosis was seen in 20(40%) patients on SUG and none on RUG. False tracts were seen in 5(10%) patients on SUG and in 1 (2%) patient on RUG. Calculi were seen in 3(6%) patients on SUG and in 2(4%) patients on RUG(Table 7).

Table 1: SOCIODEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

Socio-demographic variable	number of cases n=50	percent 100%
Age group (years)		
< 20	1	2.0
20-40	11	22.0
> 40	38	76.0
Mean age ± SD		**51.44±14.28 years**
Marital Status		
Single	7	14
Married till date	41	82
Others	2	4
Educational level		
No formal education	10	20
Primary	22	44
Secondary	11	22
Tertiary	7	14
Employment status		
Construction workers	9	18
Trader/businessmen	26	52
Artisan	3	6
Civil / public servant	5	10
Farmer/palmwine tapping	7	14

TABLE : CHARACTERISTICS OF ANTERIOR URETHRAL STRICTURE

	No. OF CASES	PERCENTAGE(%)
SITE		
BULBAR	34	68.0
PENILE	16	32.0
AETIOLOGY		
TRAUMATIC	21	42.0
INFECTIVE	16	32.0
IATROGENIC	13	26.0
SYMPTOMS		
Poor stream	44	88
Straining at micturition	41	82
dysuria	22	44
Urinary retention	14	28
Hematuria	18	36
DURATION		
<1 year	23	46
>1 year	27	54

TABLE 3: COMPARISON OF THE LENGTH OF ANTERIOR URETHRAL STRICTURE

Variable	sample size	Mean length(mm)	t test	p value
AUS	**n=50**			
RUG length		19.05	2.368	0.020
SUG length		24.48		
BULBAR	**n=34**			
RUG length		16.38	3.076	0.030
SUG length		23.59		
PENILE	**n=16**			
RUG length		24.72	0.334	0.741
SUG length		23.38		
RUG and Surgery	**n=5**			
RUG length(modality)		13.24	2.269	0.024
Intraoperative(surgery)		21.04		
SUG and Surgery	**n=5**			
SUG length(modality)		20.88	0.023	0.982
Intraoperative(surgery)		21.04		

TABLE 4: COMPARISON OF THE DIAMETER OF ANTERIOR URETHRAL STRICTURE

Variable	sample size	Mean Diameter(mm)	t test	p value
AUS	**n=50**			
RUG diameter		0.71	0.444	0.658
SUG diameter		0.61		
BULBAR	**n=34**			
RUG diameter		0.58	0.168	0.867
SUG diameter		0.54		
PENILE	**n=16**			
RUG diameter		0.98	0.482	0.634
SUG diameter		0.76		
RUG and Surgery	**n=5**			
RUG diameter (modality)		1.44	1.381	0.205
Intraoperative(surgery)		0.56		
SUG and Surgery	**n=5**			
SUG diameter (modality)		0.60	0.074	0.943
Intraoperative(surgery)		0.56		

TABLE 5A: CORRELATION OF ANTERIOR URETHRAL STRICTURE ON SUG/RUG

MODALITIES	PARAMETER	CORRELATION VALUE (r)	P VALUE
RUG/SUG	LENGTH	0.811	<0.001
RUG/SUG	DIAMETER	0.779	<0.001

TABLE 5B: CORRELATION OF IOP, RUG AND SUG MEASUREMENTS

MODALITIES	PARAMETER	CORRELATION VALUE (r)	P VALUE
RUG/IOL	LENGTH	0.785	0.115
RUG/IOL	DIAMETER	0.694	0.194
SUG/IOL	LENGTH	0.999	<0.001
SUG/IOL	DIAMETER	0.999	<0.001

TABLE 5C: CORRELATION OF PENILE URETHRAL STRICTURE

MODALITIES	PARAMETER	CORRELATION VALUE (r)	P VALUE
RUG/SUG	LENGTH	0.891	<0.001
RUG/SUG	DIAMETER	0.843	<0.001

TABLE 5D: CORRELATION OF BULBAR URETHRAL STRICTURE

MODALITIES	PARAMETER	CORRELATION VALUE (r)	P VALUE
RUG/SUG	LENGTH	0.782	<0.001
RUG/SUG	DIAMETER	0.734	<0.001

TABLE 6: COMPLICATIONS OF RUG/SUG(N=50)

COMPLICATION OF PROCEDURES	RUG(%)	SUG	? ^{2}	*p* value
BLEEDING	6	5	0.102 `	0.749
PAIN	41	7	46.314	<0.001
CONTRAST INTRAVASATION	13	-	14.943	-

TABLE 7: CONCOMITANT FINDINGS ON RUG/SUG

FINDINGS ON SUG	SUG	% ON SUG	RUG	% ON RUG	X^2	*p* value
Spongiofibrosis	20	40.0	0	0	25.000	-
False tracts	5	10.0	1	2.0	2.837	0.092
Calculi	3	6.0	2	4.0	0.211	0.646

DISCUSSION

The ages of the patients with AUS in this study ranged from 19 to 72 years, with the most affected age group being those above 40 years. This is similar to the age range of 19 to 61years by Khan et al.[3] In a similar study, Mteta et al[16] in Moshi, Tanzania reported an age range of 3-95 years. Similarly, Zango and Kambou[17] in Burkina Faso reported an age range of 17-90 years in male patients with anterior urethral stricture, with the most affected age group being those above 50 years. The mean age of patients with AUS in the present study is 51.4±14.2 years. This is comparable to the mean age of 49.8 in a similar study by Akano.[18]

In this study, anterior urethral stricture was detected in all the patients on SUG and RUG. Similarly, Nzeh et al[19] noted that all the patients who had anterior urethral strictures on SUG also had them demonstrated on RUG. On the contrary, Akano[18] in his study observed that a case of urethral stricture in the bulbar urethra was missed on RUG but detected on SUG, possibly due to overlap of segments and obliquity in patient's positioning on RUG. Gupta et al[20] in a similar study reported that two cases of the ten stricture in the penile urethra detected on SUG were missed on RUG because the stricture was submeatal.

More patients had AUS in the bulbar urethra than in the penile urethra in the present study. This is in keeping with a recent study by Palminteri et al[21] who found out that majority of anterior urethral stricture were in the bulbar urethra. Similarly, Fenton et al[22] identified the bulbar urethra as the most common site of AUS constituting 52% of the cases. They also indicated that inflammatory strictures most often involve the penile urethra, whereas iatrogenic strictures predominantly affect the bulbar urethra. Fenton et al[22] also noted that post- traumatic urethral strictures tend to be short, occurring exclusively in the bulbar urethra.

Trauma was the commonest cause of anterior urethral stricture in the present study and was mostly due to road traffic accidents. Other causes of traumatic anterior urethral strictures were due to fall from trees, in patients whose occupation was palm wine tapping, and fall from high-rise buildings at construction sites. This is in keeping with findings by Osegbe et al[23] who also noted an increase in frequency of strictures due to trauma in comparison with infection. They attributed this to the increase incidence of road traffic accidents and accidents at construction sites. Sumanta et al[24] also noted that 52% of the patients they studied had anterior urethral strictures due to trauma. On the contrary, Omodare[25] in an earlier study noted that infection was the predominant cause of urethral stricture in South-West Nigeria.

Historically, infective urethritis was the leading cause of urethral strictures. However, with patients' education and improved diagnosis and treatment methods of sexually transmitted diseases, infectious urethritis is now responsible for only a small proportion of cases.[26] Trauma represents a very significant etiology of urethral stricture disease.[26] Different mechanisms of trauma result in urethral strictures with straddle injury being the most common.[21] Post-traumatic AUS has been found to have the have the best long term outcome following post surgical intervention, as well as, the lowest complication rate, and the best prognosis whereas post infective strictures had the worse outcome.[27] Albers et al[28] identified the aetiology of urethral stricture disease as a risk factor for recurrence after internal urethrotomy. Postinflammatory strictures and those occurring after trans-urethral prostatic resection were found to be at a high risk for recurrence. Fenton et al[22] reported infection-induced strictures, including lichen sclerosis, as being the third leading cause of stricture disease at 26.6% following idiopathic (31.9%) and iatrogenic causes (31.9%). In the developed world, anterior urethral strictures, regardless of age, are most commonly idiopathic.[27]

No case of multiple urethral stricture was demonstrated in the present study. This is comparable to similar studies in the medical literature.[3,29] Previous studies have suggested that inflammatory strictures usually involve the bulbar urethra and are mostly multiple, whereas traumatic strictures commonly involve the membranous urethra and are single, and iatrogenic strictures due to catheterization involve the penile urethra and are often multifocal or panurethral.[26] However, other studies have indicated that inflammatory strictures most often involve the penile urethra, whereas iatrogenic strictures are predominant in the bulbar urethra.[30] It has been suggested that idiopathic strictures are more common in the bulbar urethra and in younger men. Idiopathic strictures may be congenital, but other possible causes include unrecognized trauma in childhood, or ischemia in older men.[26,30]

The cases of iatrogenic urethral strictures, in the present study, were due to urethral catheterization. Similarly, the majority of the male patients studied by Morchouse et al[31] had anterior urethral strictures due to long-term catheterization. This is in contrast to the current trend in Europe and America where the increase incidence in iatrogenic urethral stricture is due to transurethral surgery.[28] Prolonged catheterization, as in multiple trauma or burn patients, leads to urethral inflammation and ischemia, and ultimately stricture formation.[22] Moreover, improper urethral catheter

insertion is a preventable source of injury, with a recent report suggesting that 3.2 urethral injuries per 1000 inpatients occurred due to improper urethral catheterization.[26,32] Post instrumentation strictures are usually short and well defined, commonly located in the bulbomembranous urethra, whereas those occurring post- catheterization tend to be long and irregular, and more common at the penoscrotal junction.[26,33]

In this present study, the overall mean length of AUS was greater on SUG than on RUG. The mean length of urethral stricture was 1.9cm on RUG and 2.4cm on SUG. This is comparable to the mean urethral stricture length of 2cm on RUG and 3.8cm on SUG obtained by Gupta et al[21] in a similar study. This is possibly due to underestimation of bulbar urethral length on RUG.

The mean length of urethral stricture was greater in the bulbar urethra on SUG than RUG in the present study. This is possibly due to underestimation of bulbar urethral length on RUG. Most previous studies show consistently poor comparisons between RUG and SUG in estimating stricture length, especially for bulbar urethral strictures.[3-5]

In the present study, the mean length of urethral stricture was greater in the penile urethra on RUG than SUG. This is possibly due to radiographic magnification on RUG. This is in keeping with work done by Babnik et al[34] who noted that stricture lengths measured by RUG were significantly greater than those measured by sonourethrography because of radiographic magnification.

The present study shows a good correlation between SUG and RUG in the measurement of stricture length. This corroborates the work done by Razon et al[29] who noted a good correlation between SUG and RUG in the measurement of stricture length, especially for urethral strictures longer than 2cm (mean overall stricture length in the present study is 1.9cm on RUG and 2.4cm on SUG). Nzeh et al[19] also observed a very good correlation between SUG and RUG in the estimation of stricture length. On the contrary, Khan et al[3] reported a poor correlation between the AUS length obtained at RUG and SUG.

The present study shows a good comparison between SUG and RUG in the measurement of stricture diameter. This corroborates the work by Nzeh et al[19] who also noted that both methods detected similar percentage lumen reduction and were useful in grading stricture severity.

There was a good correlation between SUG and RUG in the measurement of stricture length in the penile urethra. Anand[35] observed that when strictures were grouped according to anatomical sites, both RUG and SUG were equally sensitive in length estimation in the penile urethra. Morey et al[36] noted that RUG has a strong positive correlation with the length of penile urethral stricture on SUG and intraoperative measurements.

However, sonourethrography correlated positively with intraoperative measurements in the bulbar urethra in the present study unlike RUG which correlated poorly with the same measurements. The mean stricture length on SUG was closer to that at surgery unlike RUG. The mean length of urethral strictures for the five patients who underwent surgery are 1.32cm on RUG, 2.08cm on SUG and 2.10cm at surgery. This is comparable to the mean stricture lengths of 2.0cm on RUG, 3.8cm on SUG and 3.5cm obtained by Gupta et al[37] in a similar study. Other previous studies have shown that retrograde urethrography correlated poorly with the intra-operative length of strictures in the bulbar urethra, underestimating the length in spite of radiographic magnification.[38,39]

The accurate estimation of stricture length is important as it is one of the factors that determine the suitable operative procedure.[39] Urethral ultrasound is more accurate in length estimation because the hand-held transducer is positioned in the mid-sagittal plane, directly perpendicular to the diseased urethral segment.[36] Conversely, during RUG the pelvis is aligned obliquely with respect to the AP x-ray beam. As a result the radiographic image of the bulbar urethra is an end-on view, which reduces apparent stricture length.[36,39] Bircan et al[11] observed that routine use of RUG was misleading when it is not used with urethroscopy. Gupta et al[40] reported poor correlation between SUG and RUG in estimation of stricture length, RUG underestimating the length in most cases. Akano[18] in a study observed that the lengths of anterior urethral stricture were better assessed on SUG.

In the present study, the mean stricture diameter in the bulbar urethra on SUG showed a good correlation with intraoperative measurements unlike RUG. The mean stricture diameter was 1.44mm on RUG, 0.66mm on SUG and 0.56mm at surgery. The mean stricture diameter on SUG was closer to that at surgery unlike RUG. The estimation of stricture diameter is important for assessing the severity of narrowing when compared with the normal lumen.[19,39] Sonourethrography diameter measurements in the bulbar urethra have been shown to correlate better with operative findings than RUG.[39] Choudhary et al[39] found out that accurate determination of stricture diameter by RUG was difficult due to overlapping segments in radiographs

taken with improper positioning and also due to poor opacification of severe degree strictures. Other previous studies also indicated poor correlation between bulbar stricture luminal diameter measured by RUG and that by operative findings.[41-43]

In the present study, five false tracts were detected at SUG and only one on RUG. Choudhary et al[39] found out that all false tracts confirmed at surgery were detected by SUG whereas three false tracts were missed at RUG, possibly due to temporary occlusion of the tracts from contrast instillation and overlap of segments due to obliquity in one case. On the contrary, Gluck et al[43] found out that SUG was not able to pick up bulbar sinus tracts detected on RUG. On the other hand Gupta et al[37] picked up ten false tracts on RUG and eight of these on SUG.

In this study three cases of urethral calculi were detected on SUG and two on RUG. Choudhary et al[39] noted that all cases of urethral calculi were detected by SUG, but most were missed on RUG. They opined that most calculi were too small to produce any contour change or visible filling defects in the contrast radiographs.[39] Some of the calculi seen on SUG were not also detected on the standard penetration pilot radiographs taken before retrograde urethrography.[39]

In the present study, 20 cases of periurethral spongiofibrosis (PUS) were seen on SUG and none on RUG due to lack of soft tissue delineation in the latter. Similarly, Sumantha et al[24] found out that PUS was detected in 50% of the patients by SUG and none by RUG. Choudhary et al [39] detected PUS by SUG but none on RUG. Nzeh et al[19] noted that one case of mild spongiofibrosis did not have stricture demonstrated on either SUG or RUG. Periurethral spongiofibrosis is a critical determinant of appropriate therapy and ultimate prognosis.[39] Sonourethrography provides information about the extent and severity of PUS which is not provided by RUG.[39] Excessive PUS is said to be responsible for high recurrence rates after urethral surgery.[39,41] Nash et al[44] reported that even though sonourethrography identified periurethral spongiofibrosis, it was unreliable in predicting its depth.

In this study, contrast intravasation was seen in 13 (26%) patients on RUG. Similarly, Choudhary et al[39] also encountered contrast intravasation in 4.3% of their patients during RUG but none on SUG. On the contrary, Nzeh et al[19] noted contrast intravasation in three cases on RUG and two of these were also detected on SUG on colour doppler imaging. Other complications encountered in this study were pain and bleeding on SUG and RUG with more patients complaining of pain on RUG while the frequency of bleeding was similar on both modalities. Similarly, Choudhary et al[39] noted that 57.1% of their patients had pain and 5.7% of their patients had urethral bleeding on RUG. While on SUG, pain was experienced in 21.4% of their patients and urethral bleeding in 1.4% of their patients. The frequency of pain and bleeding they encountered during SUG was lower when compared with RUG.

CONCLUSION

Sonourethrography is a simple and effective technique for evaluating the male anterior urethra. When compared with conventional RUG, sonourethrography is equally efficacious in detecting anterior urethral strictures but it is better in further characterization of anterior urethral strictures in terms of presence of calculi, periurethral pathologies like spongiofibrosis and demonstration of false tracts. In addition, the ability of SUG to determine the precise stricture length and diameter in the bulbar urethra, unlike RUG, makes it more useful when determining the type of operative procedure suitable for patients with anterior urethral strictures.

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