

**ORIGINAL ARTICLE**

## Diagnostic Accuracy of Sonourethrography in Anterior Urethral Strictures Taking Surgical Findings as Gold Standard

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### ABSTRACT

**Objective:** To compare the utility of sonourethrography (SUG) in conjunction with fluoroscopic guided urethrography in determination of urethral strictures taking surgical findings as gold standard.

**Methods:** This cross-sectional study was conducted at department of Radiology, Liaquat National Hospital, Karachi from May to October 2016. All male patients having lower urinary tract symptoms (thin streak of micturation or interrupted micturation) for 1 week or longer were included. Probe with high frequency was used for evaluation of strictures by SUG. Procedure was done by introduction of normal saline via Foley's catheter with its bulb inflated in navicular fossa. Anterior urethra was visualized up to the penoscrotal junction with multiple longitudinal and transverse scans by placing the transducer on the ventral surface of penis. The findings of SUG were compared with retrograde urethrogram and surgical findings when stricture was preoperatively detected.

**Results:** Out of total 145 patients, the average age of the patients was 37.22±11.09 years. SUG findings showed true positive cases in 31 (21.37%) patients whereas 98 (67.58%) patients were true negative. The sensitivity, specificity, PPV and NPV and accuracy of SUG for detection of anterior urethral stricture was 81.6%, 91.6%, 77.5%, 93.3% and 88.9% respectively. Postsurgical confirmation of anterior urethral stricture was 26.2% while SUG was diagnosed in 27.6% cases

**Conclusion:** SUG can be used as an alternative to conventional fluoroscopic guided urethrography in evaluation and categorization of strictures in urethra, their grading and is the procedure without ionization radiation.

**Keywords:** Anterior urethral strictures, Sonourethrography, Surgical outcomes

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### INTRODUCTION

Urethral strictures are not uncommon pathology since the beginning. In ancient Greeks and Egyptian literature by Shusruta more than 600 BC, the management of urethral stricture was first described by using reeds for urethral dilatation.<sup>1</sup> Around 15-20% adult males were diagnosed with urethral stricture in 19th century.<sup>2</sup> Various studies have reported that the most common etiology in anterior urethral strictures is idiopathic, iatrogenic such as posttraumatic catheter placement or removal or a chronic indwelling catheter or due to blunt

trauma to the perineum; with straddle injury.<sup>3-5</sup> Variety of symptoms such as weak urinary stream, straining to urinate, urinary hesitancy, incomplete urinary bladder emptying, urinary retention and post urination dribbling are present in anterior urethral stricture patients. To overcome these strains and to better define the anterior urethral stricture disease, the use of ultrasonography to image the male urethra was started in 1985 at San Francisco.<sup>6</sup> These days retrograde urethrography (RUG) is the investigation of choice for the evaluation of male anterior urethra, but it also has some of its limitations such as inadequate patient

positioning and penile traction during contrast injection which greatly alters the appearance and length of stricture hazards of radiation exposure to testes and complication such as extravasation of contrast into other areas of the penis and intravasation of contrast into venous and lymphatic system.<sup>7-11</sup>

On the other hand, sonourethrography (SUG) is the latest investigation for the evaluation of male anterior urethra which offers three dimensional dynamic studies with high-resolution ultrasound by using intra-urethral normal saline instillation, without ionization radiation. Some authors have evaluated SUG for detecting the degree of urethral spongiositis as compared to retrograde urethrography which is a two-dimensional study involving use of ionizing radiation and contrast medium.<sup>7,8</sup>

This study was conducted with the aim to determine the accuracy of SUG in detecting and characterizing male anterior urethral strictures and to standardize its use over RUG for the benefit of patients as this technique is cost effective, non-invasive, easily available and does not involve ionizing radiations.

## METHODS

This cross-sectional study was conducted from May to October 2016 in radiology department of Liaquat National Hospital, Karachi. All male patients with age 15 to 65 years were selected which were presented with lower urinary tract symptoms for 1 week or longer and clinically suspected of having urethral stricture (thin stream of urine and with difficulty in micturation) referred from urology outpatient department and urology ward were consecutively enrolled. Patients who had per-urethral pus discharge or pain on physical examination were excluded from the study. Moreover, patients having meatal stenosis, hypospadias or epispadias on physical examination were also excluded from the study. Informed consent from patient and approval from ethical committee was taken before start of study.

The sample size was calculated by using WHO sample size calculator taking confidence interval 95%, sensitivity 81%, specificity 92%, reported prevalence 46%, and margin of error 9%. The

final sample size came out to be 145.

Patients were subjected to Toshiba (Xario 200) real time ultrasound Doppler scanner for SUG by using the high frequency linear probe of 7.5 MHz while keeping the patient in supine position. Aseptic measures were taken to clean the penis and 2% lignocaine jelly was introduced through anterior urethra to provide adequate local anesthesia. Catheter of 12Fr was introduced in penis and its bulb was inflated by 2ml of normal saline in navicular fossa. The procedure was started by keeping the penis over lower abdomen. The gel was applied to probe and multiple transverse and longitudinal scans were taken after infusion of 30 to 120 ml of saline. The urethra was scanned upto penoscrotal junction. The scanned was also performed through Transperineal approach for more clear delineation of bulbous urethra.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

The findings of SUG in conjunction with retrograde urethrogram were compared with surgical findings when stricture was preoperatively detected. The whole study was statistically evaluated to determine the sensitivity and specificity of SUG in diagnosing anterior urethral strictures taking surgical findings as gold standard.

Data were entered and analyzed by using Statistical Package for Social Sciences (SPSS 21.0). Frequency and percentage were computed for qualitative variables like presenting complains, history of presenting illness, SUG findings and surgical findings. Mean  $\pm$  SD was calculated for age of the patients. Taking surgical findings as gold standard; the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of SUG findings were calculated.

## RESULTS

Of 145 male patients, the mean age was 37.22  $\pm$  11.09 years. Majority of the patients (n=81, 55.9%) were presented with >35 years of age. There were 103 (71%) patients with painful

**Table 1: Diagnostic accuracy of sonourethrography in determination of anterior urethral strictures taking surgical findings as gold standard (n=145)**

Sonourethrography Finding	Surgical Finding		Total
	Positive	Negative	
Positive	31 (TP)	9 (FP)	40 (27.6%)
Negative	7 (FN)	98 (TN)	105 (72.4%)
<b>Total</b>	38 (26.2%)	107 (73.8%)	145 (100)
<b>Sensitivity</b>	81.6%		
<b>Specificity</b>	91.6%		
<b>PPV</b>	77.5%		
<b>NPV</b>	93.3%		
<b>Diagnostic Accuracy</b>	88.9%		

FP: False Positive, FN: False Negative, TN: True Negative, TP: True Positive

**Table 2: Baseline characteristics and diagnostic accuracy of sonourethrography in determination of anterior urethral strictures taking surgical findings as Gold Standard (n=145)**

	Age, years		Duration of symptoms		History	
	≤35	>35	≤5	>5	Yes	No
<b>Sensitivity</b>	77.27%	87.50%	84.00%	76.92%	81.25%	81.82%
<b>Specificity</b>	97.62%	87.69%	91.67%	91.49%	93.02%	90.62%
<b>PPV</b>	94.44%	63.64%	80.77%	71.43%	81.25%	75.00%
<b>NPV</b>	89.13%	96.61%	93.22%	93.48%	93.02%	93.55%
<b>Diagnostic accuracy</b>	90.62%	87.65%	89.41%	88.33%	89.83%	88.37%

NPV, Negative Predicted Value; PPV, Positive Predicted Value

**Table 3: Complications and diagnostic accuracy of sonourethrography in determination of anterior urethral strictures taking surgical findings as gold Standard (n=145)**

	Painful Urination		Urinary Hesitancy		Post-Urination Dribbling	
	Yes	No	Yes	No	Yes	No
<b>Sensitivity</b>	78.26%	86.67%	84.62%	73.68%	73.68%	89.47%
<b>Specificity</b>	91.25%	92.59%	93.10%	91.94%	91.07%	92.16%
<b>PPV</b>	72.00%	86.67%	84.62%	73.68%	73.68%	80.95%
<b>NPV</b>	93.59%	92.59%	93.10%	91.94%	91.07%	95.92%
<b>Diagnostic accuracy</b>	88.35%	90.48%	90.48%	87.65%	86.67%	91.43%

NPV, Negative Predicted Value; PPV, Positive Predicted Value

urination, 84 (57.93%) with urinary hesitancy, 81 (55.86%) with urinary retention and 75 (51.72%) with post-urination dribbling. The mean duration of symptoms was  $5.36 \pm 1.81$  months. Most of the patients were presented with  $\leq 5$  months of duration of symptoms.

Post-surgical confirmation of anterior urethral stricture was 38 (26.2%) while SUG was diagnosed in 40 (27.6%) cases.

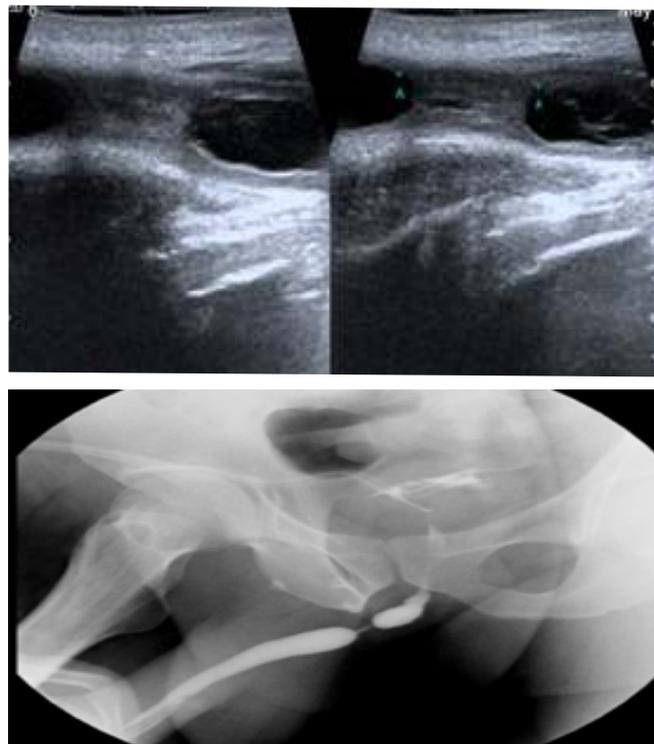
SUG findings showed true positive cases in 31 (21.37%) patients whereas 98 (67.58%) patients were true negative. The sensitivity, specificity, PPV and NPV of SUG for detection of anterior urethral stricture was found to be 81.6%, 91.6%, 77.5% and 93.3% respectively. Whereas the overall diagnostic accuracy was found to be 88.9%. (Table 1) Diagnostic accuracy with respect to baseline characteristics of the patients and complications are shown in Table 2 & 3.

Figures 1 and 2 shows the accurate length of urethral strictures with pre and poststenotic urethral dilatation on SUG as compared to corresponding RUG study.

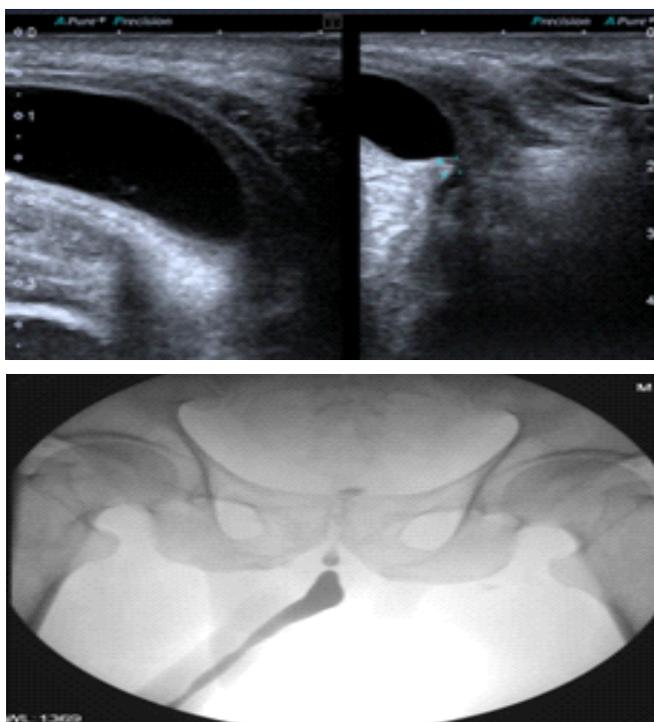
## DISCUSSION

SUG is a simple technique which gives real time accurate assessment of anterior urethral stricture and can be employed as a staging where the need for surgery is clear.<sup>12</sup> The finding of the current study has reported high diagnostic accuracy of SUG in detection of the severity and length of the strictures. Similar findings were observed by several other studies as well.<sup>11,13,14</sup>

According to one study, RUG and SUG have same diagnostic efficacy in detection of anterior urethral strictures.<sup>11</sup> In another study it was reported that SUG is more accurate for estimating stricture length when compared to RUG.<sup>15</sup> In our study, one patient showed a short segment of smooth stricture at penoscrotal junction on RUG but when that area was examined on SUG, no stricture or any other abnormality was found and this was confirmed on subsequent operative findings. These findings are in accordance with a previously published study.<sup>16</sup> The average age of the patients in our study was around thirty-seven years showing most patients were in their 3rd decade. Mean age



**Figure 1: Anterior urethral (bulbous urethral) stricture showing length of 2.0 cms with pre and poststenotic urethral dilatation on sonourethrograph and corresponding retrograde urethrogram**



**Figure 2: Urethral stricture (bulbomembranous junction of urethra) showing length of 0.2 cms with pre and poststenotic urethral dilatation on sonourethrograph and corresponding retrograde urethrogram**

of patients around third decade was reported in several other studies as well.<sup>14,16,17</sup> Regarding lower urinary tract symptoms, majority of the patients in the current study had urinary hesitancy, followed by urinary retention, post urination dribbling, and painful urination. Somewhat similar findings were observed in the study of other studies.<sup>3,18</sup>

For this study, normal saline is used as a negative contrast agent to distend the urethra to perform the SUG imaging. In a study, radiographic contrast medium was used immediately after the contrast.<sup>8</sup> Normal saline was used when no contrast imaging was to be performed. Moreover, in our study dorsal scanning approach was described to the penile urethra moving ventrally for subscrotal and perineal views of the bulbar urethra which was also reported in few other studies.<sup>19,20</sup>

In this study, patients below fifteen years of age who also can develop strictures due to various causes were not included. However, high diagnostic accuracy remains strength of the current study for anterior urethral strictures. The use of posterior urethra through transperineal approach by curved array transducer is highly recommended and future studies should be done on posterior urethral strictures by SUG.

Development of new techniques in ultrasonography gave a new ability in diagnostic of urethral strictures. The novelty in SUG is the three-dimensional visualization of urethral strictures which is its strength and further studies are recommended for the evaluation of the visualization of posterior urethra which can be possible by using low frequency curvilinear probe.<sup>21</sup>

## CONCLUSION

For evaluation of anterior urethral strictures in males, the SUG is a multi-planner and very cheap technique with easy availability. It is not carrying any burden of radiations. It has effective combo of high resolution and using saline as negative contrast agent.

**AUTHORS' CONTRIBUTION:** PAA, AJ substantially contributed to the conception and design of the study, PAA worked in the acquisition, analysis, and interpretation of

data. KM drafted the manuscript. PAA, AJ revised it critically for important intellectual content and gave the final approval of the manuscript.

**CONFLICT OF INTEREST:** None

**FUNDING:** None

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