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Grading Anterior Urethra Stricture to Predict Surgical Complexity and Outcome Using the Urethra Stricture Score

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ABSTRACT

Urethral stricture is a cause of impedance of urine outflow and is quite common in urology. 300 out of 100,000 men are affected by this disease. There is no objective system for determining the structure's complexity. **Objectives:** To appraise the relationship between Urethral Stricture Score (USS) and surgical complexity, standardize the surgical approaches, and predict the surgical outcomes with the use of USS. **Methods:** This was a descriptive study conducted in the Department of Urology, Sindh Institute of Urology and Transplantation, Karachi. The duration for sample collection was six months. Non-probability consecutive sampling was employed. Mean and standard deviation were computed for age, duration of disease, duration of surgery, BMI, and USS. Effect modifiers like age, duration of disease, and BMI were stratified to see the effect of this on the outcome. Post stratification spearman correlation and Anova test were applied. The p-value <0.005 was considered significant. **Results:** A total of 45 patients were included in this study that was diagnosed with anterior urethral strictures. We found a significant association of USS with surgical complexity. As the score increased, surgical complexity increased; the F-value of the ANOVA test was 61.25, and the p-value was <0.001. The study also found a significant correlation between USS and duration of surgery, with a correlation coefficient of 0.806 and p-value <0.001. **Conclusion:** This study affirms the positive correlation between the increasing USS and increasing surgical complexity.

INTRODUCTION

The key to maintaining optimal function of the kidneys is storage under low pressure and timely and complete emptying of the bladder. Impedance of either of the two parameters can inflict severe damage to renal parenchyma and hence renal function [1]. Urethral stricture is one such cause of impedance of urine outflow and is quite common in urology. 300 out of 100,000 men are affected by this disease [2]. The most common cause of urethral stricture is iatrogenic injury. This is followed by accidental urethral strictures, for example, forgotten minor trauma. Some other causes include bacterial urethritis and lichen sclerosis. The stricture can be on a variety of locations, such as the bulbar or penile urethra, navicular fossa, and panurethra [3-5]. Anterior urethral stricture can cause significant morbidity amongst patients and presents with symptoms such as a weak stream, incomplete emptying, spraying of the urinary stream, dysuria, and sexual dysfunction [6, 7]. Several management options are

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available to alleviate the symptoms and improve the quality of life of patients. These include urethral dilatation, urethroplasty, direct vision internal urethrotomy, and urinary diversion. The selection and employment of appropriate surgical technique involve consideration of several factors: Surgical acumen of the surgeon, location of the stricture, age of the patient, etiology of the stricture, and availability of resources [1]. There is no objective system to determine the complexity of the structure and thus no preference for surgical technique. Furthermore, the lack of an objective numerical system renders the statistical analysis of urethroplasty techniques and efficacy really difficult. To cater to this, Wiegand and Brandes developed the urethral stricture score (USS) to quantify the complexity of the strictures [8]. This scale calculates a score on the basis of location, etiology, number, and urinary retention. Urethral stricture Etiology: if inflammatory, then receives two points (maximum) while other etiologies receive one. One point is given for each structure (Number) and for each centimeter (Length). For Retention, one point if the urethra is patent and two (maximum) if it is obliterated. Regarding the anatomic location, one for the bulbar urethra, two for the penile urethra, and three (maximum) for pan-urethral or both penile and bulbar strictures [8]. Another iteration of this system is the U-score, which omits urinary retention as a category and simplifies the scores [9].

There is a lack of literature from Pakistan pertaining to the implementation of USS, which can provide an objective, standardized, and comprehensive assessment of the condition. This can predict the surgical outcomes and can help standardize the surgical approaches, which ultimately enhances the overall quality of care for patients. This study aimed to validate the scoring system for the local population of Pakistan, to appraise the relationship between USS and surgical complexity.

METHODS

A prospective descriptive study was conducted at the Department of Urology, Sindh Institute of Urology and Transplantation (SIUT) from 1st December 2022 till 31st May 2023. The institutional review board approval was duly obtained (SIUT-ERC-2020/A-255; dated 28th November 2020). Non-probability consecutive sampling was employed. The sample size of 45 was calculated using PASS 2020 Power Analysis and Sample Size Software (NCSS, LLC, Kaysville, Utah, USA), setting Spearman's correlation as 0.901, deduced from a previous study with a power set to 80%, along with 5% level of significance [10]. The Urethral stricture score (USS) and level of surgical complexity have been provided as a separate table. Higher scores represent a higher severity of the urethral stricture. The surgical complexity of three different procedures was ranked from least complex to maximum complexity on the basis of operative times, blood loss, and transfusions. DVIU- Direct Vision Internal Urethrotomy- least complex, EPA- Excision and primary anastomosis, and BMG- Buccal Mucosal graft urethroplasty- most complex (Table 1).

Table 1: Description of the Urethral Stricture Score (USS) and Level of Complexity of Surgery

Variables	Points
Length of Stricture (cm)	
1 Point per cm of Length (to the Nearest 0.1 cm)	1
Retention	
Patent Urethra	1
Obliterated or Near Obliterated	2
Anatomic Location	
Bulbar Urethra	1
Penile Urethra	2
An-Urethra or Both Bulbar and Penile	3
Number of Strictures	
1 Point Per Stricture	1
Etiology	
(Non-Inflammatory) Trauma, Idiopathic, Iatrogenic	1
Inflammatory, Hypospadias	2
Level of Complexity of Surgery	
Direct Visual Internal Urethrotomy (DVIU)	1
Excision and Primary Anastomosis (EPA)	2
Buccal Mucosal Graft Urethroplasty (BMG)	3

All male patients aged 18-60 years with anterior urethral stricture and a duration of disease of more than one month with an American Society of Anesthesiologists (ASA) class of up to II were included in the study. Patients with posterior urethral strictures, prior open urethroplasty, confirmed diagnosis of benign prostate hyperplasia, on corticosteroids, and uncontrolled diabetes mellitus were excluded from the study. Those patients who did not consent to this study were also excluded. Written and informed consent was taken from the patients before enrollment. Detailed but pertinent history was obtained from the participants. Data were entered and analyzed on SPSS version 22.0. Mean and standard deviation were computed for age, duration of disease, duration of surgery, BMI, and urethral stricture score. Frequencies and percentages were computed for the type of stricture, retention, etiology, and surgical complexity. An ANOVA test was used to determine if there were significant differences in mean scores with surgical complexity. The obtained USS was related to the type of surgical procedure and duration that the patient underwent, and a correlation using Spearman's correlation coefficient was determined. Effect modifiers like age, duration of disease, and BMI were stratified to see the effect of these on outcomes. Post stratification spearman correlation was applied. The p-value <0.005 was considered significant.

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RESULTS

A total of 45 patients were included in this study that was diagnosed with anterior urethral strictures. The descriptive statistics of the demographic and clinical characteristics of patients were determined (Table 2).

Table 2: Demographic and Clinical Characteristics of Patients

Variables	Age (years)	Duration of Disease (Days)	Duration of Surgery (minutes)	BMI (kg/m^2)	Urethral Stricture Score
Mean ± SD	44.60 ± 11.71	153.31 ± 64.69	133.27 ± 91.46	24.90 ± 1.97	8.68 ± 3.57
Minimum	18	30	10	21	4.40
Maximum	60	1825	290	29	18.00

Retention was found in 35 (77.77%) and not in 10 (22.22%) patients. Frequency of etiology, non-inflammatory (trauma, idiopathic, iatrogenic) was found in 34 (75.56%) and inflammatory in 11 (24.44%) patients. Stricture was located at the penile region in 07 (15.56%) patients, at the bulbar in 27 (60.00%), and pan-urethral in 11 (24.44%) patients. Mean length of stricture was 2.94 ± 2.29 cm while the mean number of strictures was 1.16 ± 0.37. There was no blood products transfused within 24 hours post-operative period in 43 (95.56%) patients, and 01 blood product was transfused within 24 hours post-operative period in 02 (4.44%) patients. On frequency of complexity, DVIU (level 1) was performed in 15 (33.33%) patients, EPA (level 2) in 14 (31.11%), and BMG (level 3) in 16 (35.56%) patients. The study found a statistically significant relationship between USS and surgical complexity, with increasing USS corresponding to greater surgical complexity. This was confirmed by ANOVA, which demonstrated an F-value of 61.42 and a p-value <0.001 (Table 3).

Table 3: Comparison of Mean Urethral Stricture Score Across Surgical Complexity Levels Using One-Way ANOVA

Type of Surgery (Surgical Complexity)	Urethral Stricture Score (Mean ± SD)	F-value	p-value
DVIU (Level 1)	5.38 ± 0.94	61.42	<0.001
EPA (Level 2)	7.75 ± 1.15		
BMG (Level 3)	12.58 ± 2.74		

This study also found a significant correlation between USS and duration of surgery, with a correlation coefficient of 0.806 and a p-value <0.001. With increasing USS, the time of surgery was significantly increased (Table 4).

Table 4: Spearman's Correlation Matrix Between Urethral Stricture Score and Duration of Surgery

Variables	Urethral Stricture Score	Duration of Surgery
Urethral Stricture Score	1.00	0.806*
Duration of Surgery	0.806*	1.00
Sig. (2-tailed)	—	<0.001
N	45	45

*Correlation is significant at the 0.01 level (2-tailed).

When stratified based on duration of disease, there was a significant association of USS with surgical complexity, with an F-value of 58.19 and p-value <0.001 when duration of disease was <100 days. Similarly, in patients having a duration of disease ≥100 days, the F-value was 18.54, and the p-value was <0.001. In patients having a duration of disease <100 days, there was a significant correlation between USS and duration of surgery, with a correlation coefficient of 0.84 and a p-value <0.001. In patients having a duration of disease ≥100 days, the correlation coefficient between USS and duration of surgery was 0.87, and the p-value was <0.001. Stratification of age, duration, and BMI was done to evaluate the relationship between USS and surgical complexity (Table 5).

Table 5: Stratified One-Way ANOVA Showing Mean Urethral Stricture Scores by Surgical Complexity Across Age, Disease Duration, and BMI Groups

Variables		Type of Surgery	Urethral Score (Mean ± SD)	F-value	p-value
Age (years)	18-44	DVIU	5.37 ± 0.97	39.87	<0.001
		EPA	7.56 ± 1.29		
		BMG	13.58 ± 2.57		
	45-70	DVIU	5.38 ± 0.99	24.60	
		EPA	8.0 ± 1.00		
		BMG	10.91 ± 2.33		
Duration (days)	<100	DVIU	5.40 ± 0.95	58.19	<0.001
		EPA	9.50 ± 1.23		
		BMG	12.48 ± 2.47		
	>100	DVIU	6.26 ± 1.07	18.54	
		EPA	10.40 ± 0.98		
		BMG	14.96 ± 2.57		
BMI (kg/m^2)	≤ 24kg/m^2	DVIU	5.30 ± 0.94	46.22	<0.001
		EPA	7.70 ± 1.22		
		BMG	12.55 ± 2.46		
	≥25kg/m^2	DVIU	5.57 ± 1.07	13.65	
		EPA	7.87 ± 1.11		
		BMG	12.60 ± 3.03		

DISCUSSION

Anterior urethral stricture requires prompt management lest renal damage occur. There are several management options depending on the severity and complexity of urethral stricture [1]. Current study attempts to externally validate the USS (urethral stricture score) based on parameters such as etiology, urine retention, length, number, and location of strictures. Payne *et al.* discuss difficulties faced in low-income countries and identify several factors, such as the etiology of urethral strictures, length, and number of the strictures contributing to it [11]. Furthermore, owing to limited resources, it is imperative to opt for the best surgical approach, and for that, an objective scoring system is warranted. The scoring system used in this study, the USS, incorporates all these factors

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mentioned above. Tritschler *et al.* document that 20% of the cases of urethral stricture arise from inflammation, and our study shows a similar rate of acquired inflammatory strictures, which was 11% [12]. Multiple studies have shown that the most common site for strictures is the bulbar urethra, followed by the penile and lastly by the navicular fossa [11-14]. A similar fashion was obtained from our results, and the most common site was found to be the bulbar urethra, followed by the penile urethra. The most common symptom at presentation is urinary retention, and this is what often brings this to the notice of patients [15]. This study consolidates this fact, and more than 75% of the patients had retention as a presenting symptom. The U-score eliminates the score for retention [9], but USS incorporates this in its scoring system and thus increases the scores of respective patients. Several approaches exist for the treatment of urethral strictures. These procedures are opted for on the basis of the complexities of the strictures. Verla *et al.* mention in their study that DVIU (Direct vision Internal Urethrotomy) is the simplest of procedures performed in patients with a single stricture of less than1.5cm [16]. This corresponds to a low score on the USS scale, and this study opted for DVIU as a low complexity surgery. The results are promising; however, with increasing lengths, the results start to deteriorate [17, 18]. The complexity of the buccal mucosal graft is maximum and requires surgical expertise and a longer duration of surgery. Furthermore, it can cause significant discomfort to patients and lengthen their hospital stay. With all the demerits stated, this procedure nevertheless has been proven valuable and is widely used [19, 20]. This study institute resorted to this procedure where the urethral scores were high, and strictures were complicated. Using evidence from the world literature, we categorized the surgical approaches according to the level of their complexity, buccal mucosal grafts being the most complex, while DVIU remained the least complex. The results elucidate a significant relationship between increasing USS and increasing complexity of surgery. There is a positive correlation between the two. This score is of paramount importance as it not only predicts the surgical complexities but also forms the basis for future statistical analyses, as it objectively grades the complexity and can reliably compare the treatment modalities. It can also aid the urologists in determining the most appropriate surgical modality. A similar study conducted by Alwaal *et al.* also established a positive correlation between the U-score and surgical complexity [2]. U-score is an iteration of USS by Eswara *et al.* [9], which omits retention as a parameter but otherwise is similar to the USS. Our study also establishes a similar correlation. The parameters that positively correlated with the surgical complexity were etiology, length of strictures, and number of strictures. There are a couple of studies in the literature that have attempted to validate the scoring system [9]. In contrast, our study used the USS instead of the U-score. To reprise, this study affirms the positive correlation between the increasing urethral stricture score and increasing surgical complexity.

The research is limited to one locality, the Sindh Institute of Urology and Transplantation, which makes it difficult to extrapolate to other Pakistani communities. The sample size of the study is relatively small (n=45) and might not fully reflect the range of diversity of urethral strictures. The non-probability consecutive sampling presents the issue of selection bias, and the 6-month period of study does not allow for evaluating the long-term results of surgery or recurrence rates. There are also subjective elements of the USS scoring system, such as the etiology classification, which could lead to inter-observer variability. The question that needs to be investigated by research is whether USS-guided surgical selection positively affects patient-reported outcomes and quality of life. USS-based procedure selection could be cost-effective to assist in resource allocation in the public sector hospitals.

CONCLUSIONS

This study demonstrates a significant correlation between increasing urethral stricture scores and surgical complexity. This key finding will aid urologists in opting for an optimal procedure in clinical settings and comparing different surgical approaches objectively.

Authors' Contribution

Conceptualization: NA, AK, HHQ, MH
Methodology: NA, UBS, NM
Formal analysis: NA, AK, UBS, NM
Writing and Drafting: NA, AK, UBS, NM, HHQ, MH
Review and Editing: NA, AK, UBS, NM, HHQ, MH, PK

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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