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Urethral Stricture Score is Associated with Anterior Urethroplasty Complexity and Outcome

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Purpose: Several surgical techniques are available to treat anterior urethral stricture. The choice of surgical technique largely depends on the severity of stricture disease. The U-score (urethral stricture score) is based on urethral stricture characteristics, namely length (1 to 3 points), number (1 or 2 points), location (1 or 2 points) and etiology (1 or 2 points), which are tallied to provide a total score of 4 to 9 points. Our aim was to identify whether the U-score system is predictive of the surgical complexity and outcome of anterior urethroplasty.

Materials and Methods: We retrospectively reviewed the records of all patients who underwent anterior urethroplasty from 2002 to 2012 by examining our prospectively collected urethroplasty database. We calculated the U-score and looked for an association with surgical complexity, recurrent stricture and time to recurrence. We defined recurrent stricture as the need for a secondary procedure.

Results: There were 341 patients who underwent low complexity urethroplasty (anastomotic, buccal mucosal graft and augmented anterior urethroplasty) with a mean U-score of 4.7 while 48 underwent high complexity urethroplasty (double buccal mucosal graft, flap and graft/flap combination) with a mean score of 6.9. Higher U-score was predictive of higher surgical complexity ($p < 0.001$). U-score was also significantly associated with recurrence. There was a consistent increase in the risk of recurrence with each additional U-score point. However, there was no association of U-score with time to recurrence.

Conclusions: We confirmed the validity of U-score to predict the complexity of surgery for anterior urethral strictures. For the first time to our knowledge we report an association between higher U-score and anterior urethroplasty outcome. The U-score could be used to risk stratify patients and help with perioperative counseling.

Key Words: urethral stricture; recurrence; surgical procedures, operative; risk; prognosis

Abbreviations and Acronyms

LS = lichen sclerosus

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URETHRAL stricture disease affects almost 300/100,000 men[1] and causes a significant burden of illness to those affected. Often mismanagement and delay in definitive treatment cause men to experience a variety of associated symptoms, including a weak stream, incomplete emptying, urinary retention and recurrent urinary tract infections due to progressive narrowing of the urethral lumen.[2] Several surgical techniques are available to treat urethral strictures, which vary in complexity and outcomes. The choice of treatment is based on preoperative and intraoperative assessments, and shared decision making between patient and physician. Unfortunately

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little standardized methodology exists to gauge stricture complexity.

The development of a standardized scoring system for stricture disease severity would be useful for patient perioperative counseling regarding surgical complexity and stricture recurrence. A standardized scoring system would allow for stricture related research to be reported in a common language among centers when comparing surgical techniques and outcomes. Several scoring systems have proved successful in urological surgery, including prostate cancer scoring systems to predict the outcome after surgery[3] and renal mass complexity classification.[4]

In 2012 Wiegand and Brandes developed the URETHRAL score, a novel scoring method of the severity of anterior urethral stricture that uses stricture etiology, length, number, location and urinary retention.[5] They identified an association of the score with surgical complexity. More recently Eswara et al further refined and simplified the score, renaming it the U-score, and removing retention from the scoring system.[6] They found that the simplified score was associated with the surgical complexity of anterior urethral strictures.

Our aim was to validate whether the U-score system is predictive of surgical complexity and determine whether it is associated with recurrence after anterior urethroplasty.

MATERIALS AND METHODS

We retrospectively analyzed our prospectively collected institutional database to gather U-score data and demographic factors such as age, etiology and comorbidities, specifically diabetes mellitus, chronic obstructive pulmonary disease and hypertension. We included in study patients who underwent anterior urethroplasty from 2002 to 2012 and had complete data available. Two surgeons (JWM and BNB) performed all urethroplasties. We obtained institutional review board approval from our institution.

U-Score

The U-score is based on urethral stricture characteristics, namely length (1 to 3 points), number (1 or 2 points), location (1 or 2 points) and etiology (1 or 2 points), which are tallied to provide a total score of 4 to 9 points.[6] Stricture length was measured by perioperative sonourethrogram and in the operating suite with a ruler by the surgeon. Stricture number and location were determined by preoperative retrograde urethrogram performed in standard fashion[7] and later verified at surgery. Stricture etiology was determined by patient history and comprised trauma/idiopathic/iatrogenic (1 point) or inflammatory/hypospadias (2 points).

We used criteria defined by Eswara et al[6] to classify surgical complexity into low complexity—anastomotic, buccal mucosal graft and augmented anterior urethroplasty, and high complexity—double buccal mucosal graft, flap and graft/flap combination. We calculated the U-score of all patients who underwent those procedures and looked for associations between the U-score and surgical complexity, recurrent stricture and time to recurrence. We defined stricture recurrence as the need for a secondary procedure.

Statistics

Data analysis was performed with STATA®, version 14. The chi-square and Fisher exact tests were used to assess categorical data (demographics) and the t-test was used to analyze continuous variables (surgical complexity and time to recurrence). The relationship between U-score and surgical complexity was determined by the t-test for the mean U-score in high and low complexity procedures. Statistical significance was considered at $p < 0.05$. Univariable logistic regression was done to evaluate the association of U-score with stricture recurrence. A Cox proportional hazards model and Kaplan-Meier curves were used to assess the effect of U-score on time to recurrence.

RESULTS

A total of 389 patients underwent anterior urethroplasty and had complete records available during the study period. We excluded from study 297 patients during this period who underwent posterior urethroplasty, 2-stage urethral reconstruction, perineal urethrostomy, urethrocutaneous fistula repair, urethrectomy, hypospadias repair, urethral erosion repair, urethral diverticulum repair, neophallus urethroplasty, urethroplasty with UroLume® removal, meatoplasty or urethroplasty associated with Fournier gangrene. We also excluded 29 patients treated with anterior urethroplasty who were lost to followup after removing the catheter.

Median age of our patients was 45 years (range 14 to 85). Our analysis revealed that 4.9% of patients had diabetes mellitus, 7% had hypertension and 1.8% had chronic obstructive pulmonary disease. Median followup was 12 months (range 6 to 156). Table 1 shows a distribution of our patients

Table 1. *Patient U-score characteristics*

	No. Recurrence (%)	No. No Recurrence (%)	p Value
U-score:			
4	10 (14)	141 (44)	—
5	27 (39)	141 (44)	—
6	9 (13)	18 (6)	—
7	16 (23)	14 (4)	—
8	8 (11)	5 (2)	—
9	0	0	<0.001
Stricture cm length (points):			
2 or Greater (1)	16 (23)	157 (48)	—
Greater than 2—5 or less (2)	29 (41)	132 (42)	—
Greater than 5 (3)	25 (36)	30 (10)	<0.001
No. strictures (points):			
1 (1)	58 (83)	313 (98)	—
Greater than 1 (2)	12 (17)	6 (2)	<0.001
Location (points):			
Bulbar urethra (1)	40 (57)	283 (89)	—
Penile urethra (2)	30 (43)	36 (11)	<0.001
Etiology (points):			
Trauma, idiopathic, iatrogenic (1)	64 (91)	309 (97)	—
Inflammatory, hypospadias (2)	6 (9)	10 (3)	0.08

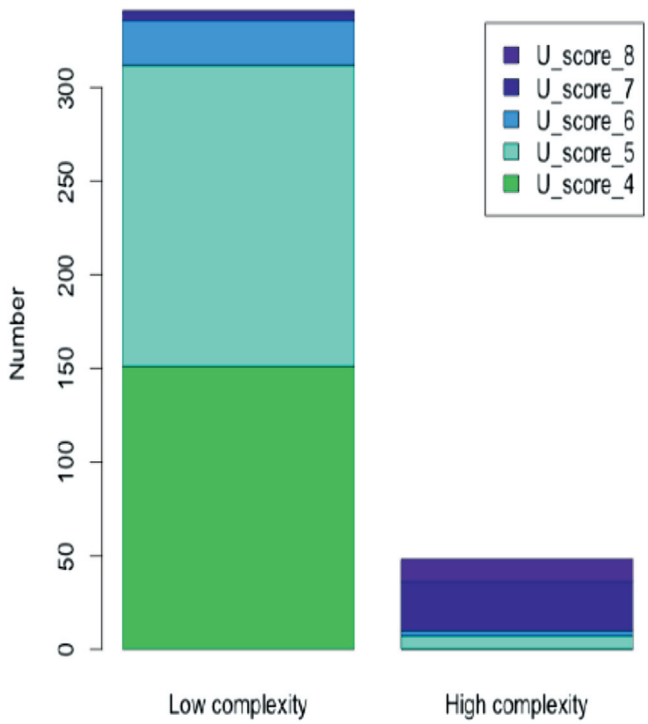

Figure 1. U-score of low and high complexity anterior urethroplasty.

across the different U-score categories. Using the mentioned surgical complexity stratification 341 patients underwent low complexity urethroplasty with a mean U-score of 4.7 while 48 underwent high complexity urethroplasty with a mean score of 6.9. A higher U-score was predictive of higher surgical complexity ($p < 0.001$, fig. 1).

A total of 70 patients (18%) experienced recurrent urethral stricture as defined by the need for a secondary procedure. Figure 2 shows the U-score distribution between the 2 groups. Notably no patient had a score of 9. U-score was also significantly predictive of recurrence. There was a consistent increase in risk with each additional U-score point (table 2). Median time to recurrence for all U-scores was 12 months (range 2 to 108).

To determine whether U-score predicted time to recurrence we constructed Kaplan-Meier curves for only patients in whom stricture recurred stratified by U-score. We evaluated differences between U-scores using a Cox proportional hazards model and identified no association with time to recurrence ($p = 0.49$, fig. 3).

DISCUSSION

To our knowledge the U-score is the first scoring system for anterior urethral stricture disease complexity.[5,6] Our study confirms the findings of Eswara et al[6] in demonstrating the U-score association with surgical complexity. In addition, we establish for the first time to our knowledge the validity of the U-score in predicting the outcome of anterior urethroplasty. There was a consistent increase in the recurrence rate with each point increase in the U-score. However, in our data there was no association of the U-score with time to recurrence.

The U-score measures urethral stricture complexity using 4 stricture components, including length, number, location and etiology. Stricture length is probably the most important U-score component to determine surgical complexity.

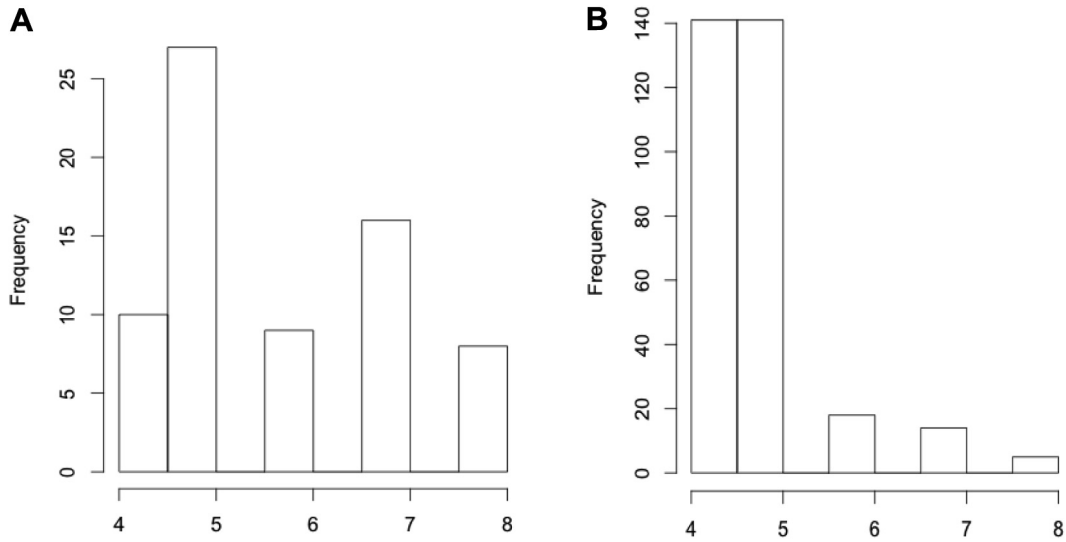

Figure 2. U-score in 70 patients with (*A*) and 319 without (*B*) recurrent stricture

Table 2. *U-score association with recurrent stricture*

U-score	% Recurrence	OR (95% CI)	p Value
4	7	Referent	—
5	16	1.10 (1.02—1.19)	0.02
6	33	1.31 (1.13—1.52)	<0.001
7	53	1.63 (1.32—2.02)	<0.001
8	62	1.78 (1.36—2.32)	<0.001

A longer stricture requires more difficult surgical repair. As length increases, anastomotic urethroplasty becomes more difficult and the need for grafts and flaps increases. Multivariate analysis revealed that stricture length (particularly longer than 4 cm) predicted failure of urethroplasty.[8,9] To our knowledge there is no evidence to associate the number of strictures with the risk of recurrence after open urethroplasty. However, because it has been shown that an increased number of strictures predicts the failure of endoscopic urethrotomy,[10] this was incorporated into the score. Multiple strictures can be mistaken as 1 long stricture, affecting the length component and increasing the U-score.

Penile urethral strictures are associated with more complex surgical repair due to the much thinner corpus spongiosum compared to that of the bulbar urethra, and the thinner skin and subcutaneous tissue on the penis with the more tenuous blood supply.[11] Therefore, penile urethral strictures received more points in the U-score. LS is associated with more complex repair, given its propensity to involve the penile urethra. Levine et al have previously reported up to a fivefold increased risk of recurrent stricture in patients with LS.[12] Andrich et al have also described increased surgical complexity and the risk of recurrence in patients with LS.[13] Furthermore, adults with hypospadias require more challenging surgical treatment.[14] For these reasons LS and hypospadias received higher points on the U-score.

To our knowledge this is the first study to externally validate the U-score in determining the surgical complexity of anterior urethroplasty and the first to illustrate its usefulness in predicting outcomes. Our results help clinicians and researchers confirm the U-score as a standardized methodology by which urethral stricture severity is assessed preoperatively to predict the operative difficulty and the outcome of anterior urethroplasty. The U-score might also prove valuable to compare different techniques for a certain U-score number among institutions, thereby becoming a grading scale for urethral stricture severity.

We used the same U-score criteria modified by Eswara et al[6] as we believe that these criteria are important, and easy to identify and measure preoperatively. Other variables that impact complexity and surgical outcomes, such as spongiofibrosis, may improve future grading systems.

The main limitation of our study is its retrospective design. In addition, the U-score does not account for other factors that may influence the results of anterior urethroplasty such as age, obesity and smoking.[8,9]

The median followup of 12 month in our study is another limitation. Furthermore, our followup protocol during the study period may underrepresent or overrepresent our true success rate. We also examine the results from a single institution where 2 surgeons performed these urethroplasties. Further large multi-institutional prospective studies are needed to evaluate the validity of the U-score to predict anterior urethroplasty complexity

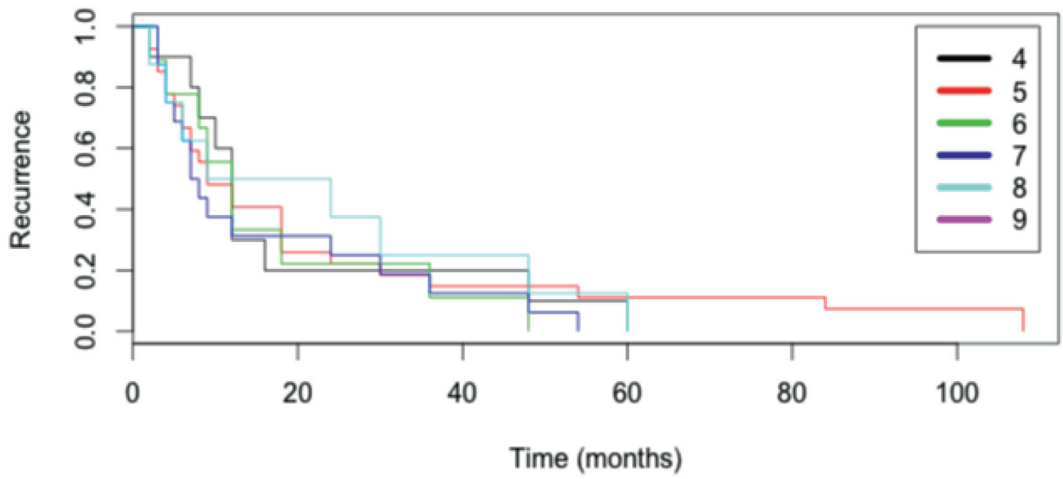

Figure 3. Kaplan-Meier curves of patients with recurrence stratified by U-score show no difference in time to recurrence based on U-score ($p = 0.89$).

and outcome. In addition, the U-score could be a useful way to determine a cost-effective strategy for anterior urethroplasty surveillance protocols. Patients with a higher U-score could receive more intensive surveillance since cost has been shown to vary considerably with the post-urethroplasty surveillance protocol.[15,16] Further research on the topic is much needed.

CONCLUSIONS

This study confirms the validity of the U-score to predict the complexity of surgery of anterior urethral strictures. For the first time to our knowledge we report an association between higher U-scores and anterior urethroplasty outcomes, although without an association with time to recurrence. These results help in perioperative patient counseling and might influence the patient decision to undergo a more successful definitive procedure such as perineal urethrostomy rather than more complex, less successful anterior urethroplasty. Further research is needed to further examine the use of the U-score in anterior urethral stricture disease.

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