

Prognostic Factors Affecting Recurrence After Internal Urethrotomy in Primary Short-segment Urethral Strictures

Mustafa Serdar Çağlayan¹, Cemil Aydın¹, Mustafa Kestel², Musa Ekici¹, Muhammet İhsan Öztürk¹, Metin Kızgın¹, Mehmet Murat Baykam¹

¹Hitit University Faculty of Medicine, Department of Urology, Çorum, Türkiye

²Hitit University Erol Olçok Training and Research Hospital, Department of Urology, Çorum, Türkiye

What's known on the subject? and What does the study add?

Internal urethrotomy (IU) is the most common first-line treatment for short-segment urethral strictures. Despite its simplicity and minimal invasiveness, IU has high recurrence rates reported in the literature. Various patient and stricture-related factors have been studied to predict recurrence after IU, but results remain inconsistent. Identifies advanced age, diabetes mellitus, coronary artery disease, and postoperative complications as independent risk factors for recurrence after IU. Provides evidence that stricture length, etiology, and location are not significant predictors of recurrence. Supports individualized management strategies and early surgical planning for high-risk patients.

Abstract

Objective: This study aimed to identify prognostic factors affecting recurrence after internal urethrotomy (IU) performed without adjuvant therapy in patients with urethral strictures shorter than 2 cm.

Materials and Methods: We retrospectively analyzed the records of 263 patients who underwent IU for the first time between January 2018 and June 2024. Patient characteristics, including age, comorbidities, stricture length, etiology, location, postoperative complications (hematuria, urinary tract infection), and catheterization duration were recorded. Recurrence was defined as the need for re-intervention within the first year. Statistical analyses were performed using chi-square, Fisher's exact, Student's t-test, Mann-Whitney U, and Kruskal-Wallis tests.

Results: The mean patient age was 68.2±18.9 years. Recurrence rates were 29.6% at 3 months and 64.2% at 1 year. Advanced age, diabetes mellitus (DM), coronary artery disease (CAD), and postoperative complications (hematuria, urinary tract infection) significantly increased the risk of recurrence (all p<0.001). No significant association was observed between recurrence and stricture length, etiology, location, or catheterization duration.

Conclusion: Advanced age, DM, CAD, and postoperative complications (hematuria, urinary tract infection) are independent risk factors for recurrence after IU. Evaluation of these parameters may aid in planning early surgical strategies for high-risk patients. This study was retrospectively conducted and was not registered in a clinical trial registry as it did not meet the criteria for prospective registration.

Keywords: Urethral stricture, internal urethrotomy, recurrence, risk factors, prognostic factors

Introduction

Urethral stricture is characterized by narrowing of the urethral lumen due to fibrosis affecting the urethral epithelium and the underlying corpus spongiosum (1). Patients typically present with obstructive voiding symptoms, recurrent urinary tract

infections, or urinary retention (2). Urethral strictures are considered one of the most challenging problems in urology due to diagnostic complexity, treatment difficulties, recurrence tendency, and the need for long-term postoperative follow-up. In developed countries, the prevalence of urethral stricture has been reported to range between 0.6% and 1.2% (3). Iatrogenic,

Correspondence: Mustafa Serdar Çağlayan MD, Hitit University Faculty of Medicine, Department of Urology, Çorum, Türkiye

E-mail: serdar.09.09@hotmail.com **ORCID-ID:** orcid.org/0000-0002-5086-8671

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traumatic, inflammatory, and idiopathic causes are the most common etiological factors (2).

Diagnostic evaluation includes uroflowmetry, retrograde urethrography, and urethrocystoscopy (4). While a low Qmax value and plateau-shaped flow curve on uroflowmetry suggest the presence of a stricture, retrograde urethrography provides information about the location and length of the stricture. Cystoscopy, which can be easily performed in outpatient settings, allows for rapid confirmation of the diagnosis, immediate interventions such as dilatation, and precise determination of the distal location of the stricture (4).

Treatment of urethral stricture depends on the length, location, and etiology of the stenosis. The technique of visual internal urethrotomy (IU), first described by Sachse (5) in 1974, is currently the most commonly used first-line treatment option, especially for short (<2 cm), uncomplicated strictures in the bulbar and membranous urethra (6). However, long-term recurrence rates after IU have been reported to range from 35% to 70% (7), raising concerns regarding its long-term efficacy. Several adjuvant intralesional therapies such as Mitomycin-C, paclitaxel, triamcinolone, platelet-rich plasma (PRP), and erythropoietin have been investigated to reduce recurrence rates, but the results have been inconclusive (6).

In our study, only primary, uncomplicated strictures shorter than 2 cm were included, and therefore, more invasive surgical options such as urethroplasty were not planned. The literature suggests that IU is recommended as the initial treatment for short-segment strictures, whereas urethroplasty is reserved for recurrent or long-segment (>2 cm) strictures (6). For this reason, IU was preferred in patients without an indication for urethroplasty or in those refusing more invasive surgical approaches.

The aim of this study was to evaluate the factors affecting treatment success after IU performed without adjuvant therapy in patients with primary urethral strictures shorter than 2 cm.

Materials and Methods

This retrospective study was approved by the Institutional Review Board of Hitit University Clinical Research Ethics Committee (approval number: 2024/88; date: 15.10.2024) and conducted in accordance with the principles of the Declaration of Helsinki and informed consent was obtained from all participants.

The medical records of 263 patients aged 18-90 years who underwent IU for the first time between January 2018 and June 2024 due to urethral strictures of various etiologies (e.g., transurethral resection for bladder tumor or prostate, traffic accidents, ureterorenoscopy, radical prostatectomy, traumatic catheterization, idiopathic causes) were retrospectively analyzed.

Preoperative evaluation included uroflowmetry for all patients, and those with a stricture pattern, and Qmax ≤10 mL/sec underwent routine retrograde urethrography to assess stricture length and location (Figure 1). Intraoperatively, the location and length of the stricture were also recorded. Patients with a history of neurogenic bladder, recurrent strictures, or receipt of adjuvant therapies (e.g., Mitomycin-C, PRP, steroids) were excluded from the study.

All procedures were performed using Sachse's (5) technique, involving a single cold-knife incision at the 12 o'clock position, utilizing a 21F urethrotome. Following the incision, urethrocystoscopy was performed in all patients, and a 16-20F Foley catheter appropriate for the urethral diameter was inserted. In our series, the urethral catheter was routinely removed on the 3rd to 5th postoperative day in uncomplicated cases once local edema had subsided. A retrograde urethrogram was subsequently performed immediately after catheter removal to verify urethral patency and to rule out extravasation prior to resumption of spontaneous voiding.

Postoperatively, patients were followed up at 3-month intervals during the first year. Uroflowmetry and if necessary, retrograde urethrography (for Qmax <10 mL/sec) were performed at each visit (Figure 2). The need for repeated surgical intervention within the first year was defined as recurrence.

Statistical Analysis

Statistical analyses were performed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Differences between categorical variables were assessed using the chi-square test or Fisher's exact test where appropriate. For comparisons between two groups, Student's t-test was used for parametric continuous variables, and the Mann-Whitney U test was used for non-parametric



Figure 1. Preoperative retrograde urethrography

continuous variables. Comparisons among three or more groups were performed using the Kruskal-Wallis analysis of variance. A p-value <0.05 was considered statistically significant for all tests.

Results

A total of 263 patients were included in the study, with a mean age of 68.2 ± 18.9 years (range: 20-91). Among them, 70 patients (26.6%) had diabetes mellitus (DM), 54 (20.5%) had hypertension, and 61 (23.1%) had coronary artery disease (CAD), while 46 patients (17.5%) had no comorbidities. The mean follow-up duration was 42.1 ± 11.2 months (range: 5-63).

At the 3-month follow-up, recurrence was observed in 78 patients (29.6%), whereas 185 patients (70.4%) had no recurrence. By the end of the first year, the recurrence rate increased to 64.2% (n=169), with a mean time to recurrence of 6.9 months.

The mean stricture length was 1.4 ± 0.43 cm (range: 0.5-2), and the majority of strictures (73%) were located in the bulbar urethra. Functional outcomes showed that the mean preoperative Qmax was 6.75 ± 1.41 mL/sec, which improved to 14.3 ± 4.96 mL/sec postoperatively. The mean catheterization duration was 4.94 ± 1.26 days (range: 2-10). Postoperatively, hematuria occurred in 2 patients, and urinary tract infection occurred in 1 patient. The urinary tract infection was managed with antibiotic therapy and observation.

Risk factor analysis demonstrated that advanced age significantly increased the risk of recurrence (71.4 ± 19.1 years in the recurrence group vs. 66.4 ± 13.4 years in the non-recurrence group; $p < 0.001$). The presence of DM and CAD also significantly elevated recurrence risk (both $p < 0.001$). Patients with postoperative complications had a significantly higher risk of recurrence ($p < 0.001$) and prolonged catheterization times ($p = 0.012$). In contrast, no significant association was found

between recurrence and stricture length, etiology, location, or catheterization duration (all $p > 0.05$) (Table 1).

Discussion

Urethral stricture is a common and challenging condition encountered in daily urological practice (1). Its etiology includes transurethral interventions, trauma, catheterization, infections, and in some cases, idiopathic (2). The fact that the etiological distribution in our study aligns with the existing literature increases the generalizability of our findings.

Although the pathogenesis of urethral stricture has long been understood, there is still no consensus on the optimal treatment approach. IU, first described by Sachse (5) in 1974, is widely used as a first-line treatment for primary, isolated strictures shorter than 2 cm due to its simplicity, reliability, and minimally invasive nature. However, the high long-term recurrence rates reported in the literature, ranging from 35-70%, raise concerns regarding its long-term efficacy (7). Moreover, repeated IU procedures have been shown to decrease success rates and negatively impact the outcomes of subsequent reconstructive surgeries such as urethroplasty (8). Kessler et al. (8) also reported

Table 1. Factors associated with recurrence after internal urethrotomy

Variable	Recurrence (n)	No recurrence (n)	p-value
Age (years)	71.4±19.1	66.4±13.4	<0.001 ^a
Diabetes mellitus			
Yes	24	46	<0.001 ^b
No	54	139	
Coronary artery disease			
Yes	20	41	<0.001 ^b
No	58	144	
Postoperative complications (hematuria, UTI)			
Yes	3	0	<0.001 ^b
No	75	185	
Stricture length (cm)	1.6±0.27	1.3±0.12	0.125 ^a
Stricture etiology			
Iatrogenic	56	136	0.198 ^b
Trauma	15	37	
Idiopathic	7	12	
Stricture location			
Membranous	15	41	0.073 ^c
Bulbar	57	133	
Penile	8	11	
Catheterization time (days) (mean)	5.89±1.62	4.59±1.71	0.249 ^a

^a: Mann-Whitney U test, ^b: Chi-square test, ^c: Kruskal-Wallis test, UTI: Urinary tract infection

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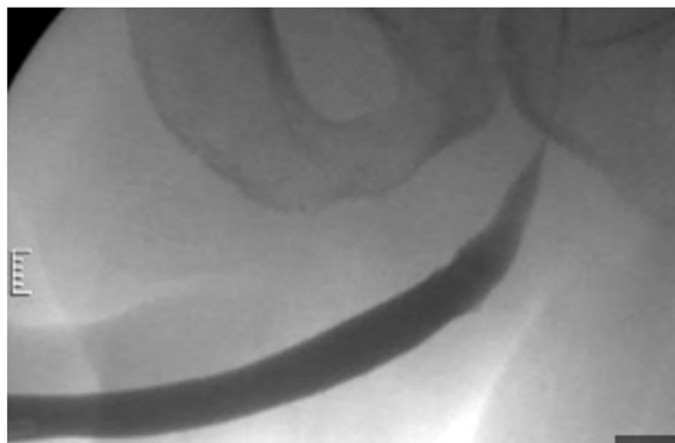


Figure 2. Postoperative retrograde urethrography

significantly lower urethroplasty success rates in patients with two or more prior IU procedures. Therefore, identifying risk factors for recurrence is essential for optimizing clinical decision-making.

The relatively high success rate in our study may be attributed to the inclusion of only primary, short-segment strictures, the predominance of bulbar urethral strictures, and the definition of success as the absence of re-intervention. Nevertheless, prospective, multicenter studies with longer follow-up periods are required to validate these findings.

Our results demonstrated that advanced age, DM, CAD, and postoperative complications (hematuria, urinary tract infection, etc.) significantly increased the risk of recurrence after IU. Yahşi et al. (9) reported that urethral strictures in elderly patients are associated with vascular insufficiency and decreased tissue perfusion. Similarly, Mondal et al. (10) emphasized that low serum testosterone levels were associated with longer strictures and higher recurrence rates. Consistent with these findings, our data confirmed a significant association between increasing age and recurrence risk.

The negative impact of diabetes and aging on wound healing has been well established in previous studies (11,12). Additionally, components of the metabolic syndrome have been linked to adverse urologic outcomes and may influence stricture biology (13).

In line with this, our study also demonstrated a significantly higher recurrence risk among patients with DM. Likewise, CAD plays a key role not only in the development of urethral strictures but also in recurrence risk. Yildiz et al. (14) reported a positive correlation between CAD severity and urethral stricture formation while Meyer et al. (15) found that CAD significantly increased recurrence rates after urethroplasty. Our findings also support a significant association between CAD and recurrence after IU.

Regarding etiology, iatrogenic causes predominate in developed countries, whereas traumatic and infectious causes are more frequent in developing regions (16). Sawyer et al. (17) reported a limited impact of postoperative infections and hematomas on early recurrence, whereas in our study, all patients with postoperative complications experienced early recurrence, suggesting a stronger association in our cohort.

Although some studies have suggested that stricture length and catheterization duration may affect recurrence risk (18,19), we found no significant association between these variables and recurrence in our analysis.

Study Limitations

The main limitations of our study include its retrospective design, single-center setting, limited long-term follow-up data, and the fact that procedures were performed by different surgeons.

Future prospective, multicenter studies with standardized surgical techniques and longer follow-up periods are warranted to confirm our findings.

Conclusion

IU is a simple, minimally invasive procedure that is safely applied in selected patients; however, advanced age, DM, CAD, and postoperative complications significantly increase the recurrence risk. Identifying these risk factors may help in selecting high-risk patients who could benefit from early consideration of alternative surgical options such as urethroplasty.

Ethics

Ethics Committee Approval: This retrospective study was approved by the Institutional Review Board of Hitit University Clinical Research Ethics Committee (approval number: 2024/88; date: 15.10.2024) and conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.S.Ç., C.A., M.K., M.E., M.İ.Ö., Me.K., M.M.B., Concept: M.S.Ç., C.A., M.K., M.E., M.İ.Ö., Me.K., M.M.B., Design: M.S.Ç., C.A., M.K., M.E., M.İ.Ö., Me.K., M.M.B., Data Collection or Processing: M.S.Ç., C.A., M.K., M.E., M.İ.Ö., Me.K., M.M.B., Analysis or Interpretation: M.S.Ç., C.A., M.K., M.E., M.İ.Ö., Me.K., M.M.B., Literature Search: M.S.Ç., C.A., M.K., M.E., M.İ.Ö., Me.K., M.M.B., Writing: M.S.Ç., C.A., M.K., M.E., M.İ.Ö., Me.K., M.M.B.

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