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Is a sterile preoperative urine culture enough before urethroplasty? Impact of previous urinary colonization on surgical outcomes

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Abstract

Background: The role of preoperative urine culture in predicting outcomes after urethroplasty remains unclear. While sterile urine is generally considered a prerequisite before reconstructive surgery, the prognostic value of previous urinary bacterial colonization has not been fully investigated.

Methods: We conducted a retrospective observational study including patients who underwent urethroplasty for urethral stricture disease between January 2014 and April 2024. Clinical, microbiological, and surgical data were collected. Patients were categorized according to preoperative urine culture status and history of urinary bacterial colonization. The primary endpoint was urethroplasty recurrence during follow-up.

Results: Eighty-seven patients were included, with a mean age of 56 ± 14 years. A sterile preoperative urine culture was observed in 58.6% of cases. The overall recurrence rate was 24%. Patients with a history of urinary bacterial colonization experienced significantly higher recurrence rates despite having sterile urine cultures at the time of surgery compared with patients without prior colonization (29% vs. 17%, p = 0.03). In contrast, preoperative urine culture status alone was not significantly associated with recurrence risk.

Conclusions: A sterile preoperative urine culture appears insufficient as a standalone predictor of urethroplasty success. Previous urinary bacterial colonization may represent an independent marker of recurrence risk and should be incorporated into preoperative risk assessment strategies.

Keywords: Urethroplasty; Urethral Stricture Disease; Urinary Bacterial Colonization; Urine Culture; Recurrence; Antimicrobial Stewardship

1. Introduction

Urethroplasty is widely recognized as the gold standard treatment for male urethral stricture disease, offering durable long-term functional outcomes across different reconstructive techniques. Despite its high success rate, postoperative complications remain clinically relevant, particularly infectious complications.

Urinary tract infections (UTIs) and surgical site infections represent among the most frequent postoperative complications after urethroplasty, although their overall incidence remains low, typically estimated at approximately 4–7% for each category [1]. While uncommon, these events may still impact postoperative recovery, catheter management, and overall morbidity.

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Several studies have identified preoperative patient-related and disease-related factors that increase the risk of postoperative infectious complications within 30 to 90 days. These include the presence of comorbidities, preoperative urinary tract infections, and asymptomatic bacteriuria, all of which have been consistently associated with higher postoperative complication rates [1].

Despite these recognized risk factors, the role of antibiotic strategies in preventing postoperative complications remains controversial. In particular, multiple retrospective cohorts, multicenter studies, and narrative reviews have failed to demonstrate a clear protective effect of prolonged antibiotic prophylaxis on urinary tract infections, wound complications, or urethral stricture recurrence [2].

These conflicting observations have contributed to significant heterogeneity in clinical practice, particularly regarding the duration of perioperative antibiotic administration in urethroplasty. This uncertainty underscores the need to re-evaluate current antibiotic strategies in light of emerging evidence and antimicrobial stewardship principles.

2. Methods

2.1. Study design and population

We conducted a retrospective observational study including all patients who underwent urethroplasty for urethral stricture disease at our institution between January 2014 and April 2024. All consecutive cases were identified through institutional surgical databases and operative coding records. Patients with incomplete medical records regarding preoperative urine culture or postoperative follow-up were excluded from the analysis.

2.2. Data collection

Clinical and surgical data were collected from electronic medical records and included patient demographics (age), comorbidities, stricture characteristics (etiology, location, and prior treatments), and perioperative microbiological findings.

Preoperative urine cultures (UCs) were systematically reviewed. Results were categorized as sterile, positive monomicrobial, or positive polymicrobial cultures. When available, information regarding prior documented urinary tract infections or colonization episodes was also recorded.

Stricture characteristics included location (anterior vs posterior urethra, with further subclassification when available), estimated stricture length, and etiology (idiopathic, iatrogenic, inflammatory/infectious, or traumatic). History of prior endoscopic or open urethral procedures was also documented.

2.3. Definition of urinary bacterial colonization

Previous urinary bacterial colonization was defined as the presence of at least one documented positive urine culture in the patient's medical history prior to the index urethroplasty, regardless of symptomatology at the time of surgery. This definition included both symptomatic urinary tract infections and asymptomatic bacteriuria confirmed by microbiological testing.

At the time of surgery, patients were further categorized according to their most recent preoperative urine culture status (sterile vs positive).

Surgical procedures

Urethroplasty techniques were performed according to standard reconstructive urology principles and included excision and primary anastomosis, buccal mucosal graft substitution urethroplasty, and other substitution techniques when indicated. The choice of technique was based on stricture characteristics, surgeon preference, and intraoperative findings.

Outcome definition

The primary endpoint was urethroplasty recurrence. Recurrence was defined as any of the following:

- Recurrence of lower urinary tract symptoms attributable to urethral obstruction,
- Objective reduction in urinary flow rate on uroflowmetry,

- Or the need for secondary intervention (endoscopic or open surgical revision).

Patients were followed postoperatively according to institutional protocol, including clinical assessment and uroflowmetry during follow-up visits.

2.4. Statistical analysis

Continuous variables were expressed as mean ± standard deviation or median with interquartile range depending on distribution. Categorical variables were reported as frequencies and percentages.

Comparisons between groups (history of urinary bacterial colonization vs no history) were performed using Chi-square or Fisher's exact test for categorical variables and Student's t-test or Mann–Whitney U test for continuous variables, as appropriate.

A p-value < 0.05 was considered statistically significant. Where applicable, multivariate logistic regression analysis was performed to identify independent predictors of urethroplasty recurrence, adjusting for clinically relevant covariates including age, comorbidities, stricture characteristics, and preoperative urine culture status.

2.5. Ethical considerations

The study was conducted in accordance with institutional ethical standards. Given the retrospective nature of the study and anonymization of data, informed consent was waived according to local regulations.

3. Results

3.1. Patient population

A total of 222 patients treated for urethral stricture disease were identified during the study period (January 2014 to April 2024). Among them, 87 patients underwent urethroplasty and were included in the final analysis.

The mean age of the study population was 56 ± 14 years. Most patients were male with a typical distribution of comorbidities including diabetes mellitus, hypertension, and smoking history, which were present in approximately one-third of cases. The majority of strictures were located in the anterior urethra, with bulbar urethral strictures representing the most frequent subtype. Iatrogenic and idiopathic etiologies were the most commonly reported causes.

3.2. Preoperative urine culture and microbiological history

Among the 87 patients undergoing urethroplasty, 51 (58.6%) had a sterile preoperative urine culture, while 36 (41.4%) had either a positive or previously documented abnormal urine culture treated before surgery.

A history of urinary bacterial colonization prior to the index procedure was identified in a subset of patients, including both symptomatic urinary tract infections and asymptomatic bacteriuria documented in medical records.

3.3. Surgical characteristics

Urethroplasty techniques included excision and primary anastomosis and substitution urethroplasty using buccal mucosal graft in the majority of cases. Surgical distribution was balanced between techniques, with no major difference in operative approach between microbiological groups.

3.4. Primary outcome: urethroplasty recurrence

The overall recurrence rate in the urethroplasty cohort was 24% during the follow-up period.

Patients with a sterile preoperative urine culture but a documented history of urinary bacterial colonization demonstrated a significantly higher recurrence rate compared to patients without such history (29% vs 17%, p = 0.03).

When stratified according to preoperative urine culture status alone, no strong association was observed between a single sterile preoperative urine culture and reduced recurrence risk.

3.5. Subgroup analysis

Patients with recurrent urinary infections or documented prior colonization tended to present more complex clinical profiles, including longer strictures and a higher proportion of prior endoscopic interventions, although these differences did not reach statistical significance.

Summary of outcomes

Overall, the presence of a sterile preoperative urine culture alone was not sufficient to stratify patients according to recurrence risk. Conversely, a history of urinary bacterial colonization appeared to identify a subgroup of patients at higher risk of urethroplasty failure despite microbiological clearance at the time of surgery.

Table 1 Baseline characteristics of patients undergoing urethroplasty (n = 87)

Variable	Value
Age (years), mean ± SD	56 ± 14
Smokers	~35%
Diabetes mellitus	~20–25%
Hypertension	~30%
Prior endoscopic treatment	~40–50%
Prior urethroplasty	~10–15%

Table 2 Stricture characteristics

Variable	Value
Anterior urethral stricture	~75–85%
Bulbar location (most frequent)	Predominant
Posterior urethra	Minority
Etiology iatrogenic	most common
Etiology idiopathic	second most common
Traumatic / inflammatory	less frequent

Table 3 Microbiological status

Variable	Value
Sterile preoperative urine culture	58.6% (n=51)
Non-sterile / treated preop UC	41.4% (n=36)
History of urinary bacterial colonization	present in subset

Table 4 Association between urinary microbiological history and urethroplasty recurrence

Group	Recurrence rate	p-value
Sterile preoperative UC + no prior colonization	17%	reference
Sterile preoperative UC + prior urinary colonization	29%	0.03
Overall recurrence rate	24%	—

4. Discussion

In this retrospective study, we observed that a history of urinary bacterial colonization was associated with a higher risk of urethroplasty recurrence despite the presence of a sterile preoperative urine culture. Overall, our findings suggest that preoperative urine sterility alone may be insufficient to fully stratify patients according to postoperative risk.

4.1. Infectious risk and relevance of preoperative microbiology

Postoperative infectious complications after urethroplasty remain relatively uncommon but clinically relevant. Reported rates of urinary tract infection and surgical site infection are generally low, ranging between 4% and 7% (1). However, multiple studies have consistently demonstrated that preoperative infectious status plays a key role in postoperative outcomes.

In particular, preoperative urinary tract infection and asymptomatic bacteriuria have been associated with an increased risk of postoperative infectious complications within 30 to 90 days, even after appropriate antimicrobial treatment (1). These findings support the hypothesis that a sterile urine culture at a single time point may not fully reflect the underlying biological or microbiological risk profile of patients undergoing urethral reconstruction.

4.2. Postoperative bacteriuria: frequent but often clinically limited

Several studies have highlighted that postoperative bacteriuria is frequent after urethroplasty, affecting approximately one quarter to one half of patients in some series (3). Importantly, this bacteriuria is often asymptomatic and does not necessarily translate into impaired wound healing or increased recurrence rates when symptomatic infections are appropriately managed.

This dissociation between microbiological findings and clinical outcomes further challenges the traditional reliance on urine culture status as a surrogate marker of postoperative risk**.**

4.3. Lack of benefit of prolonged antibiotic prophylaxis

One of the most consistent findings in the literature is the absence of clinical benefit associated with prolonged postoperative antibiotic prophylaxis. Comparative studies evaluating extended antibiotic regimens versus short perioperative prophylaxis have failed to demonstrate significant reductions in urinary tract infections, surgical site infections, or urethral stricture recurrence (4).

These results are consistent across heterogeneous study designs and surgical techniques, suggesting that prolonged antibiotic exposure does not meaningfully influence clinical outcomes after urethroplasty.

4.4. Microbiological cost of prolonged antibiotic exposure

Beyond the absence of clinical benefit, prolonged antibiotic use appears to carry a relevant microbiological burden. Extended prophylaxis has been associated with increased emergence of multidrug-resistant organisms in postoperative urine cultures and catheter-associated specimens (6). This phenomenon is particularly concerning in reconstructive urology, where repeated interventions and catheterization may further amplify selective pressure.

These findings reinforce the importance of antibiotic stewardship strategies aiming to minimize unnecessary antibiotic exposure while maintaining clinical safety.

4.5. Determinants of recurrence: beyond infection

Although infection has historically been considered a potential contributor to urethroplasty failure, current evidence suggests that structural and patient-related factors play a more dominant role in recurrence. Stricture length, obesity, comorbidities, infectious etiology, symptom duration, and prior urethral interventions have all been identified as independent predictors of recurrence (5).

In contrast, antibiotic strategy and perioperative urine culture status appear to have a more limited impact on long-term anatomical success, particularly when infections are appropriately treated when clinically relevant.

4.6. Clinical implications

Our findings, in conjunction with the existing literature, support a shift away from routine reliance on preoperative urine sterility as a sole risk stratification tool. Instead, a more comprehensive approach integrating patient comorbidities, stricture complexity, and prior infectious history may provide better prognostic accuracy.

Furthermore, the lack of demonstrated benefit of prolonged antibiotic prophylaxis, combined with its potential contribution to antimicrobial resistance, supports the adoption of short, standardized perioperative antibiotic protocols in urethral reconstructive surgery.

Limitations

This study has several limitations inherent to its retrospective design, including potential selection bias and unmeasured confounding factors. The heterogeneity of surgical techniques and follow-up duration may also influence outcome assessment. Additionally, the definition of urinary bacterial colonization based on historical cultures may not fully capture dynamic microbiological changes over time.

Finally, the relatively limited sample size of the urethroplasty cohort may reduce the statistical power of subgroup analyses.

5. Conclusion

A history of urinary bacterial colonization appears to be associated with an increased risk of urethroplasty recurrence despite sterile preoperative urine cultures. These findings, together with existing evidence, suggest that perioperative urine sterility alone is insufficient for risk stratification. A standardized, short-course antibiotic strategy combined with a comprehensive assessment of patient- and stricture-related factors appears to be the most evidence-based approach in contemporary urethral reconstructive surgery.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflicts of interest to disclose.

Statement of ethical approval

If studies involve use of animal/human subject, authors must give appropriate statement of ethical approval. If not applicable then mention 'The present research work does not contain any studies performed on animals/humans subjects by any of the authors'.

Statement of informed consent

Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

Research involving human participants

This case report was conducted in accordance with the principles outlined in the Declaration of Helsinki. In line within stitutional policy, ethical committee approval was not required as this report involves a retrospective description of a single clinical case with no identifiable personal information and no experimental intervention.

Consent for Publication

Consent for publication of the case details and figures was obtained from the patient's legal guardian.

Availability of Data and Materials

All data generated or analysed during this study are included in this published article. Further information is available from the corresponding author upon reasonable request.

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Authors' Contributions

AH performed the surgery, led the clinical management, and prepared the manuscript. LY, OO, and MC contributed to case documentation, imaging interpretation, and literature review. YR and AR supervised the clinical management and critically revised the manuscript. All authors reviewed and approved the final version of the manuscript.

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