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Cost-effective Strategies for the Management and Treatment of Urethral Stricture Disease

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KEYWORDS

• Urethroplasty • Cost-effectiveness • Utilization

KEY POINTS

- Urethroplasty is a cost-effective strategy for operative management of urethral stricture disease.
- An accurate estimation of stricture recurrence will guide urologists toward the appropriate intervention.
- Symptom-based surveillance of postoperative urethral stricture disease will reduce unnecessary diagnostic procedures and cost.

INTRODUCTION

Urethral stricture disease (USD) is a narrowing of the urethra from scar tissue, attributed to traumatic urethral injury, infections of the genitourinary tract, pelvic radiation, inflammatory skin conditions, and/or prior lower urinary tract instrumentation.[1] USD causes both obstructive and irritative voiding symptoms and can result in bladder and renal impairment.[1] The prevalence of USD among men from industrialized countries is estimated to be 0.9%.[1] In the United States between 2007 and 2012, an estimated 1.2 million patients sought medical care for USD.[2]

Treatment options for USD include endoscopic and/or open surgical techniques. The mainstay for endoscopic managements include urethral dilation or direct vision internal urethrotomy (DVIU). Open reconstructive surgical techniques include urethroplasty, which may be performed in conjunction with a graft or flap.[1] The management of USD has shifted from periodic dilation to DVIU and now urethroplasty, as the definitive procedure of choice for recurrent USD.[3,4] Although DVIU may be used for short, bulbar strictures,[5] its long-term efficacy has been called into question.[6] Urethroplasty is considered to be the gold standard for USD and has high success rates.[7] Despite the convincing evidence for urethroplasty, a recent Cochrane review concluded that there are insufficient data to determine which intervention is best for USD in terms of balancing efficacy, adverse effects, and costs.[8]

To date, many urologists report repeating a DVIU or dilation procedure despite the high rate of recurrence.[9] Repeated endoscopic interventions for recurrent USD are futile and have been proven to be cost-ineffective.[3,4,10] Estimates of procedural costs for USD are limited.[11] With the passage of the Affordable Care Act and paradigm shift toward cost-effective medicine, urologists are urged to perform efficacious procedures at lower

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costs.[12] There is an increased attention toward high-value, low-cost health care in the United States as the projected cost of current practices may be unsustainable.[13] Policy makers, government officials, and insurance companies have scrutinized procedural costs and surgical outcomes to maximize quality care at lower costs.[14] Such scrutiny has led to the development of quality reporting clearinghouses like the American Urologic Association Quality Registry and the National Surgical Quality Improvement Program.[14,15]

Within the last 10 years, several studies have been published on cost-effective management strategies for USD as part of a growing focus on high-quality, low-cost health care. Here the authors present a review of current literature on minimizing cost for patients with USD. In particular, the authors focus on the costs of managing USD with DVIU versus urethroplasty, inpatient hospital costs following urethroplasty, and the costs of USD surveillance strategies.

COST OF INTERNAL URETHROTOMY/ DILATION VERSUS URETHROPLASTY

In 1974, optical DVIU was first reported and quickly gained acceptance because of its simplicity, reliability, safety, and short convalescence.[9] Today, urologists use either a cold-knife or a laser source to perform cuts within the urethra at the level of the stricture. Although initial reports suggested short-term success to be around 80%,[16] it is well known that the success of DVIU is much lower with longer follow-up and well-designed prospective studies.[5,17] In patients with at least 60 months of follow-up, DVIU was found to be successful in only 32% of men.[5] Urethral dilation has a similar success, as several studies have shown dilation to be equal in efficacy to DVIU.[17,18] Nevertheless, DVIU remains the most common procedure performed for USD in the United States.[19] In a nationwide survey, 31% of urologists reported repeating a second DVIU after the first failed DVIU.[9] However, DVIU has been proven to be cost-ineffective in several well-reported studies.

In 2004, Greenwell and colleagues[3] developed an algorithm for the management of USD based on cost-effectiveness. The investigators used the UK's medical insurance reimbursement rates and applied them to 126 men treated for USD over an 8-year period. Men with preexisting USD that previously required intervention were excluded from the study. The investigators followed patients for a mean of 25 months (range 1–132 months). Of the 126 men with a new diagnosis of USD, 60 (47.6%) required more than 1 endoscopic treatment (mean 3.13 treatments). In total, 194 additional procedures were performed for recurrent USD, of which 7 were urethroplasties. The investigators calculated the total costs of care for USD over their follow-up period by multiplying the number of procedures by the costs of endoscopic treatments, the costs associated with clean intermittent catheterization, and ultimately the costs associated with urethroplasty. They concluded that the total cost per patient with USD was $9170; however, this cost could be lowered if urethral dilation or DVIU was performed as a first-line treatment and then subsequent urethroplasty was performed for recurrent USD. In doing so, the cost per patient would be reduced to $8799.[3] Despite a theoretic savings of $371 if urethroplasty was performed after endoscopic failure, the article has several limitations. The investigators presumed a second-stage urethroplasty would require only 2 postoperative visits; they assumed the hospital length of stay for all patients to be standard (24-hour hospital stay for DVIU or dilation, 3 days for simple urethroplasty, and 5 days for complex urethroplasty); the investigators assumed a ratio of first- to second-stage urethroplasties to be 1.9:1.0; and lastly they assumed a 10.5% stricture recurrence rate, both figures derived from their historical data. They also included data from both bulbar and penile urethral strictures, which are not comparable groups. Each of these factors could dramatically alter the costs of USD.

In 2005, Rourke and Jordan[4] constructed a decision model using decisional analysis (DA). Briefly, DA is a statistical method whereby a systematic framework for decision-making is applied between 2 competing options. One outcome of a DA is a cost-effectiveness ratio that attempts to maximize the outcome for a given budget.[10] In this study, the investigators used published data on the costs of bleeding, urinary tract infection, and stricture recurrence following DVIU and compared this with published data on the costs of a wound complication, complications from high lithotomy positioning, and stricture recurrence. The primary aim was to determine the least costly approach for a hypothetical male patient seeking treatment of a 2-cm bulbar urethral stricture.[4] Cost estimates for the postoperative complications, surgeon's fees, hospital fees, operative costs, and costs of follow-up procedures were based on Medicare reimbursement and data from the investigators' home institutions. Total costs for DVIU were calculated to be $17,748 versus $16,444 for anastomotic urethroplasty yielding a cost savings of $1304 per patient. Only when a theoretic success of DVIU approached

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60% did the procedure become cost-effective.[4] Similarly, as long as the theoretic success of urethroplasty remained more than 71%, then it was more cost-effective; most large series report urethroplasty success to be much higher.[20] Despite a clear monetary difference between procedures, it is unclear that this would generalize to a prospective series of patients. Furthermore, the investigators point that that they used estimates of costs based on their own institution's data and surgeries were performed by high-volume surgeons. The investigators also point that their study failed to analyze outcomes and, thus, the cost-effectiveness of different interventions cannot be determined unless the effectiveness of the alternatives is assumed to be similar. Nevertheless, the up-front cost of urethroplasty, although costlier, has a higher success rate.

In **Table 1**, the authors summarize data based on Greenwell and colleagues[3] and Rourke and Jordan.[4] For simplicity sake, the authors assume that urethroplasty is highly successful (eg, ~100%). The authors demonstrate that the combined cost of a failed DVIU procedure followed by a urethroplasty is higher than the up-front cost of urethroplasty alone.

Using a similar DA, Wright and colleagues[10] published data in 2006 comparing the costs of different management strategies for a 1- to 2-cm bulbar stricture. The authors constructed a decision tree whereby the number of planned DVIUs was hypothesized before planned urethroplasty. Fees associated with procedural costs derived from Medicare data, office visits, and lost wages from convalescence were collected. The authors found that for a 1- to 2-cm bulbar stricture, with published success rate of 50% for the first DVIU, 20% for the second DVIU, and 95% for anastomotic urethroplasty, a strategy of one DVIU preceding urethroplasty was least costly ($8575) compared with 2 DVIUs followed by urethroplasty ($9285) or up-front urethroplasty ($10,222). When first-time DVIU success was estimated to be less than 35%, up-front urethroplasty was most cost-effective.[10] This finding differs from the study by Rourke and Jordan[4] because of the differing rates of success and cost estimates.

Taking the 3 aforementioned studies together, as the success of a DVIU decreases, the most cost-effective option for USD is urethroplasty. In **Fig. 1**, the authors demonstrated that the theoretic cost per patient is inversely proportional to the success rate of the procedure. As DVIU becomes more successful, it is cheaper on a population level or per patient and the same is true for urethroplasty. In either case, the failures are costly. Perhaps the most challenging aspect of determining cost-effectiveness of urethroplasty over DVIU is an accurate prediction of success and recurrence rates. Given the heterogeneity of data, urologists who treat USD must choose the appropriate and cost-effective procedure after weighing a patients' presenting symptoms, their proposed outcomes, predicted success, existing comorbidities, predicted postoperative convalesce, and patient preferences (**Fig. 2**). Here, expert clinical judgment is essential to guide patients to the most appropriate surgery. For example, a straddle injury-induced stricture has a notoriously high restricture rate following DVIU due to dense focal spongiofibrosis and is unlikely to respond to DVIU.[21] In this instance, clinical acumen and understanding of USD is key to providing cost-effective, efficacious patient care.

UNDERUTILIZATION OF URETHROPLASTY

Despite studies demonstrating improved efficacy and cost-effectiveness of urethroplasty over DVIU, there remains high regional variation using urethroplasty within the United States. Using claims from MarketScan data, Figler and colleagues[19] found that endoscopic management of USD was far more common than urethroplasty.

Table 1
Success and cost of urethroplasty versus direct vision internal urethrotomy

First Treatment	Cost	Success Rate (%)	Second Treatment	Cost	Success Rate (%)	Cost Per Patient
DVIU	$3375.00	28	Urethoplasty	$7522.5	~100	$8791.20
Urethoplasty	$7722.50	96	2-Stage urethroplasty	$15,555.00	~100	$8144.70
DVIU	$3375.00	28	Lifelong intermittent catheterization	$17.00/mo	0	$8144.70

Data from Greenwell TJ, Castle C, Andrich DE, et al. Repeat urethrotomy and dilation for the treatment of urethral stricture are neither clinically effective nor cost-effective. J Urol 2004;172(1):275–7; and Rourke KF, Jordan GH. Primary urethral reconstruction: the cost minimized approach to the bulbous urethral stricture. J Urol 2005;173(4):1206–10.

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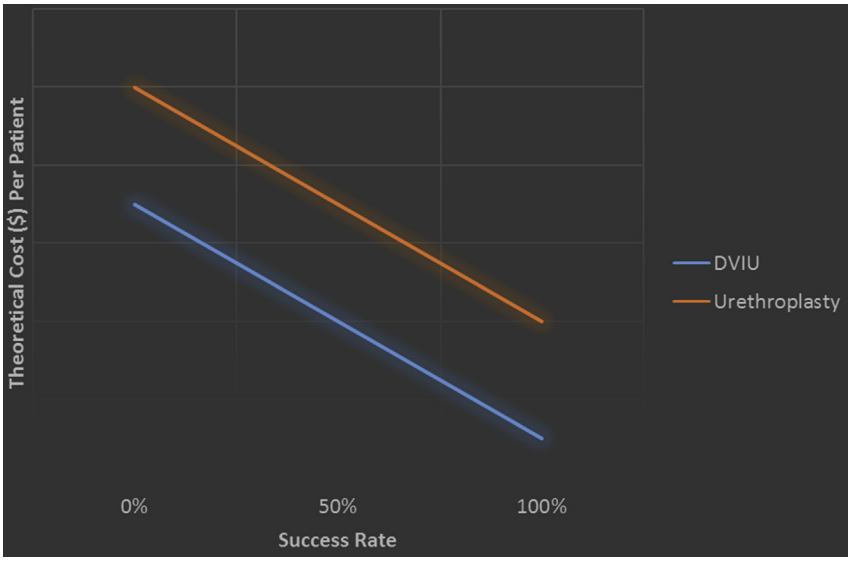

Fig. 1. Cost-effectiveness of DVIU versus urethroplasty.

Those patients who underwent urethroplasty were younger, more likely to travel to a metropolitan area for treatment, and a reconstructive urologist was more likely to be involved in their treatment. Among the Veterans Affairs' hospital system, a similar phenomenon is seen whereby only 5% of men underwent a urethroplasty, and most underwent a DVIU or dilation.[22] Among the elderly, Anger and colleagues[23] demonstrate that Medicare beneficiaries are also more likely to undergo DVIU or dilation over a urethroplasty despite increasing trends in USD. Review of the American Board of Urology's surgical case logs demonstrated that urologists performed 17 DVIU or dilations per every 1 urethroplasty.[24] These trends are attributable to several factors, including an unfamiliarity of published outcomes of urethroplasty[9] and a lack of qualified reconstructive urologists in certain regions of the United States, yet 74% of urologists think that urethroplasty should be offered after repeat endoscopic treatment failure.[19]

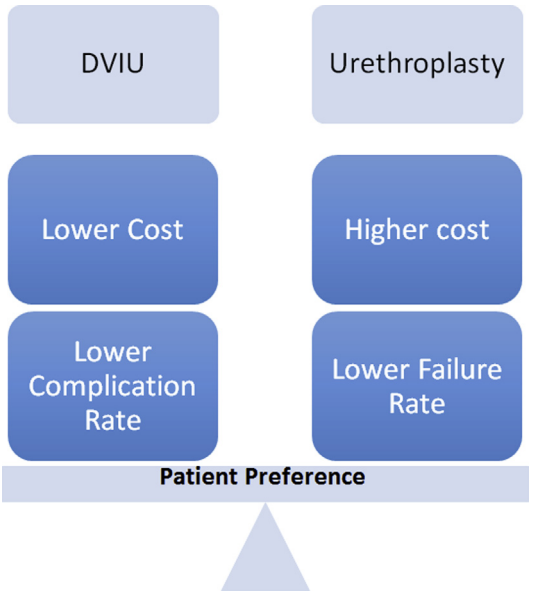

Fig. 2. Balancing efficacy and cost-effectiveness for DVIU versus urethroplasty.

INPATIENT HOSPITAL COSTS ASSOCIATED WITH URETHROPLASTY

Although most endoscopic management of USD is performed in an outpatient setting, most urethroplasties performed in the United States are done with either a short stay or inpatient hospital admission.[25] Associated costs with hospital admission may challenge up-front urethroplasty over an initial DVIU attempt. Characterizing hospital costs associated with urethroplasty may better identify the major drivers of hospital costs associated with USD.

Blaschko and colleagues[2] used the National Inpatient Sample data to determine national trends of urethroplasties and costs associated with inpatient hospitalization. The investigators reported an overall complication rate of 6.6%, which increased with age and comorbidities but not type of urethroplasty performed. As the number of complications increased, the mean length of hospital stay and total charges rendered for the hospital stay increased. The mean total hospital charges were

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3-fold higher for patients with 3 or more postoperative complications (from $24,853 to $77,059).[2] Interpretation of hospital costs associated with urethroplasty is limited because the investigators did not control for length of stay or complexity of urethroplasty.

To gain a more granular assessment of inpatient costs associated with urethroplasty, Harris and colleagues[25] used the same data set but captured hospital charges relating to USD. Over the investigators' study period, a total of 2298 urethroplasties were performed with a median hospital cost of $7321. With extreme costs defined as the top 20th percentile of expenditure, the investigators found that patients with multiple comorbid diseases were associated with increased costs (odds ratio [OR] 1.56, 95% confidence interval [CI] 1.19–2.04, $P = .02$).[25] Inpatient complications increased the odds of extreme costs (OR 3.2 95% CI 2.14–4.75, $P < .001$), as did graft urethroplasties (OR 1.78, 95% CI 1.2–2.64, $P = .005$). Interestingly, the investigators did not find any differences in extreme costs based on patient age, race, hospital region, bed size, teaching status, payer type, and volume of urethroplasty cases.[25] Although the study was limited to inpatient/short-stay hospital-associated costs, the major drivers of costs associated with urethroplasty stem from postoperative complications and to a lesser degree from preoperative patient comorbidities and surgical complexity. Currently, the total costs of outpatient urethroplasty have not been reported in the literature. Future studies should compare an in-depth analysis of outpatient urethroplasty stratified by stricture location/complexity.

COSTS OF FOLLOW-UP AFTER URETHROPLASTY

The cost-effectiveness of urethroplasty for recurrent USD may be sustained by the prolonged stricture-free rates. This highly efficacious procedure will allow for decreased postoperative follow-up visits. With recurrence rates after DVIU as high as 80%, patients will often require repeat office evaluation, diagnostic retrograde urethrograms, and cystoscopies.[5] For urethroplasty, despite a lower recurrence, patients will also undergo repeat office evaluation with diagnostic evaluation. Currently, there remains no standard surveillance approach for USD following urethroplasty. A wide range of both noninvasive (uroflowmetry, questionnaires, postvoid residual ultrasound, and so forth) and invasive (retrograde urethrogram, voiding cystourethrogram, urethral calibration, and cystoscopy) options is available for stricture surveillance.[26] In 2015, Zaid and colleagues[26] surveyed current literature to delineate commonly used surveillance strategies and compared the costs of varying diagnostic evaluations used by urologists. The investigators reported that the median cost for the first year of USD surveillance following anterior urethroplasty was $660, and over 5 years this extrapolated to $1069. Following a posterior urethroplasty, the median cost of surveillance at 1 and 5 years was $800 and $1286, respectively. Most surveillance costs occurred in the first postoperative year.[26] This study demonstrates there is significant variability in the frequency and intensity of postoperative USD surveillance. Currently, there is no standard of surveillance that balances cost-conscious care with early diagnosis of recurrence. Furthermore, it is not known whether early diagnosis of USD recurrence following urethroplasty has been shown to improve clinical outcomes.

To demonstrate a cost-effective, risk-stratified approach to patient follow-up following urethroplasty, Belsante and colleagues[27] performed a DA demonstrating a reduction in unnecessary follow-up visits, invasive testing, and radiation exposures. In 2013, the investigators compared a hypothetical simplified, symptom-based follow-up protocol with a standard regimen of close follow-up following anastomotic urethroplasty. The two arms of the study included a low-risk, anastomotic urethroplasty group in which theoretic patients only followed up as needed and a standard-risk group, which included any flap/graft urethroplasty and/or a history of radiation, lichen sclerosus, or hypospadias. This hypothetical standard-risk group underwent a regimented follow-up protocol every 3 months for 1 year and then yearly after with a uroflowmetry and retrograde urethrogram. Using a simplified, symptom-based follow-up scheme of men who underwent anastomotic urethroplasty, Belsante and colleagues[27] found that it was 85% lower in cost versus a regimented follow-up practice ($430 vs $2827) for standard patients. Using sensitivity analysis, the investigators concluded that when the success rate of anastomotic urethroplasty was greater than 10%, a symptom-based follow-up was most cost-effective. The rationale for the authors' conclusion is that recurrent USD will manifest with lower urinary tract symptoms, and unnecessary diagnostic testing is of little benefit to patients.[27] Therefore, stratifying USD by risk of recurrence will greatly decrease the burden of follow-up and cost.

SUMMARY

When considering the most cost-effective option for men with USD, a surgeon must rely on his or

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her estimates of recurrence, complication rates, and convalescence. Current data suggest that urethroplasty is a more cost-effective procedure for USD, especially in patients who have failed DVIU. Costs for inpatient urethroplasty are mainly driven by postoperative complications and patient comorbidities. Standard surveillance regimens for USD recurrence are lacking; however, a simplified, symptom-based approach is more cost-conscious. The authors present current data that balances the accessibility and inexpensiveness of a DVIU with the long-term efficacy at a higher surgical cost for urethroplasty. In times of fiscal constraint and managed health care, it is imperative to evaluate surgical efficacy in terms of cost-saving strategies. Future studies should examine the cost-effectiveness of up-front urethroplasty and efficacy as compared with endoscopic management followed by urethroplasty. Well-designed, adequately powered, multicenter trials are also needed to prospectively evaluate if urethroplasty is more cost-effective over DVIU/dilation. As urologists, our duty is to improve our patients' quality of life by maximizing patient outcomes and experience in a cost-conscious manner.

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