JOURNAL OF ENDOUROLOGY
Volume 00, Number 00, Month 2026
Mary Ann Liebert, A Part of Sage

Pp. 000–000
DOI: 10.1177/08927790261472746

A New Technique for the Treatment of Ureteral Stricture in Patients with Solitary Kidney

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Abstract

Objective: To evaluate the safety and efficacy of the Allium metal ureteral stent (AMUS) in treating ureteral stricture (US) in patients with solitary kidney (SK).

Patients and Methods: We prospectively collected clinical data from 47 SK patients with US who underwent endoscopic AMUS placement between January 2019 and December 2021. Surgical success was defined as in-place AMUS stenting with unobstructed drainage.

Results: This research included 47 patients with 50 cases of US, achieving successful stent placement in 98.0% of cases. The surgical success rates at 1 week, 1 year, and 2 years postoperatively were 96.0%, 82.0%, and 70.0%, respectively. Long-term postoperative follow-up demonstrated significant reductions in hydronephrosis volume, serum creatinine, and blood urea nitrogen levels compared to preoperative values, with glomerular filtration rate (GFR) maintained at stable levels. Causes of procedural failure during follow-up included stent migration (10.0%), occlusion (6.0%), stone impaction (8.0%), and urinary tract infection (UTI) (4.0%). Complications associated with AMUS placement included pain (12.0%), hematuria (14.0%), UTI (14.0%), and lower urinary tract symptoms (10.0%).

Conclusions: Two-year follow-up demonstrated that AMUS endoscopic treatment is feasible and potentially effective for US in SK patients, maintaining stable GFR in the short- to medium term. For patients who are unwilling or unsuitable for surgical reconstruction, AMUS serves as an alternative management approach; however, larger sample sizes and longer follow-up periods are needed to validate these findings further.

Keywords: endoscopic treatment, solitary kidney, ureteral stricture, metallic ureteral stent

Introduction

Ureteral stricture (US) is a relatively rare and complex urological condition, typically caused by iatrogenic injuries resulting from various abdominal surgeries (gastrointestinal, gynecological, and urological) and transurethral urological procedures.[1,2] Furthermore, with the increasing refinement and maturation of endoscopic urological treatment techniques—particularly the growing use of high-frequency lasers—the incidence of this condition is rising.[2] Without timely intervention, prolonged obstruction and narrowing of the ureter can lead to hydronephrosis and even kidney failure.[3,4] According to current guidelines from the European Association of Urology or the American Urological Association, there are several treatment options for US, including end-to-end ureteral anastomosis, ileal bladder substitution, ileal ureteral replacement, and *in situ* bladder reconstruction.[5,6] However, this becomes significantly more complex in patients with a solitary kidney (SK), although there are various treatment options available, the varying degrees of invasiveness of these approaches make it impossible to guarantee they won't further deteriorate the already compromised renal function.[7] The earliest documented treatment for US in SK patients dates back to Kosto et al.'s 1990 report.[8] Nevertheless, surgical approaches for US in SK patients remain relatively limited, with most interventions still centered on ureteroplasty.[7] Although current reports on such procedures in patients with US in SK indicate high cure rates, it must be acknowledged that these surgeries are often complex, involving significant surgical trauma and high risks of complications.[9,10] Furthermore, in cases of failed ureteroplasty, repeated procedures present substantial challenges and markedly reduce the success rate of secondary surgery.[10] Most patients ultimately require long-term nephrostomy to maintain renal function.[11]

In recent years, with advances in minimally invasive techniques, endoscopic procedures have demonstrated increasingly significant clinical efficacy.[12] Compared to ureteroplasty, this

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therapy offers patients a less invasive option with reduced trauma, fewer side effects, and lower complication rates.[13] Furthermore, endoscopic procedures are less technically demanding, making them more suitable for implementation in areas with limited medical resources.[14] For instance, Double-J stent placement has become the standard drainage method for urinary tract strictures because of its safety and minimally invasive nature, widely applied across various US.[15] However, this procedure also presents unavoidable drawbacks, such as stent migration, obstruction, infection, and frequent replacements, all of which significantly impact patient quality of life.[16] To address these limitations, the Allium metal ureteral stent (AMUS) has emerged as an effective drainage solution for urinary tract strictures. This self-expanding stent features a biocompatible polymer coating.[17] As a locally supportive, large-bore stent, it minimizes stent-related complications and has demonstrated efficacy as a reliable long-term drainage option for US.[17] However, limited attention has been given in the literature to the application of AMUS in US in SK patients. Therefore, in this study, our objectives are to provide firsthand experience with AMUS in treating US in SK patients, investigate the long-term safety and efficacy of AMUS for this indication, and offer meaningful insights and clinical references for its application in managing US in SK patients.

Materials and Methods

Patient selection process and characteristics

We prospectively enrolled patients diagnosed with functional SK and undergoing AMUS placement for US at our center between January 2019 and December 2021. The inclusion criterion were as follows: (1) Patients with SK diagnosed by imaging as US; (2) Patients with severe renal failure diagnosed with US. Exclusion criteria were as follows: (1) Patients with severe urinary tract strictures or uncontrollable urinary tract infection (UTI) precluding urological endoscopy; (2) Patients with uncontrolled acute or chronic UTI; (3) Patients unable to undergo anesthesia or surgery because of the medical contraindications or severe systemic diseases; (4) Patients with malignant tumors and a life expectancy of less than 1 year. This study was conducted in accordance with the international ethical recommendations outlined in the Declaration of Helsinki and its subsequent revisions, or equivalent ethical standards. All patients participating in this study provided informed consent and signed agreements authorizing the release of their clinical indicators. The work has been reported in line with the strengthening the reporting of cohort studies in surgery criterion.[18]

Surgical procedure

All procedures were performed by the same surgeon. All patients underwent surgery in the lithotomy position under general anesthesia. After general anesthesia, retrograde pyelography or ureteroscopy was performed to assess urinary tract strictures (Fig. 1A). Subsequently, under the guidance of a ureteroscopy, an ultrasmooth guidewire was retrograde advanced through the urinary tract until it traversed the stricture segment (Fig. 1B). A 6 cm (21F) urinary balloon dilatation catheter

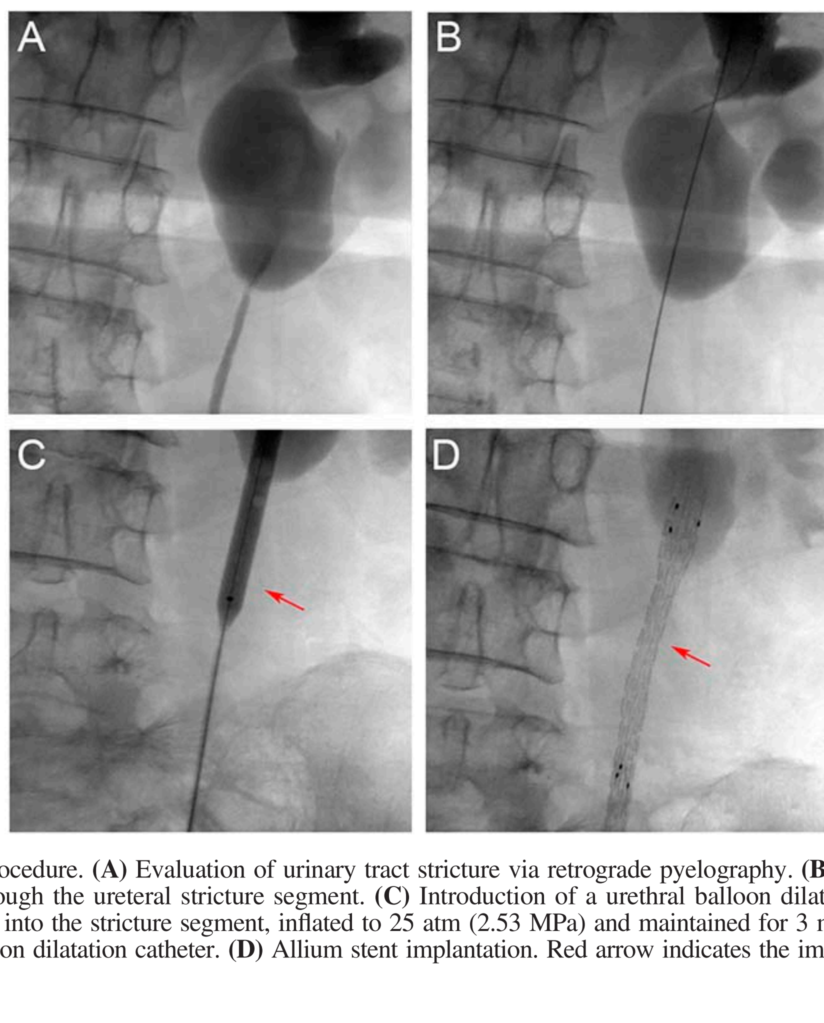

FIG. 1. Surgical Procedure. **(A)** Evaluation of urinary tract stricture via retrograde pyelography. **(B)** Placement of an ultrasmooth guidewire through the ureteral stricture segment. **(C)** Introduction of a urethral balloon dilatation catheter along the ultrasmooth guidewire into the stricture segment, inflated to 25 atm (2.53 MPa) and maintained for 3 minutes. Red arrow indicates the urethral balloon dilatation catheter. **(D)** Allium stent implantation. Red arrow indicates the implanted Allium stent.

was then inserted along the ultrasmooth guidewire into the stricture segment and inflated to 25 atmospheres (2.53 MPa) for 3 minutes (Fig. 1C). Following successful dilation of the stricture, an AMUS device (10 cm or 12 cm) is selected based on the stricture length. The AMUS is advanced over the guidewire into the stricture site and ensuring both ends extend at least 2 cm beyond the stricture before releasing the AMUS (Fig. 1D). Subsequently, perform retrograde ureterography to confirm AMUS placement and unobstructed drainage.

Follow-up protocol

Follow-up visits were scheduled during the first week postoperatively and every 3 months thereafter, continuing for a total of 2 years. During these follow-up visits, patients underwent regular abdominal computed tomography (CT) scans, routine urine and blood tests, and renal function assessments. During follow-up, we meticulously documented stent-related complications, as well as occurrences of stent migration, occlusion, and encrustation. Ultimately, 47 eligible patients (50 urinary strictures) were enrolled in this study. Surgical success in this study was defined as unobstructed drainage via the AMUS.

Data collection

Data collection encompassed multiple parameters, including: gender, age, body mass index (BMI), length and location of stricture, laterality, etiology, treatment history, preoperative and postoperative hydronephrosis volume, preoperative and postoperative serum creatinine, blood urea nitrogen, and estimated GFR (eGFR). Surgical parameters included: operative time, success rate, reasons for failure, complications, hospital stay time, average hospitalization cost, and stent-related symptoms. Hydronephrosis volume was calculated using abdominal CT imaging measurements: Hydronephrosis volume = Renal hydronephrosis volume = Length $\times$ Width $\times$ Depth $\times$ 0.523 (Unit: cm^3).

Statistical analysis

After screening for inclusion and exclusion criteria, all quantitative variables were treated as continuous variables and expressed as mean $\pm$ standard deviation. Categorical variables were described by frequency and proportion, with chi-square tests used to analyze correlations between categorical variables. Differences in continuous variables between preoperative and postoperative groups were assessed using paired t-tests. Statistical analysis was performed using SPSS 22.0 software, with $p < 0.05$ considered statistically significant.

Results

From January 2019 to December 2021, a total of 47 patients with 50 cases of US underwent AMUS implantation and completed follow-up. Basic patient data are presented in Table 1. Among them, 22 patients were male, and 25 were female. The mean age was 48.1 $\pm$ 14.8 years, with a mean BMI of 23.5 $\pm$ 3.1 kg/m^2. The mean length of urinary tract stricture was 2.7 $\pm$ 3.7 cm. The incidence of left and right US was similar: 23 cases on the left, 21 cases on the right, and 3 cases involving both ureters. Strictures were most commonly located in the proximal (25 cases) and distal (25 cases) segments. Among all etiologies resulting in SK, ureteral stones (42.6%) and following tumor radiotherapy and chemotherapy treatment (27.7%) are the primary causes. Regarding prior treatment history, 37 patients had undergone Double-J stent placement, 12 had undergone balloon dilation, 10 had undergone ureteroscopic incision, 9 had undergone nephrostomy, and 8 had undergone ureteroplasty. The mean operative time was 48.7 $\pm$ 24.7 minutes, the mean hospital stay was 3.6 $\pm$ 1.9 days, and the mean hospitalization cost was \$13,734.5 $\pm$ \$5,911.9.

Table 1. Patients and Surgery Characteristics

Variable	*Value*
Number of patients	47
Number of renal units, *n*	50
Age, years	48.1 ± 14.8
BMI, kg/m^2	23.5 ± 3.1
Male/Female, *n*	M 22 F25
Length of stricture, cm,	2.7 ± 3.7
Location of stricture, *n* (%)	
Proximal	25 (53.2%)
Middle	20 (42.6%)
Distal	25 (53.2%)
Laterality, *n* (%)	
Left	23 (48.9%)
Right	21 (44.7%)
Bilateral	3 (6.4%)
Etiology, *n* (%)	
Urinary stones	20 (42.6%)
Following tumor radiotherapy and chemotherapy treatment	13 (27.7%)
Ureteropelvic junction obstruction	7 (14.9%)
Following gynecology and obstetrics treatment	4 (8.5%)
Congenital ureteral diverticulum	2 (4.3%)
Tuberculosis	1 (2.1%)
Treatment history of ureteral stricture, *n* (%)	
JJ stent	37 (78.7%)
Balloon dilatation	12 (25.5%)
Endo-incision	10 (21.3%)
Ureteroplasty	8 (17.0%)
Nephrostomy	9 (19.2%)
Average hospitalization cost, $	13734.5 ± 5911.9
Operative time, min	48.7 ± 24.7
Hospital stay time, day	3.6 ± 1.9

The follow-up information regarding surgical success rates and complications is presented in Table 2. In 47 patients with 50 cases of US, the AMUS stent placement success rate was 98%. One case required a long-term nephrostomy because the guidewire could not be advanced to the US segment. In another case, the initial procedure was suspended because the ureteroscopy could not be advanced; while in the second attempt, using our center's proprietary endoscopic interventional technique, AMUS placement was successfully achieved. During the subsequent 2-year follow-up period, five patients (10.0%) experienced stent migration, three patients (6.0%) developed stent occlusion, four patients (8.0%) exhibited stent encrustation, and two patients (4.0%) failed because of UTI. For cases of stent migration, we repositioned the stents to their normal locations via endoscopy and replaced four stents. Stent replacement was performed for the three patients with occlusion. For the four patients with stent encrustation, ureteroscopic lithotripsy successfully removed the stones. For the two patients requiring stent removal because of recurrent infections, long-term nephrostomy was performed post-removal. In all patients requiring

Table 2. Surgical Success Rate and Complications

Variable	*One week after surgery*	*One year after surgery*	*Two years after surgery*	*Total*
Release of obstruction, *n* (%)	49 (98.0)			49 (98.0)
Follow-up success rate, *n* (%)	48 (96.0)	41 (82.0)	35 (70.0)	35 (70.0)
Reasons for failure of surgery, *n* (%)	1 (2.0)	7 (14.00)	6 (14.0)	14 (28.0)
Stent migration	1 (2.0)	3 (6.00)	1 (2.00)	5 (10.00)
Stent occlusion	0 (0)	1 (2.0)	2 (4.0)	3 (6.0)
Stent encrustation	0 (0)	2 (4.0)	2 (4.0)	4 (8.0)
Urinary tract infection	0 (0)	1 (2.0)	1 (2.0)	2 (4.0)
Operative complications, *n* (%)				
Pain	3 (6.0)	1 (2.0)	2 (4.0)	6 (12.0)
Hematuria	2 (4.0)	1 (2.0)	4 (8.0)	7 (14.0)
Urinary tract infection	1 (2.0)	3 (6.0)	3 (6.0)	7 (14.0)
Lower urinary tractsymptoms	0 (0)	2 (4.0)	3 (6.0)	5 (10.0)

secondary surgery, the stents remained in place after the second procedure and were patent at the last follow-up. Stent-related complications included pain (12.0%), hematuria (14.0%), UTI (14.0%), and lower urinary tract symptoms (LUTS) (10.0%). These symptoms were effectively resolved with appropriate symptomatic management.

Postoperative follow-up results are shown in Table 3. One week postoperatively, hydronephrosis volume decreased from 58.9 ± 93.0 cm^3 preoperatively to 32.2 ± 38.4 cm^3, indicating effective drainage via AMUS and significant resolution of hydronephrosis within 1 week. Serum creatinine, blood urea nitrogen, and eGFR remained stable compared to preoperative levels. At 1 year postoperatively, hydronephrosis volume remained at 30.8 ± 32.9 cm^3, showing no significant change compared to the volume 1 week postoperatively. Beyond hydronephrosis resolution, serum creatinine and blood urea nitrogen levels showed marked improvement. Serum creatinine decreased from 109.9 ± 50.8 μmol/L preoperatively to 99.5 ± 40.8 μmol/L; blood urea nitrogen decreased from 6.1 ± 3.0 mmol/L to 5.5 ± 2.7 mmol/L. The eGFR level remained stable at 71.5 ± 20.4 mL/min/1.73m^2, comparable to the preoperative eGFR level. The 2-year postoperative status was similar to that at 1 year postoperatively. These findings demonstrate the long-term maintenance efficacy of AMUS in SK patients with US.

Given the small sample size and the complex, diverse etiologies, we limited our comparison of treatment efficacy to AMUS in the urinary stones and iatrogenic injury groups. The supplementary tables show the baseline data (Supplementary Table S1), total surgical success rate, and complications (Supplementary Table S2), as well as the follow-up outcomes (Supplementary Table S3) for the two groups. The analysis revealed no statistically significant differences between the two groups. In terms of postoperative follow-up results, AMUS demonstrated a consistent trend of improvement for both etiologies. Although some BUN, serum creatinine, and blood urea nitrogen levels showed no significant short-term improvement because of sample dilution, long-term follow-up results indicated statistically significant improvements in renal function and maintenance of eGFR in both groups.

Discussion

US, a complex urological condition, has long posed a challenge for urologists, with a complex and varied etiology, including stones, external pressure compressing the ureter, radiation therapy and chemotherapy for tumors, and surgical trauma, etc.[11,19] Therefore, the management of US is particularly challenging for patients with SK who already have impaired renal function. The extent of renal function recovery depends on multiple factors, including patient age, preoperative single-kidney function, renal perfusion, and hydronephrosis severity.[7] Many surgical approaches cannot guarantee that they will not further deteriorate already compromised renal function.[7] Currently, ureteropelvic reconstruction remains the primary surgical technique for treating US in SK patients. Elbaset et al. reported that renal function was preserved in 90.4% of 62 SK patients with US following pyeloplasty.[9] However, it must be acknowledged that such procedures are complex, with a higher risk of postoperative complications and a relatively prolonged recovery period.[10] In patients with failed ureteroplasty, the success rate of re-ureteroplasty is significantly reduced.[11] Furthermore, given the relative rarity of this disease state, reports on US in SK patients remain scarce, with most studies being retrospective. Consequently, this article represents the largest prospective study to date evaluating the efficacy and safety of AMUS in treating US in SK patients.

Table 3. Follow-up Outcomes of the Surgery

Variable	*Preoperative*	*One week after surgery*	p *Value*	*One year after surgery*	p *Value*	*Two years after surgery*	p *Value*
Hydronephrosis (volume/mm^3)	58.9 ± 93.0	32.2 ± 38.4	0.043	30.8 ± 32.9	0.044	31.7 ± 28.4	0.049
Creatinine (μmol/L)	109.9 ± 50.8	105.7 ± 47.3	0.43	99.5 ± 40.8	0.009	97.8 ± 42.0	<0.001
Urea nitrogen (mmol/L)	6.1 ± 3.0	5.9 ± 2.4	0.215	5.5 ± 2.7	0.003	5.3 ± 1.9	0.006
GFR (mL/min)	70.6 ± 24.9	69.4 ± 19.9	0.429	71.5 ± 20.4	0.621	70.2 ± 24.5	0.836

With advances in minimally invasive surgical techniques, endoscopic surgical treatment for US has been successfully implemented, demonstrating significant efficacy in clinical practice.[11] Kwong et al. confirmed that the success rate of endourological techniques can reach 64.3%.[12] Endoscopic balloon dilation is the preferred endoscopic treatment for US. Clinically, it is often combined with transureteral endo-incision to achieve recanalization of completely obstructed ureters.[20] This approach offers high safety, minimal trauma, and rapid recovery, but its long-term efficacy is suboptimal for long-segment US. A retrospective study conducted by Gnessin et al. confirmed that, over a median follow-up of 27 months, the procedure had a success rate of only 64.2% in strictures longer than 1 cm; therefore, it is primarily used for patients with short-segment strictures under 1 cm, where it achieves an 89.4% success rate.[21] Double-J stent placement was the most frequently used treatment in our patient cohort (78.7%). While this approach provides effective short-term drainage, Double-J stent require replacement every 3–6 months.[22] Frequent replacements and stent-related symptoms significantly impair patients' quality of life. Studies indicate that conventional Double-J stents exhibit failure rates as high as 30%–45%, with overall complication rates exceeding 80% post-placement.[10,23] These factors increase financial burdens and inconvenience for patients. Among all endourological procedures, percutaneous nephrostomy is the least preferred. Compared to Double-J stent placement, nephrostomy has a postoperative complication rate of only 10%. However, external drainage restricts patient mobility, leading to discomfort, skin erosion, and consequently negatively impacting quality of life.[10]

In recent years, AMUS has demonstrated remarkable efficacy and safety in treating US.[23] AMUS consists of a helical structure of interwoven metal wires coated with a novel biocompatible and stable Double-sided membrane material.[17] The metal wires in the middle layer facilitate stent removal and extraction, while the sealed membranes on both inner and outer sides effectively prevent tissue ingrowth and stone deposition within the lumen, enabling long-term in-body retention of the stent.[24] As a large-bore local dilation stent, AMUS achieves a fully dilated lumen diameter of 24F or 30F. It can establish and maintain unobstructed urine drainage, minimize the risk of urine reflux, thereby alleviating symptoms and protecting renal function.[17] Moskovitz et al. reported a clinical study involving AMUS placement in 49 sides of US across 40 patients, achieving an overall success rate of up to 95% with an average retention time of 17 months.[17] However, Avitan et al. reported that in 17 patients with AMUS placement, nearly 30% of stents became occluded during a 10-month follow-up period, with a surgical success rate below 40%.[25] Considering the small sample sizes in both studies, significant bias factors exist. To clarify the role of AMUS in treating US, our large-scale, long-term follow-up study preliminarily confirmed that AMUS achieved cure rates of 78.5%, 71.5%, and 61.5% at 1, 2, and 3 years, respectively, in 310 patients with US.[10] This provides valuable experience for applying AMUS in US and lays a solid foundation for using AMUS to treat US in SK patients.

To explore the efficacy and feasibility of AMUS in treating US in SK patients, we conducted a large-scale cohort study and follow-up observation of all patients enrolled between 2019 and 2021. AMUS was implanted in 50 sides of USs across 47 patients, with 49 cases successfully treated through AMUS implantation. Postoperative retrograde ureteroscopy and pyelography confirmed all AMUS devices remained in place with unobstructed drainage. Surgical success rates at 1 week, 1 year, and 2 years postoperatively were 96.0%, 82.0%, and 70.0%, respectively. Compared with preoperative measurements, hydronephrosis volume significantly decreased at 1 week postoperatively (58.9 ± 93.0 cm^3 *vs* 32.2 ± 38.4 cm^3) and stabilized around 30 cm^3 during subsequent 1-year and 2-year follow-ups. Beyond hydronephrosis, serum creatinine and blood urea nitrogen levels showed a marked downward trend during the 1-year and 2-year follow-ups. Notably, renal function remained stable following stent placement, with postoperative eGFR maintained at approximately 70 mL/min/1.73m^2, consistent with preoperative levels. These findings demonstrate the long-term maintenance efficacy of AMUS in SK patients with hydronephrosis, confirming its effectiveness in resolving hydronephrosis and preserving renal function.

Regarding US caused by different etiologies, although the large-caliber drainage characteristics of AMUS demonstrated no statistically significant difference in efficacy between the urinary stones group and the iatrogenic injury group, the impact of these different etiologies on patient prognosis requires further study. Compared to US caused by urinary stones, the management of US resulting from complex etiologies is more challenging. In patients following tumor radiotherapy and chemotherapy treatment, the ureteral wall is often accompanied by ischemic necrosis.[26] Furthermore, given the ureter's inherently fragile blood supply, it is poorly capable of self-repair following injury, particularly when an AMUS is in place—such patients often face a risk of ureteral fistula formation following stent placement.[26,27] In patients with US caused by tuberculosis, the ureteral urothelium thickens, and the ureteral wall becomes irregular because of the invasion and spread of Mycobacterium tuberculosis within the ureter. As the disease progresses, extensive inflammation and fibrotic strictures can shorten the ureter, resulting in a beaded or spiral appearance.[28] Therefore, for the treatment of such complex US, the AMUS placement strategy must be tailored to the patient's anticipated management plan for the underlying etiologies of US.

In our study, 5 cases (10.0%) of stent migration occurred among 50 implanted AMUS stents, slightly lower than the previously reported rate of 14.2%.[17] Three cases experienced stent occlusion, four cases developed stent encrustation, and two cases were deemed surgical failures due to UTI. Stent migration predominantly occurred within the first year, while stent occlusion and encrustation were more common in the second year. The overall surgical success rate was 70%. For all patients requiring secondary intervention, all stents remained in place after secondary procedures and were patent at the last follow-up. Compared to Moskovitz et al.'s report, the overall success rate of AMUS implantation was 95%. In our study, any unplanned stent replacement, removal, or adjustment was classified as surgical failure. Conversely, Moskovitz et al. considered patients who underwent stent replacement and maintained patency as successful.[17] This difference in classification likely contributes significantly to their higher success rate. Among all stent-related complications, we hypothesize that stent migration is primarily associated with the length of US and the patient's physical activity. Excessively long strictures result in insufficient coverage of normal ureteral segments by the AMUS ends, compromising stent anchoring.[10] Stent occlusion and encrustation are predominantly linked to secondary strictures and stone formation caused by excessive granulation tissue growth at the stent's proximal and distal ends. AMUS complications include pain (12%), hematuria (14%), UTI (14%), and LUTS (10%). Symptoms such as pain and hematuria can be alleviated by reducing physical activity and increasing fluid intake, while UTI and LUTS can be managed with symptomatic antibiotic therapy.

Among all patients enrolled in the study, the average hospital stay time was 3.6 ± 1.9 days. Patients experienced minimal postoperative trauma, rapid recovery, and short hospitalization periods. The average hospitalization cost was \$13,734.5 ± \$5,911.9. Compared to other metallic ureteral stents, López-Huertas et al. reported an annual cost of \$13,633 for their Resonance metallic stent, which is similar to our findings.[29] Compared to conventional Double-J stents, Taylor et al. proposed that although the cost per conventional Double-J stent is relatively low, the frequency of replacement is higher. The estimated annual cost for traditional Double-J stents (requiring 3–6 replacements) ranges from \$18,218.25 to \$36,436.50, equivalent to 1.3–2.7 times the annual cost of the AMUS.[22]

Although this study offers new insights into the use of AMUS to treat US in SK patients, it has several limitations. First, we did not include studies evaluating the efficacy of other treatment options (such as Double-J stents or ureteroplasty) for managing US in SK patients, thus lacking direct comparisons with AMUS. Second, given the relative rarity of the disease state, the sample size included was not particularly large, and the follow-up period was relatively short; consequently, the long-term efficacy of the AMUS treatment strategy, complications associated with stent placement, and long-term economic burden remain unclear. Additionally, we did not perform more detailed subgroup analyses based on the etiology of US, which may introduce potential biases. Finally, we have yet to conduct in-depth and detailed research on stent removal. Specifically, when patients can undergo stent removal and how to prevent and manage the risk of recurrence after stent removal. These areas will be key focuses for future research at our center.

Conclusion

In summary, this study provides preliminary clinical evidence evaluating AMUS for treating US in SK patients. The findings suggest that AMUS is a feasible and potentially effective alternative management approach for these patients. It maintains a high patency rate over a short- to medium-term period with a low complication rate, thereby improving hydronephrosis and preserving renal function. However, given the relatively small cohort size and limited follow-up period, further large-scale, multicenter studies with extended follow-up are necessary to fully establish its long-term safety and efficacy.

Authors' Contributions

Y.Z.: Writing—original draft. J.Y. and Y.H.: Investigation and methodology. J.C.: Investigation. F.L. and X.G.: Reviewing. G.C.: Editing. X.W.: Supervision.

Ethics Approval

This prospective clinical trial was approved by the Ethics Approval Committee of West China Hospital, and the registered number is 2019-009.

Clinical Trial Registration

Our clinical trial is registered in the Research Registry (https://www.researchregistry.com), and registration identifier: researchregistry7266.

Authors' Disclosure Statement

All authors declared no competing interests.

Funding Information

This study was supported by the Natural Science Foundation of China (Grant No. 82300789) and Sichuan University Postgraduate Education Teaching Reform Research Project (Grant No. GSSCU2024093).

Supplementary Material

Supplementary Tables

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Abbreviations Used

AMUS = Allium metal ureteric stent
BMI = body mass index
CT = computed tomography
eGFR = estimated GFR
LUTS = lower urinary tract symptoms
SK = solitary kidney
US = ureteral stricture
UTI = urinary tract infection