ORIGINAL PAPER

Retrospective analysis to evaluate Allium stents as an alternative method for the treatment of ureteral strictures

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Citation: Nowakowski K, Panfil A, Lurka A, et al. Retrospective analysis to evaluate Allium stents as an alternative method for the treatment of ureteral strictures. Cent European J Urol. 2025. doi: 10.5173/ceju.2025.0155

Article history
Submitted: Jul. 5, 2025
Accepted: Jun. 5, 2025
Published online: Nov. 18, 2025

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Introduction Allium metal ureteral stents have become an increasingly popular endoscopic treatment option for ureteral strictures. This study aimed to present the outcomes of Allium ureteral stents in the treatment of refractory ureteral strictures of different origin at a single center.
Material and methods The objective of our study is to present the retrospective analysis of patients treated with an Allium ureteral stent in our department and to evaluate its effectiveness. The success rate of treatment, postoperative resolution in hydronephrosis, symptom and complication rates were evaluated during the follow-up period. The study group consisted of 18 patients with unilateral or bilateral hydronephrosis due to the ureteral stricture of different etiologies.
Results The total percentage of regression of hydronephrosis was observed in 77.78% of cases. The median follow-up period was 575 days. The main causes of hydronephrosis were urolithiasis and its previous treatment, as well as neoplastic diseases of the abdomen and pelvis.
Conclusions The study found that the use of Allium ureteral stents can be an effective and helpful option in the treatment of ureteral strictures, especially in cases where primary treatment options are not suitable.

Key Words: hydronephrosis ‹› ureteral stricture ‹› ureteral stent

INTRODUCTION

Ureteral strictures present a significant clinical challenge in urology, often requiring innovative approaches for effective management. Without treatment, obstruction may lead to hydronephrosis, renal impairment, renal failure, or even loss of the kidney. Stents have been employed in endoscopic urological procedures for many years, primarily for the management of urinary tract strictures [1]. The ureter may become narrowed due to benign or malignant lesions, urolithiasis, tumors, or external compression [2, 3]. Ureteral stricture can be asymptomatic or present with symptoms such as renal colic, urinary tract infection, or impaired renal function [4]. Treatment options include open surgery, minimally invasive reconstruction (robotic or laparoscopic), endoscopic ureterotomy, nephrostomy, or stent placement [5, 6]. However, open surgery is often difficult for patients with strictures after malignancy surgery or radiation, making complex ureteral stricture management a persistent clinical challenge [7]. It should also be emphasized that long-term maintenance of double J stents can lead to numerous complications and adverse effects [8].
Ureteral metallic stents represent a viable option for patients who are elderly, high-risk, or have not responded to primary therapies [9]. The Allium

ureteral stent is a self-expanding device with a flexible nitinol framework coated by a biocompatible polymer. This construction provides radial strength through the metal structure while the inner polymer coating prevents tissue ingrowth and early incrustation within the lumen [10].

This study aims to provide an in-depth evaluation of the use of Allium ureteral stents in patients treated at the Regional Specialized Hospital in Rybnik, focusing on patient demographics, coexisting conditions, etiologies, and post-procedural results. By assessing the resolution of hydronephrosis and the alleviation of clinical symptoms, we seek to determine the overall efficacy and safety of this minimally invasive method.

MATERIAL AND METHODS

A retrospective analysis was conducted on 18 urological patients treated for ureteral strictures with Allium ureteral stents at the Regional Specialized Hospital in Rybnik, Poland, from January 2021 to December 2024. In all analyzed patients, an Allium ureteral stent (Allium Medical Solutions Ltd., Caesarea, Israel) was used for treatment; the procedures were performed by two operators using the same technique. None of the stents used were equipped with an anchor. In 16 cases, we used stents that were 200 mm long and 9 mm in diameter, while in 2 cases, stents measuring 120 mm in length and 8 mm in diameter were utilized. On the first postoperative day, hydronephrosis was assessed with ultrasound, and pain symptoms were evaluated.

Following stent placement, the patient underwent periodic outpatient check-ups at the Ambulatory or in the Department. If a reduction or disappearance of hydronephrosis and/or a decrease in pain symptoms were observed in the follow-up period, and if the stent remained patent, the procedure was deemed successful. Stents were removed in cases of ureteral obstruction, intolerance, or after the planned period had elapsed (longest 23.9 months).

The procedure was performed with the patient in the lithotomy position under general or spinal anesthesia, and prophylactic antibiotics were given (routinely 1.5 g cefuroxime intravenously). Anterograde or retrograde ureterography under X-ray guidance identified the location and length of the stenosis. A guidewire was inserted, followed by use of a ureteral dilator to expand the ureter to at least 12 Fr in diameter. All the stents were applied through retrograde access. The Allium stent was subsequently positioned in the stricture segment and confirmed by fluoroscopic imaging (Figures 1, 2). Postoperative management included routine administration of antibiotics and analgesics.

In this study, Allium stents were successfully inserted in all patients, regardless of the severity or location of the stricture. Stent exchange, removal due to migration, or conversion to another method were classified as treatment failures.

According to the manufacturer's Instructions for Use, the stent may be maintained *in situ* for a maximum period of up to three years. The typical indwelling time for an Allium ureteral stent varies considerably, with studies reporting median indwelling durations of approximately

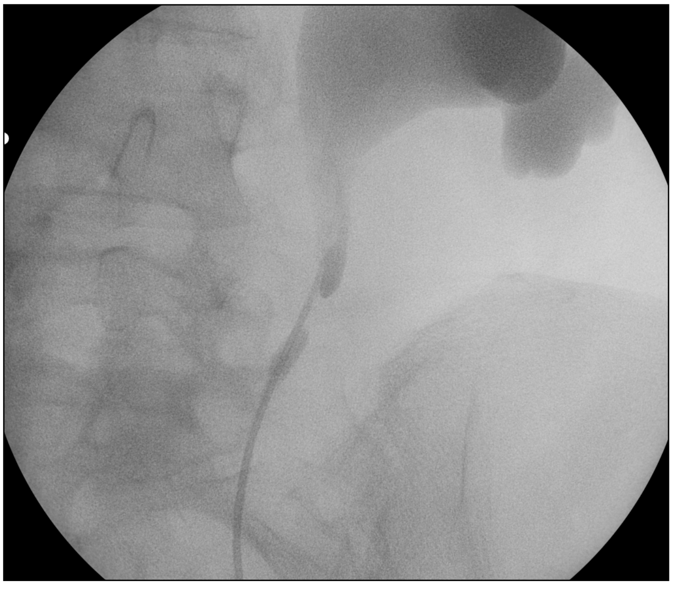

Figure 1. *Antegrade ureterogram before stent placement.*

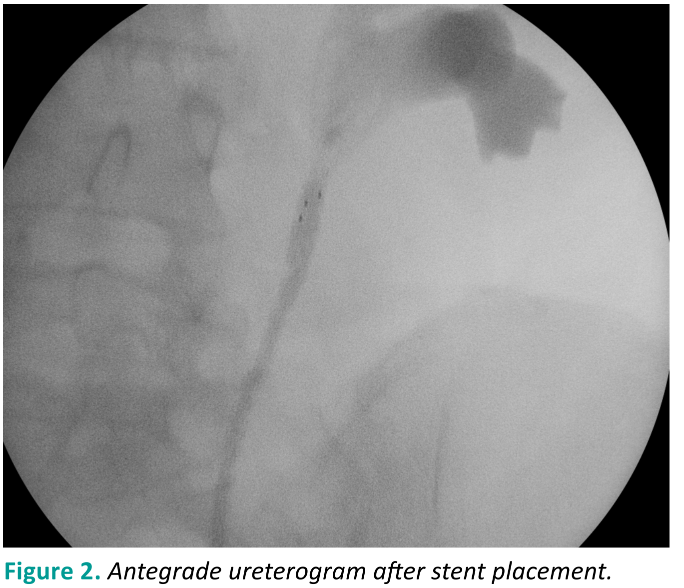

Figure 2. *Antegrade ureterogram after stent placement.*

12–22 months. However, the actual duration depends on the individual patient's clinical situation, as factors such as stent migration, encrustation, or persistent stricture may necessitate earlier removal or exchange [9].

Table 1. *Patients' characteristics and preoperative findings.*

Category	Number of patients	Percentage (%)
Gender		
Female	10	55.6
Male	8	44.4
Average age	~55 years	–
Etiology of ureteral stricture		
Post urolithiasis	10	55.6
Pelvic surgery/radiotherapy	8	44.4
Location of stricture		
Upper ureter	7	38.9
Lower ureter	11	61.1
Side of ureteral stricture		
Right ureter	10	55.6
Left ureter	7	38.9
Bilateral stricture	1	5.5

Bioethical standards

This retrospective study was performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments. The study involved only the analysis of fully anonymized data collected previously during routine clinical care, without any direct patient involvement or modification of diagnostic or therapeutic procedures. Therefore, approval from the institutional bioethics committee was not required, as confirmed by institutional policy. Patient confidentiality and data protection regulations were strictly observed throughout the study.

RESULTS

The study group comprised 18 patients, with a mean age of approximately 55 years (Table 1). Most strictures (55.6%) were complications of urolithiasis, usually after treatment of impacted ureter-

Table 2. *Outcomes of the procedure for individual patients*

Number	Etiology	Effectiveness	Location	Complications	Follow-up (months)
1	Urolithiasis	Successful	UPPER	Stent migration	15.7
2	Pelvic surgeries	FAILURE (dysuria, infections)	LOWER	Intolerance, infections	17.1
3	Status post radical cystoprostatectomy with Bilateral ureterocutaneostomy	FAILURE (stent migration)	LOWER	Stent migration	0.7
4	Urolithiasis Status post radical prostatectomy and radiation therapy for prostate cancer	Successful	LOWER	Stent migration	9.8
5	Hynes-Anderson pyeloplasty Status post endopielotomy	FAILURE (stent migration)	UPPER	stent migration	3.3
6	Urolithiasis	Successful	UPPER	fungal infection	12.2
7	status post radical cystectomy with ureterocutaneostomy	Successful	LOWER	–	1.5
8	Urolithiasis Status post surgery and radiation therapy for endometrial cancer	Successful	LOWER	–	23.9
9	Status post cystectomy	Successful	LOWER	Stent migration	3
10	Urolithiasis	Successful	UPPER	–	17
11	Urolithiasis	Successful	UPPER	–	13.6
12	Status post radiotherapy, surgery and chemotherapy for ovarian cancer	Successful	LOWER	–	13.4
13	Urolithiasis Status post radiotherapy for prostate cancer	Successful	LOWER	–	6.3
14	Status post radiotherapy to the rectal tumor area and regional lymph nodes	Successful	LOWER	–	5.3
15	Urolithiasis Status post radiotherapy	Successful	LOWER	–	7.8
16	Urolithiasis	Successful	UPPER	–	4.1
17	Urolithiasis	Successful	UPPER	–	9.9
18	Radiotherapy + pelvic surgery	Failure (stent intolerance)	LOWER	Stent intolerance	7.1

al stones. Another 44.4% of strictures occurred after abdominal or pelvic surgery and/or radiotherapy for cancer. Among these cases, 3 patients underwent radical cystectomy due to bladder cancer (16.7%), 3 female patients had surgery and radiotherapy for gynecological cancers (16.7%), 2 patients developed strictures after radiotherapy for prostate cancer (11.1%), 2 patients underwent surgery and radiotherapy for colorectal cancer (11.1%), 1 female patient had a failed Hynes-Anderson procedure (5.6%), and 1 female patient underwent surgery for endometriosis (5.6%). Hypertension was the main comorbidity identified in 44.4% of the participants. Within the study group, right ureteral stricture was more common, occurring in 55.6% of subjects, while left ureteral stricture was observed in 38.9%. One individual (4.5%) had both right and left ureteral strictures.

All patients were discharged within three days. Ultrasound showed a reduction or complete regression of hydronephrosis. During the observation period (median follow-up time of 9.85 months), recurrence of hydronephrosis and the presence of pain symptoms were monitored. Premature stent removal with recurrence of hydronephrosis or symptoms was considered unsuccessful, and failure reasons were analyzed.

The overall success rate of the procedure was approximately 77.78%. In 4 patients (22.22%), the treatment was unsuccessful, and early stent removal was necessary due to either stent migration and recurrence of hydronephrosis (50% of failed cases), as well as recurrent infections and pain (the remaining 50%) (Table 2). In these patients, alternative therapeutic interventions were required, including double J stent placement (2 cases), nephrectomy (1 case), and nephrostomy (1 case).

DISCUSSION

Restoring the patency of the ureter is essential for the proper functioning of the urinary system. This often requires urgent intervention, usually with ureteral stenting or percutaneous nephrostomy. Ureteral stenosis is a prevalent cause of declining renal function, posing a significant threat to a patient's clinical condition. In this study group, urolithiasis was identified as the primary cause of ureteral stricture, particularly in cases involving complicated ureteroscopy for impacted ureteral stones. This association with ureteral strictures has been documented in the literature [11]. Ureteral stricture can also result from pelvic surgery, mechanical damage, or infection. Additionally, this condition may be observed as a consequence of the treatment of malignant lesions, such as radiation-induced strictures in cases of prostate cancer in men and cervical cancer in women. Surgical reconstruction of these structures can be considered, or alternatives such as Allium ureteral stents may be utilized.

The first authors to publish results suggesting satisfactory effectiveness of this type of treatment were Moskovitz et al. [2]. Recent literature shows that Allium stents are a valuable alternative. They are safe, minimally invasive, and ensure effective urinary drainage. Our study utilized allium-type ureteral stents and found significant improvement in hydronephrosis regression and patients' clinical condition. The Allium stent's advantage lies in its minimal invasiveness and low complication risk. If unsuccessful, the procedure can also be repeated or successfully replaced with another treatment method without permanent consequences.

As confirmed by other authors, we have shown that Allium ureteral stents can successfully be used regardless of the cause of the stricture, even in cases where other upper urinary tract drainage methods fail, such as in extensive infiltrating abdominal and pelvic tumors or strictures after radiotherapy [7, 10].

The most frequently reported reason for failure was early migration, leading to loss of ureteral patency. Moskowitz et al. identified stent displacement in 7 patients within their study group [2]. Guandalino et al. [12] reported Allium stent migration in 18.9% of cases and suggested that advanced age could be associated with a higher risk of migration, supporting these findings. As demonstrated in other analyses, stent migration is a significant complication that often necessitates stent removal. Several hypotheses have been proposed regarding the causes of stent migration, including the natural peristalsis of the ureter and physical activity [13, 14]. The displacement of the Allium stent may also result from the complete dilation of the ureteral stricture. Furthermore, if one end of the stent is deployed with minimal dilation while the other is fully released, the stent may be more prone to movement due to normal ureteral peristalsis and the patient's activity [15]. Gao et al. [16] described two cases where antibiotic therapy was required due to infection, and also indicated that reduction of hydronephrosis can serve as an indicator of procedural success. Very similar results to those obtained in our study were demonstrated in the study by Turkish researchers, particularly regarding the number of subjects, the etiology of the stricture, and the complications [17].

Ebram Nainggolan et al. [18] discuss proper stent implantation based on the length of the ureteral stenosis, which determines the correct placement of the Allium stent. In the majority of patients in our study, the intended therapeutic effect was achieved (77.78%). Our results confirm previous reports of hydronephrosis regression and effective urinary drainage with the Allium stent. Regardless of the cause of the urinary tract stricture, the restoration of normal urinary drainage led to an improvement in renal function in our study subjects. We observed that stent migration in our patients was the main complication of the procedure (27.8%), and the majority were men (80%). In two cases, the stent migrated into the bladder, but these patients experienced regression of their hydronephrosis.

Additionally, in our cohort, stent intolerance was encountered in two women after pelvic procedures for various reasons (11.1%).

Our success rate is comparable to that reported by Moskovitz et al. [2], who reported a total success rate of 95% for Allium stents, with a median indwelling time of 17 months; their definition of success included both stent exchange and secondary luminal patency. Wang et al. [13] reported a stent patency rate of 84% over a median observation period of 16 months. Zhong et al. [19] described a success rate of 87.5% in treating ureteral stricture after kidney transplantation with Allium stents.

Management strategies for failures associated with stent use, as documented in the literature, include robot-assisted or laparoscopic pyeloureteroplasty, ureterocystoneostomy, nephrostomy drainage, ureterolithotripsy, exchange with a new Allium stent, insertion of an additional Allium stent, and replacement with a different type of metal stent [15, 20].

The phenomenon of stent encrustation is also described in the literature, despite the stent being coated with a polymer intended to reduce the risk of this occurrence. In our study group, we did not observe this phenomenon, likely due to the shorter follow-up period, as the deposition of encrustations in the stent is typically detected at a median of approximately 23.5 months [9].

There are various methods of treating ureteral strictures, each with its own advantages and disadvantages. Considering the results we obtained regarding the treatment of patients with ureteral stenosis with Allium stents, it is important to carefully review the patient's medical history and select the optimal treatment option to ensure the lowest possible risk and the best therapeutic effect. The appropriate coating covering the stent, designed to reduce friction and provide anti-inflammatory properties, is also relevant [21].

Our study has several limitations, including the relatively small number of patients. This is a retrospective, single-center study that included 18 patients. Although promising efficacy and a minimally invasive nature were reported, further observations are needed in a larger prospective study.

CONCLUSIONS

Allium stents are effective and safe for treating some ureteral strictures. They often improve hydronephrosis and patients' clinical conditions with minimal invasiveness and risk, making them suitable for patients with multiple health conditions. However, due to the risk of stent migration, infection, and the necessity to maintain the stent in the urinary system for many months, this method should be reserved for patients who are not eligible for standard treatments for ureteral strictures.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no external funding.

ETHICS APPROVAL STATEMENT

The ethical approval was not required.

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