Case Report

# Antegrade removal of a knotted ureteric stent: Case report and review of literature

Jennifer Bradshaw, Atif Khan[1], Ese Adiotomre[1], Simon Burbidge[1], Chandra Shekhar Biyani[2]

Medical Student, University of Leeds, Departments of [1]Radiology and [2]Urology, Leeds Teaching Hospitals NHS Trust, Leeds, England

**Abstract**

Ureteral stents are routinely used in urological practice for many indications including obstruction of ureter, ureteral stricture, prior to treatment with extracorporeal shock wave lithotripsy, and to promote healing following ureteral injury. Complications reported with ureteric stents include stent migration, stent rupture, encrustation, ureteral perforation, erosion, and fistulation. Knotting of an indwelling ureteral stent is a very rare complication, with fewer than 30 cases reported in the literature. Techniques for managing this complication include using a holmium laser to cut the knot, percutaneous antegrade removal, and gentle traction. We describe the case of a knotted stent and its removal along with a comprehensive literature review.

**Keywords:** Knotted stents, knotted ureteric stents, ureteric stents

**Address for correspondence:** Mr. Chandra Shekhar Biyani, Leeds Teaching Hospitals NHS Trust, St James University Hospital Leeds, Beckett Street, LS9 7TF, Leeds, England.
E-mail: shekharbiyani@hotmail.com

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## INTRODUCTION

Ureteral stents were first described over five decades ago by Zimskind *et al*.[1] and are widely used in current urological practice. Indications for ureteral stenting include obstruction of the ureter, ureteral stricture,[1] prior to treatment with extracorporeal shock wave lithotripsy, identification of ureter during pelvic surgery,[2] to promote healing following ureteral injury,[3] and protection of ureteral anastomosis in urinary diversion.[4] Complications reported with ureteral stents include stent migration, stent rupture, encrustation, ureteral perforation, erosion, and fistulation.[5,6] An unusual complication is knot formation of the indwelling ureteral stent; this is very rare, with fewer than 30 cases reported in the literature. We searched previous reports using the MEDLINE database and the specific keywords "knotted stents" and "knotted ureteric stents." All English language articles were reviewed. We describe our experience of a knotted stent alongside a detailed review of the literature.

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## CASE REPORT

We present the case of a 57-year-old female with a previous history of radiotherapy for cervical cancer. Unfortunately, she developed a very abnormal bladder with bilateral vesicoureteric junction strictures following radiotherapy. She was initially managed conservatively along with bilateral ureteric stents. Her symptoms of dysuria and leakage were very bothersome, and she was unable to tolerate a catheter. The decision was made to perform a cystectomy with ileal conduit formation.

Following surgery, her left ureteric stent was removed, but the right-sided stent could not be removed as it had migrated



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into the ureter. Her renal function deteriorated subsequently, and she had a right-sided nephrostomy placed.

Following nephrostomy, an attempt was made to snare the right ureteric stent through an antegrade approach under a local anesthetic and sedation. The nephrostomy was removed over a guidewire and exchanged for an 8Fr sheath. BMC/Terumo and Amplatz wires were negotiated down the ureter past the stent. Attempts were made at snaring with 20 mm, 10 mm, and 5 mm gooseneck loop and small basket snares. Snaring was successful with a 5 mm snare. Unfortunately, the stent formed a knot on withdrawing and could not be removed. Attempts were made to untie the knot and snare the knot unsuccessfully [Figure 1]. The patient was unable to tolerate any further attempts at removal under local anesthetic and sedation. A second wire was placed alongside the stent and a new 8.5Fr right nephrostomy placed.

Further attempts at stent removal were done in theater under a general anesthetic. The nephrostomy position was confirmed and exchanged for an Amplatz/BMC. An attempt to pass a guidewire in the conduit was unsuccessful. Conduitogram demonstrated no filling of the right ureter. An Amplatz wire was placed down the stent into the renal pelvis, and the tract was dilated using serial metal dilators up to 15fr. The stent and wire were then withdrawn together through the tract without difficultly [Figure 2]. A new 8.5Fr right-sided nephrostomy was placed without any immediate complications.

## DISCUSSION

The increasing use of ureteral stents in urological practice has resulted in an increased frequency of complications associated with them.[7] However, knotting of an indwelling ureteral stent is still a rare complication. A search of the MEDLINE database revealed 27 cases of knotted stents (24 papers) including one pediatric case and one case following renal transplantation. All papers in the English language were reviewed and one non-English report, published in German, was excluded.[8] In the remaining 26 cases, the patients' ages ranged from 4 to 86, with a male to female ratio of 4:1. Renal and/or ureteral stones were the most common indication for the ureteral stent. In the vast majority of cases, the knot was reported in the proximal end, two formed in the mid-section and one was reported in the distal portion. The patient data are summarized in Table 1.

It is unclear exactly what causes knot formation in an indwelling ureteral stent. Excessive stent length, coil formation, and individual patient factors such as renal pelvis dilatation have been hypothesized as causes for this rare complication. Multi-length stents (used in 10 cases) are associated with lower risks of migration but potentially have a higher risk of knotting;[5] thus optimal selection of stent length may help prevent knotting. The experience of the surgeon has also been hypothesized as a contributing factor following a high frequency of cases reported at a single institution during 1-year period.[13] Careful real-time fluoroscopic imaging during stent removal aids in preventing stent knotting.

At present, there are no guidelines on how to manage this complication. Poor management can result in serious consequences such as major ureteric injury or loss of the kidney.[13] Various techniques for removal of the knotted stent have been recorded. Gentle traction has been used in eight cases to remove the knotted stent, including Rivalta *et al.* who used sterile Vaseline within the ureterocutaneostomy, and Sighinolfi *et al.* where the stent was attached to the patient's leg and 3 days of continuous gentle traction achieved removal.[23,24] Eisner *et al.* reported a unique case where a series of forceful coughs from the patient produced Valsalva effect allowing the proximal knot to unite

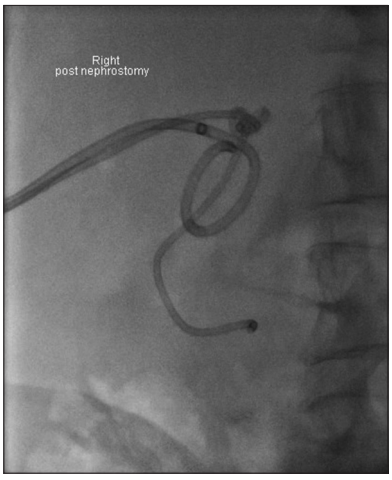


**Figure 1:** Right ureteric stent knotted during removal (arrow showing knot)

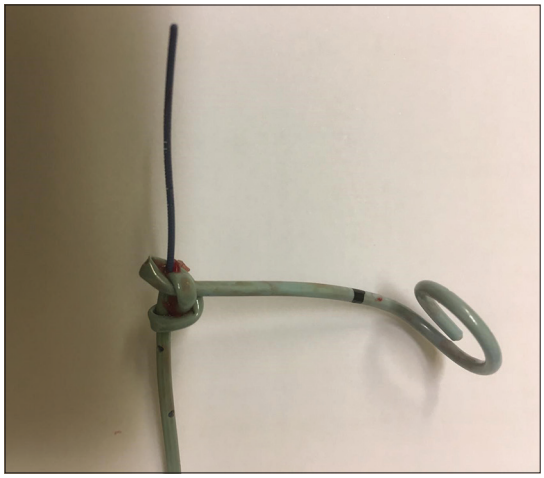

**Figure 2:** Knotted stent with guidewire through a side hole postremoval

**Table 1: Review of the literature on knotted ureteric stents**

| Lead author | Year | Patient age | Sex | Side | Location of knot | Stent configuration | Indication for stent | Removal | Laser | Complications | Postremoval nephrostomy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quek and Dunn[9] | 2002 | 66 | Female | Right | Mid-portion | 7 Fr 24 cm Double J | Renal stone | Cystoscopy and distal traction | No | None | Not recorded |
| Bhirud *et al.*[10] | 2012 | 41 | Male | Right | Mid-portion | Double J | Renal stone | Percutaneous using 26 Fr nephroscope | No | Hydronephrosis | Not recorded |
| Moufid *et al.*[11] | 2012 | 32 | Male | Left | Proximal | Double J | Ureteral stone | Gentle continuous traction under fluoroscopic guiding | No | Hydronephrosis, urosepsis | Not recorded |
| Picozzi and Carmignani[5] | 2010 | 41 | Female | Right | Proximal | Double J | Ureteral injury following surgery | Cystoscopy and continuous traction | No | None | Not recorded |
| Kim *et al.*[4] | 2015 | 53 | Male | Right | Proximal | Double J | Renal and ureteral stone | Percutaneous. antegrade | No | Not recorded | Yes |
| Kundargi *et al.*[12] | 1994 | 53 | Male | Left | Proximal | 6 Fr 26 cm Double J | Renal stone | Percutaneous | No | None | Not recorded |
| Ahmadi *et al.*[13] | 2015 | 45 | Male | Left | Proximal | 6 Fr doUble J, Multi-Length Soft | Renal stone | Cutting of stent using holmium YAG laser. Remaining stent fragment retrieved with a basket | Yes | None | Not recorded |
| Ahmadi *et al.*[13] | 2015 | 43 | Male | Left | Proximal | 6 Fr Double J, Multi-Length Stiff | Ureteral stone | Cutting of stent using holmium YAG laser. Remaining stent fragment retrieved with a basket | Yes | None | Not recorded |
| Ahmadi *et al.*[13] | 2015 | 71 | Male | Right | Proximal | 7 Fr Double J | Retroperitoneal fibrosis secondary to treated lymphoma | Percutaneous | Yes (unsuccessfully) | None | Not recorded |
| Ahmadi *et al.*[13] | 2015 | 71 | Male | Left | Proximal | 7 Fr Double J | Retroperitoneal fibrosis secondary to treated lymphoma | Percutaneous | No | None | Not Recorded |
| Ahmadi *et al.*[13] | 2015 | 52 | Male | Right | Proximal | 6 Fr Double J, Multi-length | Ureteral stone | A combination of rigid and flexible pyeloscopy was used with holmium laser to remove all encrustation of the proximal stent, “Undo” the knot and retrieve the stent entirely over a wire | Yes | Not recorded | Not recorded |
| Kondo *et al.*[14] | 2005 | 37 | Male | Left | Proximal | 6 Fr Double J, Multi-Length | Renal stone | Open ureterotomy | No | None | Not recorded |
| Baldwin *et al.*[15] | 1998 | 73 | Male | Left | Proximal | 7Fr Multi-Length Double J | Transitional cell carcinoma | Amplatz Super Stiff Wire inserted through lumen of stent to untie knot | No | None | No |
| Basavaraj *et al.*[16] | 2007 | 70 | Female | Right | Proximal | 6 Fr Multi-Length Double J | Renal and ureteral stone | Rigid conduitoscopy | No | None | Not recorded |
| Braslis and Joyce[17] | 1992 | 37 | Female | Right | Proximal | 4.7 Fr Multi-Length Double J | Renal stone | Percutaneous | No | None | Yes |
| Corbett and Dickson[18] | 2005 | 4 | Male | Not recorded | Proximal | 4.7 Fr Multi-Length Double J | Reimplantation of an obstructed megaureter | Cystoscopy and distal traction | No | Hydronephroureter | No |
| Das and Wickham[19] | 1990 | 45 | Male | Right | Distal | Single J (Length Not Recorded) | Renal stone | Cystoscopy and distal traction | No | None | Not recorded |

*Contd...*

**Table 1: Contd..**

| Lead author | Year | Patient age | Sex | Side | Location of knot | Stent configuration | Indication for stent | Removal | Laser | Complications | Postremoval nephrostomy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flam *et al.*[20] | 1995 | 86 | Male | Left | Proximal | 6 Fr 26cm Double J | Ureteral stone | Ureteroscopy and retraction of knot | No | None | Not recorded |
| Karagüzel *et al.*[21] | 2012 | 53 | Male | Right | Proximal | 4.7 Fr 28-Cm Double-J Stent | Ureteral stone | Ureterorenoscopy under general anaesthesia. Knotted stent extracted using foreign body forceps | No | None | Not recorded |
| Nettle *et al.*[22] | 2012 | 43 | Male | Right | Proximal | 6 Fr Double J (length not recorded) | | Holmium laser | Yes | Not recorded | Not recorded |
| Richards Nettle *et al.*[7] | 2011 | 67 | Male | Left | Proximal | Not recorded | Ureteral stone | Ureterorenoscopy and holmium laser | Yes | Not recorded | Not recoded |
| Rivalta *et al.*[23] | 2009 | 83 | Male | Right | Proximal | 7 Fr (Length Not Recorded) | Bladder and prostate cancer | Sterile Vaseline applied through the cutaneous stoma, then gentle traction | No | None | No |
| Sighinolfi *et al.*[24] | 2005 | 48 | Male | Right | Proximal | 5 Fr Multi-Length Double J | Renal stones | 3 days continuous slight traction | No | Hydronephrosis | Not recorded |
| Zhou *et al.*[25] | 2018 | 33 | Male | | Proximal | 6 Fr 26cm Double J | Postoperative ureterovesical anastomotic stricture | Holmium laser, stent fragments cleared by stone basket extractor | Yes | None | No |
| Eisner *et al.*[26] | 2006 | 82 | Female | Left | Proximal | Cook Kwart Retro-Inject 6F×22-32 Cm | Renal stones | Gentle traction following several forceful coughs | No | None | Not recorded |
| Tempest *et al.*[27] | 2011 | 68 | Male | Left | Proximal | 6F Multi-Length | Renal stones | Laser cut knot into two pieces which were removed separately, using the tri-radiate graspers | Yes | None | Not recorded |

YAG: Yttrium-aluminum-garnet

spontaneously which could subsequently be removed by gentle traction.[26] The risk of serious ureteral trauma should be considered when removing the knotted ureteral stent with traction, especially if strong resistance is encountered.[5]

Another minimally invasive method for removal is untying the knot *in situ* which has been done in two cases. Baldwin *et al*. inserted Amplatz super stiff guidewire through the stent lumen to successfully untie the knot before removal by traction[15] and Flam *et al*. untied the knot using 5F alligator forceps during ureteroscopy.[20] More invasive procedures such as using percutaneous removal[4,10,12,13,17] or open ureterotomy[14] have been described when conservative methods have been unsuccessful.

The use of a holmium laser to fragment the knotted stent was first described by Richards *et al*.[7] as a minimally invasive alternative to other methods of removal. It has since been used successfully in eight cases. Due to its safety and noninvasive approach, it has been recommended as a first-line treatment for the removal of a knotted stent.[13] Limitations of this approach include ureteric strictures, which prevent the advancement of the ureteroscope to the level of the knot as encountered by Ahmadi *et al*.

## CONCLUSION

Knotted ureteral stents are a rare complication of stent use. Poor management can result in serious consequences for the patient. Various techniques have been described for removal including gentle traction, percutaneous removal, open ureterotomy, and using a holmium laser. Antegrade removal of a knotted stent as described is a reliable and safe method of removal in select cases, especially where antegrade access is already available.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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