Magnetic Ureteral Stents Are Feasible in Kidney Transplant Recipients: A Single-Center Experience

P. F. Pohlmann[1]*, M. Kunzelmann[1], K. Wilhelm[1], A. Miernik[1], C. Gratzke[1], A. Jud[2], P. Pisarski[2], B. Jänigen[2]

[1]*Department of Urology, Faculty of Medicine, University of Freiburg–Medical Centre, Freiburg, Germany*
[2]*Transplantation Centre, Department of General and Visceral Surgery, Faculty of Medicine, University of Freiburg–Medical Centre, Freiburg, Germany*

ABSTRACT

Background: Insertion of ureteral catheters is a common procedure in kidney transplantation. The stent is usually removed by cystoscope. Magnetic ureteral stents may be an alternative to conventional stents.

Objective: To assess the functional efficacy and feasibility of magnetic double J (DJ) stents in kidney transplant recipients.

Methods: We used 6 Fr (diameter), 22 cm (length) magnetic DJs. We examined 7 cases of exclusively AB0-identical living donations. Stent were removed 10–12 days after transplantation. Ureteral Stent Symptoms Questionnaire (USSQ) and visual analog scale (VAS) were used to determine quality of life and pain of the recipients. The total removal time was recorded and cost reduction was calculated.

Results: Removal of the magnetic DJ was successful in all cases. The mean±SD duration of the removal was 3.4±1.6 min. The mean±SD overall pain score on the VAS during the procedure was 2.6±1.1. Using this technique was associated with a cost reduction of € 130.

Conclusion: Using magnetic ureteral stents is a feasible option for living donation AB0-identical kidney transplant recipients.

KEYWORDS: Kidney transplantation; Ureteral obstruction; Cystoscopy; Urinary catheters

INTRODUCTION

Various techniques can be used to accomplish the ureteroneocystostomy in renal transplantation. Nowadays, Lich-Gregoir technique is the most commonly used method [1]. After ureteroneocystostomy, insertion of a ureteral catheter is a prophylactic measure for the reduction of urological complications such as stenosis or leakage; it is routine in many centers [2]. It seems that early stent removal reduces urinary tract infections. However, it remains uncertain if it increases the probability of major complications [3-5]. Ureteral stents cause a variety of symptoms and have an impact on the quality of life of patients [6]. Ureteral stents are usually removed by cystoscopy. The procedure, nonetheless, is associated with fears and pain for patients and costs for the health care system [7, 8].

To reduce these side-effects, different solutions have so far been proposed. Non-endoscopic techniques such as ureteral stents on a string, external ureter catheter or stents attached to a urinary catheter are often used in stone therapy [9]. For kidney transplant patients, these solutions are less suitable because of the high possibility of dislodgment of the stent and the increased probability of urinary tract infections due to the artificial connection to the outside of the immunosuppressed recipient [10].

To avoid additional cystoscopies, various urinary catheters and magnetic ureteral stents have been developed over the last decades [11, 12]. However none of the devices led to sufficient satisfaction and safety. The first studies with a recently developed magnetic ureteral

*Correspondence: Philippe F. Pohlmann, MD, Department of Urology, Hugstetter Str. 55 79106 Freiburg, Germany
Tel: +49-761-270-25824
E-mail: philippe-fabian.pohlmann@uniklinik-freiburg.de

Figure 1: Kidney before implantation with inserted magnetic stent. Note that non-magnetic instruments should be used.

stent demonstrate good feasibility, patient comfort, and safety in stone therapy [13-15]. We therefore conducted this study to assess the functional efficacy and feasibility of magnetic double J (DJ) stents in kidney transplant recipients. We focused on the impact on patient's quality of life regarding the stent-related and stent-removal-related symptoms, as well as the DJ removal.

PATIENTS AND METHODS

The magnetic ureteral DJ stent (Black Star© UROTECH GmbH, Achenmühle, Germany) is made of polyurethane. A magnet is fixed to its distal part through a string. We used stents with a diameter of 6 Fr and a length of 22 cm, identical to the standard of care DJs without magnets we commonly use in our Department.

We first used the magnetic DJ in seven cases of kidney transplantations with approval of the local Ethics Committee; the study was registered with DRKS and the WHO (DRKS00015038). These were exclusively AB0-identical living donations.

The retrieval device was made of soft polyurethane and had a magnetic tip on its end (Fig 1). We used non-magnetic instruments (*e.g.*, titanium or plastic) for the insertion of the magnetic ureteral stent to avoid getting stuck with

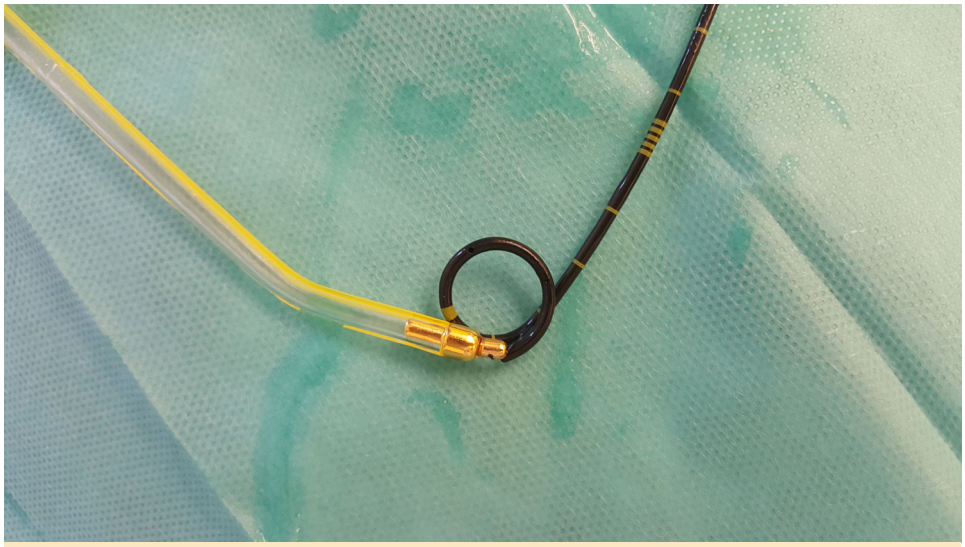

Figure 2: Magnetic DJ with attached retrieval device after removal from the bladder

the magnetic distal end (Fig 2).

The retrieval device was inserted into the bladder comparable to a urinary catheter. When the magnetic ends of the retrieval device connected the magnetic ureteral stent, they were removed. The surgeon or nurse conducting the procedure could feel and sometimes even hear that the connection of the two magnets.

In our study, the stent was removed by transplant surgeons in an Intermediate Care Unit (IMC). Routinely, the stent was removed 10–12 days after transplantation. In some recipients, however, the DJ catheter remained for 6–8 weeks due to medical reasons, *e.g.*, lymphoceles, hematomas, etc.

We used a validated German version of the Ureteral Stent Symptoms Questionnaire (USSQ) to determine the quality of life of the recipients. The questionnaire covers pain, general health status, sexual health, voiding symptoms, and other DJ stent-related problems [16, 17]. The questionnaire was filled out by the patients around day five after transplantation. Additionally, we used a pain questionnaire including a visual analog scale (VAS) of pain with scores ranged from 1 to 10 for the extraction of magnetic DJs. We also measured the total time of the procedure.

RESULTS

The mean±SD age of the seven studied kidney recipients (3 males, 4 females) was 48.7±12.4 years. The mean±SD body mass index (BMI) was 24.2±4.2 kg/m^2. The stents were removed after a mean±SD of 30.0±221.1 days post-transplantation. Removal of the magnetic DJ was successful in all patients. Removal of the stents took a mean±SD of 3.4±1.6 min.

Six of seven USSQs distributed were collected. The mean±SD pain with indwelling DJ was 2.67±2.51. Two patients did not report any pain, two reported pain in their bladder area, one in his penis and one in the flank region. The mean±SD overall pain during magnetic removal using the VAS was 2.6±1.1. Use of magnetic DJ was associated with a cost reduction of € 130 per case.

DISCUSSION

A variety of possibilities for non-endoscopic removal of DJ stents has been proposed over the last decades. DJ stents with a string attached leading to the outside of the patient are a well-described and often-used method in urolithiasis cases. The removal by pulling the string is convenient when the stent only stays in situ for a few days [18]. However, in immunosuppressed renal transplant recipients with the risk of major complications such as lymphocele, lower urinary tract infection or urinary leakage, this method is less suitable. The accidental dislocation of the stent is especially high in female patients [19].

Two groups have been working on magnetic devices: one Chinese group has reported positive animal studies but is still lacking in vivo data [12]. The other group from Croatia only tested their device in women and has not yet described randomized data [20]. Therefore, the magnetic device we used in our study is currently the only one available on the market.

Some of the items mentioned in the USSQ are not perfectly fitted to our study population. For example, the item on flank pain is not suitable for NTX patients because of the heterotopic implantation of the donor kidney and its denervation. Evaluation of the effects on the sexual life is also limited because most patients were hospitalized until stent removal; they were not able to have sex with indwelling DJ stent. We therefore did not demonstrate whole data on the USSQ.

We observed comparable USSQ results with those of another trial showing that the magnetic ureteral stent Black Star© has demonstrated good safety, quality of life and pain reduction at removal [13]. One limitation of the magnetic ureteral stent is the contraindication for magnetic resonance tomography (MRI) with the stent in situ. The magnet might heat up and therefore could damage the bladder

wall. In our study there was never the need for MRI; it always could have been replaced by computer tomography (CT). However, it is important for the responsible staff and the patient to be informed about that fact.

In our study, removal of the stent was successful in all patients. However, if the magnetic DJ removal was not effective for any reasons, say a large prostate, cystoscopy would still be used to remove the stent.

A limitation of our study is the low number of patients, a missing control group and randomization to reduce the likelihood of the selection bias. However, the study was performed to demonstrate the feasibility and safety of magnetic ureteral stents in kidney transplantations. As a result of the feasibility study, the authors aimed at conducting a randomized trial to compare the magnetic DJ stents and regular DJ stents in kidney transplant recipients.

One could argue about the high costs of purchasing the magnetic ureteral stent compared to a regular DJ stent (approx. € 80 vs. 20). However, by avoiding an additional appointment for the cystoscopy in the outpatient clinic of our Department, money for patients, the hospital and the health care system in general has been saved. The procedure could in fact result in a cost reduction of € 130—endoscopic removal costs € 210 while the cost of a magnetic DJ removal is € 80. As there is no need for an appointment in the outpatient clinic for the cystoscopic removal including urologist, an operating room (OR), OR staff, a cystoscope and, therefore, no sterilization, this reduction is feasible. In conclusion, magnetic ureteral stent is a feasible option for kidney transplant patients.

ACKNOWLEDGMENTS

The authors would like to thank Prof. Hans-Martin Fritsche for granting permission to use the validated German USS-Questionnaire free of charge.

CONFLICTS OF INTEREST: The Magnetic Black Star© ureteral stents were provided by UROTECH GmbH (Rohrdorf OT Achenmühle, Germany). Dr. Philippe-Fabian Müller and Dr. Konrad Wilhelm were partly paid from project funds of the German Federal Ministry of Education and Research. However, there was no influence of the company or the Ministry on the study results or interpretation of the data.

REFERENCES

1. Pan XM, Xiang HL, Ding CG, *et al*. Comparative study of one-stitch versus Lich-Gregoir ureterovesical implantation for kidney transplants. *World J Urol* 2014;**32**:1355-61.
2. Wilson CH, Rix DA, Manas DM. Routine intraoperative ureteric stenting for kidney transplant recipients. *Cochrane Database Syst Rev* 2013(6):CD004925. doi: 10.1002/14651858.CD004925.pub3. Review
3. Gomes G, Nunes P, Castelo D, *et al*. Ureteric stent in renal transplantation. *Transplant Proc* 2013;**45**:1099-101.
4. Thompson ER, Hosgood SA, Nicholson ML, Wilson CH. Early versus late ureteric stent removal after kidney transplantation. *Cochrane Database Syst Rev* 2018;**1**:CD011455.
5. Zschiedrich S, Kramer-Zucker A, Jänigen B, *et al*. An update on ABO-incompatible kidney transplantation. *Transplant International* 2015;**28**:387-97.
6. Damiano R, Oliva A, Esposito C, *et al*. Early and late complications of double pigtail ureteral stent. *Urol Int* 2002;**69**:136-40.
7. Haleblian G, Kijvikai K, La Rosette J de, Preminger G. Ureteral stenting and urinary stone management: A systematic review. *J Urol* 2008;**179**:424-30.
8. Koprowski C, Kim C, Modi PK, Elsamra SE. Ureteral Stent-Associated Pain: A Review. *J Endourol* 2016;**30**:744-53.
9. Oliver R, Wells H, Traxer O, *et al*. Ureteric stents on extraction strings: A systematic review of literature. *Urolithiasis* 2018;**46**:129-36.
10. Vogel T, Utech M, Schmidt F, *et al*. Double-J Versus External Ureteral Stents in Kidney Transplantation: A Retrospective Analysis. *Nephrourol Mon* 2015;**7**:e27820.
11. Macaluso JN, Deutsch JS, Goodman JR, *et al*. The Use of the Magnetip Double-J Ureteral Stent in Urological Practice. *J Urol* 1989;**142**:701-3.
12. Wang J, Feng J, Hu W, *et al*. Preclinical evaluation of a newly designed ureteral stent and magnetic retrieval catheter for minimally invasive stent re-

moval. *Urology* 2014;**84**:960-6.

13. Rassweiler M-C, Michel M-S, Ritter M, Honeck P. Magnetic Ureteral Stent Removal Without Cystoscopy: A Randomized Controlled Trial. *J Endourol* 2017;**31**:762-6.
14. Ozturk H. Facilitate Stent Removal: Magnetic DJ Stent. Urol Case Rep 2017;11:55-6.
15. Sevcenco S, Eredics K, Lusuardi L, Klingler HC. Evaluation of pain perception associated with use of the magnetic-end ureteric double-J stent for short-term ureteric stenting. World J Urol 2018;36(3):475-9.
16. Joshi HB, Newns N, Stainthorpe A, MacDonagh RP, Keeley FX, Timoney AG. Ureteral stent symptom questionnaire: Development and validation of a multidimensional quality of life measure. J Urol 2003;169(3):1060-4.
17. Abt D, Dötzer K, Honek P, *et al*. The German linguistic validation of the Ureteral Stent Symptoms Questionnaire (USSQ). *World J Urol* 2017;**35**:443-7.
18. Barnes KT, Bing MT, Tracy CR. Do ureteric stent extraction strings affect stent-related quality of life or complications after ureteroscopy for urolithiasis: A prospective randomised control trial. *BJU Int* 2014;**113**:605-9.
19. Althaus AB, Li K, Pattison E, *et al*. Rate of dislodgment of ureteral stents when using an extraction string after endoscopic urological surgery. *J Urol* 2015;**193**:2011-4.
20. Altarac S, Vražić M. A new type of ureteral stent will facilitate stent removal. *Eur Urol* 2012;**61**:225-6.