Case Report
Olgu Sunumu

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# Knotting of Percutaneous Nephrostomy Catheter within the Renal Calyx and Endoscopic Removal: An Extremely Rare Complication

## Perkütan Nefrostomi Kateterinin Renal Kaliks İçinde Düğümlenmesi ve Endoskopik Çıkarılması: Son Derece Nadir Bir Komplikasyon

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***ABSTRACT***

Percutaneous nephrostomy catheter placement is a widely used decompression method for upper urinary tract obstructions. This case report presents the successful endoscopic management of an extremely rare complication: spontaneous knotting of a nephrostomy catheter within the renal calyx.

A 31-year-old female patient presented to the urology clinic with right flank pain of colicky nature. Non-contrast computed tomography imaging revealed a 17 mm stone in the right proximal ureter and grade 3 hydronephrosis in the right kidney, while laboratory tests indicated urinary tract infection. An emergency percutaneous nephrostomy catheter was placed, and endoscopic stone treatment was planned following infection treatment and hospitalization. During the operation, it was discovered that the nephrostomy catheter could not be removed and the catheter tip was knotted. Under flexible renoscopy guidance, stone formations around the catheter were fragmented with holmium laser, and the catheter was successfully removed. The patient was discharged on the first postoperative day without complications.

Nephrostomy catheter knotting is an extremely rare but serious complication reported in the literature. Endoscopic approaches represent a safe and effective treatment option in such cases. Proper technical use during catheter placement and regular follow-up are crucial in preventing this complication. For clinicians encountering similar situations, endoscopic solution methods should be the preferred choice.

**Keywords:** catheter knotting, complication management, flexible renoscopy, percutaneous nephrostomy

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## ÖZET

Perkütan nefrostomi kateteri yerleştirilmesi, üst üriner sistem obstrüksiyonlarında yaygın olarak kullanılan bir dekompresyon yöntemidir. Bu olgu sunumu, son derece nadir bir komplikasyonun başarılı endoskopik yönetimini sunmaktadır: nefrostomi kateterinin renal kaliks içinde spontan düğümlenmesi.

31 yaşında kadın hasta sağ yan ağrısı şikayeti ile üroloji kliniğine başvurdu. Kontrastsız bilgisayarlı tomografi görüntülemesinde sağ proksimal üreterde 17 mm taş ve sağ böbrekte grade 3 hidronefroz saptanırken, laboratuvar testlerinde üriner sistem enfeksiyonunu saptandı. Acil perkütan nefrostomi kateteri yerleştirildi, enfeksiyon tedavisi ve hastaneye yatış sonrası endoskopik taş tedavisi planlandı. Operasyon sırasında nefrostomi kateterinin çıkarılamadığı ve kateter ucunun düğümlendiği keşfedildi. Fleksible renoskopi rehberliğinde, kateter çevresindeki taş oluşumları holmium lazer ile parçalandı ve kateter başarıyla çıkarıldı. Hasta postoperatif birinci günde komplikasyon olmaksızın taburcu edildi.

Nefrostomi kateteri düğümlenmesi literatürde bildirilen son derece nadir ancak ciddi bir komplikasyondur. Endoskopik yaklaşımlar bu tür vakalarda güvenli ve etkili bir tedavi seçeneğini temsil eder. Kateter yerleştirme sırasında uygun teknik kullanımı ve düzenli takip bu komplikasyonun önlenmesinde kritiktir. Benzer durumlarla karşılaşan klinisyenler için endoskopik çözüm yöntemleri tercih edilecek seçim olmalıdır.

**Anahtar Kelimeler:** fleksible renoskopi, kateter düğümlenmesi, komplikasyon yönetimi, perkütan nefrostomi

## INTRODUCTION

Percutaneous nephrostomy (PCN) has been used since 1955 to provide urinary diversion in upper urinary tract obstructions and has become one of the standard treatment modalities today—a safe decompression procedure (1,2). With technical advances and increased experience, success rates have exceeded 95%, and morbidity and mortality rates have significantly decreased.

Current literature reports PCN-related complication rates between 4-25%, mostly consisting of minor complications such as bleeding, infection, adjacent organ injury, catheter migration, and obstruction (3,4). The vast majority of these complications can be successfully managed with conservative treatment or minimally invasive interventions.

Nephrostomy catheter knotting is an extremely rare complication reported in the literature but involves serious technical challenges (5). Multiple factors play a role in the development of this condition, including inappropriate catheter length for renal pelvis anatomy, prolonged catheterization, development of catheter coiling with kidney movements, and the effects of inflammatory processes (6). While removal of a knotted catheter has traditionally been considered a complex situation requiring open surgery, recent advances in endoscopic techniques, particularly the widespread adoption of flexible renoscopy and holmium laser lithotripsy combinations, have made minimally invasive solutions possible for such complicated situations. The high success rates and low morbidity profile of endoscopic combination techniques (ECIRS) offer safe alternatives to open surgery.

This case report presents the spontaneous knotting of a percutaneous nephrostomy catheter placed for ureteral stone and its successful endoscopic removal using flexible renoscopy with holmium laser lithotripsy, discussing management strategies for this rare complication in light of similar cases in the literature.

## CASE PRESENTATION

A 31-year-old female patient presented to the urology clinic with right flank pain of colicky character persisting for three days. The patient's medical history included parathyroid adenoma, with no previous urological surgical history. Physical examination revealed right costovertebral angle tenderness and right flank pain. Laboratory tests showed serum creatinine at 0.9 mg/dL within normal limits, while hemoglobin was 9 g/dL indicating mild anemia, and erythrocyte count was 173/µL showing decreased levels. White blood cell count was elevated at 15,600/µL and C-reactive protein at 88 mg/L. Complete urinalysis revealed 273 erythrocytes and 328 leukocytes. These findings

were generally consistent with inflammatory process and mild anemia.

Computed tomography (CT) examination revealed thinning of the right kidney parenchyma and grade 3 hydronephrosis, particularly prominent in the calyces. A 17 mm hyperdense lesion in the right proximal ureter was consistent with stone, while a 16 mm hyperdense lesion in the right kidney lower pole was similarly evaluated as consistent with stone. These imaging findings supported the diagnosis of obstructive uropathy and multiple stone disease (Figure 1).

The patient was hospitalized in the urology clinic with diagnoses of urinary tract infection and obstructive uropathy. Right percutaneous nephrostomy was placed emergently. Urine culture showed Pseudomonas aeruginosa growth at 100,000 CFU/mL. The patient received meropenem 3×1 g intravenous treatment for 10 days. Following sterile control urine culture, endoscopic stone treatment was planned.

The patient was taken to surgery under general anesthesia in the lithotomy position. Initially, a 9.5 Fr ureterorenoscope was inserted through the external meatus via guide wire through the right ureteral orifice to reach the proximal ureter. The 17 mm stone observed in the proximal ureter was fragmented with holmium laser.

During the operation, it was noticed that the nephrostomy catheter could not be removed, and fluoroscopic imaging showed that the catheter tip was knotted (Figure 2). In this situation, an access sheath was placed over the guide wire, and the kidney was entered with a flexible renoscope. The tip of the nephrostomy catheter was observed to be knotted in the right kidney middle-lower calyx and surrounded by stone fragments. Stone fragments around the catheter were fragmented using holmium laser, and the nephrostomy catheter was successfully removed (Figures 3, 4). At the completion of the procedure, the access sheath was removed and a 4.8 Fr, 26 cm single-ended double J catheter was placed retrogradely into the right kidney (Figure 5). Postoperative control imaging showed the double J catheter in appropriate position, and the procedure was completed successfully. The patient, who developed no complications on the first postoperative day, was discharged with recommendations.

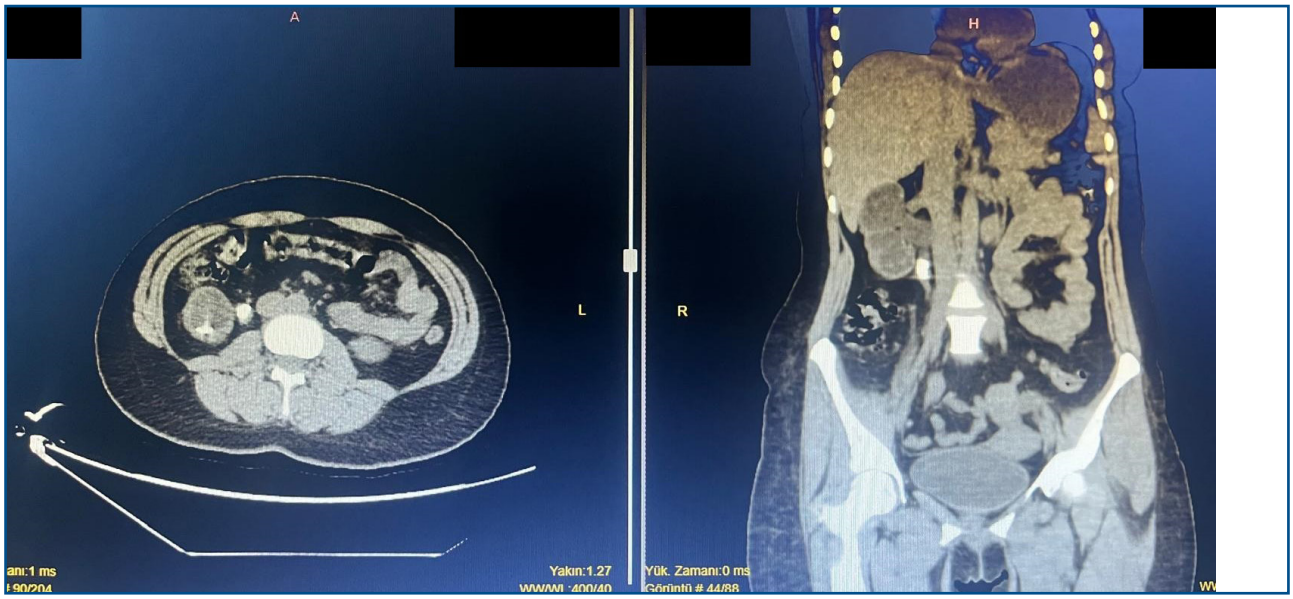


**Figure 1.** Axial and coronal CT appearance - grade 3 hydronephrosis and ureteral stone

Technetium 99m Dimercaptosuccinic acid (Tc-99m DMSA) static renal scintigraphy showed significantly decreased radiopharmaceutical uptake in the right kidney, with global function contribution calculated as 16%. Multiple photopenic areas disrupting parenchymal contour integrity were observed, indicating parenchymal damage findings. The left kidney showed diffusely decreased uptake in the upper portion with photopenic areas disrupting contour regularity, and global function contribution was calculated as 84%.

Technetium-99m diethylene-triamine-pentaacetate (Tc-99m DTPA) diuretic dynamic renal scintigraphy showed decreased size in the right kidney with functional contribution calculated as 32% and inadequate response to diuretic.

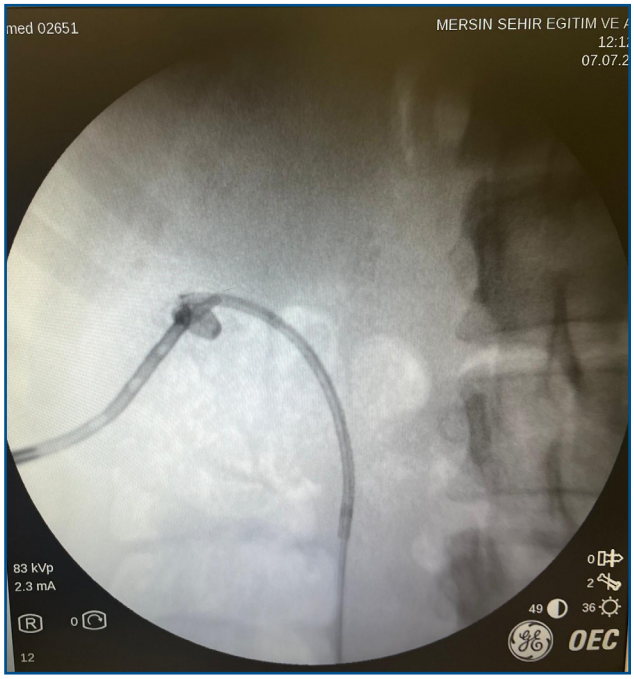


**Figure 2.** Fluoroscopic image of nephrostomy catheter - appearance of knotted catheter tip

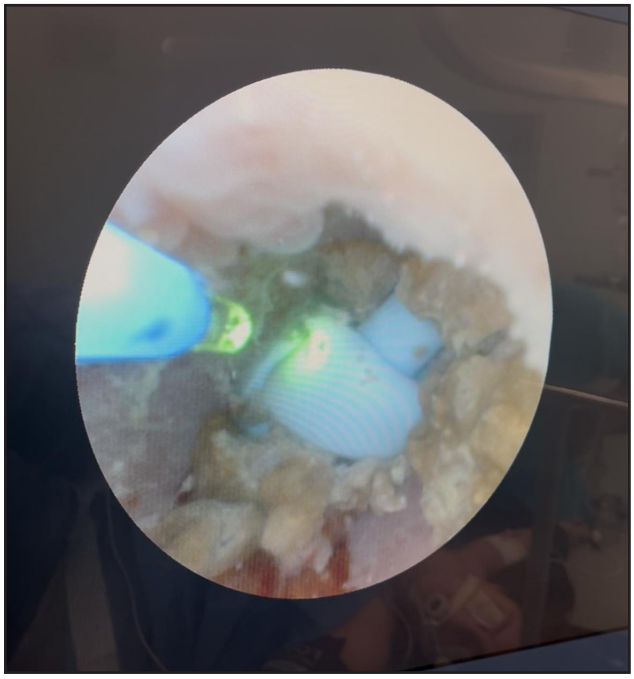

**Figure 4.** Intraoperative image of stone fragments around the catheter

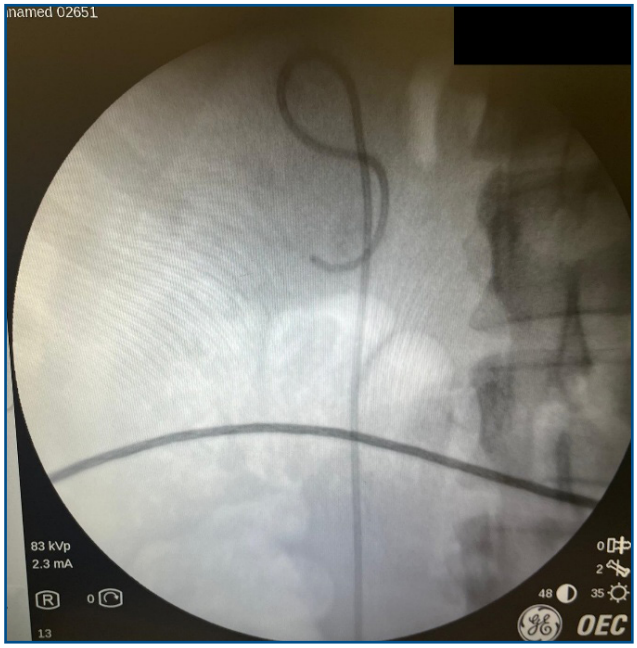


**Figure 3.** Fluoroscopic image of double J catheter placed after procedure

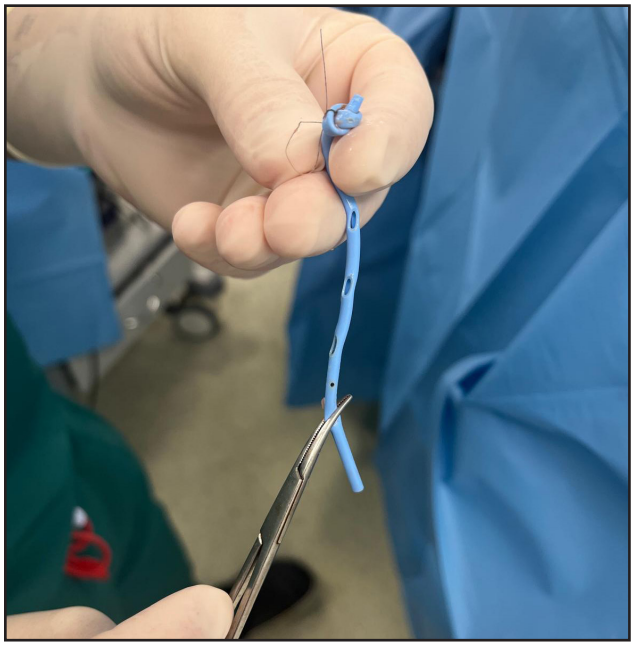

**Figure 5.** Image of removed nephrostomy catheter in knotted state

The left kidney showed increased size with functional contribution calculated as 68% and partial response to diuretic. These findings were consistent with severe function loss in the right kidney.

## DISCUSSION

PCN is applied as a standard treatment method in upper urinary tract obstructions and is one of the preferentially chosen therapeutic modalities, especially in cases accompanied by urinary tract infections. Current literature reports complication rates varying between 4-25%, mostly minor complications (4). Nephrostomy catheter knotting is an extremely rare complication with limited case reports in the literature (5).

Nephrostomy catheter knotting can develop as a result of a combination of various factors. One study identified risk factors for catheter displacement in long-term nephrostomy patients, noting that first-time catheter placement, inexperienced operator, and catheter type significantly influence displacement risk (6). Comparative analysis of catheter designs revealed that pigtail-type catheters tend toward earlier accidental dislodgement compared to Foley-type catheters, with mean times of 20 versus 61 days respectively (6). The knotting mechanism observed in our case was likely formed by a combination of catheter length being excessively long relative to renal pelvis size, development of catheter coiling with kidney movements, accumulation and fixation of stone fragments around the catheter, and inflammatory process developing after infection. Our imaging findings support this mechanism. Several case reports in the literature document similar catheter-related mechanical complications including intravenous migration, malposition, and encrustation with stone formation, all requiring endoscopic or open surgical intervention (7,8).

Various approaches exist for removing knotted nephrostomy catheters and retained urological materials. In a similar case, successful removal of a guide wire fragment remaining in renal parenchyma by retrograde intrarenal surgery has been reported (9). Successful removal of foreign body forgotten after percutaneous nephrolithotomy (PCNL) with endoscopic methods has been reported (10). The endoscopic approach chosen in this case offered a safe alternative to open surgery due to its minimally invasive nature. Comparative analysis of management approaches for catheter-related mechanical complications demonstrates that endoscopic techniques have largely replaced open surgery, with success rates exceeding 90% and significantly shorter hospital stays compared to historical open approaches (11,12). The combination of flexible renoscopy with holmium laser lithotripsy, as employed in our case, provides both visualization and therapeutic capability for managing encrusted or knotted catheters (9,10).

Current literature reports that ECIRS shows high success rates. A series of 1000 cases reported that ECIRS is safe and effective, and tract localization does not affect stone-free rates (13). Additionally, simultaneous fragmentation of stone fragments around the catheter with holmium laser was made possible, allowing the patient to be discharged the same day with less complication risk compared to traditional open surgery (14,15). Vacuum mini-PCNL technique has also been reported to give successful results in similar complicated situations (16). These advantages are clearly seen in our imaging follow-up.

A reported case of knotted double J catheter shares similar endoscopic approach principles with our case (17). In both cases, successful results were achieved with minimally invasive methods using lithotripsy techniques.

A reported case of non-inflatable nephrostomy balloon catheter demonstrates the diversity of nephrostomy complications (18). This emphasizes the importance of creative endoscopic approaches in managing such complications.

A multicenter study investigating infectious complications after mini-ECIRS found that female gender, presence of ureteral stone, preoperative pyuria, and presence of previous nephrostomy were risk factors for postoperative fever

(19). Most of these risk factors were present in our case, and treatment was completed without complications with appropriate antibiotic therapy. Therefore, appropriate antibiotic treatment is critically important in complicated cases. In light of current literature, prevention of nephrostomy catheter knotting and other mechanical complications requires systematic attention to multiple technical factors. First, appropriate catheter size and type selection is crucial for preventing malposition. Studies comparing different catheter designs demonstrate that catheter type significantly impacts displacement risk, with pigtail catheters requiring more careful monitoring in the initial weeks post-placement compared to Foley-type designs (6). Second, catheter length must be carefully matched to renal pelvis anatomy and degree of hydronephrosis. In cases of grade 3 hydronephrosis, as observed in our patient, excessive catheter length within the dilated collecting system creates redundancy that predisposes to coiling and knotting (11). Current guidelines recommend selecting catheter length based on renal pelvis diameter measurements from preoperative imaging, avoiding excessive intraparenchymal coiling (4,5). Third, in patients requiring long-term nephrostomy drainage, planned catheter exchanges at regular intervals (typically 6-8 weeks) reduce the risk of encrustation, stone formation, and mechanical complications (20). Fourth, operator experience plays a significant role in complication prevention, with studies showing higher displacement rates when catheters are placed by less experienced operators (6). Micro-percutaneous nephrostomy technique has been reported to have advantages in critically ill patients and complex obstructive cases, potentially reducing mechanical complication risks through smaller caliber catheters (21). A study comparing nephrostomy tube with double J catheter showed that spontaneous stone passage was higher in the nephrostomy group and quality of life scores were better, though catheter-related complications must be carefully managed in both approaches (22). Systematic reviews comparing percutaneous nephrostomy with retrograde stenting have demonstrated that while PCN has lower initial failure rates, displacement remains a concern requiring attention to the technical factors outlined above (11,12).

Regular follow-up imaging should be performed for early detection of catheter position and complications, with fluoroscopic or ultrasonographic assessment recommended within the first week and subsequently as clinically indicated (20). Recent advances in home monitoring protocols and early warning systems have demonstrated significant reduction in catheter-associated complications, with remote monitoring reducing risk of catheter detachment (OR 0.060), poor drainage (OR 0.061), and retrograde infection (OR 0.195) compared to conventional follow-up methods (23). Infection control should be provided with appropriate antibiotic prophylaxis and treatment. Particularly in female patients, in the presence of ureteral stones, and in cases requiring preoperative nephrostomy, infectious complication risk is high, so a proactive approach should be adopted (11,19). These evidence-based preventive measures are critically important in preventing the mechanical and infectious complications seen in our case in the future.

## CONCLUSION

Percutaneous nephrostomy catheter knotting is a rare but serious complication. As demonstrated in this case, endoscopic approach offers a safe and effective solution. With current literature support, cleaning stone fragments around the catheter and catheter removal under flexible renoscopy guidance can yield successful results. The development of endoscopic combination techniques makes minimally invasive solutions possible in such complicated situations. For complication prevention, evidence-based strategies are essential including appropriate catheter type and size selection matched to renal pelvis anatomy, consideration of hydronephrosis grade in catheter length selection, regular catheter exchanges in long-term drainage patients, and systematic imaging follow-up protocols (6,11,20). Particularly in patients with high infection risk and in cases of severe hydronephrosis as seen in our patient, multidisciplinary approach and proactive complication management with attention to catheter selection criteria are critical success factors.

**Conflict of Interest:** The authors declare no conflict of interest.

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**Informed Consent:** An informed consent form was signed by the patient, and permission was obtained for publication of the case.

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