RESEARCH ARTICLE / *Araştırma Makalesi*

Factors Affecting Success of the Reinsertion of Nephrostomy Catheters through the Original Tract

Nefrostomi Kateterlerinin Orijinal Yolak Kullanılarak Yeniden Yerleştirilmesinin Başarısını Etkileyen Faktörler

Mustafa GÖK[1,2,3], Oghuz Abdullayev[1], Mehmet Burak Çildağ[1]

[1] Aydin Adnan Menderes University, Department of Radiology, Aydin/TURKIYE.
[2] Sydney Medical School & School of Health Sciences, Faculty of Medicine and Health, University of Sydney, NSW, AUSTRALIA.
[3] Imaging and Phenotyping Laboratory, Charles Perkins Centre, University of Sydney, NSW, AUSTRALIA.

Yazışma Adresi / *Correspondence:*
Mustafa Gök

Aydin Adnan Menderes University, Faculty of Medicine, Department of Radiology. Aydin/TURKIYE
T: **+90 532 420 46 16** E-mail **: mustafagok@yahoo.com**

Geliş Tarihi / Received : **20.05.2022** Kabul Tarihi / Accepte: **10.06.2022**

Orcid :

Mustafa Gök https://orcid.org/0000-0001-7021-0984
Oghuz Abdullayev https://orcid.org/0000-0002-2292-1906
Mehmet Burak Çildağ https://orcid.org/0000-0003-2371-3540

(Sakarya Tıp Dergisi / *Sakarya Med J* 2022, 12(2):328-334) DOI: 10.31832/smj.1118650

Abstract

Objective	To investigate the success rate and the factors affecting the success of percutaneous nephrostomy catheter reinsertion using the existing percutaneous tract in patients who had nephrostomy dislodgement after insertion.
Materials and Methods	Retrospective analysis was performed in 47 adult patients who underwent percutaneous nephrostomy catheter reinsertion through existing tract between December 2020 and December 2021. The study reviewed the success rate of the reinsertion, the relationship between that rate, the dislodged catheter size, the indwelling time (time between placement and dislodgement) and the timeline that the original tract could be used for reinsertion procedure.
Results	The overall success rate for reinsertion through existing tract was 70.21%. Success rate of reinsertion was associated with longer catheter indwelling times compared to patients who failed reinsertion (82.27 vs 34.21 days, $p < 0.001$) and shorter reinsertion times compared to patients who failed reinsertion (13.21 vs 65.86 hours, $p < 0.001$). Receiver Operating Characteristic (ROC) curve analysis demonstrated that the cut-off time for reinsertion was 33 hours, with 84.80 % sensitivity and 85.70 % specificity.
Conclusion	Reinsertion of the percutaneous nephrostomy catheters using the existing tract has many advantages over the new tract intervention. Reinsertion can be performed successfully after the first 24-36 hours of dislodgement.
Keywords	Percutaneous nephrostomy; nephrostomy reinsertion; cutaneous tract

Öz

Amaç	*Daha önce nefrostomi kateteri takılmış ve kateteri çıkan hastalarda mevcut perkütan yol kullanılarak nefrostomi kateterlerinin yeniden yerleştirilmesindeki başarı oranını ve işlem başarısını etkileyen faktörleri araştırmak.*
Gereç ve Yöntemle	*Aralık 2020 ile Aralık 2021 arasında mevcut yolak üzerinden yeniden perkütan nefrostomi kateteri yerleştirilen 47 yetişkin hastada retrospektif analiz yapıldı. Kateterin aynı yolak kullanılarak yerine takılma başarı oranı, bu oran ile kateter boyutu, kateterin ilk takılma zamanı ile çıkma arasındaki zaman ve aynı yolağın kullanılabileceği zaman aralığı değerlendirildi.*
Bulgular	*Mevcut yolak üzerinden yeniden perkütan nefrostomi kateteri yerleştirme işleminde genel başarı oranı %70.21 idi. Yeniden yerleştirme işleminde başarı oranı, işlemin başarısız olduğu hastalara kıyasla önceki kateterin daha uzun kalma süresi (82.27'ye karşı 34.21 gün, $p < 0.001$) ve yeni kateterin daha kısa zamanda yerleştirilmesi (13.21'e karşı 65.86 saat, $p < 0.001$) ile ilişkiliydi. İşlem karakteristik (ROC) eğrisi analizinde, yeniden yerleştirme süresi için kesme değeri %84.80 duyarlılık ve %85.70 özgüllük ile 33 saat olduğu bulunmuştur.*
Sonuç	*Mevcut yolak kullanılarak perkütan nefrostomi kateterlerinin yeniden yerleştirilmesi, yeni yolak müdahalesine göre daha avantajlıdır. Yeniden yerleştirme, kateter çıktıktan sonra ilk 24-36 saatlik süre içerisinde başarıyla gerçekleştirilebilir.*
Anahtar Kelimeler	*Perkütan nefrostomi; nefrostominin yeniden takılması; kütanöz yolak*

INTRODUCTION

Percutaneous nephrostomy is the insertion of different sizes of catheter by percutaneous access to the enlarged renal collecting ducts under the guidance of ultrasonography (USG) and/or fluoroscopy. It is a well-established technique in the management of urinary obstruction and as a portal for the management of many urologic pathologic processes and/or complications.[1-4] Catheter-related complications, including obstruction, infection, and dislodgement, are common and their management is usually time-consuming. Despite routinely used catheter security measures such as external fixation devices, sutures, and a daily catheter check in hospitalized patients, accidental catheter removal is a well-known complication especially in unconscious patients.[5] The incidence of catheter dislodgment varies, ranging from 1% to 36%.[1-4,6-10] The significance of accidental catheter dislodgement is related not only to the complications caused by the traumatic removal of the catheter from the collecting system, but also to the complications of the reintervention. The management options for completely dislodged catheters are usually the insertion of a new catheter via fresh puncture or the insertion of a new catheter by using the existing percutaneous tract.[11] Using a fresh new puncture for reinsertion carries with it the additional risk of complication as a new tract is created. As well as being more time consuming, it results in more discomfort and greater overall radiation exposure. The above disadvantages can be minimised with catheter reinsertion using the existing tract, making it the preferable option when indicated. This retrospective study investigates the success rate for reinsertion of percutaneous nephrostomy catheters using the existing percutaneous tract and investigate the factors that influence its success rate.

MATERIALS and METHODS

This is a retrospective, single-center study conducted between December 2020 and December 2021 on 47 patients who presented with complete removal of previously placed catheters and had a documented attempt at reinsertion by using the existing percutaneous tract in the Aydın Adnan Menderes University Hospital, Department of Radiology, Division of Interventional Radiology. Institutional review board approval was obtained (protocol#: 2022/39). Informed written consent was obtained from all patients before the procedures. Data was obtained from the electronic medical records and picture archiving and communication system (PACS) including patient clinical history, demographic information, the size of previous catheter, the catheter indwelling time (time between placement and dislodgement), the time between removal and reinsertion. Attempts at reinsertion were performed in patients with a visible unhealed percutaneous tract after evaluation of signs of systemic and local infection. Patients requiring reinsertion via fresh puncture due to erythema or purulent discharge at the percutaneous tract were excluded from the study. Reinsertion attempts were performed under fluoroscopic guidance after the area was appropriately prepared and draped and local anesthesia (1% lidocaine injection) was administered at the entry site. The method used to regain access through the percutaneous tract, included the cannulation of the cutaneous orifice with the tip of 45cm, 5-F Kumpe catheter (AngioDynamics, Queensbury, NY,USA). After placing the catheter on the cutaneous fistula, a 0.035-inch hydrophilic coated guide wire (Terumo Glidewire®, Natick, MA, USA) was advanced through the fistula under fluoroscopic guidance. So as not to create a new tract, it is important to let the guidewire glide trough the existing tract (Figure 1). Once the guide-wire and the catheter advances to the collecting system, it can be confirmed by injecting 5cc iodinated contrast medium through the catheter. Once assured that the catheter/guide wire is in the collecting system, the guide-wire is advanced and the catheter is replaced with 8–14 F nephrostomy catheter (Indovasive™, Biorad Medisys Pvt. Ltd., Mulshi Pune Maharashtra, India) over the hydrophilic guide-wire (Figure 2).[11] At this point it is important to replace the new nephrostomy catheter with minimum the same size that is dislodged, otherwise there will be leakage around the catheter. The procedure was considered successful if

a new catheter was placed through the existing percutaneous tract after access was obtained as described above. Reinsertion through the percutaneous tract failed when a new fresh puncture had to be performed. The time elapsed between the previous placement of the catheter and dislodgement was defined as "indwelling time", the time between dislodgement and the time when reinsertion was attempted was considered as "reinsertion time" (Figure 3). These times and catheter size were noted.

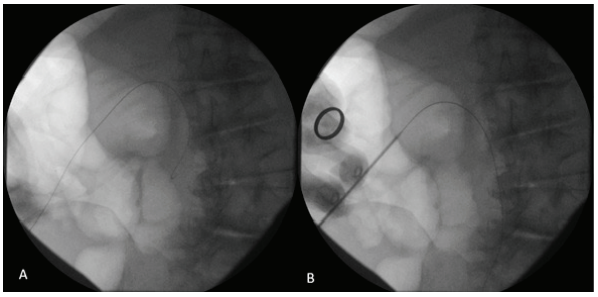

Figure 1. 0.035-inch hydrophilic coated guide wire was used to pass through along the old retroperitoneal tract under fluoroscopic guidance (A and B).

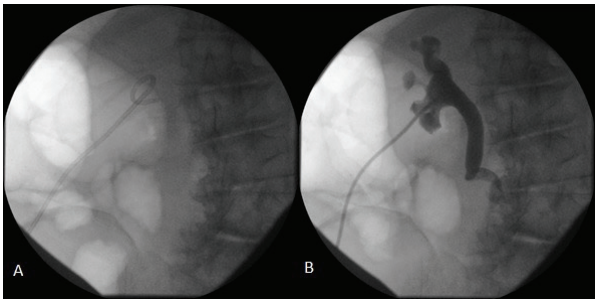

Figure 2. Nephrostomy catheter was then passed over hydrophilic coated guide wire (A). Access to the renal pelvis was confirmed injection of 5cc iodinated contrast medium through the catheter (B).

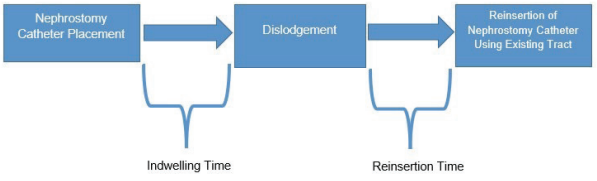

Figure 3. Diagram explaining indwelling and reinsertion times.

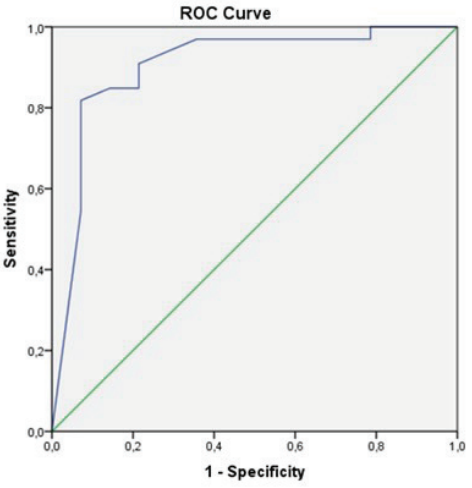

Figure 4. The effect of reinsertion time was studied by constructing a Receiver Operating Characteristic (ROC) curve with success as the primary variable. 33 hours calculated as cut-off value for successful reinsertion with 84,8 % sensitivity and 85,7 % specificity. AUC: 90,4 (79,3-100) AUC: area under curve

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) 17.0 statistical software for Windows (SPSS Inc, Chicago, IL, USA). Descriptive statistics for continuous parameters were expressed as arithmetic means ± standard deviation (SD). Mann-Whitney U test was used to determine whether there was a statistical difference between indwelling time, reinsertion time and success rate. The effect of reinsertion time was studied by constructing a ROC curve with success as the primary variable. Optimal cut-off value for reinsertion was determined; sensitivity and specificity were calculated. P values < 0.05 were considered statistically significant.

RESULTS

Between December 2020 and December 2021, 47 percutaneous nephrostomy catheters were placed by using the existing percutaneous tract. Of these patients, 27 (53.19%) were men and 22 (46.81%) were women with a mean age of 60.92 years (range: 19-88). The mean overall indwelling

time was 67.95 days (Figure 3). The mean reinsertion time was 28.95 hours (Figure 3). The overall success rate for reinsertion through existing tract was 70.21% (Table 1).

Table 1 Gender and age distribution, mean indwelling and reinsertion time in successful and failed procedures.

Definition	n
Number of patients	47
Median age	60.92 (19-88)
Gender	
Male	27 (53.19%)
Female	22 (46.81%)
Overal success rate	70.21%
Mean indwelling time in succesful procedures	82.27 days (SD:49.31)
Mean indwelling time in failed procedures	34.21 days (SD:64.07)
Mean reinsertion time in succesful procedures	13.21 hours (SD:21.17)
Mean reinsertion time in failed procedures	65.86 hours (SD:35.43)

There was no statistical difference between patient age-gender and success rate. Underlying pathologic processes for catheter placement were as follows: renal calculi (n=2), gynaecologic malignancies (n=8), urinary bladder malignancy (n=15), prostate cancer (n=7), colon cancer (n=5), neurogenic lower urinary tract dysfunction (n=4), pelviureteric tumor (n=1) and metastatic mass (n=5). Previous nephrostomy catheter sizes were as follows: 8F (n=26), 10F (n=14), 12F (n=3) and 14F (n=4). Mean catheter indwelling times before dislodgement were significantly longer in successful reinsertions than in failed attempts (82.27 vs 34.21 days; $p < 0,001$). Mean time between dislodgement and reinsertion was significantly shorter in successful reinsertions than in failed attempts (13.21 hours vs 65.86 hours; $p < 0.001$). The statistical analysis demonstrated that the factors that influenced the success of reinsertion were the indwelling catheter time before dislodgement and the time between dislodgement and reinsertion. ROC analysis was carried out and 33 hours calculated as the cut-off value for successful reinsertion with 84.8 % sensitivity and 85.7 % specificity and $p < 0.001$ (Figure 4). Catheter size was not a statistically significant parameter affecting success rate. No complications were reported in the procedures performed.

DISCUSSION

Ureteral obstruction due to nephrolithiasis, tumor, or retroperitoneal fibrosis can be uncomplicated, or complicated by urinary tract infection, renal insufficiency, or renal failure.[12] Patients with complicated obstruction need prompt decompression of the urinary tract with either placement of an indwelling ureteral stent or a percutaneous nephrostomy catheter.[13-15] In two randomized trials comparing both treatment modalities, neither modality demonstrated superiority in promoting a more rapid recovery after drainage.[16,17] A ureteral stent is generally chosen first to help relieve urinary tract obstruction because it is less invasive and has a lower risk of bleeding compared with placement of a percutaneous nephrostomy catheter. However, in cases where a stent can not be placed endoscopically or if the patient will require future percutaneous treatment of their stone burden, a percutaneous nephrostomy tube is placed primarily. Percutaneous nephrostomy catheters need to be replaced approximately every 3 months to maintain a lumen and help prevent stone formation on the tube in the renal pelvis preventing removal.[18]

Catheter dislodgement is the most common cause of catheter malfunction: it represents 52%–79% of episodes of percutaneous nephrostomy catheter malfunction.[6,19] The prevalence of catheter dislodgement is variable, ranging from 1% to 36%.[1-4,6-10] Catheter dislodgement can be caused by inadvertent removal during sleep, traction from normal daily activities, or self-removal in cases of disoriented patients. In many cases, however, the cause of dislodgement. According to Saad et al the inadvertent catheter dislodgement rates at 6, 12, 24, and 36 months were 26%, 36%, 53%, and 62%, respectively.[11] Reinsertion of the catheter by using the existing percutaneous tract is a feasible option and usually avoids the risks and discomfort

associated with a fresh puncture.[20,21] It can be performed successfully, especially in patients with catheter indwelling times longer than 3 months and during the first 36 hours after dislodgement according to the findings of the present study.

The overall success rate in our procedures for reinsertion through an existing tract was 70.2%. Success rates were significantly higher for catheters with a longer indwelling time and a shorter interval between dislodgement and reinsertion. Longer indwelling times imply a mature subcutaneous tract, and shorter intervals between removal and reinsertion imply that a subcutaneous tract did not have enough time to heal, which facilitates the reinsertion. Although it was assumed that a wider dislodged nephrostomy catheter tract would close later because of a wider tract, there was no relationship between the size of the catheter dislodged and procedural success in the present study.

Saad et al. found the success of the percutaneous tract recanalisation procedure as 74% in their study on 283 patients which is similar to the present studies success rate.[11] As in this study, longer indwelling time was positively correlated with success rate of the procedure and demonstrates that recannulation of transretroperitoneal percutaneous nephrostomy tracts is safe (ie, no complications) and effective in maintaining percutaneous nephrostomy catheter access, particularly in well-established (ie, fully epithelialised) tracts older than 6 weeks, in which case the technical success rates were 97%–100%. Reinsertion time was not investigated in their study.

Results in the study of Collares et al. were also similar to the present study with longer indwelling time (mean: 200 days) and shorter reinsertion time (mean: 9.6 hours) which played crucial role in the success of recanalisation.[22] This study differs with a larger patient size (22 vs 47 patients) and offers a cut-off value for successful reinsertions.

Reestablishing access to the targeted organ through a new fresh puncture can be technically difficult or time consuming. A new puncture, which is usually a more invasive procedure than reinserting the catheter, may also not be preferred depending on the clinical condition of the patient. Attempting to reinsert the catheter using the percutaneous tract appears to be a reasonable option if there are no contraindications (e.g., signs of local infection). There was no documented infection due to the reinsertion procedure in this study. The success rates for reinsertion of catheters using the existing percutaneous tract helps the interventional radiologist in the selection of potential candidates for reinsertion attempts. When indicated, this technique represents an additional treatment option for patients who present with completely dislodged catheters. The limitations of the study are its retrospective design and limited number of patients. A prospective study with a larger patient group would be beneficial.

CONCLUSION

The reinsertion of catheters by using the same cutaneous tract can be performed successfully during the first days after dislodgement. Success rates of this method increase with longer indwelling and shorter reinsertion times. This method is less time-consuming with less radiation dose and less complication rates.

Ethics Committee Approval

Our study was approved by the Aydın Adnan Menderes University clinical research ethics committee (Date: 28.02.2022, decision no: 09)

No conflict of interest.

Acknowledgment

Thank you to Prof.Dr. Alparslan ÜNSAL for his contribution with the cases and to Burcu YAROĞLU for English editing.

Declaration of Contribution

MG: Conception, Design, Supervision, Materials, Data

collection, Writing, Critical review.

OA: Data processing, Analysis, Literature review, Writing.
MBÇ: Data interpretation, Supervision, Critical review.

References

1. *Millward SF. Percutaneous nephrostomy: a practical approach. J Vasc Interv Radiol 2000;11:955–964.*
2. *Wah TM, Weston MJ, Irving HC. Percutaneous nephrostomy insertion: outcome data from a prospective multioperator study at a UK training centre. Clin Radiol 2004;59:255–261.*
3. *Ramchandani P, Cardella JF, Grassi CJ, Roberts AC, Sacks D, Schwartzberg MS, et al. Quality improvement guidelines for percutaneous nephrostomy. J Vasc Interv Radiol 2003;14:S277–S281.*
4. *Sim LS, Tan BS, Yip SK, Ng CK, Lo RH, Yeong KY et al. Single center review of radiologically-guided percutaneous nephrostomies: a report of 273 procedures. Ann Acad Med Singapore 2002;31:76–80.*
5. *Egglin TK, Rosenblatt M, Dickey KW, Houston JP, Pollak JS. Replacement of accidentally removed tunneled venous catheters through existing subcutaneous tracts. J Vasc Interv Radiol 1997;8:197–202.*
6. *Wah TM, Weston MJ, Irving HC. Percutaneous nephrostomy insertion: outcome data from a prospective multioperator study at a UK training centre. Clin Radiol 2004;59:255–261.*
7. *Lewis S, Patel U. Major complications after percutaneous nephrostomy: lessons from a department audit. Clin Radiol 2004;59:171–179.*
8. *Farrell TA, Hicks ME. A review of radiologically guided percutaneous nephrostomies in 303 patients. J Vasc Interv Radiol 1997;8:769–774.*
9. *Farrell TA, Michael W, Hicks ME. Long-term results of transrenal ureteral occlusion with use of Gianturco coils and gelatin sponge pledgets. J Vasc Interv Radiol 1997;8:449–452.*
10. *Stables DP, Ginsberg NJ, Johnson ML. Percutaneous nephrostomy: a series and review of the literature. AJR Am J Roentgenol 1978;130:75–82.*
11. *Saad WEA. Inadvertent discontinuation of percutaneous nephrostomy catheters in adult native kidneys: incidence and percutaneous management. J Vasc Interv Radiol 2006;17:1457– 1464.*
12. *Fiuk J, Bao Y, Calleary JG, Schwartz BF, Denstedt JD. The use of internal stents in chronic ureteral obstruction. J Urol 2015;193:1092.*
13. *Sountoulides P, Pardalidis N, Sofikitis N. Endourologic management of malignant ureteral obstruction: indications, results, and quality-of-life issues. J Endourol 2010;24:129.*
14. *Borofsky MS, Walter D, Shah O, Goldfarb DS, Mues AC, Makarov DV. Surgical decompression is associated with decreased mortality in patients with sepsis and ureteral calculi. J Urol 2013; 189:946.*
15. *Izumi K, Mizokami A, Maeda Y, Koh E, Namiki M. Current outcome of patients with ureteral stents for the management of malignant ureteral obstruction. J Urol 2011;185:556.*
16. *Pearle MS, Pierce HL, Miller GL, Summa JA, Mutz JM, Petty BA, et al. Optimal method of urgent decompression of the collecting system for obstruction and infection due to ureteral calculi. J Urol 1998;160:1260.*
17. *Ramsey S, Robertson A, Ablett MJ, Meddings RN, Hollins GW, Little B. Evidence-based drainage of infected hydronephrosis secondary to ureteric calculi. J Endourol 2010;24:185.*
18. *Philip John Haslam, Percutaneous Renal Drainage Procedures, In Matthew A. Mauro, Kieran P. Murphy, Kenneth R. Thomson(eds) Expert Radiology,Image-Guided Interventions. 3rd ed. Elsevier, 2020.p.811-822.*
19. *Radeka E, Magnusson A. Complications associated with percutaneous nephrostomies: a retrospective study. Acta Radiol 2004;45:184–188.*
20. *Gordon R, Oleaga J, Ring R, Freiman D, Funaro A. Replacing the "fallen out" catheter. Radiology 1980;134:537.*
21. *Pollack H, Banner M. Replacing blocked or dislodged percutaneous nephrostomy and ureteral stent catheters. Radiology 1982;145:203–205.*
22. *Collares FB, Faintuch S, Kim SK, Rabkin DJ. Reinsertion of accidentally dislodged catheters through the original track: what is the likelihood of success?. J Vasc Interv Radiol 2010;21(6):861-864.*