



ORIGINAL ARTICLE



Factors affecting urine leak after percutaneous nephrolithotomy: a single centre prospective study

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Abstract

Aim; We aim to determine the factors that affect urine leak after a successful PCNL.

Material and Methods; All patients who underwent PCNL from January 2016 to December 2017 at our institution were evaluated prospectively. Stones of size ≥ 2 cm in largest diameter and stones ≥ 1.5 in the lower calyx not amenable to ESWL or stone of any size resistant to ESWL were selected for PCNL. Those who were not willing to be included in the study, patients with history of PCNL in the same kidney were excluded from the study.

Results; There was a clear association between hydronephrosis and prolonged duration of leakage with group 2 showing 30 out of 31 patients having grade 1 or more hydronephrosis, presence of intraparenchymal pelvis and renal parenchymal thickness in the access line were also predictive of prolonged leak. By regression analysis, renal parenchymal thickness $< 13.95 \pm 3.48$ was found to be associated with increased leak.

Conclusion; Grade of hydronephrosis, intraparenchymal pelvis and parenchymal thickness in access line are associated with prolonged urine leak. We recommend the use of double J stent during PCNL in the presence of these factors.

1 | INTRODUCTION

PCNL was first performed in late 1970s and it heralded a breakthrough in the treatment of renal stones.¹ Although retrograde intrarenal surgery (RIRS) is widely applied in upper urinary stones, the technique of percutaneous nephrolithotomy (PCNL) is still the treatment of choice for large and complex stones.²

The postoperative success rate with PCNL is as high as with open surgery, and it is associated with a shorter hospital stay and fewer complications than open surgery.³ However, PCNL is not without complications and a recent multi-centre study has shown an overall complication rate of 20.5%.^{2,4} Most common complications are transient fever, bleeding, urinary leakage and problems related to residual stones. The major complications include haemorrhage re-

quiring embolization, urinoma, thoracic injury, organ injury, sepsis and death.⁵

Some urine leakage is normally expected from the site after removal of the nephrostomy tube. Prolonged leakage can be bothersome and may be indicative of an obstruction in the distal urinary tract by blood clot or stone fragment. The reported incidence of prolonged DUL varies widely in the literature from 0.4% to 15%.^{2,7-11} A leak for more than 48 hours and requiring insertion of a 4.7 Fr double J stent was considered 'prolonged leakage of urine'.¹² As per recent literature, the modified Clavien System, a standardized grading system for classification of complications of PCNL, a urinary leak for <12 hours is considered a grade 2 complication whereas a leak > 24hrs requiring placement of double-J stent or increased hospital stay as a grade 3a complication.^{9,13}

The duration of leakage depends on the technique used. Wide bore nephrostomy tubes used in the past were associated with longer duration of leakage.^{13,14} In the present day scenario, a 13 or 14 Fr tube is standard and the trend is moving towards tubeless PCNL for uncomplicated cases.⁵ In our study, we attempt to assess the factors affecting duration of leakage requiring placement of double-J stent. This could allow identification of the risk factors preoperatively and could possibly help us in avoiding this complication by using a DJ stent to begin with at the time of PCNL.

2 | MATERIALS AND METHODS

All patients who underwent PCNL from January 2016 to December 2017 at our institution were evaluated prospectively for the study. Stones of size > 2cm in largest diameter and stones >1.5cm in lower

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calyx that were not amenable to ESWL or stone of any size resistant to ESWL were selected for PCNL. Ethical clearance was acquired from our institution's ethical committee and written informed consent was obtained from all subjects. Those who were not willing to be included in the study, patients with history of PCNL in the same kidney were excluded from the study. History and demographic details were recorded. Preoperatively, all cases were evaluated for comorbidities and underwent an ultrasound abdomen, IVU and NCCT. A complete blood count, urine culture, blood urea, serum creatinine, serum uric acid, sodium, potassium and calcium levels and coagulation profile were done one day prior to procedure. Presence and severity of hydronephrosis was assessed and measured by USG. Stone number, location (upper, middle or lower calyx, pelvis+calyx, pelvis), size (mm² on NCCT KUB) was recorded. Any anatomic abnormality, obstruction in the collecting system and presence of intraparenchymal pelvis was recorded.

The procedure was done under general anaesthesia. A 6-F open-ended ureteral catheter was placed cystoscopically in the patient in the lithotomy position to view the anatomy of the collecting system. Next, the patient was turned to the prone position, and the collecting system was viewed via fluoroscopy using a radiocontrast medium. Alken dilator was used to dilate the tract, and a 30-F Amplatz sheath was inserted. Next, a 24-F rigid nephroscope was inserted. The stones were broken using a pneumatic lithotripter and accessible fragments were cleared through the rigid nephroscope using grasping forceps. The procedure was completed by doing a fluoroscopy to check for stone clearance and followed by placing a 14-F nephrostomy tube into the calyx. The calyx punctured number of punctures and occurrence of any intraoperative bleeding was noted. The duration of procedure was recorded as the time from insertion of the ureteral catheter to insertion of the nephrostomy tube. A broad spectrum cephalosporin was given IV prophylactically at the start of surgery and continued till day 3.

On postoperative day 1, if there was no hematuria ureteric catheter was removed. On day 2, an Xray KUB was performed to check for residual stone. If clinically insignificant or no residual stones were

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seen, foleys catheter and nephrostomy tube were removed on day 2. In presence of a residual stone, depending on the location, a repeat PCN through the same nephrostomy or ureteroscopic removal of stone was done. After removal of nephrostomy tube, a gauge dressing was applied, that was changed when patient complained of soakage. Urine leak through the nephrostomy site for more than 24 hrs was considered significant and a 6 F DJ stent was placed. Postoperatively patient was watched for any hematuria, temperature spike above 38 degree Celsius, significant drop in the haematocrit and rise in serum creatinine.

At 4weeks, an Xray KUB was repeated to check for residual fragments. At this stage, if needed ESWL or URS was done for residual stones of size >4mm or symptomatic. If no residual stones were seen, DJ stent was removed.

The patients were then divided into two groups:-

Group 1: patients who did not undergo DJ stent placement

Group 2: patients who underwent DJ stent placement

These two groups were compared with respect to :-

- Preoperative (age, sex, BMI, stone burden, past surgery, hydronephrosis grade, intra parenchymal pelvis, parenchymal thickness in access line)
- Intraoperative (multiple puncture, calyx of puncture, intraoperative bleeding) and
- Postoperative (fever, stone free rates, duration of leakage, transfusion requirement) factors.

Statistical Analysis

The data were entered in an Excel database and analyzed with STATA, version 15. Association between the main outcome variable, i.e. duration of leakage with independent variables was done using the Chi-square test, Student *t*-test, and Fischer exact test. Independent variables included patient-related factors like age, history of previous surgery, grade of hydronephrosis, renal parenchymal thickness, intra-parenchymal renal pelvis and procedure-related factors like number of access, site of puncture, calyx

of puncture, presence of fever or residual stones. Unadjusted OR and adjusted OR were calculated using binary and multivariate logistic regression to understand the strength of association between the different variables with the outcome variable. The statistical significance level was defined as a two-tailed P-value ≤ 0.05 .

3 | RESULT

A total of 561 patients underwent PCNL, out of which 31 underwent DJ stent placement due to prolonged duration of urine leak in the postoperative period. Group 1 (n=528) and group 2 (n=31) had a mean age of 41.00 and 39.29 years respectively and a male to female ratio of 1.71 and 1.58. There was no significant difference in the side affected and body mass index in the two groups. The stone burden and number of patients with history of past surgery in the ipsilateral kidney were comparable in both the study groups. There was a clear association between hydronephrosis and prolonged duration of leakage, with group 2 showing 30 out of 31 patients having grade 1 or more hydronephrosis. Presence of intra parenchymal pelvis and renal parenchymal thickness in the access line were also predictive of prolonged leak. By regression analysis curve, renal parenchymal thickness less than ...mm was found to be associated with increased leak by .. times.

Among the intraoperative factors the calyx punctured did not show any correlation to urine leak but number of punctures was statistically significant. Presence of residual stone on follow up was strongly associated with leakage and history placement of DJ stent.

4 | DISCUSSION

PCNL is the gold standard for stones larger than 2 cm, stag-horn stones and stones in the inferior calyx less than 1cm.[3, 4] Nephrostomy tubes are used after PCNL as they provide haemostasis in the tract and prevent extravasation of urine in the retroperitoneum and formation of a urinoma.¹⁷ Some urine leak after removal of nephrostomy is expected

TABLE 1: Comparison of preoperative parameters in patients without and with prolonged DUL

Parameters	Group 1 (528)	Group 2 (31)	P value
Age (years)	41.00 + 8.6	39.29 + 8.7	0.28
Gender (male:female)	1.71	1.58	0.85
Side (Rt/Lt)	240/288	16/15	
BMI*	27.46 + 3.93	26.69 + 3.65	0.28
Stone burden	619.84 + 193.77	663.48 + 258.23	0.427
h/o previous surgery	71	4	0.570
Hydronephrosis	105	1	0.02
Normal	116	4	
Grade 1	205	15	
Grade 2	68	7	
Grade 3	34	4	
Grade 4			
Renal parenchymal thickness in access line	15+ 3.48	13.95+ 3.48	0.009
Intrarenal pelvis	5	6	0.001

*BMI- body mass index

TABLE 2: Comparison of intraoperative parameters

	Group 1	Group 2	P value
Multiple punctures	91	15	0.000
Calyx punctured	56	4	0.81
Upper	251	13	
Middle	221	14	
Lower			
Intra operative bleeding	40	2	0.67
Operative time	76(45-145)	80(45-150)	0.82

TABLE 3: Postoperative factors

	Group 1	Group 2	P value
Fever	64	4	0.191
Residual stones on follow up	16	10	0.009

but if prolonged this can be a source of discomfort to the patient and prolonged hospital stay. The exact duration of leak that can be labelled 'prolonged' is not defined. As per a study by Dirim et al, the duration of leak ranged from 1 to 200 hours with a median of 14 hours and they reported that 70.3% patients have prolonged leak of more than 6 hours that prolongs hospital stay.¹³ Uyeturk reported leaks ranged from 3 to 51 hours and a median of 12 hours.¹⁶ Lee et al reported that 1.5% of their study

subjects have leak for more than a week.¹⁹ Most centres resort to double J stenting if the leak is more than 24 hours in order to limit patient discomfort and increased hospital stay.

As per modified Clavien Dindo classification, currently the most accepted reporting system for PCNL complication, a leak longer than 12 hours is not acceptable as normal and is classified as a grade 2 complication and a leak persisting longer than 24 hours and requiring stenting or prolonged hospital

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stay is considered a grade 3a complication. 5.5% of our PCNL patients had leak longer than 24 hours and underwent double J stenting. This finding was within the reported range in literature of 0.4 to 15%.^{2,8-12}

Our study groups were comparable in age, gender and body mass index. A few studies have found association with a high BMI¹⁷ to be predictive but others have seen no such correlation.^{13,16,18} Subcutaneous fat thickness in access line has also been studied in relation to urine leak but have not shown any association.¹⁶ history of past open surgery in the ipsilateral kidney was not found to be associated with increased urine leak. This is accordance to other studies, which have reported longer operating time and higher auxiliary procedures during surgery but no higher complications.^{13,19}

A possible reason for prolonged urine leak from nephrostomy site is back pressure due to a distal obstruction in the collecting system such as a blood clot, stone, edema or an anatomic abnormality. Some studies noted prolonged leakage associated with presence of bleeding intraoperatively or post-operatively, probably due to dislodging of a blood clot²⁰ but we did not find such a correlation in our study. Certain anatomical factors can also cause high intrarenal pressure such as intrarenal pelvis, PUJ obstruction. We noted a significantly higher leak in intrarenal pelvis. Similar association has been observed by others.^{21,22}

There was a strong association between grade of hydronephrosis and duration of leak. This is in accordance to many previous studies.^{13,16,21} The explanation for this is proposed by Dirim et al to be thinned out parenchyma in the access line. In a healthy kidney there is adequate amount of healthy parenchymal tissue in the access line, which is stretched at the time of nephrostomy and can conform back on removal of the tube. But if the parenchyma is unhealthy and thinned, like in a hydronephrotic patient, it will not retract back and seal the defect very well, leading to persistent leak.¹³ In a study by Uyeturk et al, parenchymal thickness was even more predictive of leak than hydronephrosis.¹⁶ A parenchymal thickness of 17.2mm or less was associated with higher morbidity and increased hospital stay in two independent studies.^{16,21} By regression analysis curve

we found a parenchymal thickness lesser than ... mm to be predictive of prolonged leak by ... times. However, there are studies which show no such correlation.^{18,23}

Residual stone fragments can also block the distal tract and this is supported by the observation that cases with residual stones have a longer DUL.^{16,18,21} There were very few patients detected with residual stones in our study and the number was not statistically significant in the cases undergoing double J stenting. This may be because we did not do a CT scan in follow up of all the cases and IVU alone is often seen to overestimate stone free rates post PCNL. This was a deficiency in our study and therefore our study does not reliably prove that prolonged urine leak has no association with residual stones.

In our study, we compared the stone size and found that it was comparable in the patients who needed double J stenting. Binbay et al reported that the both stone size and complexity were directly related to the success rates of PCNL, which in turn had an impact on the duration of leak.¹⁸ There are several studies that contradict this.^{13,16,23} Yet another study conducted by Ansari et al demonstrated that the stone complexity was associated with prolonged leak but not stone size.²¹

Guy's stone score grades the stone complexity by taking into account the location, shape and anatomic factors limiting accessibility. Few studies have found this score to be predictive of the success of PCNL and also incidence of complications.^{24,25} Lower calyx stones are difficult to approach as the calyceal angle is more acute and its infundibular width is often narrow, thus increasing the probability of multiple access and prolonged operative time.²⁶ Ibrahim et al evaluated number of tracts, calyces accessed and method of stone extraction and found it to be associated with prolonged leak.²³ Ansari et al also reported higher number of punctures to be associated with prolonged leak.²¹ In our study, number of punctures was significantly higher in the group that had prolonged leak but calyx punctured and number of punctures was comparable in both the study groups. There are other studies that found access number and location to have no predictive value.¹⁸

One of the advantages of this study was that it was prospective unlike the few studies assessing urine leak following PCNL, which were mostly retrospective. A drawback of this study is that surgeon's experience was not taken into account as it is known that PCNL has a learning curve. Being a teaching hospital, many of the procedures were performed by trainees.

In our study grade of hydronephrosis, intrarenal pelvis, parenchymal thickness in the access line and number of punctures were the factors most predictive of prolonged urine leak. A parenchymal thickness of less than ... increases the risk of prolonged leak by .. times. With an understanding of the factors predictive of prolonged urine leak, we can predict the need for double J stent and insert during the PCNL itself to avoid problems related to prolonged leak and increased hospital stay.

5 | CONCLUSION

Grade of hydronephrosis, intrarenal pelvis and parenchymal thickness in access line are associated with prolonged urine leak. We recommend the use of double J stent during PCNL in the presence of these factors. [1–26]

REFERENCES

- [1] Harris RD, Laughlin APM, Harrell JH. Percutaneous nephroscopy using fiberoptic bronchoscope Removal of renal calculus. *Urology*. 1975;6(3):367–369. Available from: [https://dx.doi.org/10.1016/0090-4295\(75\)90770-0](https://dx.doi.org/10.1016/0090-4295(75)90770-0).
- [2] Margel D, Lifshitz DA, Kugel V, Dorfmann D, Lask D, Livne PM. Percutaneous Nephrolithotomy in Patients Who Previously Underwent Open Nephrolithotomy. *Journal of Endourology*. 2005;19(10):1161–1164. Available from: <https://dx.doi.org/10.1089/end.2005.19.1161>.
- [3] Taylor;
- [4] Labate G, Modi P, Timoney A, Cormio L, Zhang X, Louie M, et al. The Percutaneous Nephrolithotomy Global Study: Classification of Complications. *Journal of Endourology*. 2011;25(8):1275–1280. Available from: <https://dx.doi.org/10.1089/end.2011.0067>.
- [5] Thomas K, Smith NC, Hegarty N, Glass JM. The Guy's Stone Score—Grading the Complexity of Percutaneous Nephrolithotomy Procedures. *Urology*. 2011;78(2):277–281. Available from: <https://dx.doi.org/10.1016/j.urology.2010.12.026>.
- [6] Marchant F, Recabal P, Fernández MI, Osorio F, Benavides J. Postoperative morbidity of tubeless versus conventional percutaneous nephrolithotomy: a prospective comparative study. *Urological Research*. 2011;39(6):477–481. Available from: <https://dx.doi.org/10.1007/s00240-011-0367-9>.
- [7] Ibrahim A, Elsotohi I, Mahjoub S, Elatreisy A, Soliman K, Mabrouk M, et al. Factors determining perioperative complications of percutaneous nephrolithotomy: A single center perspective. *African Journal of Urology*. 2017;23(3):208–213. Available from: <https://dx.doi.org/10.1016/j.afju.2017.05.002>.
- [8] Uyeturk U, Gucuk A, Kemahli E, Dagistan E, Yildiz M, Yilmaz B. Factors influencing the duration of urine leakage following percutaneous nephrolithotomy. *Adv Urol*. 2014;p. 105709–105709.
- [9] Deane LA, Clayman RV. Advances in Percutaneous Nephrostolithotomy. *Urologic Clinics of North America*. 2007;34(3):383–395. Available from: <https://dx.doi.org/10.1016/j.ucl.2007.04.002>.
- [10] Türk C, Petřík A, Sarica K, Seitz C, Skolarikos A, Straub M, et al. EAU Guidelines on Interventional Treatment for Urolithiasis. *European Urology*. 2016;69(3):475–482. Available from: <https://dx.doi.org/10.1016/j.eururo.2015.07.041>.

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- [11] Ansari H, Tomar V, Yadav S, Agarwal N. Study of predictive factors affecting the prolonged urinary leakage after percutaneous nephrolithotomy. *Urology Annals*. 2016;8(1):60–60. Available from: <https://dx.doi.org/10.4103/0974-7796.164856>.
- [12] Bergman SM, Frentz GD, Wallin JD. Ureteral Obstruction due to Blood Clot Following Percutaneous Renal Biopsy: Resolution with Intraureteral Streptokinase. *Journal of Urology*. 1990;143(1):113–115. Available from: [https://dx.doi.org/10.1016/s0022-5347\(17\)39884-1](https://dx.doi.org/10.1016/s0022-5347(17)39884-1).
- [13] Dirim A, Turunc T, Kuzgunbay B. Which factors may effect urinary leakage following percutaneous nephrolithotomy? *World J Urol*. 2001;29(6):761–766.
- [14] Smith AD; 2007.
- [15] Verma A, Tomar V, Yadav S. Complex multiple renal calculi: stone distribution, pelvicalyceal anatomy and site of puncture as predictors of PCNL outcome. SpringerPlus. 2016;5(1). Available from: <https://dx.doi.org/10.1186/s40064-016-3017-4>.
- [16] Mousavi-Bahar SH, Mehrabi S, Moslemi MK. Percutaneous nephrolithotomy complications in 671 consecutive patients: a single-center experience. *Urol J*. 2011;8:271–277.
- [17] Desai MR, Kukreja RA, Desai MM. A prospective randomized comparison of type of nephrostomy drainage following percutaneous nephrostolithotomy: large bore versus small bore versus tubeless. *The Journal of Urology*. 2004;172(2):565–567.
- [18] de la Rosette JJMCH, Opondo D, Daels FPJ, Giusti G, Álvaro Serrano, Kandasami SV, et al. Categorisation of Complications and Validation of the Clavien Score for Percutaneous Nephrolithotomy. *European Urology*. 2012;62(2):246–255. Available from: <https://dx.doi.org/10.1016/j.eururo.2012.03.055>.
- [19] Shin TS, Cho HJ, Hong SH. Complications of Percutaneous Nephrolithotomy Classified by the Modified Clavien Grading System: A Single Center's Experience over 16 Years. *Korean J Urol*. 2011;52:769–75.
- [20] Binbay M, Sari E, Tepeler A, Erbin A, Savas O, Muslumanoglu AY, et al. Characteristics of Patients Requiring Double-J Placement Because of Urine Leakage After Percutaneous Nephrolithotomy. *Journal of Endourology*. 2009;23(12):1945–1950. Available from: <https://dx.doi.org/10.1089/end.2009.0154>.
- [21] de la Rosette J, Assimos D, Desai M, Gutierrez J, Lingeman J, Scarpa R, et al. The Clinical Research Office of the Endourological Society Percutaneous Nephrolithotomy Global Study: Indications, Complications, and Outcomes in 5803 Patients. *Journal of Endourology*. 2011;25(1):11–17. Available from: <https://dx.doi.org/10.1089/end.2010.0424>.
- [22] El-Nahas AR, Eraky I, Shokeir AA, Shoma AM, El-Assmy AM, El-Tabey NA, et al. Factors Affecting Stone-free Rate and Complications of Percutaneous Nephrolithotomy for Treatment of Staghorn Stone. *Urology*. 2012;79(6):1236–1241. Available from: <https://dx.doi.org/10.1016/j.urology.2012.01.026>.
- [23] Faerber GJ, Goh M. Percutaneous nephrolithotripsy in the morbidly obese patient. *Tech Urol*. 1997;3:89–95.
- [24] Sinha RK, Mukherjee S, Jindal T, Sharma PK, Saha B, N M. Evaluation of stone-free rate using Guy's Stone Score and assessment of complications using modified Clavien grading system for percutaneous nephro-lithotomy. vol. 43. *Urolithiasis*; 2015.
- [25] Tomaszewski JJ, Cung B, Smaldone MC, Mehrazin R, Kutikov A, Viterbo R, et al. Renal Pelvic Anatomy Is Associated with Incidence, Grade, and Need for Intervention for Urine Leak Following Partial Nephrectomy. *European Urology*. 2014;66(5):949–955. Available from: <https://dx.doi.org/10.1016/j.eururo.2013.10.009>.

- [26] Lee WJ, Smith AD, Cubelli V, Badlani GH, Lewin B, Vernace F, et al. Complications of percutaneous nephrolithotomy. *American Journal of Roentgenology*. 1987;148(1):177–180. Available from: <https://dx.doi.org/10.2214/ajr.148.1.177>.

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