

# Emphysematous Pyelonephritis with Renal Calculi Treated with Percutaneous Nephrolithotomy

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## Abstract

**Introduction:** Percutaneous nephrolithotomy (PCNL) today has become the first line treatment for large renal stones. The infective complications of PCNL in patients with emphysematous pyelonephritis EPN would be higher and be responsible for the increased morbidity. We retrospectively reviewed our hospital records of patients with EPN and renal stones undergoing PCNL, and assessed the outcome especially in relation to infection. **Materials & Methods:** The case records of all patients with EPN and renal stones having undergone PCNL at our centre were retrospectively reviewed and analyzed. The age, gender, presenting symptoms, features of septicemia, preoperative drainage, post-operative complications and outcome were recorded. **Results:** During the study period, 12 patients (eight females and four males) with a mean age of years who were diagnosed to have EPN, underwent PCNL for extraction of renal calculi. All patients were initially managed conservatively; five patients underwent cystoscopy and Double J stent insertion on the affected side and seven patients underwent PCN insertion. Six weeks later, PCNL was performed (Urine culture was negative) undercover of appropriate antibiotics and general anaesthesia. Nine patients had Class II; two patients had class IIIb and one patient had class IV complications as classified by Clavien-Dindo. All patients recovered well and post-operative x-rays showed clearance of stone in all. **Conclusions:** Percutaneous nephrolithotomy is a safe, viable option in patients with emphysematous pyelonephritis and renal calculi follows a period of conservative treatment and effective drainage of the

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pelvicalyceal system by either a ureteric stent or percutaneous nephrostomy. The calculi can be effectively managed with endoscopic measures with renal preservation and a good functional outcome.

## Keywords

Complications, Emphysematous Pyelonephritis, Percutaneous Nephrolithotomy

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## 1. Introduction

Emphysematous pyelonephritis (EPN) is a urologic emergency characterized by an acute necrotizing parenchymal and perirenal infection caused by gas-forming uropathogens [1]. The pathogenesis is poorly understood [1]. Because the condition usually occurs in diabetic patients, it has been postulated that the high tissue glucose levels provide the substrate for microorganisms such as *E. coli*, which are able to produce carbon dioxide by the fermentation of sugar [1] [2]. In addition to diabetes, many patients have urinary tract obstruction associated with urinary calculi or papillary necrosis and significant renal functional impairment. The overall mortality rate has been reported to be between 19% [3] and 43% [4]. Emphysematous pyelonephritis invariably is a surgical emergency. Most patients present with signs and symptoms of severe infection, appear septic, and are usually managed by fluid resuscitation and broad-spectrum antimicrobial therapy. Conservative therapy is instituted if the kidney is functioning [5] [6]. Nephrectomy is usually indicated in patients who do not improve after conservative therapy [7] [8] and if the affected kidney is non-functioning and not obstructed. If the affected kidney is obstructed, drainage of the system with either Double J stenting or percutaneous nephrostomy is usually instituted. Fatima *et al.* [9] presented their experience of 22 (6 males, 16 females) cases of EPN treated from 1996-2012, seven cases presented with acute pyelonephritis, seven cases with urosepsis, and the remaining eight patients with multi-organ dysfunction. Computed tomography (CT) grading of EPN was class IV in three, class III in four, class II in 14, and class I in one. All were initially managed medically with parenteral antibiotics. Ten patients needed additional surgical intervention. The overall survival rate was 86.3% (19/22). Among the risk factors analyzed higher CT grade, altered sensorium and thrombocytopenia were significantly associated with mortality.

Percutaneous nephrolithotomy (PCNL) today has become the first line treatment for large or multiple renal stones and stones in lower calyx [10]. Furthermore, improvements in instruments (flexible pyeloscopes and ureteroscopes) as well as lithotripsy technology (*i.e.* ultrasound/pneumatic devices, holmium laser) have increased the efficacy of percutaneous stone disintegration yielding stone free rates of >90% [11] [12]. Michel *et al.* [13] reported an overall complication rate of up to 83% , including extravasation (7.2%), transfusion (11.2% - 17.5%),

and fever (21.0% - 32.1%), whereas major complications, such as septicaemia (0.3% - 4.7%) and colonic (0.2% - 0.8%) or pleural injury (0.0% - 3.1%) were rare. Septicaemia can occur as a result of infection introduced via the access to the kidney or if the stones are infected. Following PCNL, fever is significantly higher and more frequent in patients with infected urinary stones than in those with sterile stones [14]. It would be right to presume that the infective complications of PCNL in patients with EPN would be higher and be responsible for the increased morbidity. We retrospectively reviewed our hospital records of patients with EPN and renal stones undergoing PCNL, and assessed the outcome especially in relation to infection.

## 2. Subjects and Methods

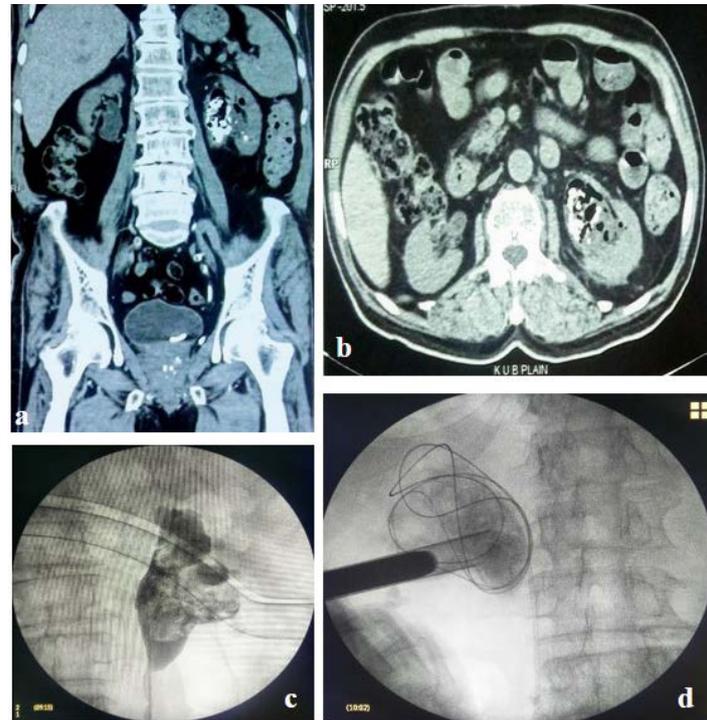
This study was conducted following approval of the Institutional/University ethical committee. The case records of all patients with EPN and renal stones having undergone PCNL at our center were retrospectively reviewed and analyzed. The age, gender, presenting symptoms, features of septicemia, preoperative drainage, post-operative complications and outcome were recorded.

## 3. Results

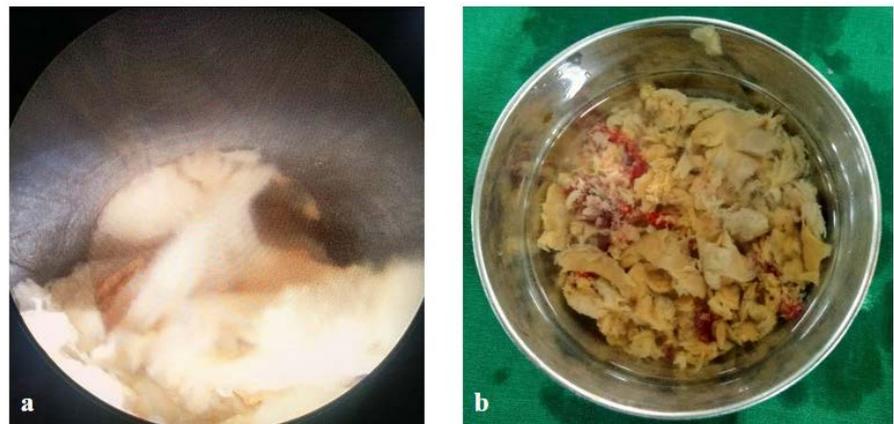
During the study period Jan 2001-Dec 2015 (15 year period), 12 patients (eight females and four males) with a mean age of  $(51.75 \pm 6.90)$  years and diagnosed to have EPN, underwent PCNL for extraction of renal calculi. The patients presented with symptoms of fever, chills and rigor, pain in abdomen, pyuria and dyspepsia. All the 12 patients were having diabetes mellitus and 9 of them were hypertensive too. The status of sugar control at presentation was poor and all the patients showed elevated HbA1c levels.

All patients were initially managed conservatively with injectable broad spectrum antibiotics, hydration, antipyretics and catheterization. Plain x-rays abdomen/KUB region were done in all, which revealed gas in the region of kidneys (grade I—4 patients and grade II—6 patients). Two patients had bilateral findings (grade IV). Computed tomography (CT) (**Figure 1(a)** & **Figure 1(b)**) was done in all patients to visualize the kidneys better and confirm obstruction. Contrast enhanced CT (CECT) was done in patients with creatinine values  $< 1.5$  mg%. A decision to insert Double J stent or put in a percutaneous nephrostomy (PCN) was made based on the dilatation of pelvicalyceal system. Five patients underwent cystoscopy and Double J stent insertion on the affected side. Seven patients underwent PCN insertion. The patients were discharged once they were clinically settled with no fever and urine appeared clear. All patients were treated with appropriate antibiotics based on culture/sensitivity reports.

All patients were called back six weeks later and PCNL performed (**Figure 2(a)** & **Figure 2(b)**) (Urine culture was negative) under cover of appropriate antibiotics and general anaesthesia. In patients with PCN (7), the same tract was used for placing the amplatz sheath. In three patients additional punctures/tracts



**Figure 1.** (a) and (b) CT scan shows renal stone in the left kidney with gas in the collecting system; (c) Left retrograde pyelogram (RGP) shows gas and stone in the left pelvicalyceal system; (d) Percutaneous nephrostomy being done with the patient in prone position.



**Figure 2.** (a) Percutaneous nephroscopy shows soft yellow matrix calculi with pus; (b) Extracted matrix calculi with mucus and pus.

were necessary to clear the renal stone. Complications were noted as follows (**Table 1**). Nine patients had either fever and/or haematuria. Addition of aminoglycosides to the antibiotic regime was necessary in five patients, antipyretics was necessary in all the nine patients for fever and blood transfusions in two patients.

Two patients had type IIIb complications. One patient had persistent pyuria and underwent Double J stent removal and retrograde pyelogram (RGP), which

**Table 1.** Complications as defined by Clavien-Dindo Classification.

SL. No.	Complication		Outcome
1	II	9 (75%)	Uneventful
2	IIIb	2 (16.6%)	Recovered
3	IV	1 (8.33%)	Acute renal failure recovered after dialysis

demonstrated small leak of contrast into the duodenum (**Figure 3**). The patient was restented with Double J stent for an additional period of 6 weeks. The stent was removed after that and repeat retrograde studies revealed that the small fistula had healed. In another patient, a residual fragment of 8 mm was noticed and underwent extraction of the fragment through the nephrostomy site in a repeat procedure. One patient, who had a huge stone burden, had fever, with fall in blood pressure and tachycardia following PCNL, needed admission into intensive care unit, ventilator support for an additional 48 hours and two sessions of dialysis. He recovered completely and discharged a week later. Post-operative KUB x-rays showed complete clearance of stones in 11 patients, whereas one patient needed an additional session of percutaneous extraction of calculi.

#### 4. Discussion

Percutaneous nephrolithotomy (PCNL) is the procedure of choice for patients with large renal and upper ureteral stones as it is less invasive than open surgery and is associated with high stone clearance rates. Advances in medical equipment for PCNL have resulted in a significant reduction in morbidity, mortality, and the cost of treatment. Even though PCNL is a minimally invasive procedure, the complications following this procedure are still common. The complications following PCNL are infection, haemorrhage, adjacent organ injury, retained stone, loss of kidney function, and death [15]. The Clinical Research Office of the Endourological Society (CROES) conducted two multicentre global studies on the complications following PCNL. The first prospective observational study reported on complications of PNL using the modified Clavien classification system [16], whereas the second study demonstrated the occurrence of urinary tract infection (UTI) and postoperative fever following this procedure [17].

The first study included 724 patients, of whom 20.5% experienced complications of which eighty percent were minor. Major complications including hydrothorax, pneumothorax, pleural effusion, urinary fistula, ureteric obstruction, and urosepsis were less common. Among all complications, fever was the most common complication followed by bleeding; however, most of them were minor and were successfully controlled using medications. Specific risk factors that were associated with postoperative UTI were positive intraoperative urine/stone culture, infected stone, neurogenic bladder, higher operative time, and postoperative nephrostomy tube placement [16].

The second CROES PCNL study group [17] reviewed the incidence of UTIs, postoperative fever, and risk factors for post-PCNL fever. This study investigated



**Figure 3.** Post-operative RGP shows contrast leaking into the second part of duodenum.

a total of 5803 patients, of whom 865 (16.2%) had a positive urine culture. The most common organism isolated was *Escherichia coli* (Gram negative), which was found in 350 patients (6.5%). Post-PCNL fever was noted in approximately 10% (550) of the cases, although the patients received antibiotic prophylaxis. The percentage of post-PCNL fever in patients with negative preoperative urine culture and positive preoperative urine culture was 8.8% and 18.2%, respectively. Postoperative PCNL fever was significantly increased with the increasing mean durations of hospitalization ( $3.4 \text{ days} \pm 1.7 \text{ days}$  vs.  $5.4 \text{ days} \pm 2.3 \text{ days}$ ;  $p < 0.001$ ). Postoperative fever was frequently observed in cases with nephrostomy tube placement and in women because the nephrostomy tube, which was used in complicated cases, acted as a foreign body and females have greater risk of UTI. Both studies demonstrated the importance of preventing infection-related complications following PCNL.

The role of conservative medical management of EPN with antibiotics and supportive care along with percutaneous drainage/stenting as a treatment option is not disputed today [18]. As far as stone management in EPN kidneys, there is not much evidence in literature except for case reports mentioning the possibility of a retrograde procedure or PCNL through the access which was established initially for drainage [18] [19]. However, these reports are not forthcoming about the timing, problems encountered, complications and final outcome of the interventions undertaken for stone clearance. Goel *et al.* [18] reported on their experience in managing seven cases of EPN of which two patients (three renal units) had EPN with urinary calculi. The patients were managed conservatively in the initial stage and the stones were tacked appropriately at a later time. Similarly Lam and Caddeo [20] reported on a 43 year old diabetic lady who presented with bilateral EPN and mild haematuria. The CT scans showed extensive

gas present in the collecting systems with inspissated debris and calculi. The ureters were tortuous, gas-filled and dilated with debris within the urine in the bladder as well as large quantities of gas in the bladder itself. The authors performed bilateral PCNL to extract the stone and drain the collecting system. The procedure was successful and follow-up CT scans showed reduction in air compared to previous scans.

Our study shows that it is feasible to clear renal stones by PCNL in patients with EPN, following a period of conservative treatment with antibiotics and drainage of the infected pelvicalyceal system by either DJ ureteric stenting/PCN. PCNL is safe as seen in our study, although the infective complications are common. In spite of the pre-operative urine culture showing no growth, stones do harbor bacteria and are released during surgery. However the complications are usually self-limiting and the outcome in terms of stone clearance and recovery are good. It is very important today that an urologist must learn how to perform a percutaneous access safely by himself. The ability to secure a safe and precise percutaneous access is an essential step in performing PCNL, and many techniques to establish renal access have been described in the literature [8] [21].

## 5. Conclusion

Our study positively indicates the importance of initial conservative management of EPN along with drainage, followed by management of calculus in a graded fashion. Such a staged approach is the cornerstone of treatment. Complication rates were similar to those encountered with regular PCNL. Infective complications are common and self-limiting.

## Conflicts of Interest

The authors declare conflict of Interest as None.

## Human and Animal Rights

Not Applicable.

## Informed Consent

Consent of patients was taken during consultation.

## References

- [1] Schaffer, A.J., Matulewicz, R.S. and Klumpp, D.J. (2016) Infections of the Urinary Tract. In: Wein, A.J., Kavoussi, L.R., Partin, A.W. and Peters, C.A., Eds., *Campbell-Walsh Urology*, 11st Edition, Elsevier-Saunders, Philadelphia, 237.
- [2] Schainuck, L.I., Fouty, R. and Cutler, R.E. (1968) Emphysematous Pyelonephritis. A New Case and Review of Previous Observations. *The American Journal of Medicine*, **44**, 134-139. [https://doi.org/10.1016/0002-9343\(68\)90245-3](https://doi.org/10.1016/0002-9343(68)90245-3)
- [3] Huang, J.J. and Tseng, C.C. (2000) Emphysematous Pyelonephritis: Clinicoradiological Classification, Management, Prognosis, and Pathogenesis. *Archives of Internal Medicine*, **160**, 797-805. <https://doi.org/10.1001/archinte.160.6.797>

- [4] Freiha, F., Messing, E. and Gross, D. (1979) Emphysematous Pyelonephritis. **18**, 9-19.
- [5] Wan, Y.L., Lee, T.Y., Bullard, M.J., *et al.* (1996) Acute Gas-Producing Bacterial Renal Infection: Correlation between Imaging Findings and Clinical Outcome. *Radiology*, **198**, 433-438. <https://doi.org/10.1148/radiology.198.2.8596845>
- [6] Best, C.D., Terris, M.K., Tacker, J.R., *et al.* (1999) Clinical and Radiological Findings in Patients with Gas Forming Renal Abscess Treated Conservatively. *Journal of Urology*, **162**, 1273-1276. [https://doi.org/10.1016/S0022-5347\(05\)68263-8](https://doi.org/10.1016/S0022-5347(05)68263-8)
- [7] Malek, R.S. and Elder, J.S. (1978) Xanthogranulomatous Pyelonephritis: A Critical Analysis of 26 Cases and Review of the Literature. *The Journal of Urology*, **119**, 589-593. [https://doi.org/10.1016/S0022-5347\(17\)57559-X](https://doi.org/10.1016/S0022-5347(17)57559-X)
- [8] Dixit, N., Nerli, R.B., Ghagane, S., Hiremath, M.B. and Guntaka, A. (2015) The Role of Public Relation In-Charge in Kidney Transplantation: The Cognitions, Emotions, Ethical, and Religious Issues in a Multicultural Society like India. *International Journal of Nephrology and Kidney Failure*, **2**, 1-7.
- [9] Fatima, R., Jha, R., Muthukrishnan, J., Gude, D., Nath, V., Shekhar, S., *et al.* (2013) Emphysematous Pyelonephritis: A Single Center Study. *Indian Journal of Nephrology*, **23**, 119-124. <https://doi.org/10.4103/0971-4065.109418>
- [10] Lingeman, J.E., Newmark, J.R. and Wong, M.Y.C. (1995) Classification and Management of Staghorn Calculi. In: Smith, A.D., Ed., *Controversies in Endourology*, Saunders, Philadelphia, 136-144.
- [11] Hafron, J., Fogarty, J.D., Boczeko, D. and Hoening, D.M. (2005) Combined Ureteroscopy and Shockwave Lithotripsy for Large Renal Stone Burden: An Alternative to Percutaneous Nephrolithotomy? *Journal of Endourology*, **19**, 464-468. <https://doi.org/10.1089/end.2005.19.464>
- [12] Marguet, C.G., Springhart, W.P., Tan, Y.H., *et al.* (2005) Simultaneous Combined Use of Flexible Ureterscopy and Percutaneous Nephrolithotomy to Reduce the Number of Access Tracts in the Management of Complex Renal Calculi. *BJU International*, **96**, 1097-1100. <https://doi.org/10.1111/j.1464-410X.2005.05808.x>
- [13] Michel, M.S., Trojan, L. and Rassweiler, J.J. (2007) Complications in Percutaneous Nephrolithotomy. *European Urology*, **51**, 899-906. <https://doi.org/10.1016/j.eururo.2006.10.020>
- [14] Takeuchi, H., Ueda, M., Nonomura, M., *et al.* (1987) Fever Attack in Percutaneous Nephrolithotomy and Transurethral Ureterolithotripsy. *Hinyokika Kyo*, **33**, 1357-1363.
- [15] Lojanapiwat, B. (2016) Infective Complication Following Percutaneous Nephrolithotomy. *Urological Science*, **27**, 8-12. <https://doi.org/10.1016/j.urols.2015.04.007>
- [16] Labate, G., Modi, P., Timoney, A., Cormio, L., Zhang, X., Louie, M., *et al.* (2011) The Percutaneous Nephrolithotomy Global Study: Classification of Complications. *Journal of Endourology*, **25**, 1275-1280. <https://doi.org/10.1089/end.2011.0067>
- [17] Gutierrez, J., Smith, A., Geavlete, P., Shah, H., Kural, A.R., de Sio, M., *et al.* (2013) Urinary Tract Infections and Post-Operative Fever in Percutaneous Nephrolithotomy. *World Journal of Urology*, **31**, 1135-1140. <https://doi.org/10.1007/s00345-012-0836-y>
- [18] Goel, T., Reddy, S. and Thomas, J. (2007) Emphysematous Pyelonephritis with Calculus: Management Strategies. *Indian Journal of Urology*, **23**, 250-252. <https://doi.org/10.4103/0970-1591.33718>
- [19] Nilsen, F.S., Karlsen, S.J. and Gjertsen, O. (2001) Gas Containing Renal Stones

Treated with Percutaneous Nephrolithotomy: Case Report. *Journal of Endourology*, **15**, 915-917. <https://doi.org/10.1089/089277901753284134>

- [20] Lam, A.K.K. and Caddeo, G. (2014) Emphysematous Pyelonephritis Treated with Percutaneous Nephrolithotomy. *World Journal of Nephrology and Urology*, **3**, 151-153. <https://doi.org/10.14740/wjnu145w>
- [21] Nerli, R.B., Devaraju, S. and Hiremath, M.B. (2014) Training in Percutaneous Nephrolithotomy: A Structured Apprenticeship Program. *Journal of the Scientific Society*, **41**, 26-31.