

Frequency of complications in image guided percutaneous nephrostomy

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Abstract

Objective: To assess the frequency of complications in image-guided percutaneous nephrostomy and to identify common sources of error.

Methods: The study was carried out at the Sindh Institute of Urology and Transplantation, Karachi, between November 2006 and May 2007. Patients of all age groups between 1 and 80 years were included using non-probability convenience sampling technique. Those suffering from obstructive uropathy due to various causes were diagnosed by imaging modalities like ultrasound, computed tomography scan, conventional X-ray and contrast studies. It also included cases where percutaneous nephrostomy was used to temporarily divert urine in the presence of urinary tract leaks and fistula so that healing may occur. Patients with uncorrectable bleeding diathesis were excluded. Nephrostomies performed for supplementary procedures were also excluded. One-month follow-up was performed by means of direct communications and using various imaging modalities. SPSS 12 was used for statistical analysis.

Result: Three hundred patients enrolled in the study. The procedure was successful in all encounters. The complications were categorised as early and late complications. Early complications were sepsis in 6 (2%) patients, retroperitoneal haematoma in 5 (1.6%) patients, bleeding in 2 (0.6%), and urinoma in 1 (0.3%). Late complications included catheter blockage in 15 (5%) patients, and dislodgement of catheter in 7 (2.3%). Total early complications were noted in 14 (4.66%) patients, and there were 22 (7.33%) late complications.

Conclusion: Percutaneous nephrostomy is a safe, simple and cost-effective technique with low morbidity and no major life-threatening complications.

Keywords: Percutaneous nephrostomy, Obstructive uropathy, Imaging modalities, Hydronephrosis. (JPMA 63:816; 2013)

Introduction

Percutaneous nephrostomy (PCN) is a method to obtain relief of obstruction in urinary collecting system when retrograde drainage is technically impossible or inappropriate and surgical nephrostomy is not indicated or feasible. First PCN was done by Goodwin, Casey and Wolfe in 1955 who drained a hydronephrotic kidney percutaneously by successfully placing a nephrostomy tube in renal pelvis.¹ Current methods of PCN insertion with ultrasound and fluoroscopic guidance ensure that the procedure is safe and has an advantage over surgical intervention in that it is performed under local anaesthesia.

Acute ureteral obstruction is most commonly related to stone disease and accounts for as many as one-fourth of PCNs performed.² Decompression with PCN may allow the cause of acute ureteral obstruction to be addressed on elective basis without risk of losing renal function.³ The longer the kidney is obstructed, the more damage occurs to the nephrons particularly in the presence of infection.⁴ In patients with pyonephrosis, urinary tract

decompression can be life-saving. PCN can yield important bacteriological information and alter antibiotic treatment regimens by correctly identifying the offending pathogen and improving the sensitivity of bladder urine cultures.⁵ Interestingly, in a recent opinion survey conducted in the UK, urologists favoured PCN more often than radiologists for the treatment of uncomplicated obstructive nephropathy.⁶ In patients with underlying malignancy where intervention is contemplated, PCN may have a higher technical success rate in relieving obstruction compared with retrograde double J ureteral stenting, especially in cases due to extrinsic compression in the emergent setting.^{7,8} In patients with pelvic malignancies, PCN decompression has been shown to be valuable in improving renal function and survival.⁹⁻¹¹ Percutaneous nephrostomy has been accepted as the procedure of choice in adults and children, in almost all cases of urinary obstruction requiring temporary drainage of the urinary tract.

PCN is also useful when the determination of functional reserve capacity of an obstructed kidney is uncertain in benign conditions like severe pelvi-ureteric junction (PUJ) obstruction or primary mega-ureter. PCN alone is usually sufficient to allow small post-surgical leaks to heal. Open nephrostomy cannot be done in a critically ill patient as

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general anaesthesia is needed, which cannot be given in a patient with several electrolyte imbalance, hyperglycaemia and electrocardiogram (ECG) changes suggestive of myocardial infarction, but despite all of these comorbidities PCN can be performed as initial life-saving procedure as it only requires local anaesthesia.

With the realization that needles and catheters could be safely and quickly used on the kidney, the method of PCN became the window into the organ for a variety of interventional uro-radiological and endo-urological procedures.¹² The resulting improved patient care has been associated with reduced morbidity, minimal mortality and cost reduction compared with previous usual surgical approaches.^{2,13}

Contraindications to PCN include uncorrectable coagulopathy and uncooperative patient. If hyperkalaemia is severe (i.e. potassium level of over 7mEq/L), haemodialysis should be performed to correct the electrolyte balance before the procedure.¹²

PCN has significantly reduced the morbidity and mortality rates, with high success rate in adults and paediatric cases. Nevertheless, significant complications may occur even after minimally invasive procedure.

The present study was designed to assess the frequency of complications in image-guided percutaneous nephrostomies, and to identify common sources of error.

Patients and Methods

The descriptive cross-sectional study was carried out at the Department of Radiology, Sindh Institute of Urology and Transplant (SIUT), Karachi, from November 2006 to May 2007. Based on non-probability convenience sampling, 300 patients of all age groups were included. Patients suffering from obstructive uropathy due to various causes were diagnosed by imaging modalities like ultrasound, computed tomography (CT) scan, plain and contrast studies. It also included cases where PCN was used to temporarily divert urine in the presence of urinary tract leaks and fistula, so that healing may occur.

Patients with uncorrectable bleeding diathesis were not included. Those with PCN performed for supplementary procedures like percutaneous nephrolithotomy (PCNL), ureteric stent insertion, nephroscopy and biopsy, were also excluded. All PCNs were performed by trained radiologists and one-month follow-up was done.

Early complications were defined as those noted immediately or within 24 hours of the procedure, including bleeding, infection, retroperitoneal haematoma, extravasation and urinoma, perforation of

adjacent viscera like colon, hydrothorax and pneumothorax.

Late complications were defined as those noted after 24 hours or later in follow-up, including blockage of catheter, catheter dislodgement, arteriovenous (AV) fistula, pseudo-aneurysm and ureteric stricture.

All the patients were referred from the out-patient department (OPD), emergency room (ER) or in-patient units of the SIUT.

Prior to PCN, stepwise details of the procedure were discussed with either the patients or, in the paediatric age group, with the parents. Benefits after the PCN procedure such as improvement of the renal function as well as risks, such as post-procedure complications were explained and informed consent was obtained from all concerned.

Post-procedure follow-up was done up to one-month, using ultrasound as the basic tool. Ante-grade pyelogram, CT scan, and colour Doppler ultrasound were used as secondary tools. Proforma encompassed variables such as procedures, early and late complications along with post-procedure follow-up.

The data was entered and analysed on SPSS version 12. Mean \pm Standard deviation was calculated for the age of the patients. Frequencies and percentages were calculated for early and late complications.

Chi-square test was applied for proportion of complications within the group divided on the bases of age and gender. P-value less than 0.05 was considered significant.

Results

The 300 patients in the study represented all age groups between 1 and 80 years. The mean age was 42 \pm 18.9 years. There were 220 (73.3%) male and 80 (26.7%) female patients.

The most common etiology was obstructive uropathy due to stone diseases either in kidney or ureter in 232 (77.3%) patients. Patients with malignancy made up the second largest group with 40 (13.3%) patients having carcinoma of the urinary bladder and 12 (4.0%) having carcinoma of cervix, rectum, prostate, abdominal lymphoma and retroperitoneal fibrosis. In 13 (4.33%) patients, upper urinary tract obstruction was in 10 (3.33%) patients due to ureteric stricture and 3 (1%) patients had hydronephrosis secondary to ligation of ureter during obstetric surgery. As SIUT is a specialised renal transplantation centre, PCN was also performed in 3 (1%) transplanted kidneys. The rate of technical success was 100%.

Most of the patients (n=272; 90.7%) were inpatients

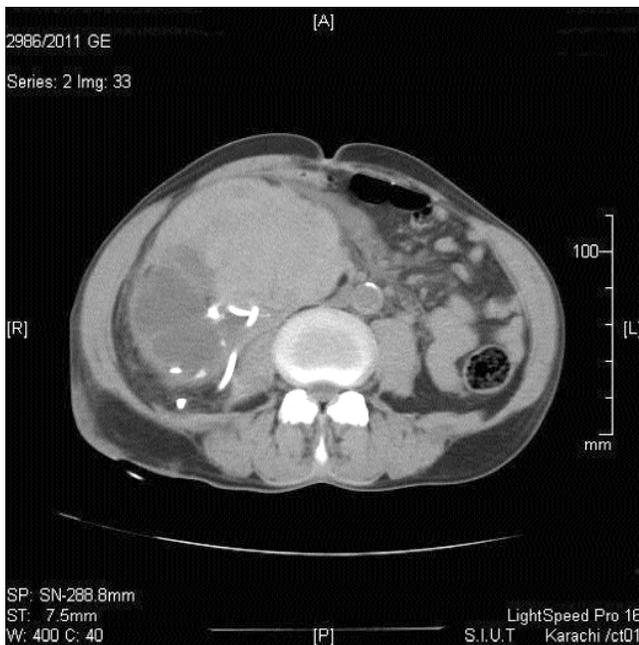


Figure: Computed tomography scan abdomen showing large retroperitoneal haematoma with the catheter.

admitted through ER and 28 (9.3%) were outpatients. Both fluoroscopy and ultrasound were used in most of the patients. Only ultrasound was used in 10 (3.33%) patients, including 4 (1.33%) pregnant women and 6 (2%) critically ill patients in surgical intensive care unit (ICU). The procedure was done under local anaesthesia. However, 26 (8.6%) patients comprising paediatric age group needed general anaesthesia.

Post-PCN complications were observed in 36 (12%) patients (Table). Early complications were noted in 14 (4.6%) patients, while late complications were seen in 22 (7.3%).

Early complications comprised sepsis 6 (2%), retroperitoneal haematoma 5 (1.6%) (Figure), haematuria 2 (0.6%), and urinoma 1 (0.3%). Complications such as perforation of adjacent viscera and pneumothorax were not observed.

Late complications comprised catheter blockage (15 [5%]), and dislodgement of catheter (7 [2.3 %]). Other complications such as AV fistula, pseudo-aneurysm and ureteric stricture were not seen.

The difference of early complications between males and females was insignificant ($p < 0.980$). There was no substantial difference in late complications between the two groups ($p < 0.758$).

Table: Post-procedure complications.

S. No.	Complications	No. of Patients	Percentage (Out of 300 PCN)
1	Sepsis	06	2.0 %
2	Bleeding required blood transfusion:		2.3%
	- Retroperitoneal haematoma	05	
	- Haematuria	02	
3	Urinoma	01	0.3%
4	Blocked catheter	15	5.0%
5	Dislodged catheter	07	2.3%
	Total Complications	36	11.9%

Early complications in children and adolescents were statistically significant ($p < 0.000$). However, late complications remained insignificant ($p < 0.369$).

Complications were further analysed to identify sources of error. Of the 6 (2%) patients with post-procedure sepsis, 4 (1.33%) already had pyonephrosis that despite antibiotic cover was aggravated. Two (0.66%) patients were not having clinical signs of infections, but urine specimens obtained were turbid and they developed sepsis. After having culture and sensitivity tests of urine specimen obtained during the PCN, the antibiotics were readjusted. Out of the 7 (2.3%) patients having bleeding (retroperitoneal haematoma 5 [1.66%] and haematuria 2 [0.66%]), 4 (1.66%) patients were in uremic state at the time of PCN; 2 (0.66%) were also having diabetes mellitus and cardiac disease. One (0.33%) patient had renal parenchymal disease along with obstruction. In all these patients, bleeding was settled with blood transfusion and prolonged tube drainage. Thus comorbidities like infection, diabetes mellitus, cardiac disease, renal parenchymal disease and deranged clotting mechanism along with technical factors like, difficulty to identify renal calyx, multiple passes of needle, excessive manipulation during PCN tract dilation and tube adjustment were identified as sources of error in early complication. The late complications mainly comprised minor complications related to the catheter. Most of the catheter blockages had pyonephrosis or bleed; however 5 (1.66%) patients had encrustation due to prolonged obstruction. Catheter dislodgement was reported in 7 (2.3%) patients; most of them were either of old age or minors and some also had language problem and were unable to understand the instructions. Catheter dislodgement was also noted in 2 (0.66%) patients in ICU. Thus identified contributory factors were: presence of pus, debris or blood in urine requiring intermittent catheter wash and patient education about care of PCN catheter. All complications including sepsis, haemorrhage requiring transfusion and urinoma were managed conservatively. Catheter related

complications were managed by replacing catheter or doing new PCN.

Discussion

After the 1970s, with improved imaging systems like image intensifier in fluoroscopy, real-time ultrasound, CT scans and technical innovations, PCN has largely replaced the surgical nephrostomy. PCN can safely be performed in low-risk patients as an outpatient procedure with same-day discharge.¹⁴

PCN is indicated for the preservation of renal function, relief of pain and in most extreme circumstances, the drainage of pyonephrosis. In the current study, the technical success rate was 100%. In the literature, the success rate is reported from 84% to 100%.^{13-15,17}

In a retrospective study of 569 radiologically-guided PCN, the success rate was 98%.¹³ There were 22 (4%) major complications, including cardiac arrest, bleeding requiring transfusion or embolisation, septicaemia, hydrothorax or pneumothorax. There were 38% minor complications, including urinary tract infection, catheter dislodgement, catheter obstruction by debris, urinary leakage, and inflammation of the skin at the site of insertion of the percutaneous catheter. Besides, 79 (14%) catheters slipped out unintentionally.¹⁵ In our study, we did 300 PCNs and had 13 (4.3%) major complications and 23 (7.6%) minor complications. Complications like cardiac arrest, hydrothorax or pneumothorax did not occur.

A review of radiologically-guided percutaneous nephrostomies in 303 patients reported technical success to be 99%. Overall complication rate was 6.5%, including haemorrhage requiring transfusion (2.8%).² In our study the success rate was 100% and the frequency of haemorrhage 2.3%. But overall, complication rate was (12%) almost double. This was because in our study a large group of PCN complications were catheter rather than procedure related.

Another study comprising 160 PCNs in an emergency setting, reported initial technical success rate to be 98%. Overall complication rate was 34%; 6% were major and 28% minor.¹⁷ This included sepsis (6%), haematuria requiring blood transfusion (2.4%), catheter displacement or mal-position (4.8%), pelvic perforation (4.3%), paralytic ileus (2.4%), pneumonia/atelectasis (1.8%) and pleural effusion (1.2%).¹⁷

The Society of Interventional Radiology Quality Improvement (SIR QI) guidelines has reported success rate of 85%-98%, depending upon clinical scenario. The suggested thresholds of major complications of PCN, including septic shock at 4%, septic shock in setting of

pyonephrosis at 10%, haemorrhage requiring transfusion at 4%, vascular injury requiring embolisation or nephrectomy at 1%, bowel injury at <1% and pleural complications (pneumothorax, empyema, haemothorax etc.) at 1%.^{18,19}

The complication rate is approximately 10% for major and minor complications together and 4-5% for major complications only.²⁰ The 12% complication rate in our study appears higher, but the incidence of major complications in our study was 4.3%, which is in line with previous studies quoted.

The study had its limitations. First, we were unable to study the patient comfort or radiation dose during fluoroscopy in detail. Second, pigtail catheters were used in all patients. Pigtail catheters are versatile, low-cost and simple in design. However, they show encrustation if placed for longer period e.g. in patients of obstructive uropathy or secondary to pelvic malignancies. Pure silicone catheters are best in these situations. Among the late complications, blockage of the catheter was reported in 15 patients, which could have been avoided by using the large-bore catheters. Catheter dislodgement reported in 7 patients could have been minimised by using pigtail catheters with locking string, patient or parent education. Attendants of old patients also required full understanding about the fixation of catheter and the drainage of urine.

Conclusion

PCN is relatively simple to perform and has great clinical value without significant complications. It is an excellent technique for upper urinary obstruction due to its efficacy, ease of insertion, low cost and satisfactory result. No deaths or significant morbidity resulted from the complications. It is a minimally invasive technique which necessitates only the use of local anaesthesia, a sound knowledge of human anatomy involved, minimum of material and close working relationship between interventional radiologists and the urologists.

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