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Ultrasound Guided Percutaneous Nephrostomy for Obstructive Uropathy in Benign and Malignant Diseases

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ABSTRACT

Objective: Analyze the success rate, complications and overall benefit of ultrasound guided percutaneous nephrostomy (PCN) for the relief of obstructive uropathy in benign and malignant diseases.
Materials and Methods: PCN was performed in 50 kidneys of 32 patients. It was performed in emergency rooms totally under ultrasound guidance by general surgeons. Seldinger technique was used in all cases. Changes in renal function after the procedure were analyzed using paired t-test.
Results: The procedure was successfully completed in 42 out of 50 kidneys (84%). There has been no major complication and 28% minor complications. The renal function improved significantly when PCN was performed for benign conditions (mean creatinine 3.52 mg/dL before and 2.18 mg/dL after PCN), however in malignancy there has been no significant improvement in renal function (before PCN mean creatinine 6.39 mg/dL and after PCN 5.41 mg/dL).
Conclusion: We conclude that PCN can be effectively performed under ultrasound guidance and should be the initial procedure in acutely obstructed kidneys with pyonephrosis and poor renal function. In malignant cases, however, improvement in renal function is possible only if the procedure is carried out at an early stage.

***Key words**: hydronephrosis; ureteral obstruction; percutaneous nephrostomy; ultrasound*
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INTRODUCTION

Obstructive uropathy is a condition occurring due to blockage of urine flow, resulting in increased pressure within the collecting system and kidney injury. Interruption of urinary flow results in pain, infection, sepsis, and loss of renal function. It is a potentially life threatening condition and immediate measures are required to decompress the kidneys. The various modalities available are retrograde stenting, open drainage of kidneys and percutaneous nephrostomy.

Percutaneous nephrostomy (PCN) has come a long way from the times of William Goodwin, who inadvertently punctured the renal pelvis attempting a translumbar aortogram (1). Although percutaneous nephrostomy was developed using fluoroscopic guidance, ultrasound guided procedures are now safe, easy and effective (2-5).

We performed PCN in patients, with both benign and malignant conditions solely under ultrasound guidance with the help of radiologists and evaluated the success rate of the procedure, related complications and outcome in patients with benign and malignant renal diseases.

MATERIALS AND METHODS

A prospective study was carried out in 50 kidneys of 32 patients suffering from obstructive uropathy. It included 18 males and 14 females with both benign and malignant causes of obstructive uropathy. The mean age in this study group was 41.4 years, ranging from 10 to 63 years. In males the average age was 41.5 years ranging from 10 to 63 years and in females it was 42 years ranging from 19 years to 63 years.

The percutaneous nephrostomy was performed entirely under ultrasound guidance as soon as it was possible in emergency. The procedure was thoroughly explained to the patient and relatives. Informed consent was obtained.

All patients were subjected to routine investigations and the following patients were excluded from the study: untreated bleeding disorders, untreated urinary tract infection, hemoglobin less than 10 mg/dL. In patients failing to meet these criteria all parameters were corrected before proceeding with PCN.

The patients were placed on the ultrasound table in prone position and a pillow placed under the abdomen on the side to be operated to correct lumbar lordosis and support the kidney. Ultrasound scanning was performed using a 7.5 MHz transducer to obtain a median longitudinal scan through the kidney. As soon as the initial puncture site was chosen it was cleaned and draped. Local anesthesia was injected at the puncture site and around it using 3-5 mL of 1% lignocaine. Sterile betadine jelly was applied to the transducer and localization of the puncture site was carried out again.

We performed the Seldinger technique in all patients. The skin and fascia were incised with a #11 blade and then the scanning head was shifted over the incision to measure the distance between the skin and the calyx. An 18G-sheathed needle was inserted blindly through the incision and aimed at the direction previously determined by the ultrasound. The sonographic view as well as urine confirmed that the needle was at the desired site. The needle was removed leaving a small catheter in place and a curved J tip 0.038 guide wire was inserted into the collecting system through the puncture needle. Once the guide wire was in position, the fascial dilators were inserted with rotating movements during advancement. The tract was dilated 2F over the desired catheter to be placed, after tract dilation a polyethylene pigtail catheter was introduced over the guide wire. The pigtail catheter was firmly sutured to the skin using silk 1-0 and adhesive strapping was performed.

RESULTS

Percutaneous nephrostomies were performed for various indications in obstructive uropathy due to benign and malignant tumors. Twenty one (42%) nephrostomies were done for benign indications and 29 (58%) for malignant conditions (Table-1).

PCN was successfully completed in 42 kidneys (84%) cases. The 8 cases in which the procedure was not completed included both benign and malignant conditions (Table-2).

Failure was seen mostly in the early part of study and was attributed to the learning curve and difficult renal anatomy. Open nephrostomy was carried out in failed procedures.

The average time taken for completing the procedure was 48 minutes ranging from 20 minutes to 120 minutes. There were no major procedure related complications or deaths. Tube displacement was seen in 6 cases (12%). Transient hematuria was seen in 7 cases (14%). No blood transfusions were required and hematuria settled on its own in 1-3 days. Post procedure urine leak was present in one patient (2%).

There were no procedure related complications in patients in whom the procedure failed. The complication rate between benign and malignant diseases was not significant p value = 0.0945.

The serum creatinine was compared after the procedure with those of previous values using the paired t test (Tables-3 and 4).

Of the 32 patients who were subjected to PCN for various conditions, 20 were subjected to open definitive surgeries. There were 4 deaths in the study group; 3 of these were in the malignancy group and 1

Table 1 – *Distribution of indications for percutaneous nephrostomy (PCN).*

Indication	Number of PCN	Definitive Surgery Performed
Benign		
Calculus diseases	8 (16%)	Pyelolithotomy/ureterolithotomy
UPJ obstruction	7 (14%)	Pyeloplasty
Pyonephrosis	4 (8%)	Pyelolithotomy
Chyluria	2 (4%)	Resolved conservatively
Malignant		
Ca urinary bladder	10 (20%)	TURBT
Ca uterine cervix	6 (12%)	None
Ca endometrium	4 (8%)	None
Ca rectum	5 (10%)	APR
Ovarian tumors	2 (4%)	None
Renal cell carcinoma	2 (4%)	None

UPJ = ureteropelvic junction; Ca = cancer; TURBT = transurethral resection of bladder tumor; APR = abdominoperineal resection.

Table 2 – *Distribution of cases in which percutaneous nephrostomy failed.*

Indication	Number
Malignant	2 (4%)
Renal cell carcinoma	2 (4%)
Ca Endometrium	1 (2%)
Ovarian tumors	1 (2%)
Ca uterine cervix	
Benign	
Calculus disease	1 (2%)
UPJ obstruction	1 (2%)

UPJ = ureteropelvic junction.

Table 3 – *Comparison of percutaneous nephrostomy complications in benign and malignant cases.*

	Complication	No Complication	Total
Benign	9	12	21
Malignant	5	24	29
Total	14	36	50

$\chi^2 = 2.8$; $p = 0.0945$ (not significant).

Table 4 – *Comparison of serum creatinine (mg/dL) before and after percutaneous nephrostomy in all 50 cases.*

	Mean	SD	SE
Before	5.22	3.73	0.528
After	4.40	3.71	0.525
Difference	0.82	2.31	0.327

Difference between means = 0.82; confidence interval (95%) = 0.16 – 1.48; t = 2.5; 2-tailed p = 0.0158 (significant).

in the benign group, however, none of these were procedure related.

In the benign group out of 17 patients, 15 improved, 1 died and 1 was referred to a higher centre.

In the malignant group of 15 patients, 6 patients showed improvement, 6 patients did not show any improvement, 3 patients died and no patient was referred.

COMMENTS

Most of the studies have shown a success rate of more than 90% under various types of guidance modalities (2,3,6). PCN has traditionally been done

under fluoroscopic guidance by radiologists and a success rate of more than 95% is common (2). It is in only the last decade that more and more procedures have been performed under other guidance modalities such as ultrasound and CT scan (7,8).

Percutaneous nephrostomy can be performed under ultrasound guidance with a success rate ranging from 83.1% to 92% (3,6).

Traditionally diversion has been accomplished by cystoscopy with retrograde passage of ureteric catheter and only in the event of obstruction to catheter passage, nephrostomy is performed but in our setup where cystoscopy is not always readily available nephrostomy is an attractive alternative.

Pederson was the first to use only sonographic guidance for Percutaneous nephrostomy, and reported a success rate of 70 % (4). Since then a large number of studies have been carried out under sole ultrasound guidance describing success rate up to 92%. This is because of the advent of high resolution ultrasound machines with better view of the pelvicaliceal system allowing a success rate comparable to fluoroscopic guidance with practically no radiation hazard.

In our study the success rate was 84%, which was consistent with the above mentioned studies.

Azotemia due to bilateral obstructed kidneys has been the most frequent indication of nephrostomy. PCN is often the simplest method for the initial management of obstructive renal failure due to hazards of surgery in uremic patients.

PCN is sometimes described as a temporizing measure prior to corrective surgery (5,6). We observed similar pattern in our series too as in 10 out of 17 benign cases (58%) surgery was carried out. PCN was definitive in 5 patients (29%). In the malignant group definitive surgery was planned according to the origin and grading of malignancy.

PCN was performed for both benign and malignant diseases. In 17 benign cases it was done to relieve obstruction and salvage the kidneys, which was significantly achieved. (Tables-4 and 5). Subsequent surgery followed in 10 cases. PCN proved to be definitive by itself in one patient with chyluria. Patient improved markedly and no further intervention was required. There was one death in the study, 7 days after the procedure; the cause of death being rheumatic heart disease with mitral regurgitation, mitral stenosis and tricuspid regurgitation. One child was referred because of procedure failure.

The most consistent and gratifying results were seen in patients who presented pyonephrosis. PCN was successfully completed in all 4 cases and kidneys were salvaged in all cases with the least morbidity. The co-existence of azotemia and pyonephrosis increases the urgency as well as value of percutaneous Nephrostomy. Camunez et al. also observed that following PCN in pyonephrosis clinical symptoms disappeared in 24 - 48 h after the procedure and once the acute phase was over definitive surgery could be carried out (9).

Table 5 – *Comparison in serum creatinine (mg/dL) in benign (n = 21) and malignant (n = 29) cases before and after percutaneous nephrostomy (PCN).*

	Benign Cases			**Malignant Cases**		
Creatinine	**Mean**	**SD**	**SE**	**Mean**	**SD**	**SE**
Before PCN	3.52	3.21	0.702	6.39	3.51	0.651
After PCN	2.18	2.18	0.475	5.41	3.21	0.596
Difference	1.34	2.27	0.494	0.98	3.20	0.595

Benign cases: difference between means = 1.34; confidence interval (95%) = 0.31 – 2.37; t = 2.72; 2-tailed p = 0.0133 (significant). Malignant cases: difference between means = 0.98; confidence interval (95%) = 0.24 – 2.20, t = 1.65; 2-tailed p = 0.1098 (not significant).

In the malignant group there was no significant recovery of the renal functions (Table-5). Definitive surgery was carried out in only 4 out of 15 patients. In 2 patients open nephrostomy had to be performed due to failure or catheter dislodgement. 3 patients succumbed to their illness in the hospital only, the cause of death being grossly deranged renal functions with dyselectrolytemia. Only 6 patients showed definite improvement.

The usefulness of percutaneous nephrostomy as an adjunct in many pelvic organ malignancies has been reviewed in many series. Samarsinghe et al. did not find any renal function improvement in patients with chronic obstruction and terminal malignancy (10).

When hydronephrosis occur from advanced pelvic malignant disease, percutaneous nephrostomy can effectively improve renal function. However, since these patients have an overall poor prognosis, several authors earlier used to question the appropriateness of interventional uroradiological procedures (11,12). Hoe & Tung observed an overall survival median of 5 months after PCN and 68% of people achieving a useful life (13). They concluded that PCN should be performed only in cases where there is no evidence of carcinomatous spread and few or no medical problems.

Various other studies have disputed this claim; Markovich et al. concluded that PCN was beneficial for malignant obstructive uropathy associated with fewer complications as compared to open nephrostomy and increased percentage of time spent at home. The average post-nephrostomy survival time in this study was 7 months (14).

Our study showed definite improvement in 6 out of 15 patients with terminal malignancy, 6 patients did not show any improvement and there were 3 deaths due to an underlying disease. Our results in malignant group were consistent with all previously mentioned studies; renal function could not be recovered in patients who presented late unsalvageable kidneys. However, patients who were seen at an earlier stage benefited from PCN.

PCN is usually performed when a retrograde stenting is not possible. It may be due to difficult anatomy or lack of technical expertise. Comparative studies have been carried out between percutaneous nephrostomy and retrograde ureteric stenting. Pearle et al. found no difference in clinical efficacy, or patient preference between the two procedures and concluded that the choice of procedure may be based on particular circumstance of the patient and availability of facilities to carry it out (15).

A similar study however found PCN to be superior to retrograde stenting, their results demonstrated that percutaneous nephrostomy is tolerated better by patients and has a lower influence on the quality of life than ureteral stents. The effectiveness of percutaneous nephrostomy should be given preference over ureteral stents in case initial signs of infected hydronephrosis are detected (16).

We observed a complication rate of 28%. There was no major complication throughout the study and in 14% of the cases hematuria settled by itself. Tube displacement was other minor complication (12%) for which 3 open nephrostomies had to be performed. Post procedure urine leak was seen in 1 patient which also subsided by itself.

Procedure-related complications continue to be widely reported regardless of the type of imaging employed (17). Rates vary from 25 - 60% though this includes late (more than 24 hours after insertion) minor complications such as those related to tube malfunction, leakage, dislodgment and incrustations. Picus et al. summarized early complications inherent with fluoroscopy-guided PCN, being the most common acute bleeding requiring transfusion (< 5%), failed access (< 5%), adjacent organ injury: bowel, spleen, lung (< 1%), and septicemia (< 1) (17).

In most of the studies significant hemorrhage requiring transfusion or surgical control ranks first among the complications (5.3%) and is equally distributed among ultrasound guided and fluoroscopic guided groups (17). Significant bleeding occurs in patients with associated stones, although this is usually manageable by means of transfusions, open control remains an option and in such instance stone surgery may then be performed. Minor bleeding is common but usually resolves spontaneously with observation and occasional flushing of the catheter.

Adjacent organ injury is another complication, the colon and pleura may be

inadvertently injured; the former had the need of a colostomy, the latter, a tube thoracostomy. Pleural tear has been deemed more common in instances wherein the nephrostomy tract is placed more superiorly, particularly when subsequent stone manipulation is contemplated (17).

These aforementioned complications being present equally in both ultrasound and fluoroscopy-guided PCN may simply indicate no distinction between the two as far as patient safeties is concerned. Overall patient status, skill of the operator, technique and instrumentation would probably play a more significant role.

All findings confirm that PCN is quite effective in improving renal functions provided it is preformed at an earlier stage. Intervention in malignant ureteric obstruction should not necessarily be viewed with as much pessimism as in the past. Ultimately the decision to place a nephrostomy tube lies in the doctor, the family and above all the patient.

CONFLICT OF INTEREST

None declared.

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