

## Original Research Article

# Percutaneous nephrostomy, feasibility of mid and anterior axillary line approach and its complications: an experience

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## ABSTRACT

**Background:** Nephrostomy performed as an emergency procedure to drain the obstructed calyceal system is a lifesaving procedure. Posterolateral approach is usually done to access the avascular plane of Brodel to avoid hemorrhage. This study evaluates the feasibility and complications in percutaneous nephrostomies placed at mid and anterior axillary line entry sites as it was found to be easier approach.

**Methods:** A prospective study with 126 percutaneous nephrostomies performed with Ultrasound guidance, using single puncture technique and 8.5F pigtail catheter. The complications rates were analyzed according to WHO guidelines.

**Results:** The technical success rate was 98.4%. Three hemorrhagic complications (2.38%) were recorded without any major interventions. Increased incidence (11.9%) of transient hematuria was observed with five cases (3.9%) of infection at entry site. One case (0.79%) of peritoneal breach recorded with no significant intraperitoneal collection.

**Conclusions:** Placement of Percutaneous Nephrostomy tube at mid or the anterior axillary line appears to be a feasible and easy approach, as its complications rates are within acceptable limits with an advantage of increased patient comfort.

**Keywords:** A vascular plane of bordel, Hemorrhagic complications, Mid and anterior axillary line, Percutaneous, nephrostomy, Urosepsis

## INTRODUCTION

Percutaneous nephrostomy (PCN), done to decompress dilated obstructed calyceal system, is placement of a catheter into the calyx, percutaneously. PCN facilitates definitive treatment as well as hastens the healing process by reducing urosepsis and is considered a lifesaving procedure.<sup>1,2</sup> The placement technique has evolved from a blind procedure to image guidance with many improvisations in the technique from the conventional

Seldinger Technique to single puncture catheters using metal stilet and without track dilatation.<sup>3-5</sup> The avascular plane of Brodel, situated at posterolateral aspect of the kidney is the preferred site of entry to avoid vascular injury.<sup>6</sup> The kidney varies in position in some patients and it was difficult to position for the avascular plane approach. The distance of the calyx to the skin was longer in obese individuals and in cases with femur fracture and ventilated patients it was difficult to position the patient. Hence, author had to choose a lateral or

antero lateral approach with an expected increased hemorrhagic complication. Author present the results pertaining to the complications and its feasibility as an alternative approach for percutaneous nephrostomy.

## METHODS

This study is a prospective study and included 126 patients over a period of 17 months from December 2016 till May 2018. All patients referred during this 15 month duration for PCN were subjected to lateral or anterolateral approach. Informed consent was obtained from all patients and ethical guidelines of the 1975 declaration of Helsinki was strictly followed.

Calculus obstruction with infection (n=74), femur fracture with pyelonephritis(n=2), terminally ill patients with urinary infection and hydronephrosis(n=10), malignancy of bladder(n=8), malignancy of cervix(n=23) and obese individuals with calculus obstruction and infection (n=5), unsuccessful ureteroscope due to tortuous or kinking of ureter with perirenal collection(n=4) were included in the study. The average creatinine value was 4.5mg/dl. Ultrasound (USG) was used as an imaging guide. All the patients had mild to moderate calyceal system dilatation. The age group varied from 2 to 76 years. The average skin to calyx distance was 5.8cms with ranges varying from 2 to 10.3cm. The axis of the kidney was rotated in 4 patients, pelvis directed more anteriorly.

**Technique:** Single puncture technique was followed with an 8.5F pig tail catheter which contains a metallic stilet and trochar. The lateral approach was chosen for the comfort of the patient during and after the procedure as well as for a shorter distance of the track. 8.5F pigtail catheter(aster) was used which contains a polyurethane catheter with a metal stilet and needle. Local anesthesia (10ml of 2% xylocaine) is injected with aseptic precaution from the skin upto the renal capsule under ultrasound guidance and the pigtail catheter was inserted upto the renal capsule. The trajectory of the needle is checked before the entry into the calyx. The posterior lower or the middle calyx is usually chosen for entry. The entry into the renal cortex is timed with the respiratory breathing.

If the breathing movement is long, then the patient is asked to hold breath. The needle and the catheter are inserted in one push upto the calyx wall. Catheter position is checked again with ultrasound. Once into the calyx, the catheter along is pushed withholding the metallic stilet and trochar. The coiling of the catheter is checked with the USG and the catheter is secured to the skin.

Post procedure, the perirenal region is checked for any collection, 48 hours after the procedure the tube position is checked with ultrasound and any collection recorded. The pictures reveal the position and site of entry at mid

axillary line (Figure 1,2 and 3). The reformatted CT image shows bilateral lateral PCN placement (Figure 4).



Figure 1: Anterolateral approach of right PCN.



Figure 2: Lateral approach of left PCN.



Figure 3: Lateral approach of left PCN.

Author defined technical success as the successful placement of drainage tube within the calyx according to

the Standards of Practice Documents By SIR(Society of interventional Radiology).<sup>7</sup> The complications were identified as major and minor in accordance to Quality improvement guidelines for Percutaneous Nephrostomy as per the SCVIR guide lines with no or nominal therapy and no consequences classified as minor complication and those that require therapy, hospitalization, with permanent sequelae and death identified as major complication. Author labelled perirenal hematoma, transient hematuria through the drainage tube, infection at the tube insertion site and pericatheter leak as minor complications.



**Figure 4: Computer tomography reformat coronal image showing bilateral PCN with lateral approach.**

The patients were assessed for pain relief and comfort with pain scale of 0-10 and comfort scale of 0-8. In pain scale 0 indicates no pain, 1 and 2 indicate mild pain, 3 to 6 indicate moderate pain and 7 to 10 indicate severe pain in relation to the catheter placement. In the comfort scale, 0 indicates severe discomfort and 8 indicates unnoticeable with assessment including physical as well as psychological discomforts in relation to the catheter. Ventilated patients were assessed with PAINAD scale. The assessment was done on the 1<sup>st</sup> postoperative day and at 3rd postoperative day.

**RESULTS**

The average duration of the procedure was 20 minutes. Technical success rate was 98.4%. In two cases, calyceal access with single puncture technique could not be obtained due to the perirenal hematoma and collection. Reduction of creatinine was observed in all the patients with an average reduction of 1.8 mg/dl on the 3rd day. The cortex in these kidneys were very pliable with highly mobile kidneys, hence the entire catheter and the trochar could not be inserted into the cortex. The two cases of perirenal hematoma noted did not require any active interventions, with one case of continuous hemorrhage through the drainage tube requiring removal and no further treatment. The bleed reduced over a period of 2 days with no significant drop of hemoglobin(<1gm/dL).

The bleed rates were compared with literature studies with Fisher’s exact test

The combined minor and major complication rate was 29.3% (Table 1). The mild higher incidence of the infection (3.9%) is due to the prolonged catheter retaining and improper care of hygiene. No incidence of catheter displacement was reported. The perirenal hematoma(n=2) resolved spontaneously and needed no intervention with hematoma size measuring 20 and 34ml. Presence of blood tinged urine in the PCN tube recorded in 15 patients gradually reduced in two hours.

**Table 1: Minor and major complications.**

Complications	Number of cases
Transient hematuria	15 (11.9%)
Infection at entry site	5 (3.9%)
Pericatheter leak	6 (4.7%)
Perirenal hematoma with no further intervention	2 (1.5%)
Hemorrhage though the drainage tube	1 (0.79%)
Peritoneal breach	1 (0.79%)

**Table 2: Pain assessment rating (n=121) for nonventilated patients.**

Pain severity rating(0-10)	Number of cases
None (0)	94(74.6%)
Mild (1-2)	12(9.5%)
Moderate (3-6)	12(9.5%)
Severe (7-10)	3(2.3%)

**Table 3: Comfort rating score (n=121) for nonventilated patients.**

Comfort rating	Number(percentage)
8(unnoticeable)	29 (23.0%)
7(occasionally noticeable)	34(26.9%)
6(constantly noticeable)	38(30.1%)
5(occasionally annoying)	19(15.0%)
4(constantly annoying)	2(1.58%)
3 (itchy irritant)	2(1.58%)
2(concerning pressure)	1(0.79%)
1(hurts)	4(3.17%)
0(painful)	0

Significant improvement in the pain scale was noted, with 106 patients had no to very mild pain or discomfort. 3 patients reported severe pain on day 2 which reduced on day 4 with analgesics (Table 2). Very high comfort score (6 and above) was reported with more than 3/4th of patients (Table 3). Ventilated patients had an average PAINAD scale of 1(four scored 1 and one scored 2). The cases were followed up in case of long duration of drainage everyone month with clinical and ultrasound

examination. The duration of retaining the catheter varied from 2 days to 3 months and 15 days.

## DISCUSSION

The requirement of external drainage in kidneys varies from ureteric calculus obstruction, urosepsis to malignant obstruction for patients who are unfit for anesthesia. Percutaneous Nephrostomy, first described by Goodwin et al, remains one of the most fundamental nonvascular interventional radiology procedures and has established itself as a lifesaving procedure for patients with acute urinary tract obstruction.<sup>8,9</sup> The procedure has gained popularity due to its minimal access, immediate recovery of renal function in infective cases, easy technique, safe, with less complications and is an alternative to surgical Nephrostomy.<sup>10-12</sup>

The lateral position was chosen as the calyx was better visible and closer to the skin than the posterior position. One has to traverse the psoas muscle plane in the posterior approach which was found to be of varying thickness in each individual and the trajectory was long with some difficulty in tracking the catheter. Author found the patient was comfortable as well with the hands above his head position. The trajectory being short, made renal cortex puncture easily visible, hence the procedure could be completed in less time. In the lateral approach author can avoid the bowel as author can see the gas column and avoid bowel injury. Catheter displacement did not occur as the site of entry was lateral and the patient was able to maintain without any discomfort indicated by a good comfort outcome score of 78.5%. The pain scoring and comfort score has not been utilized in any of previous literature reported on PCN. All the literature reports on PCN have the patient in prone position.<sup>2-6</sup>

Various guidelines have been laid to reduce the complication rates with the acceptable combined complication rate being <10%.<sup>13</sup> The higher combined complications rate (29.3%) could be because of inclusion of the blood tinged urine included in minor complications. Pericatheter leak, catheter dislodgement and infections alone are generally included in minor category in literature.<sup>14</sup> If transient hematuria is excluded, the combined complication rate is 11.9%. The mildly higher minor complication rate could be due to the higher mobility of the patient and longer duration of retaining the catheter. Pericatheter leak was noted in patients who had the drainage catheter for more than 15 days, requiring a larger bore catheter replacement. Site inflammation rate was 3.9%

The main concern was deviation from the avascular plane as, author tend to injury the cortical vessels, intra renal interlobular, intralobular as well as arcuate arteries. But results proved that there was no major bleed in lateral approach with no secondary intervention or bowel injury. The three cases of bleed required no further intervention,

indicating these cases do not qualify as major hemorrhage, indicating the approach is safe if done with precaution. The vascular complication (2.3%) is within the recommendation limits (1-4%), though a minor complication. Stables in his report has stated a similar hemorrhage rate using a single puncture technique with a posterior axillary line approach.<sup>15</sup>

The site of entry infection reported in this study is not high(3.9%) and is slightly lower than 5.3% site inflammation reported by Kaskarekis et al.<sup>16</sup> In fact, author have no case of sepsis but Lewis et al, reported 2.2% sepsis rate and a major hemorrhage rate of 0.6%.<sup>17</sup> They have encountered one case of hemorrhage with medial puncture. In comparison with this literature, the minor hemorrhage occurrence in the current study report appears to be within the acceptable range. Higher infection rates (27%) have been reported by Eva Radecka with low hemorrhagic complication rate (4%) done with posterolateral approach.<sup>18,19</sup>

Transient hematuria, a common occurrence immediately after tube placement is reported in almost all patients as stated by Ramond et al.<sup>19</sup> It is the major contributory factor for the higher minor complication rate in this study. The reason for including in the study is to access the chances of vascular injury in the lateral approach. A higher incidence of intralobular vascular injury could be the probable etiology for the transient hematuria through the PCN tube, though this can occur in any site of entry.

Author did not come across any major vascular complications like pseudoaneurysms though Lee et al, and Cope et al, have reported pseudoaneurysms and large perirenal hematomas following PCN requiring further interventions.<sup>20,21</sup> Meurice et al, have reported iatrogenic injuries at the interlobular arteries in four cases and one case of main renal arterial injury following biopsies and Nephrectomy and no reference to Brodel's avascular plane.<sup>22</sup> Incidences of retroperitoneal hematoma(3%) have been reported by Farrell et al, and Syed et al, requiring intervention with no reports of change in entry site.<sup>9,23</sup> Brodel's avascular plane is not more than 1-2mm in thickness and does not have a landmark to be identified in ultrasound. Moreover, the avascular plane need not be at the posterolateral region in all kidneys as anatomical axis variations are common. Hence, it has to be presumed that a higher chance of missing the Brodel's avascular plane persists even though the PCN catheter might enter the kidney at a posterolateral plane. Movement of the kidney with breathing should also contribute to the said factors. Reports of major hemorrhages with proven vascular injuries and no deviation in entry site indicate the possibility of vascular injuries in any plane of entry.<sup>20,21</sup> In obese individuals, prone position was difficult and the skin calyceal distance was longer hence this approach proved an easier way of inserting an external drainage. Better visualization of the catheter track and a smooth insertion, requiring no track dilatation made this approach a feasibility in these individuals. The

chances of tube tracking through the peritoneum should be kept in mind as author had one case with the tube piercing the peritoneum, found out during surgery but had no hemorrhage or bowel injury. Hence risk of bowel injury has to be considered in these approach sites. But as ultrasound or the computer tomography is used for guidance, the chances of bowel injury can be nullified.

The Limitations of the study include small sample size and the comfort rating being subjective may vary. Some difficulties with the single puncture technique were catheter kinking and poor visibility of the catheter. The tube had to be changed in cases of resistance at the capsule site and with catheter kink, occurring due to the fibrosis of the perirenal fat as well as the presence of a thick fibrous capsule in long standing hydronephrosis and in malignancy. Poor visibility of the catheter in ultrasound was observed in some patients despite medium sized fat plane but for no reason, thereby prolonging the duration.

## CONCLUSION

Mid axillary and anterior axillary line approach with a small diameter PCN tube is an option available for draining an infected and obstructed calyceal system which can be utilized in most patients especially for emergency as well as critically ill patients, obese individuals with an advantage of increasing patient comfort.

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