



Comparative study of ultrasound guided percutaneous nephrostomy by direct and Seldinger method

¹Dr. Vinod Parmar, Senior Resident, Department of Radiodiagnosis, Gandhi Medical College Bhopal, Madhya Pradesh, India.

²Dr. Lovely Kaushal, Professor, Department of Radiodiagnosis, Gandhi Medical College Bhopal, Madhya Pradesh, India.

³Dr. Swati Goyal, Associate Professor, Department of Radiodiagnosis, Gandhi Medical College Bhopal, Madhya Pradesh, India.

⁴Dr. Poornima Maravi, Associate Professor, Department of Radiodiagnosis, Gandhi Medical College Bhopal, Madhya Pradesh, India.

Corresponding Author: Dr. Vinod Parmar, Senior Resident, Department of Radiodiagnosis, Gandhi Medical College Bhopal, Madhya Pradesh, India.

Citation this Article: Dr. Vinod Parmar, Dr. Lovely Kaushal, Dr. Swati Goyal, Dr. Poornima Maravi, “Comparative study of ultrasound guided percutaneous nephrostomy by direct and Seldinger method”, IJMSIR- September - 2022, Vol – 7, Issue - 5, P. No. 132 – 137.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

The purpose of percutaneous nephrostomy is to decompress the upper urinary passage caused as a result of supra or intra vesicle obstruction and decrease the pressure within the collecting system thereby preventing its progression to renal damage. Several direct and wire guided (Seldinger) methods of PCN tube placement have been described. Our study is Hospital based prospective observational study done in GMC and HAMIDIA hospital, Bhopal. A total no. of 40 patients with grade I-IV hydronephrosis requiring PCN placement were included in the study. A proper stepwise scientific approach was adapted for performing the procedures in an aseptic setup. Pigtail catheter of 6F to 8.5F were chosen depending on age of the patient and the requirement of guide wire was decided based on the grade of hydronephrosis. Intra and post procedural parameters were charted carefully and later evaluated.

The average length of the procedure was found to be around 15mins. The procedure performed on both benign(13) and malignant cases(27). Cervical carcinoma was found to be the most common indicator (50%). Success rate was found to be as high as 95.6% with Seldinger technique and 88.2% with direct technique. Few complications were noted in the form of minor ailments (fever, hematuria, pain, etc.) in 12.5% patients to severe complications in the form of clot occlusion in 2.5% patients. Overall USG guided PCN is an effective, reliable, cost effective and comparatively easy procedure with fewer incidence of complications. Both techniques, direct and Seldinger are equally effective with slight difference in success rate depending on the grades of hydronephrosis. Direct technique is fast, cost effective and suitable for high grades of hydronephrosis while Seldinger technique has higher success rates even with

low grades of hydronephrosis but have high cost of equipment.

Keywords: PCN, USG, hydronephrosis, nephrostomy, Seldinger technique, malignant

Introduction

Percutaneous nephrostomy is a procedure of establishing a drainage tract into the upper urinary system by puncturing the kidney directly through the skin(1). The purpose of such drainage is to decompress the upper urinary passage caused as a result of supra or intra vesicle obstruction resulting in increased pressure within the collecting system and ultimately cause renal damage.

It is indicated temporarily till definitive treatment of potentially life threatening obstruction is achieved. It is also indicated in cases, where permanent treatment is not possible and in cases where access proximal to the obstruction is not technically feasible.

Several direct and wire guided (Seldinger) methods of PCN tube placement have been described (2). The procedural success includes engagement of nephrostomy tube in renal pelvis and spontaneous urine flow.

Seldinger technique is associated with potential disadvantage over direct puncture that includes the requirement of guide wire and increases the procedure cost. The direct technique is use low cost trocar catheter drainage set for the procedure. It is simple, less time consuming, less traumatic and has excellent outcome.

Material and methods

Preprocedure preparation and tips

Patient is admitted in the hospital for percutaneous nephrostomy after a written request from the concerned physician mentioning proper indication is received. Pre procedural investigations should be done before proceeding for the procedure, which includes routine blood count, bleeding time and clotting time,

prothrombin time, serum creatinine and electrolytes, urine culture and plain Xray abdomen.

The patient is described about the procedure in detail and the need for their cooperation as the procedure is done under local anaesthesia, following which a written informed consent is taken from the patient. A pre procedural sonography is also preferred to rule out any renal anomalies and determine the degree of hydronephrosis (Grade I-IV) of patients using 3.5MHz curvilinear probe.

The patient is advised not to take oral fluids for last 6hours. Sedatives and long acting analgesics were given in previous night. All eligible patients were given single dose of fluoroquinolones (tab. Prulifloxacin 600mg) within one hour of procedure. Pigtail catheter of 6F to 8.5F were chosen depending on age of the patient.

Below 12th rib approach in prone position is preferred during procedure. A supporting pillow was placed under the abdomen on the side of procedure to correct lumbar lordosis and to support the kidney.

Local anaesthetic (2% xylocaine) was injected to anaesthetize the procedure site after proper downing and drapping of the area. For intra renal access into the collecting system, lower pole posterior calyx is accessed through a puncture made 2cm below the 12th rib on the posterior axillary line.

After preparing a sterile surgical site, local anaesthetic (2% xylocaine) on the puncture line and using 11G scalpel, the anatomical layers from the skin down to fascia was punctured.

Two different techniques were used for USG guided access into collecting system (DESCRIBED BELOW)

Percutaneous nephrostomy using Seldinger technique

Collecting system was incised through 18G needle, urine flow is checked for confirmation of access, needle was removed and J shaped guide wire was advanced through

sheath. The nephrostomy tract was dilated with Am Platz type dilator up to a diameter which does not exceeds the calibre of nephrostomy tube (8-12F), which was chose n on patient's anatomical characteristics.

Afterwards, nephrostomy tube was advanced over guidance & then guide wire was withdrawn and nephrostomy tube was fixed to the skin with 3/0 silk suture.

Percutaneous nephrostomy using direct puncture technique

Trocar-tip needle placed in a nephrostomy tube (8-12 F) chosen based on patient's anatomical characteristics was inserted into collecting system, and then the needle was withdrawn. Urine flow was observed to confirm the correctness of access. The cannula of the needle was taken out, and nephrostomy tube was fixed to the skin with 3/0 silk sutures.

Inclusion and exclusion criteria

A total no. of 40 patients with grade (I-IV) hydronephrosis requiring PCN tube placement for a variety of disease were included in this study.

Exclusion criteria

bleeding diathesis, untreated UTI, pre-op Hb severely co-morbid patients were excluded categorically.

Patient's follow up after PCN: In all cases, the 1st urine sample coming from the catheter were sent for urine culture. After the procedure, patients were followed up for an average of 4 hours in a day care unit, excluding the patients who manifested complications or those scheduled for maintenance antibiotic therapy.

All patients were discharged after follow up period. Patients with clinically suspected infection/infected urine empirically maintained on antibiotics (inj. Ceftriaxone i. v – 2x1gm). Antibiotic therapy was adjusted based on the results of urine culture. Fluid electrolyte balance, RFT results were monitored.

The procedural success includes engagement of nephrostomy tube in renal pelvis and spontaneous urine flow.

Complications which did not require treatment or those without significant out comes which necessitated minimal treatment were accepted as minor complications, while complications which required treatment or hospitalization (longer or shorter than 48 hours) or those heading to unplanned increase in treatment or resulting in permanent sequela or death of patients , were considered as major complications.

Demographic data, etiologies of obstruction, technical details and complications of patients underlying USG guided PCN tube placement by urologists were evaluated .Patients with abnormal coagulation parameters, renal anomalies, previous renal surgery not included in the evaluation.

Result

A total of 40 patients were included in the study consisting of 16(40%) men and 24 (60%) women with mean age 45±10 year . The various indications for the procedure is listed in table no.1, out of which cervical carcinoma (50%) is the major contributor. Nephrostomy was done unilaterally in 34 patients and bilaterally in 06 patients due to development of obstructive uropathy, secondary to benign cause in 13 cases (32.5%) and malignant cause in 27 cases (67.5%) (table no 2).. Grades of hydronephrosis and the technique used is discussed in table no. 3 showing 6 Grade I HDN patients (Seldinger -5, Direct-1), 15 Grade II HDN patients (Seldinger -12, Direct-3), 12 Grade III HDN patients (Seldinger -6, Direct-6), 7 Grade IV HDN patients (Seldinger -0, Direct-7). Complications were noted in 6(15%) of the patients out of which 5 (12.5%) patients suffered minor complications like fever, hematuria, urine extravasation & pain and (2.5%) suffered from major

complication in the form of clot occlusion (table no 4) .

Complications noted in Seldinger was found to be 13 % whereas it was 17% in direct technique. Average time taken for procedure completion is 15 mins. Success rate is found to be 92.5 % .(Seldinger 95.6% direct 88.2%). total 3 failed pcn noted (out of 40 pt.) 2 failed pcn in direct (out of 17=one in grade 1 and one in grade 2) 1 failed pcn in Seldinger (out of 23=in grade 1) (table no 5).

Table 1: distribution of indications

INDICATION	NO OF PT
CERVICAL CARCINOMA	20
PROSTATE CARCINOMA	2
URINARY BLADDER CARCINOMA	2
OVARIAN MASS	1
PEDIATRIC PT WITH ABDOMINAL MASS	2
PYONEPHROSIS	4
IMPACTED URETERIC CALCULI	5
BROKEN AND IMPACTED DJ STENT	2
URTER TRAUMA	1
URETER STRICTURE	1
TOTAL	40

Table 2: distribution according nature of indications

INDICATION	NO
BENIGN	13
MALIGNANT	27

Table 3: grade of hydronephrosis and technique used

HDN GRADE	SELDINGER	DIRECT	TOTAL
1	5	1	6
2	12	3	15
3	6	6	12
4	0	7	7
TOTAL	23	17	40

Table 4: complication

METHOD	MINOR COMPLICATION	MAJOR COMPLICATION
DIRECT	PAIN=1 MACROSCOPIC HEMATURIA=1	CLOT OCCLUSION=1
SELDINGER	FEVER =1 URINARY EXTARVASTION =2	-

Table 5: success rate.

METHOD	SUCCESS RATE %
SELDINGER	95.6%(1 failed pcn out of 23=in grade 1)
DIRECT	88.2%(2 failed pcn out of 17=one in grade 1 and one in grade 2)
OVERALL	92.5 % (3 failed pcn out of 40 pt)

Discussion

Ultrasound guided PCN was first performed by Pederson et al., [3] and since then a large number of studies on USG guided PCN tube placement have been carried out with a reported success rate of up to 92-94% [4,1].

In our above described study, success rate is found to be 92.5 % .(Seldinger 95.6% direct 88.2%), duration of procedure is 15 min average.

Wah et al. [5] evaluated 276 attempts at ultrasound-guided percutaneous nephrostomy tube placements performed using Seldinger access (n=190) or direct puncture (n=62) techniques (n=62), and reported technical success rates of 98.2%, and 93.5%, respectively (p=0.075), while success rates for procedures realized for cases with non-dilated, and dilated collecting systems were reported as 82-96%, and 96- 100%, respectively.

When direct PCN is performed on non-dilated or minimal dilated Grade 1 hydronephrosis, it becomes very difficult and contribute for most unsuccessful case, 2 failed direct pcn was noted one in grade 1 and one in

grade 2. Our classification of hydronephrosis in grade I-IV was based on Beetz et al.,^[6]

In our study, most unsuccessful PCN was due to non-dilated or grade 1 hydronephrosis.

The potential complications of the PCN are; sepsis, perirenal hematoma, urinoma formation, perforation of a viscus and pyopneumothorax^[7]

In our study reported, minor complications were noted including macroscopic hematuria=1, fever =1, urinary extravasation =2 and pain a=1 while major complications included clot occlusion =1 .

Complication rate in our study is 15% (minor 12.5% and major 2.5%) and in Seldinger =13% direct =17 % . Değirmenci et al.^[8]

evaluated, and classified complication rates according to SIR guideline, and reported minor, and major complication rates as 9.9%, and 9.6%, respectively. Değirmenci et al.[8]

evaluated complication rates using multivariate analysis, and reported presence of nondilated collecting system increased complication rates statistically significantly (p=0.001, OR=6.1; 95% CI=2- 18.4).

Complication rate is more common in direct PCN especially when done on minimal dilated PCN where there is poor visualization of target calyces and eventually cause more tissue damage, hematuria, clot occlusion of tube and pain.

While in Seldinger, complication rates are much lower .due to use of dilator and slightly longer duration of procedure cause urine extravasation via dilated tract in 2 pt and fever in one pt of pyonephrosis.

In our study, most of complications and failed PCN is due to the procedure performed on minimally dilated system which needs precise direction and intervention radiologist experience .

Though there was no procedure related mortality in our case, but a figure up to 0.05-0.3% and significant bleeding requiring transfusion or surgical intervention in 1-4% has been reported^[9,10].

Authors recommended use of direct puncture technique for nephrostomy tube placement for temporary urinary diversion in patients with moderate, and advanced grade pelvicalyceal hydronephrosis, while in another prospective study published in our country, Cangüven et al.[11] reported procedural times, and technical success rates for Seldinger, and direct puncture techniques as 9 vs. 5 minutes, and 97.7% vs. 97.3%, respectively. Apart from these subjective data, in our study, we detected statistically significant higher success rates in cases with Grade 1 hydronephrosis when Seldinger access technique was used.

as a generally accepted corollary, experience of surgeons decreases complication rates.[12,5,13] Intrarenal access, and dilatations should be performed attentively, also medial access, extreme dilatations, and manipulations should be avoided.^[12,13]

Potential limitation of our study are sample size is small and long term complication are not seen.

Conclusion

USG guided PCN is very effective, reliable and easy procedure which does not need heavy setup or sedation. Local anesthesia is sufficient and the procedure can be performed on OPD basis. Although it has some associated complications but majority of complication are minor and its incidence is very low if done by experienced person. Both the techniques, Seldinger and direct PCN method are almost equally effective with slight difference in success rate. In general, Seldinger technique is preferred for mild or grade 1 hydronephrosis or non-dilated cases because of its safety and high success rate with the only drawback being its high cost

and in advanced grade of hydronephrosis, direct PCN is preferred over the Seldinger to cut the cost as it can be performed safely in sufficiently dilated pelvicalyceal system.

References

1. Karim R, Sengupta S, Samanta S, Aich RK, Das U, Deb P. Percutaneous nephrostomy by direct puncture technique: An observational study. *Indian J Nephrol*. 2010 Apr;20(2):84-8. doi: 10.4103/0971-4065.65301. PMID: 20835322; PMCID: PMC2931139.
2. Lodh B, Gupta S, Singh AK, Sinam RS. Ultrasound Guided Direct Percutaneous Nephrostomy (PCN) Tube Placement: Stepwise Report of a New Technique with Its Safety and Efficacy Evaluation. *J Clin Diagn Res*. 2014 Feb;8(2):84-7. doi: 10.7860/JCDR/2014/7216.4015. Epub 2014 Feb 3. PMID: 2470 1490; PMCID: PMC3972607.
3. Pedersen JF. Percutaneous nephrostomy guided by ultrasound. *J Urol*. 1974; 112: 157–9.
4. Regalado SP. Emergency percutaneous nephrostomy. *Semin Intervent Radiol*. 2006; 23: 287-94.
5. Wah TM, Weston MJ, Irving HC. Percutaneous nephrostomy insertion: outcome data from a prospective multi-operator study at a UK training centre. *Clin Radiol* 2004;59:255-61.
6. Beetz R, Bokenkamp A, Brandis M, Hoyer P, John U, Kemper MJ, et al. Diagnosis of congenital dilatation of the urinary tract. Consensus group of the Pediatric Nephrology working society in cooperation with the pediatric urology working group of the German society of urology and with the pediatric urology working society in the Germany society of pediatric surgery. *Urologe A*. 2001; 40: 495-507.
7. Li AC, Regalado SP. Emergency percutaneous nephrostomy for the diagnosis and management of

- pyonephrosis. *Semin Intervent Radiol*. 2012; 29: 218-25.
8. Degirmenci T, Gunlusoy B, Kozacioglu Z, Arslan M, Ceylan Y, Ors B, et al. Utilization of a modified clavien classification system in reporting complications after ultrasound-guided percutaneous nephrostomy tube placement: comparison to standard society of interventional radiology practice guidelines. *Urology* 2013; 81: 1161 -7.
9. Ramchandani P, Cardell JF, Grassi CJ, Roberts AC, Sacks D, Schwartzberg MS, et al. Quality improvements guidelines for percutaneous nephrostomy. *J Vasc Interv Radiol*. 2001; 12: 1247–51.
10. Daglli M, Ramchandani P. Percutaneous nephrostomy: technical aspects and indications. *Semin Intervent Radiol*. 2011; 28: 424-37.
11. Cangüven Ö, Göktaş C, Kafkaslı A, Aydemir H, Albayrak S. Comparison of direct and Seldinger percutaneous nephrostomy insertion techniques. *Medical Journal of Bakırköy* 2009;5;103-5
12. Skolarikos A, Alivizatos G, Papatsoris A, Constantinides K, Zerbas A, Deliveliotis C. Ultrasound-guided percutaneous nephrostomy performed by urologists: 10-year experience. *Urology* 2006;68:495-9.
13. Lewis S, Patel U. Major complications after percutaneous nephrostomy: my-lessons from a department audit. *Clin Radiol* 2004;59:171-9