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Percutaneous nephrostomy : Experience with 202 kidneys

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Percutaneous nephrostomy was performed on 202 kidneys in 176 patients who had 109 malignant underlying diseases and 67 benign underlying diseases at Bhumibol Adulyadej Hospital. The most common indications were to decompress obstruction in 148 patients and to drain infected urine or pus in 26 patients. The technique used in performing percutaneous nephrostomy was Seldinger's technique under fluoroscopic guidance and perhaps additional ultrasonographic guidance. The catheter used most frequently was a hand-made loop catheter. Successful catheter placement was achieved in all patients with 4% occurence of major complications which included 6 patients with severe haemorrhage, 1 patient with septicemia and impending shock, and 1 patient with infected urinoma. The indications, techniques, results, complications and problems were discussed.

Key words : *Percutaneous nephriostomy.*

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ผู้รายงานได้ทำการใส่ท่อระบายในไตจำนวน 202 ไต ในผู้ป่วย 176 ราย ซึ่งได้รับการวินิจฉัยว่าเป็นมะเร็งชนิดต่าง ๆ ในอุ้งเชิงกราน จำนวน 109 ราย และโรคอื่น ๆ ที่ไม่ใช่มะเร็ง จำนวน 67 ราย ที่โรงพยาบาลภูมิพลอดุลยเดช ข้อบ่งชี้ของการทำที่มากที่สุดคือเพื่อลดความดันที่เกิดจากการอุดตันของทางเดินปัสสาวะ จำนวน 148 ราย และรองลงมาคือเพื่อระบายปัสสาวะที่ติดเชื้อหรือเป็นหนอง จำนวน 26 ราย เทคนิคที่ใช้ในการใส่ท่อระบาย คือ เซลดิงเจอร์เทคนิคร่วมกับการใช้เครื่องเอกซเรย์แสดงภาพเคลื่อนไหว และบางครั้งอาจจะใช้อัลตราซาวด์ร่วมด้วย ท่อระบายที่ใช้ส่วนใหญ่เป็นชนิดขดด้านใน และทำขึ้นเอง ผู้รายงานสามารถใส่ท่อระบายได้สำเร็จทุกราย โดยเกิดผลแทรกซ้อนที่สำคัญประมาณ 4% ได้แก่ ตกเลือดมาก 6 ราย, ติดเชื้อจนเกือบช็อค 1 ราย, และปัสสาวะที่ติดเชื้อรั่วขังภายนอกไต 1 ราย ผู้รายงานได้อภิปรายเกี่ยวกับข้อบ่งชี้, เทคนิคของการทำ, ผลแทรกซ้อน, และปัญหาต่าง ๆ ร่วมด้วย

Percuaneous nephrostomy was initially introduced for emergency drainage of an obstructed upper urinary tract in 1955. [1] The procedure has gradually been developed and accepted by many radiologists and urologists. The last decade has seen a boom and marked expansion of indications. [2-13] We reviewed our series of percutaneous nephrostomy and discuss indications, techniques, complications and problems.

Materials and methods

Patients

Percutaneous nephrostomy was performed on 202 kidneys in 176 patients at Bhumibol Adulyadej Hospital during 6 years from 1986 to 1992. There were 113 females and 63 males, ranging in age from 15 to 87 years.

In 109 patients, the underlying diseases were pelvic malignancy which included 82 cases of carcinoma of cervix. Whereas in 67 patients, they had benign conditions including 43 cases of urinary stone. The rest were severe urinary tract infection, tuberculosis, ureteric stricture, urethral stricture, ureteric leakage with urinoma, neurogenic bladder and phimosis (Table 1 and 2).

Table 1. Malignant Underlying Diseases.

	No. Patients
Carcinoma of the cervix	82
Carcinoma of the bladder	9
Carcinoma of the colo-rectum	6
Carcinoma of the ovary	4
Carcinoma of the prostate gland	3
Carcinoma of the ureter	2
Carcinoma of the uterine corpus	2
Malignant pelvic teratoma	1
Total	**109**

Table 2. Benign Underlying Disease.

	No. Patients
Urinary stones	43
Severe urinary tract infection	8
Tuberculosis	4
Ureteric stricture	4
Urethral stricture	3
Ureteric leakage with urinoma	2
Neurogenic bladder	2
Phimosis with infected obstruction	1
Total	**67**

Diagnostic indications for percutaneous nephrostomy were to provide better anatomical picture in 18 cases, to assess renal function in 15 cases. The other diagnostic indications were to perform urine culture and cytologic study. Therapeutic indications were to decompress obstruction in 148 cases, to drain infected urine or pus in 26 cases, to achieve preliminary steps for further interventional procedures including stone extraction, ureteric stenting, fistula or leakage diversion, and stricture dilatation. In many patients, more than one indication were justified (Table 3).

Table 3. Indications for Percutaneous Nephrostomy.

	No. Patients
Diagnostic	
Provide better anatomic picture	18
Assess renal function	15
Urine culture	9
Cytologic study	2
Therapeutic	
Decompress obstruction	148
Drain infected urine or pus	26
Stone extraction	14
Ureteric stenting	4
Fistula or leakage diversion	2
Ureteric stricture dilatation	2

Technique

Previous examinations, such as IVP, ultrasonography, CT scan, and laboratory findings were reviewed for planning purposes. The appropriate kidney, the entry site, and the instruments were selected.

Before the start of the procedures, 5 mg. of diazepam were administered intramuscularly or intravenously to anxious patients and appropriate antibiotic converage were administered in the patients with active urinary tract infections.

Most patients were performed on the fluoroscopic table in a prone position, except for some patients who were unable to tolerate the prone position who were then done in a prone-oblique or supine-oblique position.

Only fluoroscopic guidance was used if the renal shadow or renal stone was localised. Sometimes intravenous injection of contrast material was administeed to enhance the renal shadow. In patients who had poor renal function, ultrasonography measuring the depth and the angle was also done. Infrequently, the patient was monitered by real time ultrasound, but none was guided by CT scan.

The puncture was below the twelfth rib at the posterior axillary line or just medial to this line. Under local anaesthesia and perhaps parenteral analgesics, a 21 G Chiba needle was introduced and advanced into the renal pelvis. The needle direction was about 45 degrees medially and slightly cephalad. There was a sensation during the passage through the renal capsule, and cephalocaudad movement of the needle due to respiration could be observed. The depth from the skin was approximately 7-8 cm. The needle was withdrawn slowly until free flow of urine was obtained. Small amount of contrast material was injected to opacify the pelvicalyceal system. If there was unsatisfactory direction or positioning of the needle, repeated puncture would be done to achieve the best results. A 0.018 inch. flexible platinum J torquable guidewire was threaded through the needle and coiled within the renal pelvis or advanced into the ureter (Fig. 1). A 6 F Cope converter dilator or a 5 F fascial dilator was inserted over the guidewire into the renal pelvis or the ureter. The guidewire was changed to a 0.038 inch. J guidewire, a Coon interventional guidewire, or a stiff Lunderquist guidewire. The tract was dilated by fascial dilators up to the size of the drainage catheter.

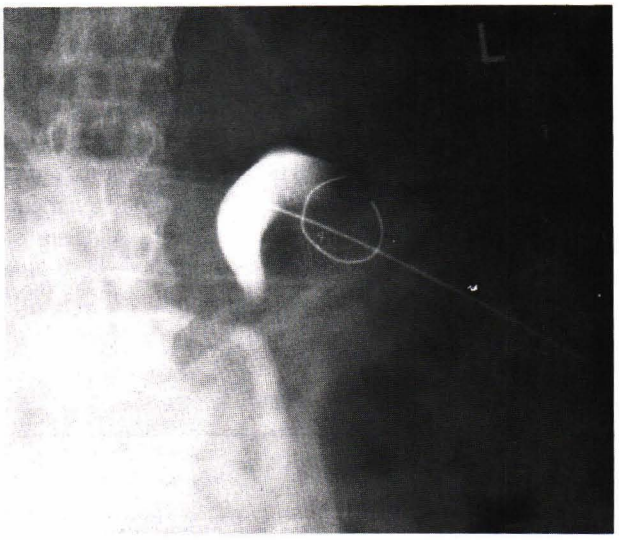

Figure 1. A 0.018 inch guidewire was threaded through a 21 G Chiba needle and coiled within the renal pelvis.

The catheter used most frequently was a 6-8 F hand-made loop catheter (Fig.2). The remaining catheters were a 8 F pigtail catheter, a 8 F Cope loop catheter, a 8-14 F Foley catheter (Fig.3), and also a straight angiographic catheter. Skin suturing to fix the catheter was performed if there was no self-retaining system.

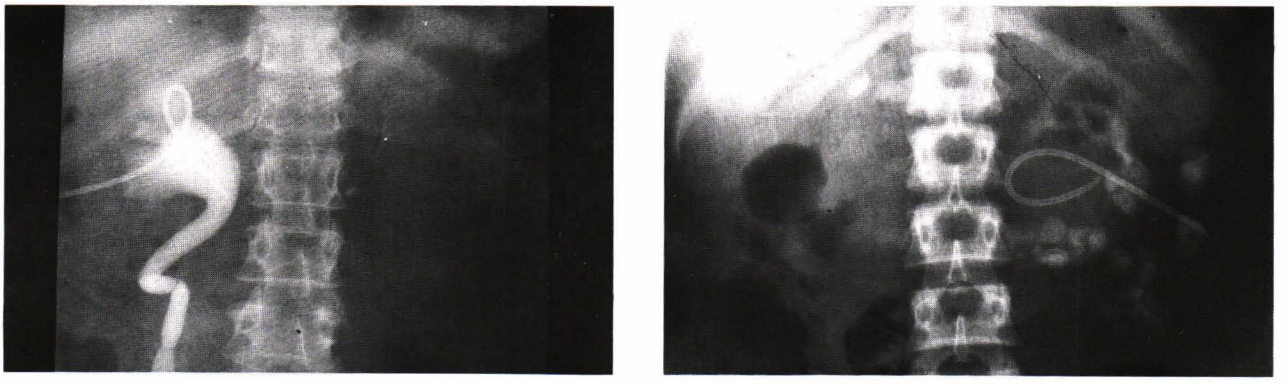

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Figure 2. The hand-made catheters :

a) A 7 F mid-loop type placing in the right kidney of the patient with bilateral ureteric obstruction due to carcinoma of the cervix.

b) An end-loop type of the 8 F hand-made catheter placing in the left kidney with UPJ obstruction, severe hydronephrosis, and multiple renal stones.

Figure 3. A 10 F Foley catheter placing in the kidney for the long-term use.

Results

Successful catheter placement of percutaneous nephrostomy was achieved in all patients (100%).

Major complications occured in 8 patients or 4% (Table 4). 6 patients had severe haemorrhage requiring blood transfusion, however 3 of them with severe haematuria resolved spontaneously, 2 patients had AV fistula with active haemorrhage into the pelvicalyceal system showing on selective angiography which completely resolved after embolization with gelfoam pieces (Fig. 4) 1 patient had severe retroperitoneal hemorrhage with hypovolaemic shock, emergency operation was performed but haemorrhage stopped spontaneously during operation. 1 patient with underlying DM and urinary tract infection had septicemia with impending shock, improved following medical treatment. The last patient had infected urinoma because of catheter dislodgement and required percutaneous drainage (Fig. 5).

Table 4. Major Complications.

	No. Patients
Hemorrhage	
Severe hematuria with blood transfusion	3
Severe hematuria with AV fistula	2
Severe retroperitoneal hemorrhage	1
Septicemia with impending shock	1
Catheter dislodgement with infected urinoma	1
Total	**8**

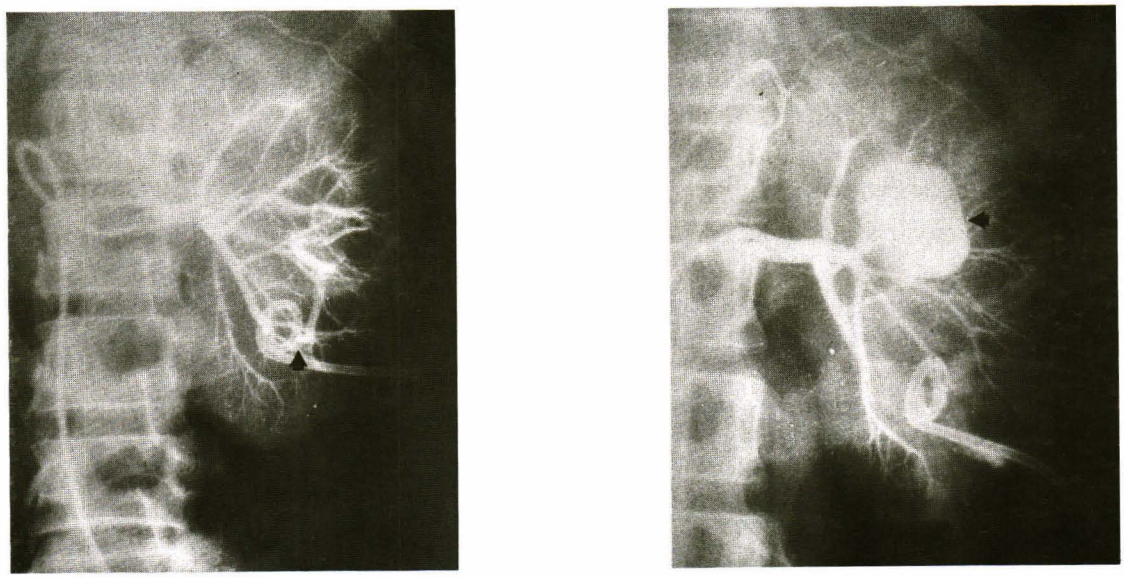

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Figure 4. Selective renal angiography in the patient with severe hematuria 4 days post percutaneous nephrostomy by using 8 F pigtail catheter.

a) There was an intrarenal AV fistula (arrow).

b) Contrast material leaked into the upper calices (arrow) during the study, and the AV fistula was embolized by using gelfoam pieces successfully.

Figure 5. Percutaneous drainage of the left retroperitoneum was performed to drain the infected urinoma (arrow) caused by previous dislodgement of the percutaneous nephrostomy catheter. Kinking of the catheter in the opposit kidney (large arrow) caused partial occlusion of the urine flow was also demonstrated in the same patient.

Other complications were considered minor including transient haematuria or clot formation (Fig.6), small retroperitoneal haemorrhage, and small urinary leakage (Fig.7). Complications relating to the catheter included were dislodgement partially or completely (Fig.8), occlusion due to urine sedimentation or catheter kinking (Fig. 5), and disruption (Fig. 9) were not uncommon.

Figure 6. Antegrade pyelography on the left side after performing percutaneous nephrostomy showed multiple filling defects due to blood clots.

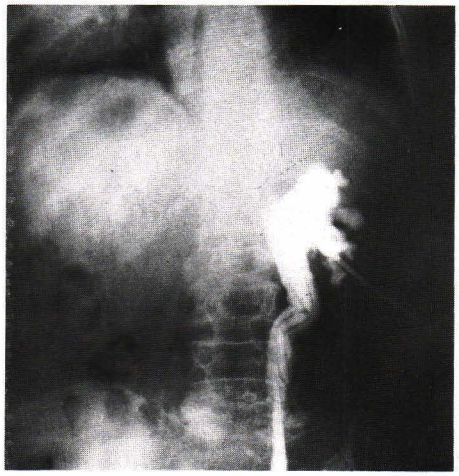

Figure 7. Small leakage of the urine and contrast material was demonstrated along the proximal ureter during percutaneous nephrostomy.

Figure 8. Pyelography was performed by injecting contrast material into the tract of previous percutaneous nephrostomy (arrow) which was accidentally dislodged, and reinsertion of the new catheter was done though the same tract.

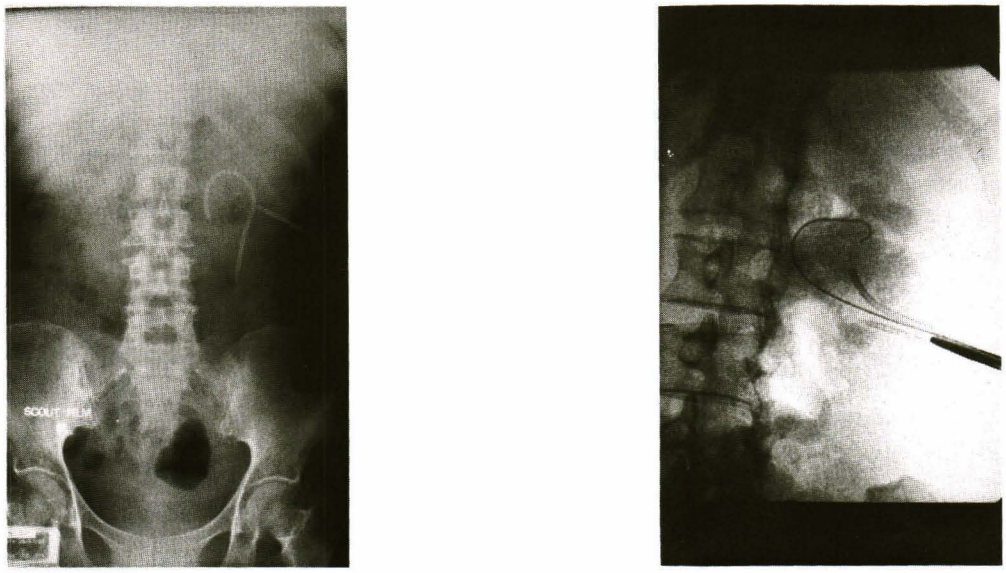

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Figure 9. a) Intrarenal disruption of the catheter occured.
b) Percutaneous retrieval by an alligator jaw forceps though the previous nephrostomy tract was done.

Discussion

Currently the most common indication for percutaneous nephrostomy is for the decompression of obstructed upper urinary tract. [8-13] Patients suffering from azotemia due to obstruction will show marked improvement, and severe electrolyte imbalance will be corrected. Patients with concomitant conditions will have their conditions under control without subjecting them to general anaesthesia or surgery. Patients with obstructed kidneys and congestive heart failure cannot be treated with diuretics until the urine is drained adequately. In malignant obstruction, percutaneous nephrostomy is considered when the patient has a chance for palliation or cure, and unilateral nephrostomy has no less benefit than bilateral nephrostomy. The use of percutaneous nephrostomy in patients with recurrent carcinoma should be individualised on the basis of expectations for prolonged functional palliation or the quality of life. [14-17] Moreover, percutaneous nephrostomy is useful for the measurement of renal function recovery in cases

of prolonged obstruction and also to provide better anatomical pictures. [9,11-13]

Dramatic clinical improvement of the patient with urosepsis associated with obstruction was seen following percutaneous nephrostomy. After decompression, renal blood flow increased significantly and causing increased antibiotic concentration in the renal parenchyma and in the urine. Irrigation will removed debris and decreased the opportunity for bacterial growth. [8-10,12,13] Topical antibiotics could be administered via percutaneous nephrostomy to raise antibiotic concentration in the urine. This feature is advantageous when antifungal agents are indicated, because these agents are poorly tolerated when administered parenterally. [9,13]

Before the era of extracorporeal shock-wave lithotripsy (ESWL), percutaneous nephrostomy was commonly used as a preliminary step for percutaneous stone extraction. [8-13,18-20] Struvite, apatite, cystine and uric acid stones could effectively be dissolved by appropriate solutions. However percutaneous nephrostomy remaired an adjuvant to ESWL treatment particularly in the case of large renal pelvic stone or a staghorn stone. [13,21]

Less frequent indications were to perform ureteral stent placement, to dilate ureteral stricture, to retrieve foreign body, to divert urine allowing post-surgical oedematous obstruction to subside or urinary leakage to seal, and to perform tract for nephroscopy or laser treatment. [8-13,22]

There were comparative studies on the positions of the patients. However prone position is desirable because of the benefit of keeping the examiner's hands out of the radiation field, but there is some difficulty recognising whether the needle tip is anterior or posterior to the renal pelvis.

The preferable site of puncture is just below the twelfth rib to avoid the risk of pneumothorax and irritation of the intercostal nerve. The posterior axillary approach allows the catheter to pass lateral to the large paraspinous muscle groups, through the lateral renal parenchyma, and into the renal pelvis with the benefit of catheter stability, better urinary sealing and increased patient comfort. Moreover, the risk of injury to the pedicle vessel is lower, and it is easier to pass the catheter into the ureter. [8-12]

Ultrasonographic guidance with or withour monitoring during the initial puncture is particularly useful in the patient whose renal shadow fails to be visualised by fluoroscopy, or in pregnant women, or the patient who has allergy to the contrast material. A major advantage of ultrasound over fluoroscopic guidance is the accurate measurements of the depth and the angle. Catheter-guidewire manipulation and final catheter positioning are best done under fluoroscopic control. However if neccessary, the entire procedure could be performed under ultrasonographic guidance. [23]

The techniques for catheter placement fall into two categories : trocar or Seldinger. [6,10,11] The trocar technique, involves advancing a trocar with a surrounding thin-walled cannula into the pelvicalyceal system, then the trocar is removed and the catheter is inserted through the cannula. The Seldinger technique which we used is safer and provides an easier controlled method to introduce the catheter into the pelvicalyceal system.

There are different catheter types commercially available, but all are quite expensive for our patients. Our hand - made loop catheter made from 6-8 F angiographic catheter is much cheaper, has satisfactory drainage function either for urine or for pus and can be used for both temporary and permanent drainage. Foley catheter is another cheap alternative and suitable for long-term drainage. Because of difficulty in the introduction of Foley catheter into the pelvicalyceal system, we recommend its use only after the tract has already been created by the other type of catheter. Most catheters have different advantages and disadvantages, such as 8 F Cope loop catheter which is now widely used because of better properties of the material and it'a ease of use.[24]

Previous reports showed 95 - 98 % success rate in catheter placement in experienced hands,[11] but in our series it was 100 %. Failure of catheter placement may occur in patients with smaller degree of dilated pelvicalyceal system, in uncooperative patients, and in children.

Complications of percutaneous nephrostomy are infrequent and much less than from surgical nephrostomy. The overall incidence of major complications is about 4 %, mostly attributed to haemorrhage and infection, and the mortality rate is about 0.2 %.[3] Our major complications occuted in the same rate of 4 %. There were more haemorrhages than infections in our series, and this may be due to the bleeding tendency seen in uraemic patients which constituted a large group in our series. However haemorrhage could be controlled conservatively or by transcatheter embolization.[25,26] Severe perirenal or retroperitoneal haemorrhage is rare. Mild haematuria is common, and may occur in up to 50 % of cases.[12]

If the obstructed urinary tracts are already infected there remains a risk of speticemia. The procedure must not overdistend the pelvicalyceal system with additional contrast material, and also adeqduate pre-operative antibiotics are neccessary.[9-12] In low risk group with no sign of urinary infection, administration of antibiotics are controversial. A report recommends that when the procedures are carried out on an outpatient basis, antibiotic prophylaxis enhance the safety of the procedures.[27]

Persistent urinary leakage from the pelvicalyceal system is rare if the catheter passes through the renal parenchyma. In our case, the catheter was dislodged and ureteric obstruction persisted, so ureteric leakage and infected urinoma occured. There would be no serious sequelae of urinary leakage if the urinary drainage is adequate.[8,12]

Other complications may include puncturing of other organs, such as the spleen, colon, lung duodenum and gall bladder. The ascending and descending colons are vulnerable, but limited experience so far has resulted in no significant sequelae.[11,12,28]

Most problems relating to the catheter are mechanical : dislodgedment, occlusion and disruption. The significant factors responsible for catheter dislodgement are inadequate fixation at the skin and no internal self-retaining system. Therefore, a plastic disk or a suture through a piece of tape and around the caheter, together with a small dressing and generous adhesive tape, will prevent this problem.[8,10-12] The self-retaining catheter, such as our hand-made loop catheter, Cope loop catheter and Foley catheter will also significantly reduce the rate of dislodgement.

Asymtomatic bacteriuria, candiduria, or pyuria occurs within 9 weeks after initial percutaneous nephrostomy. The patient often becomes febrile and demonstrate signs of sepsis if the catheter is occluded.[29] Occlusion of the catheter may be secondary to excessive sediment formation. We suggest more frequent irrigation, the use of larger catheters, and to regularly change the catheter at least at 2 monthly intervals. High fluid intake and urinary alkalinization may be helpful.[10,11] Occlusion due to catheter kinking or disruption may occur particularly when using hand-made catheters, which has less flexibility than the commercial ones. One case in our series had intrarenal disruption of the catheter, which we had of retrieve percutaneously via the previous tract and insert a new one.

Conclusion

Precutaneous nephrostomy represent one of the interventional radiologic procedures which is simple, safe and effective in various urologic conditions. It should be available in any major hospitals.

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