ORIGINAL RESEARCH

Percutaneous nephrostomy in women: an audit of more than 300 procedures

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Abstract

Background: Percutaneous nephrostomy (PCN) is inserted for a variety of causes in women and the associated complications should be known by clinicians.

Aims: To audit PCN insertions undertaken in women in order to determine the outcome, complications and their management, the age distribution and causes/indications for the procedure.

Methods: The PACS and the automated letter systems as well as the laboratory results of the patients were used to obtain the relevant data.

Results: Two hundred and seventeen patients underwent 344 PCN insertions with 100% success, 19 patients had 30 complications. No significant hemorrhage developed with 0.9% moderates and minor hemorrhages which settled. There was no death and no severe sepsis. The ages ranged from 17 to 95 years. Nephrostomy tube blockage occurred in 11(3%) patients. The nephrostomy tube fell-out and were replaced in 7(2%). One case of UTI was encountered. There most common indications for the PCN insertions were urinary tract calculi, transitional cell carcinoma of bladder, cervical carcinoma, urosepsis, pyonephrosis, and pregnancy.

Conclusions: PCN insertion can be carried out safely in women of all ages including very old patients. The complication rate in our experience is low. Radiology departments should have trained radiologists capable of inserting nephrostomies.

Key words

Percutaneous nephrostomy, Women, Sepsis, Infection, Obstruction, Complications

1 Introduction

Percutaneous nephrostomy (PCN) is a well-known ultra-sound scan/fluoroscopic guided percutaneous insertion of a catheter into the renal collecting system. The procedure which was first described by Goodwin *et al.* [1] in 1955 had been performed for many years in the developed countries and with development in interventional radiology the number of departments performing the procedure has increased in the developed countries. Furthermore, interventional radiology is gradually developing in a number of developing countries whereby percutaneous nephrostomies are gradually being

inserted in some of these developing countries. Percutaneous nephrostomies initially were mostly inserted in adults but percutaneous nephrostomies have been inserted in children. In women indications for PCN insertion may be related to non-obstetric/gynecological origin or obstetric and gynecological conditions. Various problems/complications may be encountered associated with PCN insertions.

Aims

To review records of all cases of PCN insertion performed in women (adults) from January 2009 to December 2013 in order to document.

- Ages
- Cause/indication for the PCN
- Outcome (success/failure to insert nephrostomy and reasons for failure)
- Complications and if any treatment given for the complications

2 Methods

A list of all women who underwent nephrostomy insertions between January 2009 and December 2013 at North Manchester General Hospital was obtained from the PACS Manager of the hospital.

The PACS system was used to obtain details of all women who had undergone insertion of percutaneous nephrostomy to work out the patients' ages, sides of nephrostomy insertion, outcome of the insertion procedure whether successful or not and reason for non-success; immediate complication or no immediate complication, the indication/cause of obstruction.

The Automated Letter System (ALS) was used to confirm the details obtained from the PACS system to be sure the details noted in the PACS system was correct and to document discharge letter and follow-up data to document if there were any late complications as well as treatment/outcome of these treatments. Documentation of adherence to nephrostomy protocol of (1) normal pre-procedure coagulation; (2) pre-procedure antibiotic medication; (3) pre-procedure analgesia medication; (4) pre-procedure anti-emetic medication was recorded. The cause of the obstruction/indication for the obstruction was recorded and immediate and late outcome were recorded plus further treatment documented. Note was made whether or not there was any blood transfusion post-procedure and reason for transfusion.

The laboratory results were checked to assess the full blood count results before and after the procedure; the serum urea and electrolytes before/after the procedure; the coagulation profile before the procedure; evidence of cross matching of blood after the procedure if any and the ALS system checked for evidence blood transfusion and post transfusion results.

3 Results

Two hundred and seventeen (217) women who were aged between 17 years and 95 years with a mean age of 64.5 years underwent 344 procedures. The age groups and the corresponding numbers of patients in the age groups were: 10-20 years – 5; 20-30 years – 15; 30-40 years – 9; 40-50 years – 28; 50-60 years – 26, 60-70 years – 40; 70-80 years– 52; 80-90 years – 37; 90-100 years – 5. The majority of the patients were aged between forty years and ninety years (see Figure 1a for the age distribution).

With regard to complications, 19 (8.3%) patients out of the 217 patients who underwent insertion of nephrostomy developed complications and 198 patients did not develop any complications (see Figure 1b).

The 19 patients (5.5%) had complications after undergoing a total of 344 procedures. 325 out of the 344 nephrostomy procedures were not associated with complications (see Figure 1c).

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The 19 patients who developed complications developed a total of 30 complications out of the 344 procedures in that some patients developed more than one complication. The complications were as follows: Blocked tube – 11 (3.2%); Pain – 7 (2% of all procedures, and all were post-insertion pain/discomfort and analgesia was given); Nephrostomy tube "fell-out" – 7 (2%); Hemorrhage-2 cases: ([0.6% of cases]; [minor 0.3% of procedures 1 case] and moderate hemorrhage [1 case 0.3% of procedures respectively] cause of hemorrhage not stated); Dislodged tube – 1 (0.3%); Infection – 1 (0.3%) and this was successfully treated with antibiotics and diagnosed as urinary tract infection; one case (0.3%) of a blood clot was noticed on screening during the insertion of the nephrostomy (the procedure was reported as traumatic by the radiologist who noticed a blood clot in the renal pelvis but after insertion of the nephrostomy tube the clot was evacuated into the nephrostomy bag and the hemorrhage settled without any significant bleed and there was no need for blood transfusion). The total of 3 hemorrhages (0.9%), were not severe to require blood transfusion or any surgical intervention like embolization. The 30 complications that developed in 19 patients included (see Figure 1d): blocked nephrostomy tube 11; pain 7; the nephrostomy tube fell out 7; hemorrhage with no cause found in 2 and traumatic cause in 1 (total 3); infection requiring antibiotic treatment (the patient developed urinary tract infection and pyrexia which settled with antibiotics but was not septic).

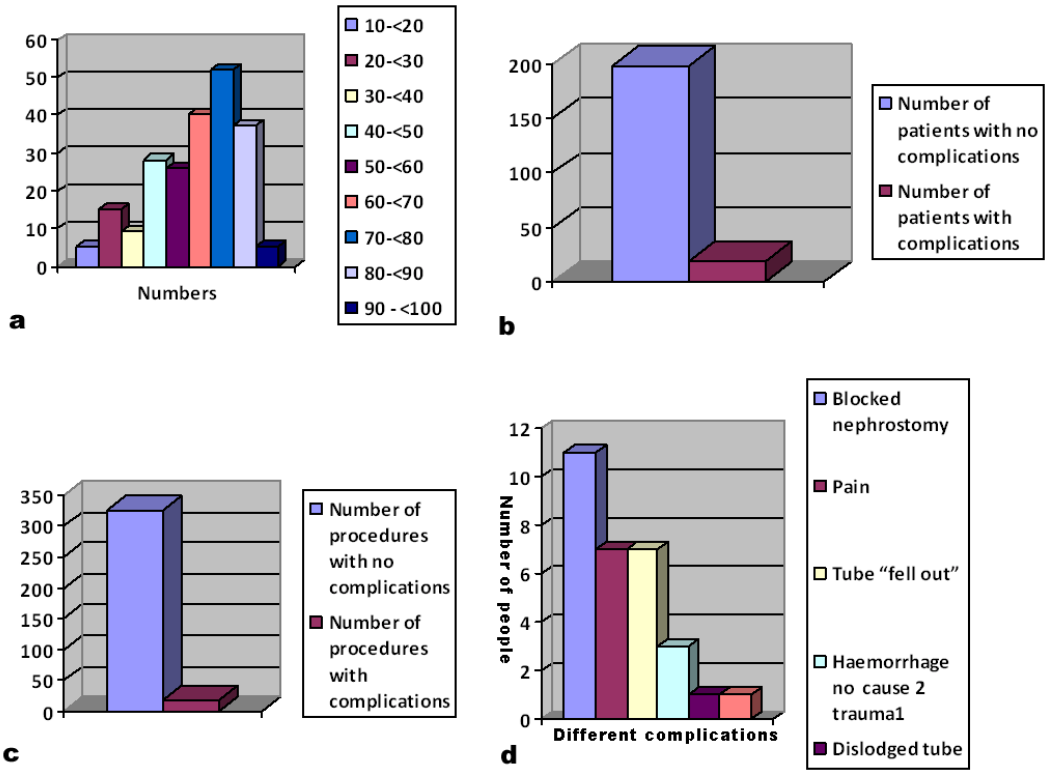

Figure 1. a: The age distribution of women who underwent nephrostomy insertions; **b:** The number of patients who developed complications among 217 patients; **c:** Number of patients with complications and no complications out of the 344 procedures; **d:** This figure shows the different complications suffered by the 19 patients.

Indications for insertion of the nephrostomy tubes included (see Table 1 and Figure 2): Carcinoma of caecum 1, Cervical carcinoma 19, Radiation cystitis with fibrosis of ureter and ureteric stricture with hydronephrosis 1, Endometrial carcinoma 3, Extrinsic compression 1, Fibroid 2, Hypotonic Ureter 1, IgG Kappa myeloma 2, Ileal conduit obstruction 1, Metastasis 7 (colon-2, breast-3, bowel-1, endometrium-1), NH Lymphoma 6, Ovarian carcinoma 2, Ovarian cyst 2, pregnancy 15, pelvi-ureteric junction obstruction (PUJ) Obstruction 2, Pyonephrosis 16, Pyeloplasty 1, Rectal carcinoma 1, retroperitoneal fibrosis 7, retroperitoneal mass 3, Sigmoid colon mass 4, Stricture 3, Stone 63, transitional cell carcinoma (TCC) 0f urinary bladder 33, thick wall bladder 1, urosepsis 17, uterine carcinoma 6, vesico-vaginal fistula (VVF) 1.

Table 1. The diagnosis/cause of obstruction (indication for nephrostomy and number of the nephrostomy procedures)

Items	Numbers
Carcinoma of caecum	1
Cervical Carcinoma	19
Radiation Cystitis/ureteric stricture/hydronephrosis	1
Endometrial Carcinoma	3
Extrinsic compression	1
Fibroid	2
Hypotonic Ureter	1
IgG Kappa myeloma	2
Ileal conduit obstruction	1
Metastasis-7 (colon-2,breast-3,bowel-1,endometrium-1)	7
NH Lymphoma	6
Ovarian Carcinoma	2
Ovarian cyst	2
Pregnancy	15
Pelvi-ureteric Junction (PUJ) Obstruction	2
Pyonephrosis	16
Pyeloplasty stricture	1
Rectal Carcinoma	1
Retroperitoneal fibrosis	7
Retroperitoneal mass	3
Sigmoid colon mass	4
Stricture of ureter	3
Stone	63
Transitional Cell Carcinoma of Bladder	33
Thick wall bladder	1
Urosepsis	17
Uterine Carcinoma	6
Vesico-vagina fistula (VVF)	1

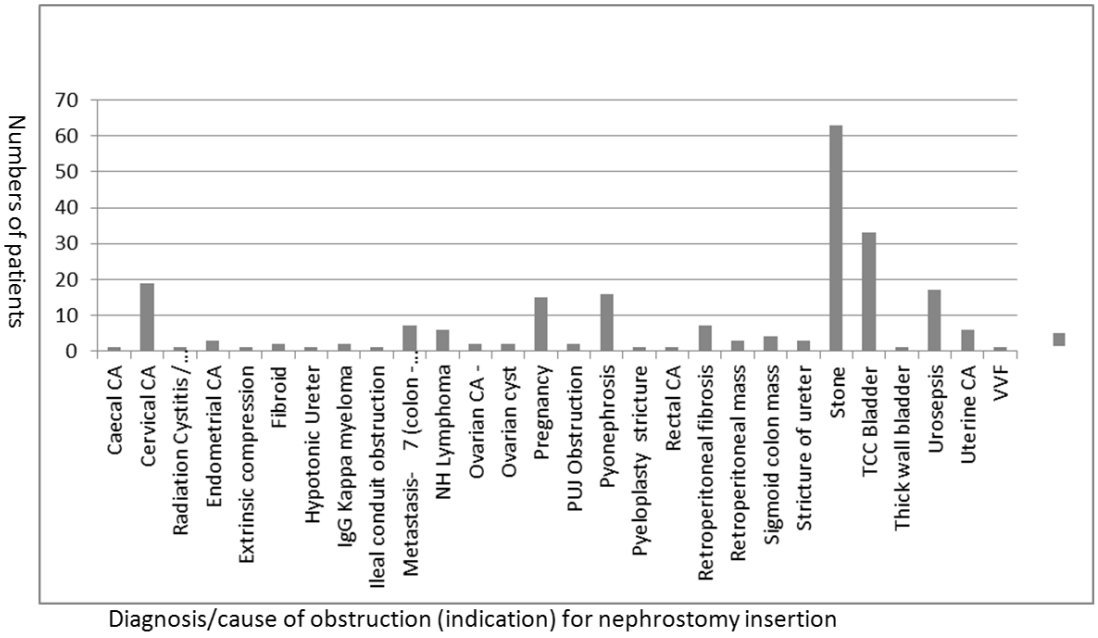

Figure 2. The diagnosis/cause of obstruction and indication for nephrostomy and number of the nephrostomy procedures

Causes of upper urinary tract obstruction in women could be of gynecological and obstetric causes or non-gynecological-non obstetric causes. A Summary of the gynecological obstetric indications for insertion of nephrostomy in our patients include (see Table 2 and Figure 3a): Carcinoma of cervix 19, pregnancy 15, uterine carcinoma 6, endometrial carcinoma 3, uterine fibroid 2, ovarian carcinoma 2, ovarian cyst 2, VVF 1, endometrial tumor metastasis 1.

The respective numbers of procedures and the sides for the insertion of the nephrostomy tubes was as follows: one hundred and twenty one (121) were bilateral; one hundred and twenty nine (129) procedures involved the right kidney; and ninety four (94) procedures involved the left kidney (see Figure 3b).

Table 2. A summary of obstetric and gynaecological indications for the insertion of nephrostomy procedures in our series

Indication	Numbers
Cervical Ca	19
Pregnancy	15
Uterine Ca	6
Endometrial ca	3
Fibroid	2
Ovarian ca	2
Ovarian cyst	2
Vesico-vaginal fistula (VVF)	1
Endometrial tumor metastasis	1

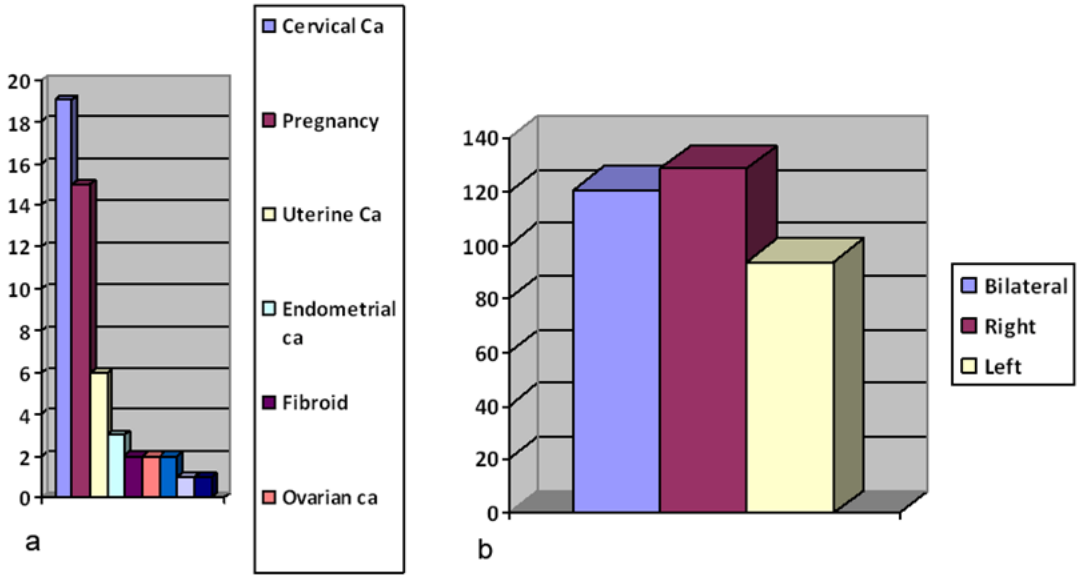

Figure 3. a: A summary of obstetric and Gynaecological indications for insertion of the nephrostomy procedures; **b:** Number of patients undergoing insertion of nephrostomy and the sides of the nephrostomy insertion.

4 Discussion

Lewis and Patel [2] audited the performance of their percutaneous nephrostomy service by comparing the major complication rate with the standards that had been recommended by the Society of Cardiovascular and Interventional radiology and the American College of Radiology which recommended that major hemorrhage should occur in less than 4%, and septic shock in less than 4%. They also conducted the audit to identify common sources of errors for quality improvement. They identified the major complications associated with percutaneous nephrostomy insertions which were

sustained between January 1997 and December 2002. They stated that their departmental protocols specified pre-procedure antibiotics for suspected infected cases and normal coagulation studies. Lewis and Patel [2] reported that ten of 31(3.1%) of cases sustained a major complication as follows: five had sepsis alone, two hemorrhages (one with sepsis as well) and three patients developed a major pelvic injury (1 with sepsis as well). The major sepsis and hemorrhage rates were 2.2% and 0.6%, which were within the recommended threshold limits. However, Lewis and Patel [2] stated that proportionately, more complications occurred out of hours and these included six out of 105(5.7%) versus 4 of 312 (1%; $p = .07$). Lewis and Patel [2] additionally reported that:

- Sepsis was the most serious complication which might have contributed to the death of two patients.
- Results of individual case analysis revealed that failed instrumentation with delay to definitive renal drainage was a common factor with sepsis; nevertheless, the ensuing were adjudged to be contributory factors in one or more cases: omitted antibiotics (in 3 of 10 cases; two became septic), technical factors in four cases (medial renal puncture [n = 1], damage due to fascial dilator [n = 1] or peel-away sheath [n = 2]) and delay in diagnosis/ therapy (of one to eight days, in six of 10 cases of whom four out of six became septic). One pelvic injury required surgical correction (the contributory factor in this case was faulty use of peel-away sheath).
- The patients who had hemorrhages settled with prolonged tube drainage alone.

Lewis and Patel [2] concluded that:

- An adequately staffed percutaneous nephrostomy service can perform within published clinical standards.
- The best practice factors which they had identified include: attention to agreed protocols and algorithms; pre-procedure antibiotics, careful renal puncture and care with use of dilators/peel-away sheaths, nevertheless, the paramount finding was that sepsis was the most serious complication and this contributed to death (two of 10 in the study), or a significant increase in the level of care required.
- The risk of complications is greatest pursuant to failed instrumentation (retrograde ureteric stent or percutaneous nephrostomy insertion) and especially if there is a further delay before the establishment of renal drainage.
- A close working relationship between interventional radiologists and urologist is crucial.

Christos *et al.* [3] studied 12 pregnant women with right ureter and kidney dilatation (hydroureteronephrosis) which was caused by ureteric obstruction in 11 out of the 12 patients. They reported that they had inserted a double J stent in 11 patients but in one woman they had inserted percutaneous nephrostomy because of intermittent abdominal pain resistant to analgesic therapy, or feverish pyelonephritis. They stated that the double J stents and the nephrostomy under ultrasound guidance without anesthesia. They also reported that after insertion of the double J stents in the 11 patients and insertion of percutaneous nephrostomy in one patient, the colic attacks resolved immediately and the feverish pyelonephritis resolved in a few days. Furthermore, they reported that at no time during the procedures (insertion of double J stent, and insertion of percutaneous nephrostomy) there was a risk for pregnancy. They concluded that: (1) ovarian vein syndrome in pregnancy can lead to violent renal colic pain and can become complicated by accompanied pyelonephritis; (2) In these cases insertion of a JJ stent or percutaneous nephrostomy under ultrasound guidance is possible and safe, and leads to an improvement of complaints immediately.

Tomislay *et al.* [4] reported a 27-year-old woman who had complete obstruction of her solitary left kidney due to uric acid stones. She was admitted as emergency a result of anuria. Five days pursuant to insertion of PCN, irrigation with 1.6% sodium bicarbonate solution was started. Because of complete ureteric obstruction, the "Y" extension with a valve was connected to the nephrostomy tube and the urinary bag and this enabled the patient to perform intermittent self-irrigation. Tomislay *et al.* [4] reported that after 12 days of irrigation, all the stones had completely dissolved. Tomislay *et al.* [4]

concluded that in the era of extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), and ureterorenoscopy, PCN-dissolution of urinary stones is a rare procedure. Nevertheless, this minimally invasive procedure could be successfully performed in selected cases [4].

Negru *et al.* [5] conducted a retrospective study of 111 cases that were managed conservatively or by means of endoscopic urological procedures for renal colic (insertion of JJ stents and per-cutaneous nephrostomy). They stated that clinical evolution determined the insertion of JJ Stent in 60 cases and the failure of insertion of JJ stent imposed insertion of per-cutaneous nephrostomy in five cases. In 56 cases urinary tract infection was associated and in two cases, despite all efforts, the patients died due to severe sepsis. Negru *et al.* [5] made the following conclusions.

- The immediate drainage of the upper urinary tract for renal colic in pregnancy is the recommended treatment, especially when the pain is associated with fever.
- JJ stents were well tolerated, although they were replaced after three months.
- Pregnant women with a history of urinary tract infection or stone disease should be carefully followed-up.

Doronochuk *et al.* [6] conducted a sociological study of quality of life of patients with nephrostomy drainage and 71 patients who had insertion of ureteric stents according to the standard international questionnaires SF-36 and EORTC QLQ-C30, version 3.0. Doronochuk *et al.* [6] found that:

- Both internal and external drain significantly aggravated the quality of life in the same degree.
- Younger patients of both groups suffered less.
- The quality of life was higher in both groups in drainage duration of up to one month ($p < .05$); in one to six month drainage duration, the quality of life was worse in both groups.
- Internal drainage (ureteric stent) was worse tolerated by males who were aged 25 to 44 years and elderly women who were aged between 60 years and 75 years, especially in long-term drain (over six months).
- Internal drainage (ureteric stent) was worse tolerated by elderly females (60 years old to 75 years old) and senile women (over 75 years old) in six month and longer drainage.

Doronochuk *et al.* [6] concluded that the study of large number of patients revealed significant differences in quality of life in patients with nephrostomy drain and ureteric stent.

Verdelo Pedro *et al.* [7] retrospectively evaluated the results obtained in 162 pregnant women who had suffered symptomatic hydronephrosis over a period of 12 years in their institution. They found that conservative treatment was effective in most patients, 39 patients required more aggressive therapy. Thirty five patients underwent insertion of double J (JJ) catheter, two patients had per-cutaneous nephrostomy, and another two patients underwent ureteroscopy and extraction of ureteric calculi. They made the ensuing concluding statements:

- The most frequent etiology of symptomatic hydronephrosis during pregnancy was external compression by the gravid uterus, followed by uretero-lithiasis.
- They considered conservative treatment as the treatment of choice, leaving ureteric double J catheter (stent) insertion or percutaneous nephrostomy for the refractory cases. Ureteroscopy is a new diagnostic and therapeutic option when other less aggressive measures fail.

Chelli *et al.* [8] reported a case of pyeloureteral malformation which had occurred on a single kidney. The malformation was discovered when the patient was 32 weeks pregnant when she had an ultrasound scan which revealed hydronephrosis.

Her initial treatment consisted of ultrasound scan-guided drainage (Per-cutaneous nephrostomy). The patient gave birth to a live infant via normal vaginal delivery and she subsequently underwent resection of the pyeloureteral malformation with anastomotic reconstruction of the upper urinary tract.

Kavoussi *et al.* [9] reported a total of six pregnant women with obstructing urinary calculi they had managed by ultrasound scan-guided nephrostomy insertion under local anesthesia. They stated that all the patients initially had relief of acute obstruction. Nevertheless, occlusion of the percutaneous nephrostomy tubes with debris necessitated change of nephrostomy tubes in 5 of the 6 patients. In two patients, recurrent nephrostomy tube obstruction, fever and pain led to percutaneous stone removal during pregnancy. In the remaining four patients, the nephrostomy tubes were left in situ during the pregnancy through delivery. During the post-partum period three patients successfully underwent ureteroscopic stone extraction and one patient passed the stone spontaneously. Bacteremia developed in each patient despite the use of preventive antibiotics. All of the six patients had uncomplicated vaginal deliveries of healthy new-borns and they were asymptomatic with no evidence of obstruction. Kavoussi *et al.* [9] concluded that percutaneous drainage of an acutely obstructed kidney in a pregnant woman is an effective temporary alternative to ureteric stent insertion until definitive treatment can be performed.

Semins and Matlaga [10] stated that urolithiasis during pregnancy is an uncommon, but a serious problem and that the options of for the treatment of pregnant women with obstructing calculi include: (1) insertion of ureteric stent, (2) per-cutaneous nephrostomy insertion, and (3) ureteroscopic stone removal. They also stated that even though insertion of ureteric stent and insertion of nephrostomy have been the historically standard treatment option for pregnant women with obstructing stones, there is an emerging collection of literature that reviewed the safety of ureteroscopic stone removal for pregnant women. Semins and Matlaga [10] performed a systematic review of MEDLINE and EMBASE data base from January 1966 through to April 2009 in order to identify all the literature on ureteroscopic stone removal in pregnant women. They reviewed the literature on ureteroscopic stone removal during pregnancy, with a focus on the safety of ureteroscopic stone removal. They concluded that:

- Ureteroscopic stone removal is an appropriate intervention in the pregnant population with urolithiasis.
- In all cases the procedure should be performed on a properly selected patient by a surgeon with appropriate experience and equipment.
- With such an approach, the complication rates are low and the success rates are high.
- A multi-Disciplinary Team approach should be emphasized as a key to a successful outcome.

The observation of a low rate of complications following insertion of nephrostomies in our cases may be related to strict adherence to percutaneous nephrostomy protocol of our interventional radiology unit which includes the following: (1) pre-procedure prophylactic antibiotics to be taken by all patients about half an hour preceding the nephrostomy insertion; (2) normal coagulation (the procedure would be postponed until the coagulation is normal in cases of impaired coagulation to avoid/reduce bleeding); (3) analgesia (pethidine) is given half an hour preceding the procedure to minimize pain during the procedure; (4) anti-emetic to reduce nausea and vomiting associated with the analgesia. Even though luckily there was no case of sepsis it is important to appreciate that despite the use of prophylactic antibiotics some patients may develop sepsis following insertion of percutaneous nephrostomy and clinicians as well as radiologists should be prepared to manage any episode of sepsis that may emanate. Even though none of our patients had severe bleeding following insertion of nephrostomy there is the possibility that severe hematuria in the nephrostomy tube may occur to require blood transfusion and very rarely the bleeding could be so severe that may require investigation for the cause of bleeding in the form of selective renal artery angiography and super-selective embolization of a minor branch of the renal artery to stop bleeding. After successful insertion of nephrostomy tubes some of the nephrostomy tubes may be blocked by debris resulting in reduction in nephrostomy tube output or no urine draining from the nephrostomy which may be

associated with loin pain but most of these blockages can usually be successfully unblocked by flushing the nephrostomy tubes. We have found the use of 2 ml syringe and saline more easily unblocks nephrostomy tubes better than larger sized syringes. Occasionally the blocked nephrostomy tubes cannot be unblocked and would require nephrostogram and replacement of nephrostomy tube over a guide-wire. A number of our patients required admission to the ward for flushing of the nephrostomy tubes which were successfully done and it was felt that if the district nurses were adequately trained to flush the tubes then re-admission of the patients would be reduced. At times nephrostomy tubes may fall out accidentally or may be inadvertently pulled out in the process of changing the nephrostomy bag which would require change of nephrostomy. Furthermore nephrostomy tubes may dislodge in that the end of the nephrostomy tube may no longer be located in the renal pelvis which would require readmission and replacement of nephrostomy. Women with obstructed upper renal tract may be admitted under different medical specialties depending upon the cause of obstruction and the presentation and therefore such patients may be admitted in the Urology ward, the general surgical ward, the medical ward, as well as the obstetrics and gynecology ward. A multi-disciplinary approach to the management of upper urinary is required and co-operation between interventional radiologists and clinicians is helpful in the management of patients. In cases where there is impairment of coagulation advice from a hematologist may be required. In cases of severe impairment of renal function an input from a nephrologist may be required. In cases where the patient's serum potassium level is high the use of insulin glucose to lower the serum potassium prior to insertion of nephrostomy would be a helpful approach in the management of the patient. When a patient with an obstructed upper urinary tract is acidotic the nephrologists tend to recommend the use of sodium bicarbonate. As part of a multi-disciplinary team approach sometimes patients who are very ill are managed in the high dependency unit prior to the insertion of nephrostomy and rarely a patient with severe renal impairment may initially undergo hemofiltration prior to insertion of nephrostomy. The observation from our audit would confirm that nephrostomy insertion can be performed in patients of all age groups and old women with obstructed upper renal tract can successfully undergo nephrostomy insertions.

5 Conclusions and recommendations

Various non-obstetric/gynecological as well as obstetric/gynecological causes were responsible for upper ureteric obstruction requiring insertion nephrostomies in our female patients.

Nephrostomy insertion can be carried out in women safely for a variety of causes of upper renal tract obstruction.

Nephrostomy insertion can be safely carried out in women of all ages including very old patients.

The complication rate following insertion of percutaneous nephrostomy in women in our experience is low.

Every radiology department should have a trained radiologist who is capable of inserting nephrostomies and radiology departments which do not have interventional radiologists should endeavor to have some of their radiologists trained to undertake interventional radiological procedures, like insertion of per-cutaneous nephrostomies.

Conflict of interests

The authors declare that they have no conflict of interests.

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