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Keyhole Surgery of the Kidney at Sultan Qaboos University Hospital, Oman

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جراحة الكلى بالمنظار في مستشفى جامعة السلطان قابوس ، عمان

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الملخص: الهدف: أدخلت جراحة الكلى بالمنظار في مستشفى جامعة السلطان قابوس في عام 1998. نعرض تجربتنا المبكره في أول 31 مريضا أجريت لهم هذه العملية على مدى ثماني سنوات . الطريقة: بطريقة استعادية تم استعراض 25 من المرضى الذين خضعوا لتكسير حصى الكلية بالمنظار (استخراج حصاة الكلية من خلال الجلد) لوجود حصى كلوية كبيرة و 6 مرضي خضعوا لتوسيع منطقة الاتصال الحويضي الحالبي بالمنظار من خلال الحويض . النتائج: في مجموعة تكسير حصى الكلية تحقق إزالة الحصى في 68% (25/17) من المرضى وكان معدل المضاعفات 28% (25/7). في مجموعة توسيع الحالب كانت نسبة النجاح في إزالة ضيق الحالب 83% (6/5). الخلاصة: كانت نتائج عمليات المنظار ناجحة ومقارنة للنتائج العالمية.

مفتاح الكلمات: تكسير حصى الكلية بالمنظار، حصى الكلى ؛ فتح الحويض.

ABSTRACT ***Objectives:*** Percutaneous access surgery of the kidneys was introduced in Sultan Qaboos University Hospital (SQUH) in 1998. We are presenting our early experience in the first 31 patients operated on over an eight year period using the percutaneous approach. ***Methods:*** A retrospective review of 25 patients, who underwent percutaneous nephrolithotomy (PCNL) for the treatment of large renal stones and 6 patients who underwent endopyelotomy for the treatment of pelviureteric junction (PUJ) obstruction. ***Results:*** In the PCNL group complete stone clearance was achieved in 68% (17/25) patients and the complication rate was 28% (7/25). In the endopyelotomy group the success rate of relief of obstruction of PUJ measured by renogram and relief of symptoms was 83% (5/6 patients). ***Conclusion:*** Our early results of PCNL are promising and comparable to international results.

Keywords: Percutaneous nephrolithotomy; Kidney calculi; Endopyelotomy.

Advances in Knowledge

This article describes the technique of PCNL and how to deal with large renal stones and the different ways of managing residual stones.

Application to Patient Care

The article educates the treating doctor that large renal stones (> 3 cm) are likely to be associated with decreased stone clearance. It is therefore advisable to discuss different treatment options to deal with residual stones with the patient before surgery.

The prevalence of renal stones in Oman is unknown, however a study in the Gulf area has shown a clear stone season corresponding to the hot summer months.[1] Data from developing countries have shown that calcium oxalate was the commonest constituent of both kidney and bladder stones.[2] The percutaneous approach to the kidney for the management of large kidney stones and PUJ obstruction has revolutionised their management by avoiding large surgical incisions to access the kid-

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neys.

PCNL and extracorporeal shock wave lithotripsy (ESWL) have largely replaced open surgical intervention for the management of upper urinary tract calculi. ESWL is the preferred treatment modality for calculi less than 3 cm in diameter as morbidity is lower than PCNL and success rates are comparable, however in stones 3 cm or larger (staghorn calculi) the morbidity of ESWL rises substantially while the stone-free rate is less when compared to PCNL. PCNL is preferred for stones which are hard in consistency, in a dependent position or associated with distal obstruction.

Fernstrom and Johansson reported the first percutaneous stone removal through mature nephrostomy tract in 1976, subsequently Kurth and colleagues used an ultrasonic lithotrite to fragment and retrieve a staghorn calculus successfully.[3] Endopyelotomy, albeit seemingly new, is a contemporary of pyeloplasty. Smith popularized the endourologic incisional approach in the United States and named it endopyelotomy.[3]

At Sultan Qaboos University Hospital (SQUH), keyhole surgery of the kidney for removal of renal stones and repair of PUJ obstruction was introduced in 1998. The aim of this paper is to present our series of cases including 25 cases of PCNL and 6 cases of endopyelotomy.

METHODS

The study included a review of 31 patients who were in two groups. The first group comprised 25 patients, who had PCNL for large kidney stones, and the second group comprised 6 patients who had endopyelotomy for PUJ obstruction. The study included all patients who underwent these two procedures over an 8 year period from May 1998 to October 2005 at SQUH. The patient files in both the groups were reviewed retrospectively and the following data were collected: clinical presentation, age of the patient, preoperative investigations, indications for surgery, complications and the outcome. Preoperative assessment included: urine culture, renal function, coagulation, abdominal ultrasound and computed tomography (CT) scan. A CT scan of the abdomen (noncontrast and contrast) is obtained to identify the number and position of the stones, as well as to demonstrate the renal anatomic detail necessary for planning the percutaneous approach. A prophylactic parenteral antibiotic (Gentamicin or Ceftriaxone) was given at induction of anesthesia. A ureteric catheter was passed on the affected side using cystoscope and the patient was put in a prone position on the operative table. In both groups, a percutaneous nephrostomy tract was created to gain access to the renal pelvicaliceal system. This was done by a 1cm skin incision and puncture with 18-gauge needle into the desired calyx under X-ray control. In PCNL, the selection of the appropriate calyx used for percutaneous puncture was chosen to achieve the shortest tract to the stone. By taking a posterolateral transparenchymal path, damage to major blood vessels was avoided. The calyx was inspected for three factors: the relation to the 12th rib, the degree of hydronephrosis, and any malrotation. In endopyelotomy, generally, a midposterior or superolateral calyx was chosen, although, occasionally, an inferolateral calyx might be utilized. A guide wire was placed into the pelvicaliceal system and the needle was removed. The tract was then dilated by a set of dilators over a guide wire. Finally, a rigid nephroscope was passed through a 30 french amplatz sheath into the collecting system [Figure 1]. In PCNL the stone was broken by a pneumatic lithotripsy probe (lithoclast) whereas in endopyelotomy the stricture was cut by a cold urethrotome knife. Postoperatively, in the PCNL group, the nephrostomy tube was removed within 48 hours after a check X-ray of KUB (kidney, ureter, bladder) had ruled out residual fragments. If residual stones were present a second-look PCNL was done through the same track immediately on removing the nephrostomy tube in the operation theater, or if the residual stones were inaccessible, ESWL was done at a later date. In the endopyelotomy group, a special nephrostomy tube with ureteral stent was left in place for 2-6 weeks and the patient was followed up by diuretic renogram after nephrostomy tube removal.

RESULTS

In the PCNL group of 25 patients, the mean age was 33 years (age range 2-60 years), of which 2 (8%) were children, including 16 males (64%) and 9 females (36%) The most common presentation was flank pain, 28% of patients had left flank pain and 24% had right flank pain [Figure 2]. The indications for percutanous surgery were the removal of staghorn calculi in 36% (9/25) of patients, partial staghorn calculi in 28% (7/25) and lower caliceal calculi in 16% (4/25). The complication rate was 28% (7/25). The complications included urine leaking from the nephrostomy site 16% (4/25), urinary tract infection 8% (2/25), and one pa-

Figure 1: ***The operative settings with C-arm fluroscopy monitoring for the percutaneous approach***

tient was converted to open surgery (pyelolithotomy) for failure to place the guidewire due to nondilatation of the lower calyx which was filled with the stone. Complete stone clearance by PCNL was achieved in 68% (17/25) and 32% (8/25) of patients had residual stones that were cleared by ESWL in 4% (1/25), second-look PCNL in 20% (5/25) and second-look PCNL followed by ESWL in 4% (1/25) of patients [Figure 3]. The size of stones treated were 1-2 cm (20%), 2-3 cm (32%) and more than 3 cm (48%). In the patients with residual stones, 87.5% (7/8) had stones larger than 3 cm. Clinically insignificant residual fragments of less than 4 mm were kept under observation. The mean operative time for PCNL was 3.5 hours (range 2-6 hours). No blood transfusion intra or postoperative was required. The time between first and second look PCNL ranged from 5 to 7 days. The mean duration of follow up was 6 months.

In the endopyelotomy group (6 patients), 66.6% (4/6) presented with left flank pain; one was found incidentally and one presented with abdominal mass (palpable kidney). The age ranged from 4-67 years. Fifty percent (3/6) had endopyelotomy for secondary PUJ obstruction following failed pyeloplasty. All patients in this group had a preoperative renogram to establish the functional obstruction of PUJ and a postoperative renogram to assess relief of obstruction in combination with the clinical assessment of relief of symptoms. The success rate after endopyelotomy was 83% (5 patients out of 6 had relieve of obstruction documented by renogram and improvement in their symptoms). One patient had perinephric fluid collection and fever postoperatively for 1 week, which was resolved with antibiotics. The endopyelotomy stent was kept in for an average of 4 weeks.

DISCUSSION AND CONCLUSION

PCNL and endopyelotomy are considered minimal access surgery for the kidney. They have several advantages over open surgery including small incision, minimal postoperative pain, rapid recovery and early return to work. PCNL has an additional advantage over open surgery in that the stone bearing calyx is directly entered, ensuring stone clearance under direct vision. PCNL is safe during pregnancy and is ideal for large, multiple, hard stones. Co-existing distal obstruction such as infundibular stenosis and PUJ stenosis can be corrected during PCNL. The PCNL is the treatment

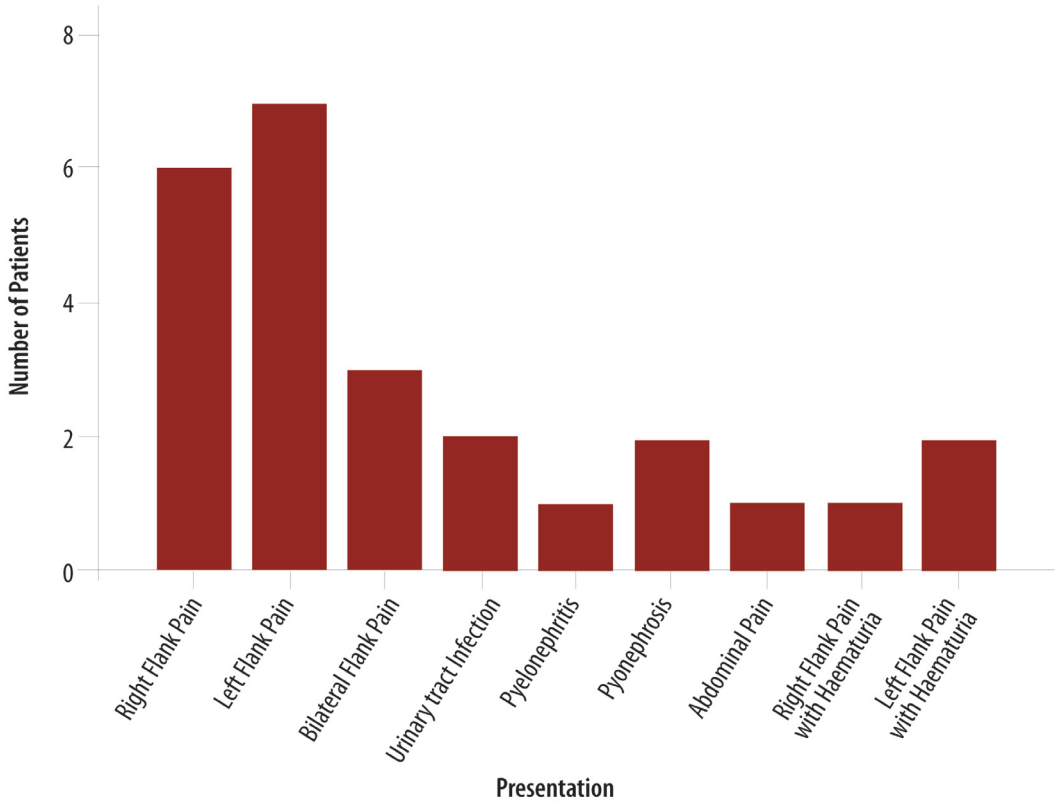

Figure 2: ***Clinical presentation of the 25 patients who had PCNL***

of choice for partial and complete staghorn stones and ESWL can be used as ancillary treatment for residual fragments. Endopyelotomy is especially advantageous when dealing with restenosis following pyeloplasty where open surgery is difficult due to adhesions.

The stone free rate in our study is 68%. Review of the literature shows that the overall stone-free rate for PCNL monotherapy for staghorn calculi ranges between 60% and 92%, whereas the stone-free rate for lower pole calculi treated with PCNL is 91%.[3] In our study, all patients with lower caliceal stones, 16% (4/25), had complete stone clearance. Chibber,[4] in his study of 878 patients with staghorn calculi treated by PCNL showed that the overall complete clearance rate is 93%. In our study, the patients with residual stones, 87.5% (7/8), had stones larger than 3 cm emphasizing that the presence of staghorn calculus is a factor that leads to an increased risk of residual calculi.

In our study of the PCNL group, there were 2 children (the 9 year old male presented with left pyelonephritis and the 2 year old male presented with left pyonephrosis), both of them had complete stone clearance by PCNL. Shokeir et al.,[5] in their study of 166 children for treatment of 1 to 2 cm stones, have shown that PCNL is better than ESWL, yielding higher stone-free and lower re-treatment rates.

In the present study we have used pneumatic lithotripsy in the fragmentation of the stones. It can effectively fragment stones of varying composition with a wide range of safety, however one of the disadvantages is that it is necessary to keep the probe as straight as possible. The Holmium:YAG laser has been found to be an effective and safe lithotriptor for most percutaneous stone surgery, however in patients with a very large stone burden the combination of laser with another more powerful intracorporeal lithotriptor may be necessary.[6]

The percutaneous approach to the kidney is not free of complications; the reported complications in the literature for PCNL are bleeding, urosepsis, retained stone fragments, ureteral injury, risk of injury to the bowel, duodenum, liver or spleen, and perforation of the collecting system of the kidney, which can result in extravasation of irrigant fluid into the peritoneal cavity, retroperitoneum or intravascular space. Rare complications of PCNL include arteriovenous fistula and aneurysm of renal artery branches. The perioperative complications of PCNL reported in 128 patients

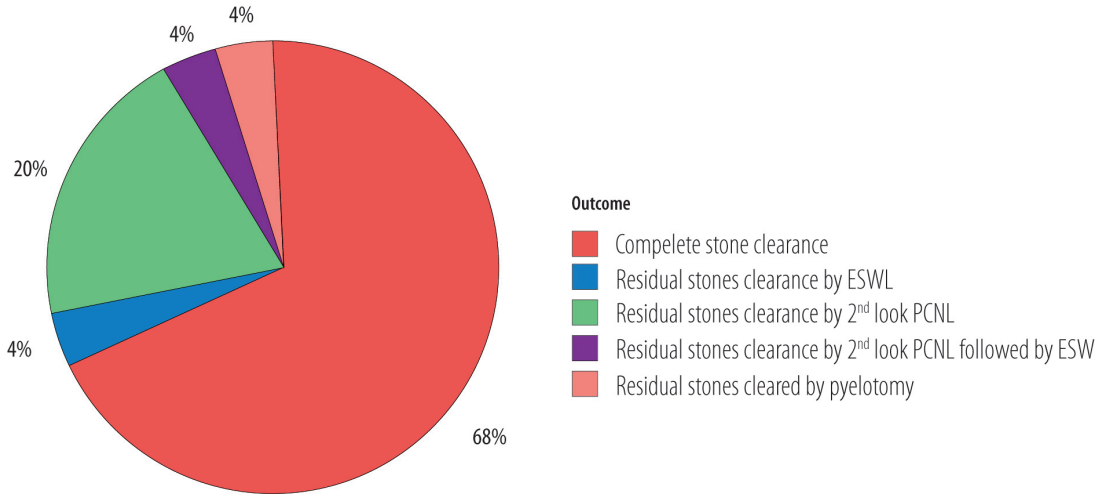

Figure 3: ***Outcome of the 25 patients who had PCNL. 68% had complete stone clearance.***

studied by Vorrakitpokatorn et al.[7] were hypothermia 56%, cardiovascular changes (57%) related to volume of irrigation fluid (normal saline), electrolyte changes, pleural tear, infection and bleeding.

Traditionally, a nephrostomy tube is placed in the tract at the end of PCNL to assure proper renal drainage, facilitate a second-look if necessary and ensure haemostasis. However, serial reports about tubeless percutaneous surgery for selected patients have recentely been published.[8, 9] Gelatine matrix haemostasis sealant has been used to seal nephrostomy tracts to reduce bleeding and extravasation after tubeless mini-percutaneous PCNL.[10] However, Aghamir et al.[11] found that sealing the nephrostomy tract with surgicel (oxidized cellulose) after totally tubeless PCNL did not decrease bleeding or extravasation from the tract. The 'mini-percutaneous' technique was first developed for use in children. An 11- to 15-F peel-away vascular access sheath was used instead of the commonly used 24- to 30-F Amplatz sheaths. PCNL was performed using pediatric instruments.[12] The mini-percutaneous technique was adapted to adult patients with stones smaller than 2 cm. The mini-percutaneous technique requires a longer operative time and fragmentation of relatively small, otherwise extractable, stones. The advantages of this technique over standard PCNL remain to be established. In our study, 16% had second-look PCNL. Davol et al.[13] have reported that aggressive stone clearance obviates the need for routine second-look PCNL.

Endopyelotomy is a widely accepted alternative in the treatment of PUJ obstruction with a success rate between 63% and 88%.[14] The success rate of our endopyelotomy group was 83%, which is based on the patients being symptom free as well as the postoperative diuretic renogram showing evidence of relief of obstruction. Endopyelotomy related complications reported in the literature include stent-related problems, infection, urinoma and unrecognized incision of renal pelvis and, rarely, necrosis of the entire ureter.[15] The serious complication of endopyelotomy is bleeding, which constitutes a 15% risk according to the series of Gallucci, in their study of 976 patients.[16] In our endopyelotomy group, the average time for leaving the stent in place was 4 weeks, however in an experimental study in an animal model (minipigs), Kerbl and his co-workers,[17] showed no statistical significance in the healing of ureters of animals with stents removed at 1 week or 4 weeks, but this finding has to be supported by clinical studies on humans.

One of the limitations of this study, in addition to being retrospective, is the short follow-up period that makes comparisons to other data difficult. Our results of stone free-rate after PCNL and the improvement of PUJ obstruction after endopyelotomy are comparable to international results.

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