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ORIGINAL PAPER

Urologists versus radiologists made PCNL tracts: the UK experience

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Abstract We aim to explore the practice of who makes the PCNL tract in the UK and Northern Ireland as well as presenting our data for two different approaches to PCNL tracts in Northern Ireland. A national questionnaire survey was carried out across the National Health Services hospitals in UK. In addition, a retrospective analysis of 134 PCNL cases was carried out. Group I included 103 (77%) cases with urologist-made tracts, while group II included 31 (23%) cases with radiologists-made tracts. The survey suggested that 45% (42) of the hospitals adopted a radiologist-made tract, 44% (41) use urologist-made tract, while the remaining 11% (11) use both. Most of the radiologists' performed tracts in our series were for complex cases. Failed access occurred in 6 (5.8%) in group I and none in Group II. The overall stone-free rate was 92 and 50% for group I and II, respectively. There is a better stone clearance rate in Group I ($p = 0.0016$). This however is likely to be attributed to the complexity of the cases in group II. However, urologist made percutaneous tract is safe and efficacious but a team approach with radiology is needed for more complex cases.

Keywords Percutaneous Nephrolithotomy · Urolithiasis · Nephrostomy · Shock wave lithotripsy

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Introduction

The routine management of renal stones has been revolutionised over the past 25 years with the introduction of a number of treatment modalities. Previously the surgical options open to the urologist for treatment of larger renal calculi were limited to open surgical techniques such as pyelolithotomy and nephrolithotomy with their inherent disadvantages. As these new techniques have been increasingly adopted and the practice perfected, there has been a dramatic reduction in morbidity and mortality from renal urolithiasis.

Percutaneous nephrostomy tube insertion for the drainage of an obstructed hydronephrotic kidney was first described in 1955 [1]. The elective dilation of a nephrostomy tract for the specific purpose of stone removal was not, however, introduced until 1976 by Fernstrom and Johansson [2]. Percutaneous stone extraction had been previously described in 1941 after a nephrostomy tube was created during open surgery [3]. The modern day technique of percutaneous nephrolithotomy (PCNL) was quickly adopted and by the early to mid-1980s, it had a more widespread use [4, 5]. Initially used for smaller stones, fragmentation of large stones and their subsequent extraction was described later [6].

The indications for PCNL have gradually changed with improvement of techniques and with the introduction of extracorporeal shockwave lithotripsy (SWL) into clinical practice [7]. The combination of these modalities have resulted in treatments which are less invasive and offer a shorter hospital stay with an earlier return to work when compared to open surgery.

We have conducted a national questionnaire across the National Health Service (NHS) hospitals in the UK with regard to the access tract in PCNL. In addition, we report our own experience in PCNL procedures in two hospitals in Northern Ireland with their outcomes and our recommendations.

Methods

A national telephone questionnaire was conducted in all urology departments across all the NHS hospitals in the UK enquiring about their individual practices with regards to the access tract for the PCNL procedures. Hospitals with no urology services were excluded. Those with urology departments were divided into those in which PCNL is/is not performed routinely. Those who perform PCNL as a routine procedure were further subdivided into those in which PCNL is performed solely by the urologist, those which obtain the radiologist's input for the access tract, and the others who practice PCNL using both approaches.

In addition, we reviewed the records of all patients who underwent PCNL between January 2004 and December 2007. Data were acquired from theatre records in Belfast City Hospital and Altnagelvin Area Hospital in Northern Ireland. Case notes were reviewed and patients were divided into two groups, based on whether they had their percutaneous nephrostomy tract placed by the urologist or the radiologist.

Group I tracts were made by the urologist, whilst group II tracts were made by the radiologist. Three operating urologists (BD, TT and CKM) were the principal surgeons in all the cases. For group I, access to the collecting system was obtained by the operating surgeons at the time of surgery without the aid of an interventional radiologist. For group II percutaneous access was obtained by the radiologists electively the day before the procedure ($n = 26$). Five patients had their percutaneous nephrostomy tubes inserted by the radiologist a week prior to the procedure, due to previous history of urosepsis secondary to stone disease. Antibiotics were used appropriately and when needed for those with previous urosepsis and spinal problems, as they represent a high risk group for infective complications.

Surgical technique

Patients received a general anaesthetic followed by rigid cystoscopy and placement of an ipsilateral ureteral catheter prior to being turned to a full prone position with the operative side elevated to 30°. For group I, renal access was obtained under fluoroscopic guidance aided by retrograde uretero-pyelogram via the ureteral catheter. An appropriate posterior calyx was chosen, over which a 1.5 cm skin incision was made. Under fluoroscopic guidance a triangulation technique was used to select the point in the body surface which represented the optimal direction to the preselected calyx. A 13-gauge introducer needle was passed through the fascia and positioned so that the long axis of the needle was directly in-line with the preselected calyx. A nephrostomy needle was then advanced while fluoroscopy is being carried out at 90° and 45° to confirm the needle pathway, until the collecting system was entered, as evident by aspiration of the previously instilled radiographic contrast (with diluted methylene-blue dye). A guidewire was manipulated down the ureter when possible. With the use of Balloon or Amplatz dilators, the nephrostomy tract was dilated, a safety wire was passed, and a 24 F to 30 F Amplatz working sheath was placed. Stone fragmentation was then performed using ultrasonic, pneumatic lithotripsy or electrohydraulic lithotripsy followed by placement of a nephrostomy tube (usually a 10 F pigtail nephrostomy tube). An antegrade nephrostogram was performed to confirm tube position and evaluation for collecting system perforation. The nephrostomy tube is then secured to the skin with 0 silk suture. A pressure dressing was applied and the ureteral catheter was taped and, both were removed in 24–48 h.

Indications for surgery, factors associated with failure to gain access to the collecting system, location and number of access sites required, complications related to the surgery, and success rates of stone removal were reviewed.

Percutaneous access was achieved in the second group by the radiologist, one day prior to the procedure (apart from five patients with history of urosepsis secondary to their kidney stones). The renal access was performed using a 22-gauge Chiba needle guided using a bi-planar C-arm fluoroscopy and ultrasound imaging. Once the renal collecting system has been entered, diluted (1:1) contrast is injected to opacify the collecting system. After the puncture a nephrostomy tube was left in and the tract dilation was performed by the operating urologists in the theatre.

Stone clearance was defined in our study by either intraoperative documentation of stone clearance or the presence of clinically insignificant residual fragments (stone size <4 mm on post operative X-ray KUB). This is confirmed on the first post operative day by performing a KUB.

The chi-square test, with Yates' correction when necessary, was used for comparison among groups.

Results

In the national survey a total of 175 NHS hospitals were contacted by two urologically trained residents (MZA and AH). 88% (154) of the contacted hospitals responded. 61% (94) of these perform the PCNL as a routine procedure. 45% (42) of these 94 adopt a radiologist-made tract, 44%

Table 1 Patients' demographics in the two groups

Variable	Urology-made tract (Group I)	Radiology-made tract (Group II)	p
No. of patients	103	31	
Age in years (mean)	54.7 (22–84)	52.5 (35–71)	
Previous procedures			0.9109
ESWL	10 (9.7%)	5 (16%)	
PCNL	3 (2.9%)	3 (9.7%)	
Ureteroscopy	2 (1.95%)	1 (3.2%)	
Others	3 (2.9%) (pyelolithotomy [2] and pyeloplasty [1])	1 (3.2%) nephrectomy (other side-1)	
Past medical history			0.2991
DM/HTN	2 (1.9%)	9 (29%)	
Spina bifida	1 (0.97%)	8 (26%)	
MS	1 (0.97%)	0 (0%)	
Renal failure	1 (0.97%)	1 (3.2%)	
Hyperparathyroidism	2 (1.9%)	1 (3.2%)	
Others	0 (0%)	6 (19.4%) Cysteine stones (2) IHD (4)	

Table 2 Stone characteristics in the two groups

Variable	Urology-made tract (Group I) *n* (%)	Radiology-made tract (Group II) *n* (%)	p
Stone location			0.6068
Renal pelvic stones	36 (37%)	12 (38%)	
Calyceal stones	31 (32%)	8 (25%)	
Staghorn stones	30 (31%)	11 (37%)	
Stone size			0.0023
<10 mm	20 (21%)	2 (6.5%)	
10–20 mm	27 (28%)	5 (16%)	
>20 mm	50 (53%)	24 (77.5%)	
Other procedures for residual stones			
PCNL	1 (0.97%)	1 (3.22%)	
Ureteroscopy and laser	1 (0.97%)	3 (9.7%)	
ESWL	4 (3.9%)	5 (16.1%)	

Table 3 Operative details and outcome in the two groups

Variable	Urology-made tract (Group I)	Radiology-made tract (Group II)	p
Mean anaesthesia time (min)	160 (60–240)	190 (120–240)	
Mean hospital stay (days)	8.13 (3–21)	8.36 (3–21)	
Number of sites required			0.8301
Single	95.1% (98)	96.7% (30)	
Multiple (2)	4.9% (5)	3.3% (1)	
Stone clearance			
Overall	92.8% (90)	50% (15)	0.0016
Renal pelvis	35 (97%)	9 (75%)	
Calyceal	29 (93.5%)	2 (25%)	
Staghorn	26 (87%)	4 (36%)	
Complications			0.0029
Sepsis	4.8% (5)	16.6% (5)	
Cardiac arrhythmia	0.09% (1)	0	
Hypoxia	0.09% (1)	3.3% (1)	
Repositioning of antegrade stent	0	3.3% (1)	

(41) use urologist-made tract, while the remaining 11% (11) use both.

In our study, most of the tracts formed by the radiologists were for cases with complex anatomy and in whom potential complications were anticipated. Patients demographics are explained in Table 1 and various stone characteristics are detailed in Table 2.

Percutaneous renal access was attempted on 136 kidneys, including 2 patients in whom the procedure was on both kidneys on two separate occasions. Simultaneous bilateral procedures under the same anaesthetic was performed on one patient. Various operative details are summarised in Table 3.

Double puncture was required in five cases in group I and in one case in group II. Failed access occurred in 6 (5.8%) cases only in group I and none in group II. Three of those failed cases were due to lack of space between the impacted stones and the calyceal wall. Two cases were abandoned due to bleeding and one was due to tear of an oedematous calyceal infundibulum.

The overall stone-free rate was 92% (90) and 50% (15) in group I and II, respectively ($p = 0.0016$). Clearance rate for the staghorn stones was 87% (26) and 36% (4) in groups I and II, respectively, for renal pelvic stones the clearance rate was 97% (35) and 75% (9) and for calyceal stones the rate was 93.5% (29) and 25% (2) for groups I and II, respectively.

Post operative urinary sepsis occurred in 4.8% (5) and 16.6% (5) patients in groups I and II, respectively. One patient from group I required ITU admission due to post operative urinary sepsis. While one patient developed cardiac arrhythmia in group I and one patient developed hypoxia in group II. One patient had to be brought back to theatre for repositioning of an antegradely placed JJ stent during PCNL. One patient in group I had significant post operative bleeding requiring selective embolization of bleeding renal vessel.

Discussion

Over the last three decades, percutaneous renal tract surgery has become an area of immense interest as it is being increasingly used for the removal of complex renal and proximal ureteral stones, removal of retained ureteral stents, catheters or guidewires and for resection of collecting system tumours. It can also be used to treat pelviureteric junction stenosis. As a result of these advancements in endourological techniques alongwith the risk of infection and deterioration of renal function, conservative management of upper tract calculi has diminished over the last 20 years [8]. Although a large proportion of urologists have the capability to acquire access tracts for these procedures, very commonly accessing the tract for PCNL is delegated to interventional radiologists, either separately or as a combined procedure. The reasons are mainly due to the steep learning curve to acquire the necessary skills for obtaining the PCNL tract [9]. There are minimal data on the teaching of renal percutaneous access and PCNL. In addition to direct apprenticeship, inanimate simulators, virtual reality (VR) simulators, and robotics provide new perspectives in the twenty-first century [10]. In addition, there are only a very few series published sharing the experience of urologist acquired access tracts [11–14].

In a recently published article [14] from one of the largest stone units in the UK, the authors describe their experience of urology led nephrostomy and percutaneous access. Over 4 years, 71 nephrostomies were placed under local anaesthetic, with a primary success rate of 96% and only three failures, all due to patient discomfort. No major and only 4% minor complications were noted. They also obtained >400 accesses for 261 PCNL procedures over the same period. Failed access occurred in only three cases, with no major access related complications and minor complications in 3% of patients.

The complication rate associated with urologists acquired tracts has been reported to be between 15.3 and 27% [9, 12]. In a series of 522 procedures [11] a failure to gain access was found to be only 1.7% (9 cases), with four of these nine occurring due to operator inexperience. The overall complication rate was 15.3% with blood transfusion, pneumothorax and hydrothorax among the most common complications encountered. The overall success rate of stone removal was 94.5%.

In another series of 100 patients [12], the authors described a total of 27 complications in 14 patients in whom nephrostomy tube placements were done by urologists. Though the most common complication was tube dislodgment ($n = 11$), only six complications were related to the tube placements which include urosepsis ($n = 3$), renal pelvis perforation ($n = 2$), and haemorrhage requiring blood transfusion ($n = 1$). It has been reported that the complications associated with tube placements decrease with operator experience [15]. In another series of 96 patients [13] who underwent 127 PCNLs, authors looked at the estimated blood loss, based on the drop in haemoglobin and the need for blood transfusion. They reported an average haemoglobin drop of 3.1 mg/dl, and an overall blood transfusion rate of 23%. In our series only one patient in group I required blood transfusion. This was due to bleeding following removal of the nephrostomy tube post operatively. The patient later underwent selective embolization of uro-vascular fistula secondary to PCNL.

It is generally perceived that the radiology-acquired access tracts are associated with lesser complications and a greater success rate. The Mayo clinic experience on 1000 cases of radiology acquired tracts was reported [16]. The failure to gain access was 1.2%. The removal was successful in 98.3% of renal stones and 88.2% of ureteral stones. Significant complications were noted in 32 cases (3.2%) and only 3% of the patients needed blood transfusion. In our series failure to obtain access was only encountered in the urologist-acquired tract only, whilst no failure was reported in the radiologist-made access, despite relative anatomical difficulties in the latter group of patients.

Most of the PCNLs performed with the radiology assistance in our series were done in complex cases such as spina bifida ($n = 8$) patients and those with significant history of urosepsis ($n = 5$) requiring the nephrostomy tube being placed in advance of the proposed procedure. Current literature strongly supports radiology assistance in patients with spinal neuropathy, since urinary stasis, recurrent UTIs, hypercalciuria and long-term catheters render them at a far greater risk of developing stone disease. Further these patients often are difficult surgical candidates, as immobility poses serious difficulties not only in patient positioning during the procedure, but also makes these patients high risk for post operative complications [17].

In a series of 39 patients with spinal neuropathy [17], 5 patients experienced major and 8 minor complications, whereas 9 patients required ITU care and 2 patients died post operatively. Only 19 renal units (48.7%) were rendered stone free by initial PCNL.

Culkin et al. [18] reported a 8.5% major complication rate following PCNL in spinal patients, in addition to the 44.4% patients who had fever post operatively, with a stone free rate of 53.6% with a single procedure. These results are a clear reflection that these patients are prone to greater number of complications as compared to the general population and to meet the operative needs, PCNL should be done as a team effort in more complex cases with urologists, radiologists and suitably qualified nursing staff in attendance.

Whether the access is made by the urologist or the radiologist, the access is as good as the operator's experience. This mainly depends on the caseload and the personal experience. In a tertiary stone centre even the most complex cases can be solely managed by urologists. In centres with a low caseload or no super-specialist expertise, a radiologist's help should be sought in more complex cases.

Limitation: One of the important limitations of the study is the fact that it is carrying comparison between radiologist and urologist in the cohort of patients with different clinical conditions and which would be our aim in future prospective studies; however, we wanted to show the effectiveness of the practice in each group.

Conclusion

Our results have clearly demonstrated that urologists can gain access to upper tracts for PCNL procedures with success and complication rate that is comparable to the interventional radiologists. However, team approach with radiology is needed for challenging cases in the patient's best interest, especially in centres with small caseload. This results in a negligible failed access rate when a combined approach is used.

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