Use of Lower Pole Nephrostomy Drainage Following Endorenal Surgery Through an Upper Pole Access

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Purpose: PNL via an UP puncture is efficient for treating complex stone disease. Access via the UP can provide better visualization, allowing greater stone clearance with a rigid instrument due to its more favorable alignment with the axis of the intrarenal collecting system. However, the presence of a NT through the upper pole tract, especially with a supracostal puncture, can generate significant patient discomfort. We reviewed our experience with a technique using tubeless UP access for PNL with concomitant placement of a NT via a LP calix.

Materials and Methods: We performed a retrospective review of our experience using tubeless UP access for PNL with concomitant placement of an LP NT for postoperative drainage. Patient demographics, the number and location of accesses, stone size, stone-free rates, concurrent/additional procedures and complications were recorded.

Results: A total of 63 tubeless UP accesses were performed in 62 patients undergoing PNL, including unilateral access in 61 and bilateral access in 1. Supracostal UP punctures were used in 58 patients, including 40 above the 12th, 17 above the 11th and 1 above the 10th rib. Each patient underwent at least 2 accesses and 3 had 3 or more accesses placed. LP access was nondilated in 37 patients and dilated in 26. Of the patients 56.6% were stone-free after a single procedure, increasing to 96.2% following secondary procedures. Three of the 62 patients (4.8%) required transfusion, 3 (4.8%) required intervention for pleural morbidity and 1 (1.6%) required a stent for a nonsealing upper pole access.

Conclusions: Tubeless UP access provides maximal efficiency for stone clearance during PNL, while minimizing the morbidity of an intercostal tube.

Key Words: kidney; kidney calculi; nephrostomy, percutaneous; upper pole access

UP access is best achieved via a supracostal puncture and it is used in about a fourth of patients undergoing PNL.[1–6] Supracostal access is indicated in patients presenting with predominantly UP caliceal distribution of stone material, multiple LP calices containing stones, staghorn calculi and stones in a horseshoe kidney. Additionally, UP access is preferable when access to the ureteropelvic junction is necessary, as in patients with proximal ureteral stones, or if an antegrade approach is planned to treat ureteropelvic junction obstruction with or without associated calculi.[2,7] The major advantage of a supracostal puncture is that the line of puncture aligns the access tract most closely with the renal axis, thus, allowing maximal use of a rigid nephroscope without undue torque, which may lead to parenchymal trauma and bleeding. In addition, the LP as well as the ureteropelvic junction are easily visualized and approached. Since a supracostal puncture may traverse the pleura, a mean pleural complication rate of 16%, of which a fourth of cases require intervention, can result from such an approach.[1–6] In addition, patients with a supracostal NT typically have more discomfort and pain postoperatively than patients with an infracostal NT.[1,6,8] We examined technique modifications that may influence morbidity secondary to UP access via a supracostal puncture by avoiding the need for a supracostal NT.

METHODS

A retrospective analysis was performed in 62 consecutive patients who underwent PNL and/or endopyelotomy between July 1997 and July 2004. All patients underwent UP access performed as a single access or in addition to mid and/or LP access (figs. 1 and 2). All UP accesses were left tubeless because a concomitant infracostal LP NT, that is an 8.5Fr or 10Fr Cope loop (Cook Urological, Spencer, Indiana), was placed for drainage in all patients through an existing access or a nondilated puncture, as described (fig. 3). All patients with stones underwent NCCT on POD 1 and secondary PNL was performed if any residual fragments were seen. In addition, all POD1 NCCTs available in our picture archiving communication viewing system were reviewed and assessed for perinephric hematomas. NTs were removed following a nephrostogram demonstrating good antegrade flow without evidence of extravasation from the pelvicaliceal system (fig. 4). Patient demographics, the number and location of accesses, stone size, stone-free rates, concurrent/additional procedures and complications were recorded.

Technique. Endopyelotomy was performed in antegrade fashion via UP access using an 11.5F Storz ureteroresecto-

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FIG. 1. Plain abdominal x-ray of stone burden in left kidney amenable to tubeless upper pole approach.

scope inserted through a 16Fr mini Amplatz sheath. In addition to placing a 7/14Fr endopyelotomy stent, an LP NT was inserted through a nondilated puncture at the end of the procedure. A flexible nephroscope was positioned in the lower pole target calix, assisting with accurate imaging of the desired calix as well as visualizing the exact location of needle entry into the renal collecting system. Puncture of the selected calix was performed with an 18 gauge diamond tip needle using a C-arm and a triangulation fluoroscopic technique. A guidewire was passed into the lower pole calix, grasped with the flexible nephroscope and delivered through the UP access. An 8Fr fascial dilator was passed over the guidewire, followed by a 10Fr Cope loop NT. UP access was closed with a 3-zero chromic subcuticular suture.

When stone removal as well as endopyelotomy was planned, standard LP access (30Fr) was performed, allowing rigid and flexible PNL, followed by endopyelotomy as described. A 10Fr Cope loop tube was inserted through the LP access.

When PNL was performed through a single (30Fr) supracostal puncture, nondilated LP NT insertion was selected in patients judged to have minimal or no residual stones. Secondary PNL through a nondilated tract was

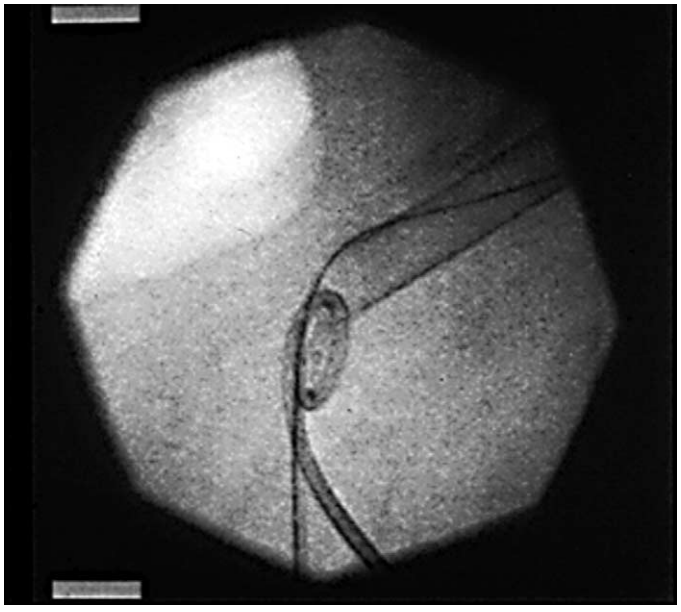

FIG. 3. Fluoroscopic view of upper pole sheath and nondilated lower pole access with Cope loop in place.

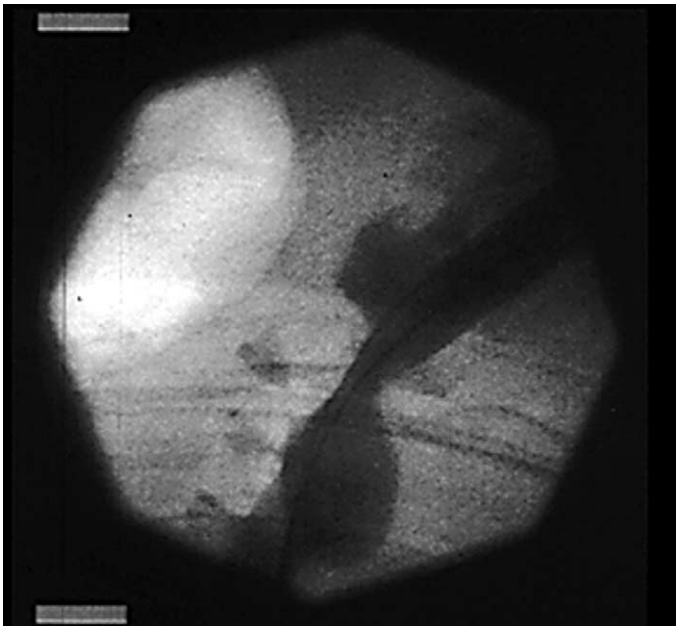

FIG. 2. Fluoroscopic view of balloon dilator and wire in upper pole access.

FIG. 4. Nephrostogram on postoperative day 1 demonstrates sealing of upper pole access.

TABLE 1. *Operative data*

	No. Pts
Supracostal access (rib):	
Above 12th	40
Above 11th	17
Above 10th	1
Concurrent procedures:	
Endopyelotomy	21
Contralateral single access PNL	15
Contralateral URS	2
Contralateral SWL	1
Upper pole access dilation (Fr):	
To 30	53
To 16	10
Nephrostomy tube (Fr):	
Cope loop (8.5 or 10)	60
Malecot (20)	3

performed, if necessary, after 2 guidewires were placed into the LP calix using a dual lumen 10Fr catheter. A flexible ureteroscope was passed over the working guidewire, allowing stone fragmentation and/or removal. The LP tract was dilated to 30Fr if standard PNL techniques were needed.

RESULTS

A total of 62 consecutive patients, including 39 females and 23 males, were successfully treated with our tubeless UP technique. Mean patient age was 45.6 years (range 8 to 81). Of the 62 patients 61 underwent unilateral access and the remaining patient underwent bilateral UP accesses. Of the 63 UP punctures 53 were dilated to 30Fr and 10 were dilated to 16Fr for endopyelotomy (table 1). Supracostal punctures were made in 58 patients, including above the 12th rib in 40, above the 11th rib in 17 and above the 10th rib in 1. A total of 39 concurrent procedures were performed, including 21 ipsilateral antegrade endopyelotomies, 15 contralateral single access PNLs, 2 contralateral URS and 1 contralateral SWL. At the conclusion of the procedure 60 accesses were left with an LP Cope loop and 2 patients had LP 20Fr Malecots placed, including unilaterally in 1 and bilaterally in 2.

Of the 62 patients 53 underwent PNL for urolithiasis. On NCCT on POD 1 the stone-free rate was 56.6% (30 of 53 cases) for a single procedure. After a secondary procedure the stone-free rate increased to 96.2% (51 of 53 cases). Only 9 of the 37 patients with nondilated LP access required secondary procedures. Three of these 9 patients required dilation of the LP tract and intracorporeal ultrasonic lithotripsy was used to clear the stone burden. Two patients with complex renal anatomy containing staghorn infection calculi required a tertiary procedure to achieve clearance of all stone material.

Pulmonary complications requiring aspiration postoperatively occurred in 3 patients (4.8%) (table 2). One of the 40 patients (2.5%) with supracostal access between the 11th and 12th ribs had pleural morbidity, while 2 of 18 (11.1%) with UP access above the 11th rib had pleural complications. Three of the 62 patients (4.8%) required transfusion, of whom 2 underwent simultaneous bilateral PNL with a total of 5 accesses placed for the removal of complex staghorn calculi. A single patient required ureteral stent placement to resolve a nonsealing upper pole access.

Only the most recent 31 consecutive POD 1 NCCTs were available on our picture archiving communication system terminal to evaluate the renal fossa after PNL. Only 2 of the 31 NCCTs evaluated (6.5%) showed small perinephric hematomas.

DISCUSSION

The role of PNL for renal calculi is being continuously redefined. While SWL remains the primary approach for most kidney stones less than 20 mm,[9] PNL is usually the optimal treatment for stones more than 20 mm.[10] For stones between 10 and 20 mm factors such as stone composition, location or renal anatomy shift the balance in favor of more invasive treatment modalities such as PNL or URS.[11,12] Although the indications for PNL are expanding, the greater postoperative pain medication requirement and longer hospital stay as well as the risk of bleeding and blood transfusion associated with PNL often relegate PNL to second line therapy. Therefore, technique modifications that may decrease morbidity are needed. Postoperative pain following PNL is in part due to the NT placed. The NT serves several purposes, including to tamponade bleeding from the nephrostomy tract, allow the renal puncture to heal, allow urine drainage and allow continued access to the collecting system if secondary PNL is required.[13] There is no agreement as to the preferred diameter of a post-PNL NT or whether a NT is required at all if other means of postoperative drainage are present. Although most urologists place a large diameter NT when a large diameter access is used,[14] Maheshwari et al recently reported that a small diameter tube (9Fr pigtail catheter) was associated with the same duration of hematuria after PNL as a large diameter tube (28Fr), although less analgesia and a shorter duration of urinary leakage following tube removal were noted in patients with small diameter tubes.[15]

The impact of large diameter NTs on postoperative pain may be particularly significant when supracostal access is used. Forsyth and Fuchs reported that patients who underwent PNL via a supracostal approach required an average of 8 mg more morphine postoperatively than those who had an infracostal NT.[6] Likewise, Golijanin et al reported that a supracostal puncture is a source of post-procedural pain that may lead to secondary atelectasis.[1] More recently Pietrow et al randomized 30 patients to a 10Fr pigtail or a 22Fr Councill tip catheter and reported significantly less pain 6 hours postoperatively for the smaller diameter tube.[8] As a strategy to decrease postoperative discomfort following a supracostal puncture, we use a modified supracostal access technique by placing a small diameter NT inserted via LP access with primary closure of the supracostal puncture. In patients with a single supracostal access a nondilated LP puncture was used to insert the NT.

A nondilated puncture may be used during PNL in several circumstances. For example, when an eccentrically lo-

TABLE 2. *Complications*

	No. Pts (%)
Transfusion	3 (4.8)
Pleural aspiration	3 (4.8)
Ureteral stent for nonsealing upper pole access	1 (1.6)

cated calix is difficult to locate through an established access tract, an adjuvant needle puncture into the desired calix without tract dilation, allowing the introduction of methylene blue, can be helpful. Alternatively if the stone containing calix still cannot be identified, a glidewire may be passed through the needle into the renal pelvis, where it can identify the infundibulum of interest, or it may be grasped and used to backload a flexible endoscope.[16] In the current series a nondilated puncture was used to insert an NT in an LP calix after initial access was achieved through an UP calix. Patients undergoing PNL via a supracostal puncture were selected for nondilated LP NT placement only if they were judged to have minimal or no residual fragments at the conclusion of the procedure. Although 21 of the 53 patients (39.6%) undergoing PNL for urinary calculi required secondary nephroscopy, this reflects the larger stone burden in patients needing multiple access during PNL, the use of NCCT to evaluate residual stones and our low threshold of performing secondary procedures to clear all residual fragments. NCCT is sensitive for detecting any residual fragments.[17] For example, the use of NCCT may explain the decreased stone-free rates in the Lower Pole II study compared to the Lower Pole I study, in which plain abdominal x-rays and tomograms were used.[11,12] When required, secondary procedures were easily performed through the LP tract with a flexible ureteroscope via nondilated tracts and a flexible nephroscope if a dilated tract had been previously created through the LP access. In only 3 cases did we need to dilate a previously nondilated LP access to use rigid percutaneous instruments.

A diverse group of patients was treated successfully using the modified supracostal puncture technique. Overall morbidity, including pleural complications, was low and compared favorably with the results of supracostal puncture access in the literature. Only 3 patients (4.8%) required intervention for pleural complications, which compares favorably with a 4% to 12% reported risk of pneumothorax or pleural effusion requiring drainage.[1,3–5] The blood transfusion rate in the current series was 4.8% compared with the rate of between 1% and 10% reported in PNL cases overall.[2,10,18–20] In addition, a review of 31 consecutive POD 1 NCCTs showed a low perinephric hematoma rate of 6.5%. The low morbidity in the current series suggests that eliminating the NT following supracostal puncture and substituting a small diameter LP NT placed through an existing access or through a nondilated puncture can maximize the advantages of a supracostal puncture, while minimizing patient discomfort secondary to an intercostal NT.

CONCLUSIONS

Tubeless UP PNL can be performed safely with concomitant placement of an LP drainage catheter. Patients deemed to be stone-free at the conclusion of PNL via a supracostal puncture can be selected for this approach. Avoiding a supracostal tube minimizes patient morbidity without compromising drainage or secondary access, if needed.

Abbreviations and Acronyms

LP	=	lower pole
NCCT	=	noncontrast computerized tomography
NT	=	nephrostomy tube
PNL	=	percutaneous nephrolithotomy
POD	=	postoperative day
SWL	=	shock wave lithotripsy
UP	=	upper pole
URS	=	ureteroscopy

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EDITORIAL COMMENT

These authors describe a modified PNL technique that uses lower pole nephrostomy drainage with an 8Fr to 10Fr catheter after an upper pole accessed procedure. This modification appears to apply the advantages of upper pole access to facilitate visualization of the pelvis and lower pole, while lower pole drainage may decrease the risk of increased pain and intrathoracic complications associated with supracostal access. Placement of a lower pole drain still allowed a second look procedure when necessary. Unfortunately the retrospective nature of this study did not allow the assessment of pain scores or narcotic requirements, measures that would be required to help prove better tolerance of lower pole drainage. Ultimately it would be interesting to compare this new technique to the so-called tubeless technique, which uses an internal ureteral stent and no external catheter after PNL.

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