

Percutaneous nephrolithotomy for the treatment of lower pole renal calculi

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The management of lower pole renal stones continues to evoke debate, and the ideal treatment remains controversial although several comparative studies have been conducted to evaluate various approaches. In an Internet and postal survey of 205 urologists, 88% preferred shock wave lithotripsy (SWL) for lower pole stones smaller than 10 mm in diameter, 65% for stones between 10 and 20 mm and 21% for stones greater than 20 mm.¹ Current practice, however, may not reflect the efficacy of any particular modality. Lower pole calyceal stones continue to pose a dilemma owing to the dependent anatomical location and difficulty in clearance of stone fragments. Sampaio and Aragao² first described the anatomical factors that would impede gravity-dependent drainage of stones from the lower pole calices. By performing endocasts of the collecting system of cadaveric kidneys, this group postulated that the infundibulopelvic angle, infundibular length and spatial distribution of the lower pole calices all represented potential contributing features in the equation related to stone clearance. Sampaio and colleagues³ conducted a prospective trial to determine stone-free rates after SWL, aligned to these anatomical features. They found that 72% of patients were rendered stone-free when the lower pole infundibulopelvic angle was greater than 90 degrees, and only 23% of patients achieved a stone-free state when the angle was less than 90 degrees. Although SWL is less invasive, its limitations for lower pole calculi are outlined in an earlier study by McDougall and associates⁴ that retrospectively compared SWL to percutaneous nephrolithotomy (PCNL)

for patients with lower pole stones. Overall, there was a significantly lower stone-free rate in patients treated with SWL (56%) compared with the stone-free rate of those undergoing PCNL (85%).

Lingeman and coworkers⁵ conducted an analysis comparing the 2 modalities including outcomes of more than 3000 patients treated with SWL and 100 with PCNL. Stone-free rates for PCNL were significantly higher (90%) compared with SWL (59%). The authors recommended SWL as a first-line treatment for lower pole calculi measuring 10 mm or less in diameter and PCNL for larger stones. These retrospective studies formed the basis for a multicentre lower pole study group,⁶ which conducted the first prospective randomized trial with the aim of determining the optimal treatment of lower pole calculi. The group compared stone-free rates in 52 patients undergoing SWL and 55 randomized to PCNL. Overall stone-free rates for PCNL were far superior to that of SWL (95% v. 37%), retreatments were more common in the SWL group (16% v. 9%) and auxiliary procedures were more frequent with SWL patients (16% v. 2%). Stratification by stone size was also consistent with prior studies⁷⁻⁹ demonstrating SWL stone-free rates of 68% for stones smaller than 10 mm in diameter, 55% for stones 10–20 mm and 29% for stones larger than 20 mm. The corresponding stone-free rates for PCNL were 100%, 93% and 86%, demonstrating that, for PCNL, stone-free rates are largely independent of stone size. PCNL is a more invasive procedure than SWL; however, overall complication rates in the Lower Pole Study were not significantly

different.¹⁰ Techniques of percutaneous stone removal have improved in recent years, such that transfusion rates, reported at 25% in early studies, have decreased significantly and in more recent studies have been in the 1%–2% range.^{5,6} The introduction of balloon dilation of the tract, use of flexible nephroscopes, improved intracorporeal lithotripters and the trend to smaller or no nephrotomy tubes have decreased the overall morbidity rates for PCNL. The Lower Pole Study Group concluded that SWL constitutes reasonable first-line treatment for lower pole stones smaller than 10 mm in maximal diameter and recommended PCNL for stones greater than 10 mm.⁶ In a more recent study, Preminger¹¹ also demonstrated the superior efficacy of PCNL over SWL in a multicentre randomized prospective trial of 112 patients with lower pole stones. Overall, only 35% of patients with lower pole calculi treated with SWL were rendered stone-free compared with a 96% success rate in the PCNL group.

In addition to discrepant stone-free rates, a further concern with SWL is the higher rate of new stone formation caused by the increased frequency of retained stone debris in the lower pole calyx. Carr and colleagues¹² looked at the incidence of new stone formation in 298 patients diagnosed as stone-free post-SWL and compared the findings with those for the group of 62 patients who had undergone PCNL and were rendered stone-free. At 1-year follow-up the patients in the SWL group had a significantly greater rate of new stone formation than patients who had undergone PCNL (22% v. 4%, $p = 0.004$). Although the rate of new stone formation in PCNL patients increased to 22% at 2 years, the rate was still higher in SWL patients at this time (35%). The authors also found that more new stones recurred in the lower and mid-calices compared with baseline location in the SWL group, which was not observed in the corresponding cadre of patients undergoing PCNL. This observation may be attributed to the dependent nature of the lower pole calices harbouring residual fragments, which may subsequently demonstrate growth and further clinical stone problems. Chen and Stroom¹³ evaluated the issue of long-term outcome of post-SWL residual fragments in performing a prospective trial in patients with residual fragments measuring 4 mm or less in the lower pole calices. One-half of all patients experienced a symptomatic stone event or required interven-

tion for stones within 2 years after SWL treatment.

Concerns related to the potential higher morbidity with percutaneous stone removal concurrent with improvements in flexible ureteroscopes and the advent of the holmium:yttrium–aluminum–garnet laser have led to interest in retrograde flexible ureteroscopy for treatment of lower pole calyceal stones.¹⁴ Ureteroscopy (URS) offers advantages in certain patient populations such as those with bleeding diathesis, those taking anticoagulants, those with renal anomalies such as a calyceal diverticulum, morbidly obese patients and those with orthopedic or other abnormalities with body habitus that may make SWL or PCNL challenging to perform.^{15–19} Other possible indications include prior SWL failure in stones with computed tomography (CT) attenuation value above 1000 Hounsfield units, which portends for lower fragmentation rates with SWL. The increased role of URS in treatment of intrarenal calculi paved the way for the second phase of the Lower Pole Study, which incorporated ureteroscopic management into a randomized trial with SWL and PCNL for lower pole calculi. Patients were divided into 2 groups. Group 1 included patients with stones 10 mm or smaller in diameter who were randomized to SWL or URS.²⁰ Group 2 included patients with lower pole stones between 10 and 25 mm who were randomized to URS or PCNL. Stone-free rates were based on noncontrast CT scan at the 3-month mark posttreatment. PCNL demonstrated a significantly superior outcome over URS with respect to stone-free rates (71% v. 37%) for 10 to 25-mm lower pole stones.²¹ The theoretical advantage of URS for group 1 patients compared with SWL is not supported as there was no statistically significant difference observed in stone-free rates between the 2 populations.²⁰ Interest in URS as a therapy for lower pole calyceal stones remains, however, as adjuvant measures such as use of ureteral access sheaths, displacement of lower pole stones with nitinol retrieval devices and ongoing improvements in flexible ureteroscope design all combine to increase the attractiveness of this modality.^{22,23}

Lower pole calyceal stones will continue to challenge those interested in urology. Advances in techniques and the associated technology for performing percutaneous stone removal make this an ideal modality for lower pole stones larger than 10 mm. The minimally invasive nature of SWL

positions this form of therapy as a preferred treatment for stones smaller than 10 mm. Interest in a retrograde ureteroscopic approach is likely to increase as the associated technology continues to evolve and improve.

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