Extracorporeal shock wave lithotripsy for lower calyceal stones: can clearance be predicted?

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Objective To determine the influence of pelvicalyceal angle, size of the lower calyx infundibulum and lower-pole calyceal anatomy in predicting the clearance of fragments after extracorporeal shock wave lithotripsy (ESWL) for lower calyceal stones.

Patients and methods The study comprised a retrospective analysis of 133 patients, divided into 92 who were considered to be completely clear of fragments 6 months after ESWL and 41 who had residual stones. The pelvicalyceal angle, diameter of the lower calyx infundibulum and lower-pole calyceal pattern were determined from intravenous urograms.

Results There were residual stones in 64% of the patients with a pelvicalyceal angle < 90°, in 12% of those with an angle > 90°. In 70% of patients with an infundibular diameter < 4 mm, in 16% of those with a diameter > 4 mm, in 78% with a complex calyceal pattern and 12% with a simple calyceal pattern.

Conclusions These three anatomical factors play a key role in predicting the clearance of stone and they should be assessed during intravenous urography to facilitate the planning of treatment for lower calyceal stones.

Keywords Extracorporeal shock wave lithotripsy, lower calyx, residual stone, renal calculus

Introduction

ESWL has rapidly become the method of choice for treating kidney stones [1,2]. The success of this therapy arises from the effective fragmentation and clearance of stones, although the rate of clearance differs for stones at different sites in the kidney [3], being the lowest for stones in the lower calyx [4–8]. Sampaio et al. [9] showed that the lower-pole anatomy varies most and that anatomical factors, e.g. the pelvicalyceal (PC) angle, size of the lower calyx infundibulum and calyceal pattern, may be important in the clearing of fragments after ESWL. We retrospectively analysed a group of patients treated with ESWL for lower calyceal stones to determine the influence of these factors in predicting the clearance of fragments.

Patients and methods

The study comprised a retrospective analysis of 133 patients, divided into those who were considered to be completely clear of fragments 6 months after ESWL and those who had residual stones. Any evidence of persistent stone fragments, irrespective of size, in the region of the lower calyx, either on plain X-ray or on ultrasonography 6 months after the completion of treatment was defined as residual stone.

Lithotripsy was carried out using a Technomed Sonolith 3000 machine in all patients: 92 patients in whom lower calyceal stones were completely cleared after 6 months comprised group A and 41 with lower calyceal stones fully treated but who had residual stones after 6 months comprised group B. The intravenous urograms of all patients were reviewed to determine the original size of the stone(s), kidney function, the angle between the pelvis and lower calyx (PC angle), the diameter of the lower calyx infundibulum and the anatomy of the lower-pole calyx.

The angle formed by joining two lines drawn in the direction of the infundibulum of the lower calyx and pelvis was taken as the PC angle (Fig. 1). The anatomy was considered simple if minor calyces opened into a single major calyx, which then joined the pelvis (Fig. 1) and complex when multiple calyces either fused with each other and joined the major calyx, or opened directly into the pelvis, outpouching from the minor calyx, or if there were any additional small calyces opening directly into the pelvis (Fig. 2). Figure 3 shows an acute PC angle and a narrow infundibulum.

Results

All the patients had good kidney function. The stones were 0.8–3.2 cm (overall mean 1.54) in diameter, the larger stones requiring more shocks and sessions (Table 1). The PC angle was 55–135°, with 36% of the
patients having a PC angle of $\leq 90^\circ$, the lower calyx infundibular diameter was 2–16 mm, with 27% of the patients having a diameter of $\leq 4$ mm; 72% had a simple and 28% a complex lower-pole calyceal pattern. The values for the two groups are shown in Table 2, with the number of patients with residual stones for each factor. Patients with a PC angle of $> 90^\circ$, an infundibular diameter of $> 4$ mm and a simple calyceal pattern were completely clear of residual stones, whereas those with a PC angle of $< 90^\circ$, an infundibular diameter of $< 4$ mm and a complex calyceal pattern all had residual stones.

Discussion

Although ESWL is the preferred method of treatment, if stones are hard or the stone burden high, then ESWL may not be completely effective. More shocks or sessions may clear the stone, but larger stones increase the chance of inadequate treatment and residual stone fragments that may not be cleared. In the present study, the initial size of the stone was not considered. The patients
results have been reported often [4–8], supporting the consensus that residual fragments are more likely with lower calyceal stones, and representing a major hindrance to the success rate of ESWL and an important factor affecting the long-term results. Several ideas have been proposed to explain these poor results. Gravity plays a major role in clearing the fragments; the position of the lower calyx is obviously unfavourable and to overcome this, various manoeuvres have been tried. Brownlee et al. [6] suggested multiple sessions of controlled inversion of the patient, with forced diuresis. Nicely et al. [10] cystoscopically placed a cobra catheter into the lower calyx and provided saline irrigation while delivering shockwaves. Tolen et al. [11] applied vibration massage with the patient inverted. It has also been suggested that percutaneous nephrostomy (PCN) with a small-bore catheter in the lower calyceal group can be used to wash the fragments into the renal pelvis [4] (Fig. 4). Although all these modalities reportedly improve the results, it remains unknown why in some patients the fragments clear quickly whereas in others they do not, despite good fragmentation.

The present study was based on the extensive anatomical study by Sampaio et al. [9]. Of their sample, 74% had a PC angle of > 90°, 60% had an infundibular diameter of > 4 mm and 53% a simple calyceal pattern, results similar to those in the present study. Thus, these factors together contribute to the large individual variability in lower-pole calyceal anatomy and it is likely that this variation might be responsible for the varied response to ESWL in different patients.

If the PC angle is > 90°, then with the patient in the opposite lateral position the lower calyx can drain by gravity and hence increase the chance of clearing any stone fragments. If the angle is acute, then even in the opposite lateral position, drainage is not aided by gravity; thus an acute PC angle may be an anatomically unfavourable factor. This is supported by the present results, where 64% of patients with an acute PC angle had residual stones. Similarly, if the infundibulum is narrow, there is more caliectasis and this might hamper the clearance of fragments; the residual stone rate in the present patients with an infundibular diameter of < 4 mm was 70%, significantly higher than in those with a diameter > 4 mm. Fragments can drain easily from a simple calyx but if the calyceal pattern is complex, then calyces are more dense, the intervening angles more difficult to negotiate and some narrower, all contributing to a poorer clearance of fragments. Of those patients in the present study with a complex calyceal pattern, 78% had residual stones.

Hence, these anatomical factors have a major role in predicting clearance; combining the factors should increase the predictability of residual stones. A patient
with a PC angle of $>90^\circ$, an infundibular diameter of $>4$ mm and a simple calyx is very likely to have complete clearance of fragments and is an ideal case for ESWL. A patient with a combination of favourable and unfavourable factors should be warned of the possibility of residual stones and the need for additional procedures, e.g. PCN irrigation, postural drainage or inversion, or even percutaneous nephrolithotomy (PCNL). In a patient where all factors are unfavourable then residual stones are almost guaranteed and alternative treatments like PCNL may be advisable. In conclusion, if these anatomical factors are assessed on IVU, the clearance of stone fragments can be predicted and therapy for lower calyceal stones planned accordingly.

Acknowledgement

We thank Mr Shashikant Chinchole for carrying out the statistical analysis and Mr Mathai TI for secretarial assistance.

References


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