Retrograde intrarenal surgery for renal stones smaller than 2 cm

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ABSTRACT

Introduction: Extracorporeal shock wave lithotripsy (ESWL) is accepted as the gold standard treatment for renal stones that are smaller than 2 cm. Recently, retrograde intrarenal surgery (RIRS) has been introduced as another form of treatment. We report our experience in dealing with renal stones smaller than 2 cm using RIRS as the primary treatment and following failed ESWL.

Methods: A retrospective analysis was conducted over a five-year period on patients with stone(s) measuring less than 2 cm each and who had undergone RIRS. The patients were divided into two groups: RIRS as the primary procedure and RIRS post-ESWL.

Results: A total of 46 patients underwent RIRS in our institute. The total stone clearance rate was 61 percent. The clearance rate was better for RIRS as the primary procedure when compared to RIRS as an adjunct procedure (70 percent versus 52 percent; p-value is 0.23). Patients with mid-pole stones achieved an 80 percent stone clearance rate as compared to 60 percent for those with lower pole stones. The clearance rate for upper pole stones was only 29 percent. When RIRS was the primary procedure for lower pole stones, the success rate was 75 percent, compared to 56 percent when it was used as an adjunct procedure post-ESWL.

Conclusion: For renal stones measuring less than 2 cm, the stone clearance rate for RIRS was as good as that for EWSL as a primary procedure and achieved a good clearance rate following the failure of ESWL.

Keywords: extracorporeal shock wave lithotripsy, kidney calculi, lithotripsy, retrograde intrarenal surgery, therapy

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INTRODUCTION

Extracorporeal shock wave lithotripsy (ESWL) has been an established form of treatment for upper urinary tract stones since the early 1980s. It is non-invasive and can be performed as an outpatient procedure under local anaesthesia or sedation. ESWL has therefore been accepted as a standard treatment for renal stones measuring less than 2 cm. On the other hand, percutaneous nephrolithotomy (PCNL), which is a more invasive procedure that requires general anaesthesia, has been used for the treatment of larger renal stones and to treat stones following failed ESWLs.

The introduction of the flexible ureteroscope has opened up a new dimension in the treatment of upper tract calculi, especially renal stones. Advances in technology and improvements to the technique have made the flexible ureteroscope popular in the treatment of stones. Retrograde intrarenal surgery (RIRS) via the use of a flexible ureteroscope has helped many in the treatment of stones. Although RIRS requires general anaesthesia, it is associated with a lower complication rate than PCNL. Since its introduction in 1990,[1] RIRS has been used as the primary treatment for renal stones that are smaller than 2 cm, and as an adjunct procedure following failed ESWL. We report our experience in dealing with renal stones smaller than 2 cm using RIRS as the primary treatment and following failed ESWL.

METHODS

This five-year retrospective study included all patients who had undergone RIRS for stone removal between July 2003 and July 2008. A total of 46 patients had been randomly selected to be treated with RIRS, either as the primary procedure or as an adjunct treatment after a failed ESWL. The case notes and operative records of the patients were reviewed. All the patients had stone(s) < 2 cm in diameter in various locations, e.g. the upper, middle or lower poles. The patients were divided into two groups. The first group included patients who underwent RIRS as the primary procedure for renal stone(s). The second group included patients who had undergone ESWL(s) but had failed to achieve stone clearance and were therefore subjected to RIRS as an

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Table I. Overall outcome of retrograde intrarenal surgery.

	No. of patients		
	Stones cleared	Stones not cleared	Total
RIRS as first modality	16	7	23
RIRS post-ESWL	12	11	23
Total	28	18	46

ESWL: extracorporeal shock wave lithotripsy; RIRS: retrograde intrarenal surgery

adjunct procedure. We analysed the stone clearance rates for the patients in these two groups. Stone clearance was defined as complete stone removal with no residuals seen on ultrasonography and radiography. We also investigated the clearance rate in accordance with the anatomical location of the stones. The number of ESWLs carried out prior to RIRS was noted and its impact on the stone clearance rate was investigated. Complications of RIRS were also noted.

All patients underwent intravenous urography (IVU) and computed tomography urography (CTU) prior to the RIRS procedure. Preoperative antibiotics were administered upon the induction of general anaesthesia. RIRS was performed using flexible ureterorenoscopy size 3.7F with a 270º deflection (Karl Storz, Endoscopes, Culver City, CA, USA). Holmium 20W Versa Pulse Power Suite laser lithotripter (Lumenis Ltd, Santa Clara, CA, USA) was used for the fragmentation of stones. An access sheath was used in all cases. Double JJ stents (Microinvasive, 6F, 24 cm, Boston Scientific, Watertown, MA, USA) were inserted upon the completion of RIRS, and were removed within six weeks postoperatively. Postoperative stone evaluations were conducted using plain radiographs and ultrasonography one week after each treatment. No patient was lost to follow-up at six months.

RESULTS

There were 23 patients in each group. Our study showed a total stone clearance rate of 61% (28 patients) after a single RIRS, regardless of which group the patients were assigned to. 70% of the patients who had undergone RIRS as the primary procedure were successfully treated with complete stone clearance. In comparison, only 52% (n = 12) of those who underwent RIRS following a failed ESWL achieved complete clearance (Table I).

It was observed that 65% (n = 30) of the stones were located in the lower pole, and out of this, 60% of the patients were stone-free following RIRS. Mid-pole stones showed better results with 80% clearance, although only 11% (n = 5) out of all the stones were found in this area. 15% (n = 7) of the stones were located in the upper pole, and only 29% of patients in this category were successfully treated and remained stone-free. In contrast, a 100% stone clearance rate was achieved in the group of patients who had stones in multiple locations (n = 4). On the lower pole, where the clearance of stones was technically more difficult using the ESWL procedure, RIRS, when used as the primary procedure, yielded a clearance rate of 75% (n = 12). This figure was higher than the 56% (n = 10) clearance rate achieved for patients who underwent RIRS after a failed ESWL (Table II).

50% (n = 23) of the study population had undergone ESWL prior to RIRS. The number of ESWLs varied from one to eight, with a mean of 2.8. A clearance rate of 75% was observed among patients who had one ESWL prior to RIRS. For those with two and three ESWLs, the stone-free rates were 50% and 57%, respectively. The clearance rate was 40% when the patients had undergone four ESWLs prior to RIRS, and only the patient who had undergone eight ESWLs did not achieve a complete stone clearance following RIRS. Five patients were subjected to a repeat RIRS procedure following the first failed RIRS. Among these patients, the clearance rate was found to be 80% (n = 4), with one patient still having a stone remaining after the second RIRS. This patient underwent PCNL to achieve stone clearance.

There were minimal complications with RIRS. Six (13%) patients had urinary tract infections (symptomatic with positive urine culture results) which were successfully treated with antibiotics. There was no stricture (which would be suggested by hydronephrosis or hydroureter and confirmed by IVU/CTU), kidney failure (suggested by a worsening renal profile) or death.

DISCUSSION

RIRS has become an increasingly popular treatment for renal calculi. The role of RIRS as the primary procedure in treating renal calculi measuring less than 2 cm is becoming more prominent with continuous technical improvements to the size of the scope, the degree of deflection and the quality of the fibre optics. It is a particularly useful procedure when lower pole and complex stones are involved. Failed ESWL and the inability to undergo ESWL (i.e. due to pregnancy, coagulopathy or morbid obesity) are recognised as the indications for ureteroscopy.[2] RIRS is known to be safer than PCNL, which carries a higher risk of infection and bleeding.

Table II. Comparison between RIRS as the first modality versus RIRS post-ESWL.

Demographic	No. (%)	
	RIRS as first modality	RIRS post-ESWL
Median age (yrs)	43.4	45.2
Race		
Malay	10 (43.5)	11 (47.8)
Chinese	10 (43.5)	9 (39.1)
Indians	2 (8.7)	3 (13.0)
Others	1 (4.3)	0 (0)
Gender		
Male	14 (60.9)	12 (52.2)
Female	9 (39.1)	11 (47.8)
Clearance rates in relation to stone location (%)		
Upper pole	70	15
Mid pole	84	85
Lower pole	75	56
Multiple locations	100	100
Clearance rates in relation to the no. of ESWL(s) (%)		
1 session	-	75
2 sessions	-	50
3 sessions	-	57
4 sessions	-	40
8 sessions	-	0

ESWL: extracorporeal shock wave lithotripsy; RIRS: retrograde intrarenal surgery

Discomfort following the use of ureteric stents to prevent blockage from stone fragments and ureteric oedema are the most common complaints identified.[3] ESWL has been upgraded over the years with advancements in its technology. It is well documented that shockwave lithotripsy can successfully treat simple renal calculi measuring less than 2 cm, with a success rate of 80%–85%.[4] A retrospective study comparing RIRS as the primary procedure with RIRS as a second-line therapy after ESWL failure was reported in 2006.[5] 60% of the stones in this study were found in the lower pole. The overall success rate was 73%, and this success rate was higher with the primary procedure (80%) as compared to the adjunct procedure (67%). RIRS as a second-line therapy after failed ESWL yields a lower success rate, as was observed in our study. This could be attributed to the same reasons that caused the failure of ESWL in the first place. The commonest reason for a failed ESWL is a stone larger than 2 cm in size.[6] Other factors include an abnormal renal anatomy, a failure to focus and suboptimal delivery of ESWL power due to poor tolerance by the patient.

In a smaller study (n = 38) carried out by Jung et al, a success rate of 68% was achieved when RIRS was used as a second-line therapy. The number of ESWLs undergone prior to RIRS varied between one and six (mean 2.3). No patient required more than two RIRS procedures to clear the stone in this study.[6] This is again similar to the results of our study, where the rate of stone clearance was lower (80%) during the repeated, second RIRS procedure. Stav et al reported a higher success rate of stone clearance (74%) when RIRS was performed as an adjunct procedure following failed EWSL.[7] However, the definition of success rate included residual stones smaller than 3 mm, whereas only complete stone clearence was considered as a success in our study.

The majority of stones in our patient series were located in the lower pole. This finding is similar to that of previous studies on RIRS. It is believed that lower pole stones are more difficult to tackle compared to stones located in other regions of the kidney because of technical difficulties in accessing them. It is also a well-established fact that stones located in places other than the lower pole can be fragmented easily with ESWL. Jung et al's study yielded a success rate of 81% for stones located in the lower pole following an unsuccessful ESWL.[6] In contrast, Zilberman et al reported only a 19% stone-free clearance rate following the first attempt at RIRS, with 30% of patients still having small residual stones that did not require further intervention. Among their patients who had residual stones, most were located in the lower pole.[8] Most of the failures involving lower pole stones were secondary to technical difficulties encountered with ureteroscope angulation.[7]

The size of the renal stones should determine the treatment modality for kidney stones. For stones larger than 2 cm, the clearance rate was only 45% in a study conducted by Grasso et al. However, if repeated RIRS was carried out, the overall clearance rate improved to 91%.[9] Although the previous study by Stav et al only included stones less than 2 cm in size,[7] Grasso et al's study challenged the perception that RIRS is only reserved for stones smaller than 2 cm.[9] For lower pole calculi smaller than 1 cm, Chaussy and Bergsdorf found that the stone-free rates were similar for ESWL and RIRS. They suggested that ESWL should be the preferred choice of treatment because it is non-invasive, anaesthesia-free and does not require hospital admission.[10] There are other studies that support this finding.[11,12] For lower pole stones measuring 1–2 cm, RIRS is a better option than PCNL given the lower complication rates of RIRS.[13] Our experience with RIRS supports similar conclusions.

In our study, we found that the success rate was significantly higher (75%) if there was only one attempt at ESWL before RIRS, as compared to multiple ESWLs

prior to RIRS (50%). To our knowledge, there are no studies in the literature that have investigated the correlation between the number of ESWLs preceding RIRS and the final outcome of RIRS itself. The decreasing efficacy in achieving stone clearance in patients with repeated ESWL procedures prior to RIRS is due to the difficulty in fragmenting the stones located at unfavourable locations such as the lower pole of the kidney.

Anatomical abnormalities that contribute to the failure of RIRS in treating renal stones include the infundibular width, infundibular length, infundibulo-pelvic angle and collecting system volume. Favourable features of infundibulum that lead to a higher success rate for renal stone clearance with RIRS include an infundibulo-pelvic angle of more than 90º, a length of less than 3 cm and a width greater than 5 mm. These three features can all be identified from the intravenous urography film.[6] In our study, factors that contributed to the failure of RIRS were technical issues (such as limited scope deflection and a malfunctioning laser) as well as anatomical variations (such as the presence of diverticulum). Complications reported included sepsis, steinstrasse, stricture, ureteric injury, urinary tract infection, kidney failure and death. The overall complication rate was 5%–9%, with a 1% rate of significant complications.[14] For renal stones measuring less than 2 cm, the stone clearance rate for RIRS was as good as that for EWSL as a primary procedure, and a good clearance rate was also achieved following the failure of ESWL. The location of the stones and the presence of anatomical variants may play a significant role in the final outcome of RIRS.

REFERENCES

1. Fuchs AM, Fuchs GJ. Retrograde intra-renal surgery for calculus disease: new minimally invasive treatment approach. J Endourol 1990; 4:337-45.
2. Grasso M, Loisides P, Beaghler M, Bagley D. The case for primary endoscopic management of upper tract calculi: I. A critical review of 121 extracorporeal shock-wave lithotripsy failures. Urology 1995; 45:363-71.
3. Miller NL, Lingeman JE. Management of kidney stones. BMJ 2007; 334:468-72.
4. Lingemen JE, Coury TA, Newman DM, et al. Comparison of results and morbidity of percutaneous nephrostolithotomy and extracorporeal shock wave lithotripsy. J Urol 1987; 138:485-90.
5. Holland R, Margel D, Livne PM, Lask DM, Lifshitz DA. Retrograde intrarenal surgery as second-line therapy yields a lower success rate. J Endourol 2006; 20:556-9.
6. Jung H, Norby B, Osther PJ. Retrograde intrarenal stone surgery for extracorporeal shock-wave lithotripsy-resistant kidney stones. Scand J Urol Nephrol 2006; 40:380-4.
7. Stav K, Cooper A, Zisman A, et al. Retrograde intrarenal lithotripsy outcome after failure of shock wave lithotripsy. J Urol 2003; 170:2198-201.
8. Zilberman DE, Mor Y, Duvdevani M, Ramon J, Winkler HZ. Retrograde intra-renal surgery for stone extraction. Scand J Urol Nephrol 2007; 41:204-7.
9. Grasso M, Ficazzola M. Retrograde ureteropyeloscopy for lower pole caliceal calculi. J Urol 1999; 162:1904-8.
10. Chaussy C, Bergsdorf T. Extracorporeal shockwave lithotripsy for lower pole calculi smaller than one centimeter. Indian J Urol 2008; 24:517-20.
11. Pearle MS, Lingeman JE, Leveillee R, et al. Prospective, randomized trial comparing shock wave lithotripsy and ureteroscopy for lower pole caliceal calculi 1 cm or less. J Urol 2008; 179:S69-73.
12. Shah HN. Retrograde intrarenal surgery for lower pole renal calculi smaller than one centimeter. Indian J Urol 2008; 24:544-50.
13. Gross AJ, Bach T. Lower pole calculi larger than one centimeter: Retrograde intrarenal surgery. Indian J Urol 2008; 24:551-4.
14. Preminger GM, Tiselius HG, Assimos DG, et al. 2007 guideline for the management of ureteral calculi. J Urol 2007; 178:2418-34.