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Treating renal calculi 1–2 cm in diameter with minipercutaneous or retrograde intrarenal surgery: a prospective comparative study

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Study Type – Therapy (pattern of practice survey)
Level of Evidence 2b

What's known on the subject? and What does the study add?
Miniperc and RIRS are commonly used modality for treating non-bulky renal urolithiasis. Both the treatment options are invasive and are associated with inherent complications. There are only a few studies that compare these two treatment modalities.

Both the modalities are effective to render patient stone free with minimal complications. Immediate stone free rate is higher with miniperc but comparable in both the modalities at 1 month. RIRS is associated with favourable pain scores and lower hemoglobin drop.

OBJECTIVE

- To plan a prospective comparative case–control designed study aiming to compare minipercutaneous (miniperc) and retrograde intrarenal surgery (RIRS) for a renal calculus of size 1–2 cm.

PATIENTS AND METHODS

- A total of 64 cases (32 in each arm) underwent miniperc and RIRS during the study period from March 2009 to April 2011.
- The primary and secondary outcome objective was stone-free rate and retreatment rate, complications, operation duration, patient visual pain scores, analgesic requirement, haemoglobin drop and hospital stay, respectively.

RESULTS

- Miniperc and RIRS had stone clearance rates of 100% and 96.88%, respectively.
- In the RIRS group, one patient required retreatment at 1 month.
- Hospital stay (0.24) and intra-operative (0.99) and postoperative complications (0.60) were similar in both groups.
- Operation duration ($P = 0.003$) was lower in the miniperc group.
- Haemoglobin drop ($P < 0.001$), patient pain and visual analogue scale score (each $P < 0.001$) at 6, 24 and 48 h, as well as analgesic requirement ($P < 0.003$), were all lower in the RIRS group.

CONCLUSIONS

- The stone clearances in both modalities are high and complications are low.
- RIRS requires a larger operation duration, although it is associated with favourable pain scores and a lower haemoglobin drop.

KEYWORDS

miniperc, RIRS, prospective, renal stone 1–2 cm

INTRODUCTION

The management of urinary stones is evolving rapidly. The past few years have seen significant advances in endoscopic instrumentation and laser technology, facilitating quick and minimally invasive stone extraction. Simultaneously, because of patients' growing reluctance for repeated treatments and hospitalizations, together with the low stone-free rate of ESWL for stones of 1–2 cm [1,2], questions are being raised about the use of this conservative non-invasive approach. As a result, there is renewed interest in minimally invasive approaches, such as minipercutaneous (miniperc) and retrograde intrarenal surgery (RIRS). Currently, there is no prospective comparative study investigating RIRS and miniperc for stone sizes of 1–2 cm.

PATIENTS AND METHODS

We planned a prospective comparative case–control designed study aiming to compare miniperc and RIRS for a renal calculus of size 1–2 cm. The institutional ethics committee approved the present clinical study. Patients were informed regarding the investigational nature of the procedure in evolution and the limitations of miniperc. The inclusion criterion was a renal stone (single or multiple) of no greater than 1–2 cm in diameter. The exclusion criteria were patients undergoing any other surgical procedure during same admission, concomitant stones at other sites, pregnancy, children, renal malformation, uncorrected coagulopathy and withdrawal of consent. Patients withdrawing their consent were excluded

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Variable	Miniperc	RIRS	*P*
Renal units	32	32	
Sex (male : female)	19:13	25:7	0.18
Age (years), mean (SD)	44.48 (12.36)	49.28 (12.19)	0.07
Stone size (cm), mean (SD)	1.52 (0.33)	1.42 (0.34)	0.24
Laterality (left : right)	10:22	16:16	0.20
Site of stone (*n*)			
Pelvis	14	8	0.19
Upper calyx	1	3	0.63
Middle calyx	0	1	1.0
Lower calyx	10	9	1.0
Multiple	7	11	0.40
Comorbidity (*n*)			
Diabetes mellitus	4	6	0.73
Hypertension	7	11	0.40
Chronic kidney disease	0	2	0.49
Ischaemic heart disease	1	2	1.0

TABLE 1
Demographic data

Miniperc, minipercutaneous; RIRS, retrograde intrarenal surgery.

from the present study and were offered treatment accordingly. Patients willing to take part in the present study were offered treatment by berry picking of chit paper. As part of the prospective study and hospital policy, all patients required admission before the procedure. After removal of the last external body tube, patients were further observed for any postoperative complications and discharged subsequently. The sample size for each group was calculated as 30 (power > 0.85). A total of 64 procedures were performed in 64 patients with renal stones of size 1–2 cm between March 2009 and April 2011. All procedures were performed under general anaesthesia. A hospital antibiotic coverage policy that was similar for both groups was employed.

MINIPERC

A 5-F ureteric catheter was placed transurethrally. Under ultrasonographic control, a selective calyceal puncture, usually at the posterior lower pole calyx, was carried out with a 22-gauge Skinny Needle (Cook Medical, Bloomington, IN, USA). A flexible 0.035-inch Zebra guidewire (Boston Scientific Corporation, Miami, FL, USA) was then inserted into the renal collecting system, preferably in the ureter or else in the upper pole calyx. The access needle was removed and the skin and fascia were incised. Nephroscopy was performed using a Karl Storz Modular Miniature Nephroscope system with Automatic Pressure Control™ (Karl Storz, Tuttlingen, Germany). The sheath sizes used were reusable 15/18-F and 16.5/19.5-F. The renal stone was fragmented by a holmium : YAG laser using 200- or 365-μm fibre (Sphinx 30; LISA Laser, Pleasanton, CA, USA). Stone fragments were evacuated by the modular design and automatic pressure control of the Karl Storz Miniature Nephroscope system. Grasping forceps (5-F) were also used for fragment removal. Planning of a tubeless percutaneous nephrolithotomy (PCNL) (no nephrostomy, with 5-F ureteric catheter/6-F JJ stent) was performed at the discretion of the operating surgeon. A 5-F ureteric catheter was placed in most of the cases, whereas, in a few cases, a JJ stent was placed. A Foley catheter was removed on postoperative day 1/2. The patient was discharged on the next postoperative day.

RIRS

Patients were placed in dorsal lithotomy position. Cystoscopy was perfomed with a 19- or 22-F cytoscope, and the ureteric orifice was cannulated with an open-ended 6-F ureteric catheter and a 0.038-mm guidewire. The ureter was actively dilated with fascial/Teflon dilators. An ureteric balloon dilator was used if sequential dilatation was unsatisfactory. In the dilated ureter, a ureteric access sheath (14-F) (Cook Medical) was placed. A 7.5-F Flex X–2™ (Karl Storz) flexible ureteroscope was used along with a 200- or 365-μm laser fibre for treatment. The lower calyceal calculus was mobilized to the upper or middle calyx before fragmentation. Holmium laser power was set in the range 10–15 W. Basketing of the fragments was carried out if necessary with a 1.7- or 2.2-F zero-tipped nitinol stone basket (Cook Medical). After lithotripsy, a JJ stent was placed in most of the cases. In a few cases, a 5-F ureteric catheter was placed for 1 day. The Foley catheter was removed on postoperative day 1. The patient was discharged 24 h after performing the procedure.

For both procedures, plain abdominal film of kidney, ureter and bladder and ultrasonography were performed at 4 weeks. The stone-free rate was defined as no stone visible on plain abdominal film of kidney, ureter and bladder and ultrasonography. Fragments less than 4 mm were considered as clinically insignificant residual fragments. The primary outcome objective was the stone-free rate, whereas secondary outcome objectives were the retreatment rate, complications, operation duration, patient visual pain scores, analgesic requirement, haemoglobin drop and hospital stay. Data are reported as the number (%) or the mean (SD), as appropriate. Continuous data were analyzed using Student's *t*-test to compare the two means. Categorical data between groups were analyzed using the chi-squared test. $P < 0.05$ was considered statistically significant.

RESULTS

Baseline demographics (Table 1) were comparable in the two groups.

Table 2 shows a comparison between miniperc and RIRS. In the miniperc group, 29 patients had tubeless procedure. There were three patients who required 1 day of nephrostomy drainage for tract bleeding ($n = 2$) and pelvic perforation ($n = 1$). The placement of a 5-F ureteric catheter ($n = 27$) was the preferred modality for postoperative drainage. There were five patients who required JJ stenting as a result of an impacted calculus, pelvic perforation and a longer duration of lithotripsy. In the RIRS group, access to the pelvi calyceal system was successful in all 32 patients. In seven patients, as a result of a tight ureter, an access sheath could not be placed. Placement of JJ stenting ($n = 27$) was the preferred modality for postoperative drainage. Pain was significantly less in the RIRS group. In the miniperc group, one

patient had postoperative pyrexia requiring antipyretics for 2 days (Clavien grade 1), whereas three patients in the RIRS group had postoperative complications, including two patients with pyrexia requiring antipyretics for 2 days (Clavien grade 1) and one patient with stent-related dysuria and fever necessitating JJ stent removal (Clavien grade 3a). The haemoglobin drop in the miniperc group was significant ($P < 0.001$). In the miniperc and RIRS group, five and 32 patients, respectively, required JJ stent removal under local anaesthesia after 1 month. Miniperc and RIRS had stone-free rates of 100% and 96.88%, respectively. This could be above normal as a result of the lack of more accurate postoperative plain abdominal film of kidney, ureter and bladder utilization. There was one patient in the RIRS group who required retreatment for residual calculi at 1 month.

TABLE 2 Comparison of intra-operative and postoperative parameters in the miniperc and RIRS groups

Parameter	Miniperc	RIRS	*P*
Operating time (min), mean (SD)	40.81 (13.79)	50.63 (19.21)	0.003*
Intra-operative complications – pelvic perforation (*n*)	1	0	0.99
Pain visual analogue score (1–10 mm), mean (SD)			
At 6 h	4.26 (1.26)	3.16 (1.17)	<0.001*
At 24 h	2.74 (0.89)	2.00 (0.92)	<0.001*
At 48 h	1.90 (0.70)	1.22 (0.42)	<0.001*
Analgesic requirement (mg of tramadol), mean (SD)	66.13 (62.43)	28.13 (42.0)	0.003*
Haemoglobin drop (g/dL), mean (SD)	1.43 (1.01)	0.40 (0.63)	<0.001*
Postoperative complications	1	3	0.60
Hospital stay (days), mean (SD)	2.07 (0.68)	1.94 (0.76)	0.24
Complete stone clearance, *n* (%)	32/32 (100)	31/32 (96.88)	0.99
Retreatment, *n* (%)	0/32 (0)	1/32 (3.13)	1.00

*Miniperc, minipercutaneous; RIRS, retrograde intrarenal surgery. *Statisically significant.*

DISCUSSION

Management of small bulk renal urolithiasis is still evolving, with no clear-cut advantage of either of the three modalities; ESWL, PCNL and RIRS [3]. PCNL modification by miniaturization, specifically miniperc, has established its role in the management of small renal urolithiasis [4,5]. In a comparative study between miniperc and standard PCNL, Mishra *et al.* [6] showed that miniperc had a better safety profile with a similar efficacy.

Srisubat *et al.* [7] performed a meta-analysis comparing ESWL, PCNL and RIRS for kidney stone management. There were a total of three studies (214 patients), although the results could not be pooled. There were two randomized controlled trials comparing ESWL with PCNL. The efficiency quotient of PCNL was higher than that of ESWL. A single randomized controlled trial compared ESWL versus RIRS for lower pole kidney stones. The success rate was not significantly different at the end of the third month (relative risk, 0.91, 95% CI, 0.64–1.30). It was concluded that ESWL is less effective for lower pole kidney stones than PCNL but not significantly different from RIRS. For miniperc or RIRS to be an appealing alternative to ESWL, they must be fully effective in one step with an acceptable morbidity. In our opinion, only a stone-free rate tending to 100% would outweigh the drawbacks of a surgical procedure requiring general anaesthesia. The stone-free rates at 1 month were 100% and 96.88% for the miniperc and RIRS groups, respectively, and these were not statistically different from each other. There are two other retrospective studies comparing RIRS and miniperc [7,8]. In the first study, Chung *et al.* [8] reported a stone-free rate of 67% in the RIRS group compared to 87% in the PCNL group. In the second study, Ferroud *et al.* [9] reported a stone-free rate of 88% in the RIRS group compared to 93% in miniperc group.

The primary objective of the present study was to evaluate the efficacy of both procedures. Both techniques were equally effective and safe. In a study by Chung *et al.* [8], the complication rate was zero in the RIRS group, whereas it was 13% in the PCNL group. Complications rates were lower in the present study, which could be explained by further miniaturization with resultant miniperc as opposed to the standard PCNL performed by Chung *et al.* [8]

The next criterion for the acceptability of a procedure is technical feasibility. We found RIRS to be more time-consuming. There are two factors that could account for this finding. First, being a high-volume PCNL centre, greater expertise could shorten miniperc significantly. The most important drawback of RIRS is the lengthy operating time. Second, time-consuming manoeuvers are required in RIRS for stone fragmentation. Giusti *et al.* [10] noted that miniperc took longer to finish, citing diminished operative field visibility, the need for fragmentation into very small stones suitable for graspers and baskets, and the small sheath size as contributing factors. Our operating times were similar to those reported by Mishra *et al.* [6] in their study comparing miniperc with standard PCNL, and the explanations in each case are probably similar. The reduced diameter of tract dilation during miniperc reduces the potential for damage to the renal vasculature and infundibular calyceal tear, thereby increasing visibility. Laser lithotripsy times were similar between the groups. In the miniperc group, the mean haemoglobin drop was significantly higher than that in the RIRS group. This shows the minimally invasiveness of RIRS. The amount of blood loss was not sufficiently significant to translate into higher transfusion rates between the groups. For the miniperc group, this highlights the advantage of the use of a smaller bore tract when performing percutaneous nephrolithotomy. A primary aim in devising the miniperc technique was a reduction of pain related to percutaneous nephrolithotomy. The results obtained in the present study show that there was significantly less pain in the RIRS group compared to the miniperc group. The general understanding is that postoperative pain depends more on the presence of a nephrostomy tube rather than on the tract's bore, as was initially assumed [11]. However, Mishra *et al.* [6] reported no significant difference in pain between the miniperc and standard PNL group, despite the fact that most of the procedures in the miniperc group were tubeless. This supports the

findings of the present study suggesting that merely performing a tubeless procedure does not lead to reduce postoperative pain. This needs to be investigated further in a larger group of patients aiming to identify the factors that are responsible. Hospital stay was similar in both the group of patients. Monga *et al.* [12] estimated a mean hospital stay of 1.1 days in their series of patients undergoing miniperc. Prabhakar *et al.* [13] discharged all of their patients 24 h after performing RIRS. In another study by Breda *et al.* [14], 97.6% of cases undergoing RIRS were performed as outpatient procedures. RIRS was carried out as an outpatient procedure and PCNL had a mean of 2 days of hospital stay in the study reported by Chung *et al.* [8].

There are a few limitations to the present study. Being a prospective comparative study, an element of internal validity bias may be unavoidable. In the future, a prospective randomized trial with a larger sample size comparing RIRS, PCNL and ESWL with follow-up data provided by non-contrast CT would allow even more accurate data to be collected, and thus help to conclude which modality is better.

In conclusion, miniperc and RIRS represent two equally safe and efficacious techniques for the treatment of renal stones of size 1–2 cm, with similar hospital stays. RIRS is superior in terms of less postoperative pain and analgesic requirement, although it is associated with a longer operating time.

CONFLICT OF INTEREST

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REFERENCES

1 **Albala DM, Assimos DG, Clayman RV *et al*.** Lower pole, I: a prospective randomized trial of SWL and PNL for lower pole nephrolithiasis initial results. *J Urol* 2001; **166**: 2072–80

2 **Elbahnasy AM, Shalhav AL, Hoenig DM *et al*.** Lower caliceal stone clearance after shock wave lithotripsy or ureteroscopy: the impact of lower pole radiographic anatomy. *J Urol* 1998; **159**: 676–82

3 **Bandi G, Best SL, Nakada SY.** Current practice patterns in the management of upper urinary tract calculi in the north central United States. *J Endourol* 2008; **22**: 631–6

4 **Jackman SV, Docimo SG, Cadeddu JA, Bishoff JT, Kavoussi LR, Jarrett TW.** The 'mini-perc' technique: a less invasive alternative to percutaneous nephrolithotomy. *World J Urol* 1998; **16**: 371–4

5 **Lahme S, Zimmermanns V, Hochmuth A, Janitzki V.** Minimally invasive PCNL (mini-perc). Alternative treatment modality or replacement of conventional PCNL? *Urologe A* 2008; **47**: 563–8

6 **Mishra S, Sharma R, Garg C, Kurien A, Sabnis R, Desai M.** Prospective comparative study of Miniperc and standard PNL for treatment of 1 to 2 cm size renal stone. *BJU Int* 2011; **108**: 896–9

7 **Srisubat A, Potisat S, Lojanapiwat B, Setthawong V, Laopaiboon M.** Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. *Cochrane Database Syst Rev* 2009; (7): CD007044

8 **Chung BI, Aron M, Hegarty NJ, Desai MM.** Ureteroscopic versus percutaneous treatment for medium-size (1–2-cm) renal calculi. *J Endourol* 2008; **22**: 343–6

9 **Ferroud V, Lapouge O, Dousseau A, Rakototiana A, Robert G, Ballanger P.** Flexible ureteroscopy and mini percutaneous nephrolithotomy in the treatment of renal lithiasis ≤2 cm. *Prog Urol* 2011; **21**: 79–84

10 **Giusti G, Piccinelli A, Taverna G *et al*.** Miniperc? No, thank you! *Eur Urol* 2007; **51**: 810–4

11 **Desai MR, Kukreja RA, Desai MM *et al*.** A prospective randomized comparison of type of nephrostomy drainage following PCNL: large bore versus small bore versus tubeless. *J Urol* 2004; **172**: 565–7

12 **Monga M, Oglevie S.** Minipercutaneous nephrolithotomy. *J Endourol* 2000; **14**: 419–21

13 **Prabhakar M.** Retrograde ureteroscopic intrarenal surgery for large (1.6–3.5 cm) upper ureteric/renal calculus. *Indian J Urol* 2010; **26**: 46–9

14 **Breda A, Ogunyemi O, Leppert JT, Schulam PG.** Flexible ureteroscopy and laser lithotripsy for multiple unilateral intrarenal stones. *Eur Urol* 2009; **55**: 1190–6

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Abbreviations: **miniperc**, minipercutaneous; **PCNL**, percutaneous nephrolithotomy; **RIRS**, retrograde intrarenal surgery.