# Comparison of Retrograde Intrarenal Surgery and Percutaneous Nephrolithotomy Methods For Management of Big- Sized Kidney Stones(≥ 4 cm): Single Center Retrospective Study

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**Purpose:** Management of ≥ 4 cm sized kidney stone is a rarely seen problem in urology. Few studies are present about this issue. Percutaneous nephrolithotomy(PNL), Retrograde Intrarenal Surgery(RIRS) and open surgery are the methods used in stone management. In our study we aimed to compare RIRS and PNL in the management of ≥ 4 cm sized kidney stones.

**Materials and methods:** Among patients who had undergone RIRS and PNL in Dıskapı Yıldırım Beyazıt Training and Research Hospital, 94 patients who had ≥ 4 cm sized kidney stones were included our study. The demographic, intraoperative and postoperative data of these patients and complications were evaluated retrospectively.

**Results:** 94 patients (67 PNL, 27 RIRS) were in the study. Stone laterality, urinary anomaly and gender were similar in two groups.(Group PNL(P) and Group RIRS(R)) Stone number were 2.55 ± 1.44 and 2.78 ± 1.42 in Group P and R, respectively. Stone size were 47.06 ± 7.02 and 46.41 ± 6.00 mm. in Group P and R, respectively. The differences between two groups were not statistically significant.($P > .05$) In Group P scopy time, hospital stay and stone free rate were higher and operation time was lower than Group R. And the difference was statistically significant($P < .05$).

**Conclusions:** As a result, PNL is an effective method and operation time is lower than RIRS. Also a second operation for JJ stent taking is lower in PNL . RIRS is a safe method. RIRS has less complications and hospitalization time. They are feasible in treatment of ≥ 4 cm sized kidney stones.

**Keywords:** nephrolithiasis; percutaneous nephrolithotomy; retrograde intrarenal surgery

## INTRODUCTION

Big sized ( ≥ 4 cm) kidney stone management is a rare seen problem in urology. Kidney stones are detected in the early period with developing technology and screening methods. However big sized stones can be seen. Percutaneous nephrolithotomy(PNL) is the first choice in the management of these stones. But serious life threatening complications can be seen in PNL[(1)]. PNL may not be suitable in patients with morbid obesity, bleeding disorders and anatomic anomalies complicating percutaneous access[(2,3)].There are several publications asserting the feasibility of PNL and even equal complications in patients with obesity.[(4)] Retrograde Intrarenal Surgery(RIRS) is recently seen method. It is used more and more due to new technology. RIRS is a safe method. Serious complications are rarely seen in RIRS. RIRS was used at first in the management of <2 cm sized stones.[(5)] RIRS was used in the management of > 2 cm sized kidney stones with the advanced technology.[(6)] RIRS is used in big sized stones too. In our study we aimed to compare the efficiency and safety of RIRS and PNL methods for the management of big sized kidney stones.

## MATERIALS AND METHODS

We retrospectively analysed the data of patients undergoing operation for kidney stone between 2011-2015 years in Ankara Dıskapı Yıldırım Beyazıt Training and Research Hospital. Patients with ≥ 4 cm sized stones were evaluated. Laboratory examinations and radiologic imagings were done preoperatively. Urine cultures were sterile preoperatively. Stone size was determined as the longest diameter in the kidney ureter bladder graphy(X-ray KUB) for radiopaque stones and for non-opaque stones, the longest diameter in ultrasound were determined as the size of the stones. The longest diameter of each stone is measured in multiple stones. And the sum of all is defined as the size of stone. Before the operation informed consent was taken from all patients. 1 hour before the operation parenteral antibiotic was administered to all patients. Treatment method was de-

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**Table 1.** Demographic Data and Stone Characteristics.

| | Group P (PNL) (n=67) | Group R(RIRS) (n=27) | *P* value |
|---|---|---|---|
| Age (SD± ) (years) | 49.81 ± 12.80 | 46.56 ± 13.66 | .278 |
| Gender Male/Female (n) | 47/20 | 18/9 | .741 |
| BMI (SD±) (kg/m$^2$) | 24.91 ± 3.02 | 24.77 ± 3.01 | .848 |
| Previous Surgery History, n (%) | 16 (23.9) | 5 (18.5) | .342 |
| SWL öyküsü, n (%) | 13 (19.4) | 8 (30.8) | .273 |
| Opacity, n (%)61(91) | 24(89) | .72 | |
| Urinary Anomaly, n (%) | 2 (3) | 2 (7.4) | .142 |
| Stone Laterality Right/Left (n) | 25/42 | 14/13 | .542 |
| Stone Number (SD ±) (n) | 2.55 ± 1.44 | 2.78 ± 1.42 | .494 |
| Stone Size (SD ±) (mm) | 47.06 ± 7.02 | 46.41 ± 6.00 | .740 |
| Stone Localization, n | | | .386 |
| Renal pelvis | 14/67 | 8/27 | |
| Lower calyx | 6/67 | 4/27 | |
| Mid calyx | 2/67 | 2/27 | |
| Upper calyx | 0 | 2/27 | |
| Multicaliceal | 45/67 | 11/27 | |
| Diverticule | 0 | 0 | |

**Abbreviations:** RIRS, Retrograde Intrarenal Surgery; PNL, Percutaneous Nephrolithotomy; BMI, Body Mass Index; SWL, Shock Wave Lithotripsy; SD, standard deviation

fined according to the choice of the surgeon and patient. 94 patients were included in the study.

RIRS was performed under general anesthesia. 7.5 French (F.) flexible renoscope was used. (Flex X2 Karl Storz, Tutlingen, Germany). Routine rigid renoscopy was performed before flexible renoscopy for dilating ureter in modified supine lithotomy position. Under fluoroscopic control 0.035/0.038 inch hydrophilic guidewire was placed. Later ureteral access sheath was placed over the hydrophilic guidewire. In case of displacement of ureteral access sheath, flexible renoscope was placed over the guidewire. With 200 mm holmium: Yttrium-Aluminum-Garnet laser probe (Dornier Medilas H20; Med Tech, Munich, Germany), stone fragmentation was performed. Dusting and fragmentation were used by surgeons. JJ stent was inserted according to intraoperative conditions. Time between starting endoscopy and completion of JJ stent insertion was calculated as operation time.

PNL was performed under general anesthesia. In modified supine lithotomy position, open ended ureter catheter was inserted. Patient was taken to prone position. Percutaneous access was supplied by 18 gauge needle under fluoroscopic control. 0.035 inch J tipped guidewire was placed into collecting system over the needle under fluoroscopic control. Dilatation was performed with Amplatz dilatators (Microinvasive, Natick. MA) up to 30 F. Later rigid nephroscope (26 F, Karl Storz®) was placed. Stone was fragmented with pneumatic lithotripter (Lithoclast; EMS, Nyon, Switzerland). The stones fragments removed with forceps through a rigid nephroscope (26F, Karl Storz®). At the end of the procedure, percutaneous nephrostomy tube was inserted. Time between starting endoscopy and end of nephrostomy fixation was calculated as operation time.

After intraoperative fluoroscopic control and postoperative first day control with X-ray KUB and ultrasound, patients who were stone-free or with clinically insignificant urolithiasis(< 4mm) one month after the last operation were considered to have been treated successfully. JJ stent was taken 3 weeks later. In case of being unsuccessful, second operation was planned 3 weeks later.

The patient and operation datas such as stone size, operation and fluoroscopy time, hospitalization time, success rates, JJ stent placement, stone free rates and complication rates of two groups were compared. Complications were evalutaed according to modified Clavien grading system.

The data was analysed with SPSS version 16. We used chi square test for qualitative variables and student-*T* test for continuous values. Normality was checked before using t-test. $P < .05$ value was accepted as statistically significant.

## RESULTS

67 patients were in PNL group and 27 patients were in RIRS group. The mean age and body mass index(BMI) were higher in Group P. The difference was not statistically significant.(p=.278 and .848) Stone laterality, urinary anomaly and gender were similar in two groups. In Group P, 16(23.9%) patients have previous surgery history. In Group R, five(18.5%) patients have previous surgery history. In Group P, 13(19.4 %) patients had shock wave lithotripsy history(SWL). In Group R eight(30.8%) patients had SWL history. In Group P, 61(91%) patients have opaque stones. In Group R, 24(89%) patients have opaque stones. Stone number and stone size were similar between Group P and R. (**Table 1**)

In the PNL group, (Group P) the important part of the stones were multicaliceal. In the RIRS group,(Group R) important part of the stones were multicaliceal similarly. (**Table 1**)

Operation time was statistically significantly shorter in Group P. ($P = .036$) Fluoroscopy time and hospitalization time were statistically significantly longer in Group P.($P = .041/.047$) JJ stent placement rate was statistically significantly lower in Group P.(**Table 2**)

Success rate was statistically significantly higher in Group P. In Group R, two patients have unsuccessful operation due to narrow ureter. Four patients have unccessful operation due to narrow infundibulopelvic angle and two patients have unsuccessful operation due to stone burden. In Group P, ten patients have unsuccessful operation due to stone burden.(**Table 2**)

Complications were seen in five patients of Group P

**Table 2.** Intraoperative and Postoperative Data.

| | Group P (PNL) (n=67) | Group R (RIRS) (n=27) | *P* value |
|---|---|---|---|
| Operation Time ( ± SD) (min.) | 61.88 ± 20.93 | 83.29 ± 14.17 | .036 |
| Fluoroscopy Time( ± SD) (min) | 5.55 ± 3.32 | 2.22 ± 0.42 | .041 |
| Dilatation Method, n (%) | | | |
| Baloon | | | |
| Amplatz | 67/67(100) | - | |
| Access Number, n (%) | | | |
| 1 | 67/67(100) | | |
| 2 | | | |
| Access Calyx, n (%) | | - | |
| Lower | 65/67(97.01) | | |
| Mid | 2/67(2.99) | | |
| Upper | 0 | | |
| Diverticule | 0 | | |
| Nephrostomy Tube, n (%) | | - | |
| Tubeless | | | |
| Present | 67/67 | | |
| Stone-free (%) | | | |
| Stone free | 42/67(62.69) | 14/27(51.85) | |
| CIRF | 17/67(25.37) | 3/27(11.11) | |
| The Rest | 8/67(11.94) | 10/27(37.04) .039 | |
| Nephrostomy Duration Time (± SD) (day) | 3 | | |
| Hospitalization Time ( ± SD) (day) | 3.06 ± 0.29 | 1.07 ± 0.38 | .047 |
| Complications (n) (%) | | | |
| Grade I | | | |
| Fever | 1(1.5) | 1(3.7) | .670 |
| Grade II | | | |
| Blood Transfusion | 3 (4.5) | - | .347 |
| Urinary Tract Infection | 1(1.5) | 1(3.7) | .670 |
| Grade III | - | - | |
| Grade IV | | | |
| Exitus | 1(1.5) | - | |

**Abbreviations:** RIRS, Retrograde Intrarenal Surgery; PNL, Percutaneous Nephrolithotomy; SWL, Shock Wave Lithotripsy; SD, standard deviation; CIRF, Clinically Insignificant Residuel Fragment
SD: standard deviation

and one patient of Group R. In Group P blood transfusion was made for three patients. In Group P one patient died due to cardiac arrest. Fever was seen in one patient of each group.(**Table 2**)
In Group P, four patients had RIRS and three patients had SWL in unsuccessful patients. In Group R, eight patients had second RIRS and one patient had SWL in unsuccessful group. One patient in each group did not follow up. (**Table 3**)

## DISCUSSION

Big sized kidney stone is a rare seen urological problem. The first choice is PNL in management but RIRS is used in the management of big sized stones recently. Aso et al. reported 50 % stone clearence rate and 50 % fever in a study they performed flexible ureteroscopic electrohydraulic lithotripsy for 34 staghorn kidney stones[7]. Mariani used combined electrohydraulic lithotripsy and holmium: YAG laser ureteroscopic nephrolithotripsy methods for > 4 cm sized kidney stones in 17 renal units and reported 88 % stone free rate. Fever was seen in three patients and pneumonia was seen in one patient three days later discharge(8). In our study stone free rate was 51.8 % and success rate was 62.9 % in Group R. One patient had fever in Group R.
There are few studies comparing treatment methods in management of big sized kidney stones. Haggag et al. compared laparoscopic nephrolithotomy(LNL) and PNL methods in big sized renal pelvic kidney stone management. 50 patients were included in the study.(40 PNL, 10 LNL) Stone free rate was 78.6 % and complication rate was 35.7 % in PNL group[9]. Singh et al. compared retroperitonoscopic pyelolithotomy and PNL methods for management of > 3 cm sized solitary pelvic stones. Stone free rate was 72.7 % for PNL group in 44 patients study[10]. Laparoscopic pyelolithotomy can be also used in treatment of big sized kidney stones[11]. In our study stone free rate was 62.68 % in Group P.
In our study fluoroscopy and hospitalization time were higher in Group P. Fluoroscopy time was higher due to time for percutaneous access. Hospitalization time was higher due to time taking percutaneous nephros-

**Table 3.** Procedures Performed to The Unsuccessful Patients.

| | Group P (PNL) (n=67) | Group R (RIRS) (n=27) | *P* value |
|---|---|---|---|
| RIRS | 4/8 | 8/10 | |
| Re PNL | 0 | 0 | |
| SWL | 3/8 | 1/10 | |
| JJ Stent Placement, n (%) | 27(40.3) | 22(81.5) | .047 |

**Abbreviations:** RIRS, Retrograde Intrarenal Surgery; PNL, Percutaneous Nephrolithotomy; SWL, Shock Wave Lithotripsy

tomy tube. Tubeless PNL can decrease hospitalization time. The decision of tubeless PNL is given according to intraoperative conditions. In our study there was no patient tubeless PNL performed.

In our study operation time was 61.88 ± 20.93 minutes in Group P and 83.29 ± 14.17 minutes in Group R. In a study in which ureteroscopic nephrolithotomy was performed for > 4 cm sized kidney stones in 17 renal units, average operation time was 49 minutes.[8] The mean operation time was 51.19 ± 24.39 min. in a study in which PNL was performed for big sized kidney stones. (9) In our study, operation time was higher in Group R due to stone fragmentation time and high patient number in Group R.

Complication number was higher in Group P. According to modified Clavien grading system, one grade 2 and one grade 1 complications were seen in Group R. Four grade 2 and one grade 4 complications were seen in Group P.[12] Bleeding is frequent in PNL. Bleeding may occur at a level that requires embolization to a conservative approach. Meria et al. reported three venous bleeding in 16 patient study.[13] In our study transfusion needed bleeding was seen in three patients in Group P. One patient died due to cardiac arrest in Group P.

The limitations of the study are retrospective design and low patient number. Large patient number and prospective designed studies are needed.

## CONCLUSIONS

As a result for the management of big sized kidney stones, PNL and RIRS are effective and safe methods. PNL is an effective method and operation time is lower than RIRS. Also a second operation for JJ stent taking is lower in PNL . RIRS is a safe method. RIRS has less complications and hospitalization time.

## CONFLICT OF INTEREST

There is no conflict of interest among the authors.

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