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ORIGINAL ARTICLE

COMPARISON BETWEEN RETROGRADE INTRARENAL SURGERY (RIRS) AND PERCUTANEOUS NEPHROLITHOTOMY (PCNL) IN THE TREATMENT OF SINGLE RENAL STONE 2-3CM

Deepak Garg[1], Thomas Appu[2], Mathew Georgie[3], Nair T. Balagopal[4], Sanjeevan K. V[5], Kumar Ginil[6], Nair Kanan[7]

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ABSTRACT: CONTEXT: Open surgery has given way to endoscopic surgeries. PCNL makes its way puncturing renal parenchyma where there is an unknown factor of damaging a major blood vessel. This may be overcome by retrograde intrarenal surgeries (RIRS) but the instrument has to traverse a long way through natural orifice and lumen. Which is less harmful and more helpful. **AIM:** To compare results from RIRS and PCNL in treating renal calculi of 2 to 3cm. **MATERIALS AND METHODS:** Retrospective analysis of consecutive patients who underwent PCNL or RIRS for stones with 20–30mm diameter, in a single institution between January 2008 and December 2014. **RESULTS:** Mean operative time for PCNL is significantly less as compared to RIRS (p=0.001). Hemoglobin drop was significantly high in PCNL group 1.2gm%. Stone clearance rate was much higher in PCNL group with 95.7% of the patients requiring only single procedure. **CONCLUSION:** PCNL is more effective than RIRS for stones between 2–3cm at a cost of longer hospital stay, increased blood loss, increased need for transfustions.
KEYWORDS: Percutaneous nephrolithotomy, retrograde intrarenal surgery, minimal invasive, flexible ureterorenoscopy.

INTRODUCTION: The development of minimal invasive surgery for the treatment of renal calculus has led to an increase in success rates and, at the same time, has decreased the morbidity associated with these treatments. Today, percutaneous nephrolithotomy (PCNL) is the gold standard in the management of renal stones larger than 2 cm, to the detriment of open surgery, which has been pushed into the background and is only indicated in exceptional cases.[1] PCNL, in turn, has evolved, to minimally invasive percutaneous procedures (MIPPs) including mini-PCNL and micro-PCNL. Although PCNL has long been the surgical treatment of choice for these complex stones, recent advances in flexible ureteroscopes, laser technology and surgical technique have led to an increased interest in performing RIRS which enables a complete management of the upper urinary tract.

The possibility of combined anterograde (Percutaneous) and retrograde (Transurethral) management, thanks to the flexible ureteroscope and cytoscope, has given the standard PCNL greater access to calyces which were not reached with rigid nephroscopy, while allowing to complete renal calculus treatment with only a single percutaneous access site in most cases. The main drawbacks of retrograde access include the requirement of costly flexible scopes, decreased visualisation, reduced size of fragment removal, and the need for flexible lithotrites and baskets.[2] Cost is a major deterrent to RIRS, particularly in developing countries.[3] However, percutaneous approaches have traditionally provided enhanced capacity for stone removal, given the use of large-sheath diameters. This paradigm has recently changed with the progressive scaled down of devices for percutaneous access. PCNL techniques offer significant economic advantages due to the decreased reliance on disposable instrumentation.

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MATERIALS AND METHODS: A retrospective analysis, which included 356 PCNLs in the prone position with standard 28F amplatz sheath and 43, RIRS using 8.5fr flexible ureteroscope and 20W holmium laser was performed between January 2005 and December 2014. Preoperative laboratory tests included serum creatinine and haemoglobin measurements, platelet counts, coagulation screen tests and urine cultures. All patients had sterile urine culture before the surgery. Before surgery all patients signed an informed consent form. A modified Clavien grading system[4] was used to classify the complications. Postoperative CT or USG was performed in patients with radiolucent stones and plain film radiography for radiopaque stones to evaluate results. The procedure was considered successful when there was absence of calculus or with residual calculi smaller than 3 mm. The overall success of the treatment was also assessed in terms of post-operative pain, mean blood loss, rate of transfusion, sepsis, duration of hospital stay and a second-line treatment, when the patient achieves stone-free status or has non-significant residual calculi.

A second-line treatment was indicated in those patients with residual calculi larger than 7mm, since spontaneous expulsion was considered unlikely.

STATISTICAL ANALYSIS: Extracted data for the analysis included operative time, estimated blood loss, postoperative pain, length of hospital stay, need for auxiliary procedures, and postoperative complication rate. Data was analyzed with the SPSS statistical package version 15.0.

RESULTS: A total of 399 procedures (356 PCNL and 43 RIRS) were made in the selected period of time after applying exclusion criteria of stone diameter. Patient demographics included mean age 41.40yrs and BMI 27.12 kg/m^2. The average stone diameter was 26.66mm for RIRS and 28.44mm for PCNL and mean HU of 892.85. The mean operative time was 82.9 min for PCNL and 131.1min for RIRS (p=0.001) and mean hospital stay was 5.83 days in PCNL group and 2.09 days in RIRS group (p=0.000). Post-operative pain requiring analgesics was much higher in PCNL group mainly due to nephrostomy tube. Stone clearance rate was much higher in PCNL group with 95.7% of the patients requiring only single procedure and in RIRS was 64.52% (p= 0.000). Overall complication rates in PCNL were higher and were statistically significant (p=0.007).

The mean drop in the postoperative haemoglobin level was 0.3gm% in the RIRS group, which was found to be statistically significant (P < 0.003) compared with the corresponding decrease 1.6gm% in the PCNL group. However, blood transfusion was required for ten (2.8%) patients in the PCNL group. Hydrothorax was developed in two patients and hemothorax in 3 patients in PCNL group having supracostal puncture for upper calyx access. Transient fever during postoperative period was encountered in six and fourteen patients in the PCNL group and RIRS group, respectively. Urosepsis was detected in three patients who underwent RIRS however preoperative urine cultures for all three were negative. The patients were successfully treated with intravenous antibiotics. In the RIRS group, creatinine levels rose in two patients in the postoperative period due to sepsis and regressed to preoperative levels 4 days after the procedure.

Furthermore, rigid ureteroscopy was done in 26.18% in RIRS group at time of stent removal due to residual fragments in ureter comparison to 3.4% in PCNL. 9.3% patients in RIRS required one session of ESWL postoperatively and all these patients had calculus in lower calyx. A second look ureteroscopic procedure was not required in the PCNL group and all stents were removed in OPD under topical anesthesia. However two patients required relook PCNL due to residual calculus before removing nephrostomy tube.

Three patients in PCNL group required angioembolisation for intractable bleeding immediately postoperatively and two patients after one month due to rupture of pseudoanneurism and presented with gross hematuria.

DISCUSSION: PCNL is currently the technique of choice for the treatment of intrarenal calculi larger than 20mm. Although this procedure has the advantage of high stone clearance rates, it is still an invasive method with serious complications despite technological advancements. At the same time, the development of new technologies (lasers) and improved flexible endoscopes have led us to the current situation where the treatment of renal calculus is seeking least invasive and more effective techniques, retrograde intrarenal surgery (RIRS). However, in spite of its good results in published series, RIRS is still considered an alternative to PCNL in calculi larger than 2 cm only if performed in specialized centers mainly due to lack of expertize and decreased stone free rate in single procedure in comparison to standard PCNL thereby escalating the treatment cost. The major limitation of RIRS in that multiple procedures may be required to clear a large stone, whereas PCNL can provide a 95% stone-free rate after the first treatment.[5]

The overall success rate of RIRS has been reported to be between 77% and 93% after additional sessions for intrarenal calculi larger than 2 cm. After second sessions, stone-free rates were comparable with those achieved using PCNL. Several groups have reported their experience with ureteroscopic management of renal stones >2 cm. Miller et al concluded that RIRS is not an effective method for treating complex renal stones >2 cm because of a clearance rate significantly lower than that of PCNL.[6] Breda et al reported the results of 51 patients with overall stone-free rates after 1 and 2 procedures of 64.7% and 92.2%, respectively, for multiple unilateral intrarenal stones: 85.1% for a stone burden >20 mm and 100% for a stone burden <20 mm.[7] Riley et al. showed a 90.9% success rate for an average stone size of 3.0cm.

They achieved a 91.6% success rate with an average of 1.9 procedures for stones larger than 3 cm, 80% success with an average of 1.8 procedures for stones larger than 3.5 cm, and 50% success with an average of two procedures for stones larger than 4 cm.[8] Chung et al. compared outcomes of 15 PCNL and 12 RIRS patients who were treated for the clearance of 1–2 cm renal calculi. They reported that stone-free rates for PCNL and RIRS were 87% and 67%, respectively.[9] in the present study, the mean operation durations for the RIRS and PCNL groups were 131.1 min and 82.9 min, respectively. Mariani reported a mean operative time of 64 min for the ureteroscopic management of renal stones measuring 2 and 4 cm.[10] The association between operative time and complications related to PCNL has been reported in various studies.[11,12] Akman et al. found that need for blood transfusion increased 2.82-fold when operative times were longer than 58 min for patients managed with PCNL.[11]

In another study, Kukreja et al. found that diabetes mellitus and a multiple access tract procedure, together with prolonged operative time, were associated with blood loss during the PCNL procedure.[12] The relationship between operative time and bleeding in RIRS is not acknowledged till date. However, development of excessive intrarenal pressure in RIRS might lead to intrarenal reflux transiently affecting renal function. Schwalb et al. found that high pressure irrigation during ureterorenoscopy (URS) in pigs caused irreversible, deleterious effects in the kidney parenchyma, and it is proposed that infectious complications may result from renal extravasation.[13] Maintaining lower pelvic pressures during RIRS can be achieved by several manipulations, such as irrigation with isoproterenol, using a ureteral access sheath and limiting operative time.[14,15]

In our study in the RIRS group, transient increase in creatinine levels due to sepsis in two patients was encountered on the first postoperative day, returning to preoperative levels 4 days later. The PCNL procedure is associated with several complications including bleeding requiring blood transfusion, septicaemia, colonic injury, haemothorax, hydrothorax, fever and urinary infection. One of the most important complications is bleeding requiring transfusion, the incidence of which has been reported to vary between 0.8% and 45% in the PCNL literature.[16,17] Intractable bleeding requiring embolization or total nephrectomy could occur. On the other hand, URS and laser lithotripsy have a universally low complication rate compared with PCNL.

A substantial decrease in the number of complications has been reported in modern series, especially related to the use of ureteroscopes of smaller size. Ureteral avulsion is exceedingly rare but the most important complication of ureteroscopy. The hospital stay was longer in the PCNL group compared with the RIRS group. One of the most important reasons for this delay is nephrostomy tube placement for better drainage. Recent studies have shown that tubeless PCNL is the most important factor in decreasing hospital stay.[18,19]

However, the decision to position a tubeless PCNL is surgeon's choice and intraoperative findings. It can be applied in the absence of a significant residual stone, pelvicaliceal system perforation, and significant bleeding. RIRS is typically an outpatient procedure. Technical improvements in flexible URS, including smaller calibre ureteroscopes with digital optics and dual deflection, have recently made RIRS a more popular and feasible option.

Limitations of our study include its retrospective nature, RIRS was started late at our centre hence very less number of RIRS patients compared to PCNL and 20 watt holmium laser was used in RIRS as energy source. Majority of studies conducted achieving higher stone clearance rate and decreased operative time had 100 watt laser for fragmentation.

However further prospective studies with high case volumes that compare RIRS vs PCNL with regard to outcomes, complications, cost and convalescence in long-term follow-up are required.

CONCLUSION: Currently, PCNL is the gold standard treatment modality for kidney stones larger than 2cm in size at the cost of longer hospital stay increased blood loss, increased need for transfusions. However, satisfactory outcomes can be achieved with RIRS in the treatment of 2–3 cm renal stones but requires multiple sessions thereby increasing treatment cost. Furthermore, hospital stay and morbidities of PCNL can be significantly reduced with RIRS. Therefore, RIRS with a holmium laser represents a good alternative treatment to PCNL in well selected cases with larger renal stones. However, these outcomes must be confirmed by further prospective randomized studies.

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AUTHORS:

1. Deepak Garg
2. Thomas Appu
3. Mathew Georgie
4. Nair T. Balagopal
5. Sanjeevan K. V.
6. Kumar Ginil
7. Nair Kanan

PARTICULARS OF CONTRIBUTORS:

1. M.Ch Resident, Department of Urology, Amrita Institute of Medical Sciences.
2. Professor and HOD, Department of Urology, Amrita Institute of Medical Sciences.
3. Professor, Department of Urology, Amrita Institute of Medical Sciences.
4. Professor, Department of Urology, Amrita Institute of Medical Sciences.
5. Professor, Department of Urology, Amrita Institute of Medical Sciences.
6. Professor, Department of Urology, Amrita Institute of Medical Sciences.
7. Professor, Department of Urology, Amrita Institute of Medical Sciences.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Deepak Garg,
Senior Resident,
Department of Urology,
Amrita Institute of Medical Sciences,
Ponnekara, Kochi, India.
E-mail: drdeepakgarg@gmail.com

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