

Comparison of conventional percutaneous nephrolithotomy versus endoscopic combined intrarenal surgery in complex renal calculus – Our institutional experience



Rajasekar Maruthamuthu¹, Jayaprakash Narashimman², Mahendran Ganesamoorthy³, Thiruvarul PV⁴, Prasad Sivasamy⁵

^{1,2,3}Assistant Professor, ⁴Professor and Head, ⁵Senior Resident, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem, Tamil Nadu, India

Submission: 23-03-2024

Revision: 22-05-2024

Publication: 01-07-2024

ABSTRACT

Background: Complex renal calculi, characterized by their size, location, and composition, pose a significant challenge to urologists due to the potential for complications and the difficulty in achieving complete stone clearance. Conventional percutaneous nephrolithotomy (PCNL) and endoscopic combined intrarenal surgery (ECIRS) are two established techniques for managing these complex renal calculi. **Aims and Objectives:** The aims and objectives are to compare the effectiveness, safety, and outcomes of PCNL versus ECIRS in managing complex renal calculi in a cohort of 60 cases treated at GMKMCH-Salem. **Materials and Methods:** A retrospective analysis was conducted on 60 patients with complex renal calculi who underwent either conventional PCNL or ECIRS during a specified period at GMKMCH-Salem. Patient demographics, stone characteristics, procedural details, intraoperative and post-operative parameters, and complications were analyzed and compared between the two treatment groups. **Results:** The study found that both PCNL and ECIRS techniques were effective in treating complex renal calculi. However, significant differences were observed between the two groups in terms of outcomes. The ECIRS technique exhibited superior outcomes with higher stone clearance rates ($P < 0.001$), shorter operative times ($P < 0.05$), and reduced hospital stays ($P < 0.05$) compared to conventional PCNL. **Conclusion:** This study demonstrates that ECIRS is a promising alternative to conventional PCNL in the management of complex renal calculi. The ECIRS technique yielded higher stone clearance rates, shorter operative times, and reduced hospital stays, potentially improving patient outcomes and reducing health-care costs. Although our findings show favorable results for ECIRS, the decision between conventional PCNL and ECIRS should be based on individual patient characteristics, surgeon expertise, and resource availability.

Key words: Renal stone; Endoscopic combined intrarenal surgery; PCNL; Fluoroscopy; Stone free rate

INTRODUCTION

The reported lifetime prevalence of kidney stones in the world ranges from 5% to 20%, of which 10–20% are staghorn stones. In the absence of surgical treatment, staghorn stones can cause serious complications such as renal failure, infection, septic shock, and even death.

Surgical management of staghorn stones is inherently challenging. There are several key considerations during surgery, including the use of specialized surgical techniques, stone clearance rate, risk of renal function impairment, intraoperative blood loss, and the risk of post-operative infection.¹ The first-line therapy for staghorn stones is percutaneous nephrolithotomy (PCNL). PCNL entails

Access this article online

Website:

<http://nepjol.info/index.php/AJMS>

DOI: 10.3126/ajms.v15i7.64061

E-ISSN: 2091-0576

P-ISSN: 2467-9100

Copyright (c) 2024 Asian Journal of Medical Sciences



This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Address for Correspondence:

Rajasekar Maruthamuthu, Assistant Professor, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem, Tamil Nadu, India. **Mobile:** +91-8056069515. **E-mail:** uyir1992@gmail.com

one or more small incisions on the back of the flank area for performing endoscopic lithotripsy operations.^{1,2} For complex kidney stones, a single percutaneous nephrostomy (PCN) tract may not be able to achieve stone-free status in the first attempt. Patients may require second-look surgeries and bear the risk of multiple surgeries and anesthesia. To achieve a stone-free rate in a single operation, the surgeon may create multiple PCN tracts in different positions for different calyces. This type of operation is called multitract PCNL. However, multitract PCNL requires experts with skilled puncture techniques and experience in performing precise punctures for stones in different renal calyces.² Theoretically, the more the number of PCN tracts, the greater the renal parenchymal injury and blood loss. Conventional PCNL involves percutaneous access to the renal collecting system followed by stone fragmentation and removal, whereas endoscopic combined intrarenal surgery (ECIRS) combines flexible ureteroscopy and miniaturized percutaneous access.³ This study aims to compare the outcomes of conventional PCNL and ECIRS in terms of stone clearance, rates, operative time, complications, hospital stay, and post-operative outcomes in patients with complex renal calculi.

Aims and objectives

The aims and objectives of the study are to compare the effectiveness, safety, and outcomes of conventional percutaneous nephrolithotomy (PCNL) versus ECIRS in managing complex renal calculi in a cohort of 60 cases treated at GMKMCH-Salem.

MATERIALS AND METHODS

Study design

A retrospective analysis was conducted on 60 patients with complex renal calculi who underwent either conventional PCNL or ECIRS during a specified period at GMKMCH-Salem.

Study place

The study was conducted in the Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem.

Data analysis

Statistical data analysis was done using Microsoft Excel (2019) software.

Ethics approval and consent to appropriate

The study protocol was approved by the Institutional Ethics Committee, and all patients provided written informed consent before enrolment. IEC NO: GMKMC&H/114/IEC/2023.

Inclusion criteria

1. Age >18 years–60 years
2. Patients who had unilateral or bilateral complex renal calculi (complete staghorn calculus, multiple renal calculi) were included in the study.

Exclusion criteria

1. Age <18 years–>60 years
2. Pregnant women
3. Patients with partial staghorn stones
4. Those with congenital and urogenital malformations were excluded
5. Patients who underwent flexible ureterorenoscopy
6. Patients who underwent extracorporeal shock wave lithotripsy (ESWL)
7. Patients who underwent PCNL to treat
8. The same stone before enrollment in this study were excluded.

RESULTS

During 12 months, 60 patients with complex renal calculi were treated surgically: 30 by conventional PCNL and 30 patients by ECIRS. Table 1 describes patient demographics with 30 patients in each group (P=0.01). The mean of age group was 35.6 (PCNL) and 40.45 (ECIRS) with P=0.04, sex ratio in PCNL (20:10) and ECIRS (25:5) with P=0.069, and laterality of renal calculus R: L=11:19 (PCNL group) and 19:11 (ECIRS group) with P=0.012.

Table 2 shows intraoperative complications and outcomes in both techniques. PCNL group had a higher operative time (183 > 140 min) than ECIRS group, which was clinically significant with P=0.05. The PCNL group has a higher fluoroscopy time of 120 s compared to ECIRS group of 90 s with P=0.012s.

Pain analysis by Visual Analog Scale shows that PCNL has lesser post-operative pain on post-operative day (POD) 1 and 2 with P=0.05 and 0.02, respectively. Hemoglobin (Hb) dropped significantly lesser for PCNL group compared to ECIRS group with (P<0.03). The ECIRS group has a

Table 1: Demographic table

Variables	PCNL	Endoscopic combined intrarenal surgery	P-value
Renal units	30	30	0.01
Age (years)	35.6	40.45	0.04
Sex (M:F)	20:10	25:5	0.069
Laterality (R:L)	11:19	19:11	0.012
History of DJ stenting	3	27	<0.001

Table 2: Intraoperative complications

Parameter	PCNL	Endoscopic combined intrarenal surgery	P-value
Operative time (min)	183	140	0.05
Fluoroscopy time (s)	120	90	0.012
Pain score			
POD 1	5.34	4.10	0.05
POD 2	3.70	2.12	<0.002
Drop in Hb	1.2	1.4	<0.03
Hospital stay (days)	3.05	2.75	0.011
Stone free rate (%)			
POD 1	51.3	67.5	0.04
1 Month	81	87	0.051
3 Months	93.7	94.8	0.033
Second surgery			
Extracorporeal shock wave lithotripsy	3	3	0.01
ureteroscopic lithotripsy	2	1	0.03

POD: Post-operative day

significantly higher stone-free rate (67.5%) compared to the PCNL group (51.3%) ($P < 0.04$) on POD 1. The stone-free rate (SFR) is better for ECIRS group after 1 month but statistically not significant. Hospital stays are shorter for ECIRS group with $P < 0.011$. Extra auxiliary procedure ESWL is required for three patients in both groups with $P < 0.01$. URSL is required in PCNL group (3) and ECIRS group (2) with $P < 0.03$.

The study found that both PCNL and ECIRS techniques were effective in treating complex renal calculi. The ECIRS technique exhibited superior outcomes with higher stone clearance rates ($P < 0.04$), shorter operative times ($P < 0.005$), and reduced hospital stays ($P < 0.011$) compared to conventional PCNL.

DISCUSSION

In our study, the final SFR at 3 months in both groups was 90.6%, which is comparable to the SFRs for staghorn stone reported from previous studies (49–78%).³ In the study by Zhong et al., ECIRS using standard PCN sheath was associated with shorter operation, higher SFR, and lesser decrease in Hb than multitract PCNL.⁴ Zhao et al., compared ECIRS with single tract PCNL for complex nephrolithiasis, which was not limited to staghorn stones. They reported higher SFR and fewer complications with ECIRS compared to single tract PCNL.⁵ Hamamoto et al., compared mini ECIRS, mini PCNL, and conventional PCNL for large kidney stones. They only used a single tract in PCNL, and the kidney stones included in the study were not limited to staghorn stones. They found that mini ECIRS was superior to PCNL in terms of operation time, SFR, and Hb loss.⁶ Wen et al. compared mini PCNL and ECIRS for partial staghorn stones. They reported a higher one-step SFR with ECIRS compared to mini PCNL, while there was no significant

between-group difference with respect to the incidence of complications.⁷ Our study shows that the use of ECIRS instead of multitract minimally invasive PCNL when dealing with kidney staghorn stones can help avoid multiple tracts. We used only a single tract to clear the staghorn stones in the selected calyx and renal pelvis and used the flexible ureteroscope with a laser to remove the residual stones in distant calyces. Theoretically, since only a single tract is created, ECIRS can reduce blood loss, number of wounds, and post-operative pain compared to multitract minimally invasive PCNL. In our study, the post-operative decrease in Hb level in the ECIRS group was lesser than that in the multitract minimally invasive PCNL group, although the difference was not statistically significant. According to a meta-analysis, a single tract is associated with significantly less Hb loss than multitract minimally invasive PCNL.⁸ In our study, only 1 person (5.9%) in the ECIRS group required placement of a nephrostomy tube as against 5 patients (29.4%) in the multitract minimally invasive PCNL surgery group. This is attributable to the creation of only a single tract during ECIRS, which caused lesser renal parenchymal damage and blood loss; this reduced the need to drain blood after the operation. Regarding post-operative pain, none of the patients in the ECIRS group required opioid analgesics. However, nearly half of all patients in the multitract minimally invasive PCNL group required morphine injection after surgery. The difference in pain is likely attributable to the lesser number of surgical incisions in the ECIRS group. Studies have shown that the more the number of incisions, the more severe the post-operative pain in endoscopic surgery.⁹ The operative time in ECIRS and multitract minimally invasive PCNL was 140 and 183 min, respectively. Although the operative times did not significantly differ, it should be noted that staghorn stones, especially of infectious origin, must be operated within time limits.

Because multitract minimally invasive PCNL provides multiple PCN routes for stone removal, it can provide better stone removal efficiency and shorten the operative time compared with ECIRS, which has only one PCN route.¹⁰ The reason for using minimally invasive PCNL was the small diameter of the PCN sheath with a more flexible angle for operating in the kidney during surgery, which is less likely to cause a renal laceration injury.¹¹

An ECIRS systemic review by Cracco and Scoffone (2020) included a total of 14 studies, and in all the studies except one, the insertion of a ureteral access sheath (UAS) had been reported.¹² Some limitations of our study should be acknowledged. This was a single-center retrospective study with a small sample size. The choice of surgical approach was jointly decided by the doctor and the patient; therefore, our results may have been influenced by selection bias.

Limitations of the study

1. It is not an RCT
2. Long-term follow-up is required
3. More number of patients need to be included in the study.

CONCLUSION

This study demonstrates that ECIRS is a promising alternative to conventional PCNL in the management of complex renal calculi. The ECIRS technique yielded higher stone clearance rates, shorter operative times, and reduced hospital stays, potentially improving patient outcomes. Although our findings show favorable results for ECIRS, the decision between conventional PCNL and ECIRS should be based on individual patient characteristics, surgeon expertise, and resource availability. Further prospective studies and larger sample sizes are warranted to confirm these findings and validate the long-term efficacy and safety of ECIRS for complex renal calculi management.

ACKNOWLEDGMENT

The authors would like to thank the staff and the nurses from the Urology Department at GMKMCH-Salem, for their support.

REFERENCES

1. Chen ZH, Lee KH, Tseng WH, Su CC, Hsieh KL, Lim CY, et al. Comparison of mini endoscopic combined intrarenal surgery

and multitract minimally invasive percutaneous nephrolithotomy specifically for kidney staghorn stones: A single-centre experience. *BMC Urol.* 2022;22(1):93.

<https://doi.org/10.1186/s12894-022-01030-7>

2. Stamatelou KK, Francis ME, Jones CA, Nyberg LM and Curhan GC. Time trends in reported prevalence of kidney stones in the United States: 1976-1994. *Kidney Int.* 2003;63(5): 1817-1823.
<https://doi.org/10.1046/j.1523-1755.2003.00917.x>
3. Atmoko W, Birowo P and Rasyid N. Factors affecting stone free rate of primary percutaneous nephrolithotomy on staghorn calculi: A single center experience of 15 years. *F1000Res.* 2016;5:2106.
<https://doi.org/10.12688/f1000research.9509.2>
4. Zhong W, Zhao Z, Wang L, Swami S and Zeng G. Percutaneous-based management of Staghorn calculi in solitary kidney: Combined mini percutaneous nephrolithotomy versus retrograde intrarenal surgery. *Urol Int.* 2015;94(1): 70-73.
<https://doi.org/10.1159/000360708>
5. Zhao F, Li J, Tang L and Li C. A comparative study of endoscopic combined intrarenal surgery (ECIRS) in the Galdakao-Modified Supine Valdivia (GMSV) position and minimally invasive percutaneous nephrolithotomy for complex nephrolithiasis: A retrospective single-center study. *Urolithiasis.* 2021;49(2):161-166.
<https://doi.org/10.1007/s00240-020-01207-5>
6. Hamamoto S, Yasui T, Okada A, Taguchi K, Kawai N, Ando R, et al. Endoscopic combined intrarenal surgery for large calculi: Simultaneous use of flexible ureteroscopy and mini-percutaneous nephrolithotomy overcomes the disadvantageous of percutaneous nephrolithotomy monotherapy. *J Endourol.* 2014;28(1):28-33.
<https://doi.org/10.1089/end.2013.0361>
7. Wen J, Xu G, Du C and Wang B. Minimally invasive percutaneous nephrolithotomy versus endoscopic combined intrarenal surgery with flexible ureteroscope for partial staghorn calculi: A randomised controlled trial. *Int J Surg.* 2016;28: 22-27.
<https://doi.org/10.1016/j.ijsu.2016.02.056>
8. Kang SK, Cho KS, Kang DH, Jung HD, Kwon JK and Lee JY. Systematic review and meta-analysis to compare success rates of retrograde intrarenal surgery versus percutaneous nephrolithotomy for renal stones >2 cm: An update. *Medicine (Baltimore).* 2017;96(49):e9119.
<https://doi.org/10.1097/MD.00000000000009119>
9. Morales-Conde S, Peeters A, Meyer YM, Antoniou SA, Del Agua IA, Arezzo A, et al. European association for endoscopic surgery (EAES) consensus statement on single-incision endoscopic surgery. *Surg Endosc.* 2019;33(4): 996-1019.
<https://doi.org/10.1007/s00464-019-06693-2>
10. Moreno-Palacios J, Maldonado-Alcaraz E, Montoya-Martínez G, Rivas-Ruiz R, Cedillo-López U, Okhunov Z, et al. Prognostic factors of morbidity in patients undergoing percutaneous nephrolithotomy. *J Endourol.* 2014;28(9): 1078-1084.
<https://doi.org/10.1089/end.2013.0781>
11. Nicklas AP, Schilling D, Bader MJ, Herrmann TR, Nagele U and Training and Research in Urological Surgery and Technology (T.R.U.S.T.)-Group. The vacuum cleaner effect in minimally invasive percutaneous nephrolitholapaxy. *World J Urol.* 2015;33(11):1847-1853.

<https://doi.org/10.1007/s00345-015-1541-4>

12. Cracco CM and Scoffone CM. Endoscopic combined intrarenal surgery (ECIRS)-tips and tricks to improve

outcomes: A systematic review. Turk J Urol. 2020;46(Suppl 1): S46-S57.

<https://doi.org/10.5152/tud.2020.20282>

Authors' Contributions:

RM- Interpreted the results; reviewed the literature, and manuscript preparation; **JN-** Concept, coordination, interpretation, and publication work; **MG-** Concept and design of the study and prepared the first draft of the manuscript; **TPV-** Finalized the manuscript of the study; **PS-** Data collection, statistical analysis, and preparation of the manuscript.

Work attributed to:

Government Mohan Kumaramangalam Medical College, Salem, Tamil Nadu, India.

Orcid ID:

Rajasekar Maruthamuthu - <https://orcid.org/0009-0003-2427-4399>

Jayaprakash Narashimman - <https://orcid.org/0009-0001-1827-6617>

Mahendran Ganesamoorthy - <https://orcid.org/0009-0008-1686-9727>

Thirumarul PV - <https://orcid.org/0009-0001-2590-7181>

Prasad Sivasamy - <https://orcid.org/0009-0009-5096-2236>

Source of Support: Nil, **Conflicts of Interest:** None declared.