



TINJAUAN PUSTAKA — LITERATURE REVIEW

Systematic Review Comparing Flexible Ureteroscopy and Percutaneous Nephrolithotomy for Lower Pole Stone

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Abstract

Background: Lower pole renal stone treatment is remains controversial, and choosing the appropriate treatment modality has become a challenge

Objective: To systematically assess the effectiveness and safety of retrograde flexible ureteroscopy (FURS) versus percutaneous nephrolithotomy (PCNL) in treating lower pole stones.

Methods: A search of PubMed, Cochrane Library, ScienceDirect, Wiley Online Library, and Scopus databases to identify all studies comparing FURS and PCNL for lower pole renal stones until August 2022 was conducted. Article selection was performed through the search strategy based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Result: A total of 10 comparative studies involving 1241 participants with lower pole calyx stone size 1.0 – 3.0 cm were included for this systematic review. Our review found out that stone free rate PCNL procedure range around 83.3% - 98.3% and FURS procedure range around 78.6% - 93.2%; operative time of PCNL procedure range around 46.2 + 24.3 to 85.5 + 41.1 minutes meanwhile FURS procedure range around 55.8 + 11.4 to 123.0 + 57.4 minutes; hospital stay of PCNL procedure range around 0.3 + 0.04 to 5.3 + 1.20 days and hospital stay of FURS procedure range around 0.16 + 0.04 to 3.2 + 0.52 days; and complications rate after PCNL procedure range around 4.4% - 25% and after FURS procedure range around 4.6% - 21.6%.

Conclusion: Most of studies shown that PCNL procedure have higher stone free rate, shorter operative time, longer hospital stays and higher complications rate compared against FURS procedure.

Keyword : Percutaneous nephrolithotomy · Micropercutaneous nephrolithotomy · Retrograde intrarenal surgery · Flexible ureteroscopy · Lower pole stone

Introduction

Lower pole stones (LPS) account for approximately 35% of renal calculi, more common than other locations in the renal. Although asymptomatic calyceal stones can be managed expectantly in most cases and lower pole stones may demonstrate a lower tendency to become symptomatic, up to 26.6% of stones will eventually require an intervention. On the other hand, treatment of LPS arguably are the most difficult to manage successfully due to the difficulty in eliminating fragments and anatomical access to

the inferior renal calyx. Therefore, a great debate has arisen regarding the best management of LPS. Currently, the management of lower pole stones includes watchful waiting, extracorporeal lithotripsy (SWL), flexible ureterorenoscopy (FURS) and percutaneous nephrolithotripsy (PCNL).¹⁻³

Some reviews and meta-analysis have been published and made a significant contribution for a better understanding of this issue. Donaldson et al. conducted a systematic review and meta-analysis of the clinical effectiveness of ESWL, FURS, and PCNL for



lower-pole renal stones (≤ 20 mm) and reported that stone-free rates were highest after PCNL, followed by FURS, then ESWL.⁴ However, this systematic review included only one study that compared PCNL and FURS. Meanwhile, endoscopic procedures such as PCNL and FURS are the preferred methods for lower renal stone treatment.⁵ They also lack of reliable evidence concerning outcomes other than stone-free rate, such as length of stay, and patients' quality of life.

Hence, this study aimed to perform a systematic review on comparative studies between PCNL and RIRS for treatment of lower pole stones, focusing on stone-free rate, operative time, hospital stay and overall complications to define the better option for patients with this type of stones.

Method

This systematic review was performed and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Literature search

Studies on the effectiveness and safety of flexible ureteroscopy or percutaneous nephrolithotomy for treatment of lower calyx stone published until August 2022 were identified using PubMed, Cochrane Library, ScienceDirect, Wiley Online Library, and Scopus databases. For search of the eligible studies, the following keywords were used: “percutaneous nephrolithotomy”, “micropercutaneous nephrolithotomy”, “PCNL”, “mini-PCNL”, “retrograde intrarenal surgery”, “flexible ureteroscopy”, “RIRS”, “FURS”, “lower pole calculi”, “lower pole stone”, “lower calyx stone”, and “lower calyx calculi”.

Eligibility Criteria

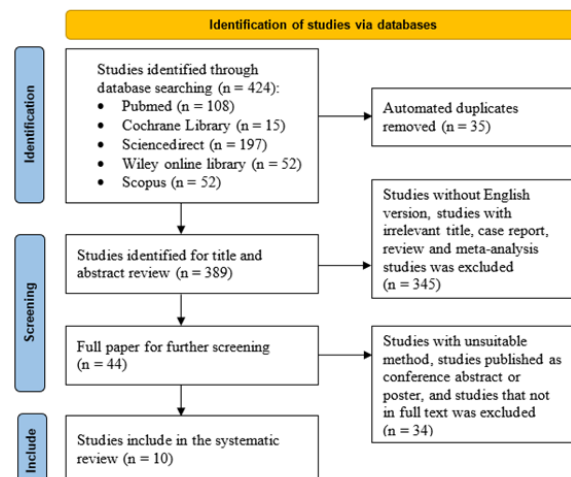
Inclusion criteria for final selected studies were as follows: (1) language limited to English; (2) lower calyx stone, with no diameter and number restriction; (3) comparative studies reporting at least one of the following outcomes of both PCNL

and FURS: stone-free rate, operative time, hospital stay and overall complications. However, studies fulfilling any of the following exclusion criteria were excluded: (1) inclusion of pediatric patients (< 18 years old), and (2) studies published as conference abstracts or posters.

Data extraction

The initial search yielded 424 studies, but only 10 studies included in the final analysis based on eligibility criteria. The flowchart of the study is shown in Figure-1. Information about the study and patient characteristics, intervention strategies, and clinical outcomes was systematically extracted.

Figure-1. PRISMA Flowsheet.



Results

Demographic characteristics of the included studies

We identified 424 studies from the keyword hits, after screening and eligibility assessment of those study 414 studies were excluded for various reason, we found 10 potentially relevant studies with the purpose of this systematic review from 6 countries include Europe, Turkey, Saudi Arabia, China, Canada, and Korea. Out of 10 potentially relevant studies, 4 studies were prospective RCT, 1 study was Cohort prospective, and 5 studies were Cohort retrospective study. All of the included studies were unblinded with studyperiod around 7 months



– 4 years and follow up duration around 1 – 12 months. Demographic characteristic of 3 included studies in this study summarized in Table 1 and 2. All of the included studies include patient with lower calyx renal stone around 1 – 3 cm measured by CT-Scan examination and undergo PCNL or

FURS procedure. Out of 1241 participants included in this systematic review participants undergo PCNL procedure are 637 participants and FURS procedure are 604 participants. Detailed information about study characteristic of included studies summarized in Table 1.

Table 1. Demographic characteristic of PCNL compared with RIRS on lower pole calyx stone patient of the included studies.

Studies	Location	Study Method	Blinding	Study-Period	Minimum Follow Up	Inclusion Criteria	Participants (n)	
							PCNL	FURS
Bozzini et al, 2017 ⁶	Europe	Prospective RCT	Unblinded	4 years	3 months	Patients with a single LP stone with a diameter of 1–2 cm as measured at CT scan that received the indication of active removal	181	207
Armagen et al, 2015 ⁷	Turkey	Cohort Retrospective	Unblinded	2 years	1 months	Patients with isolated LPSs ≤ 2 cm in diameter	68	59
Kirac et al, 2013 ⁸	Turkey	Cohort Retrospective	Unblinded	3 years	8 months	Patient with LP stones with diameter smaller than 1.5 cm	37	36
Coskun et al, 2021 ⁹	Turkey	Cohort Prospective	Unblinded	7 months	3 months	Patient with single or multiple stones (sizing 1-2 cm) localized in the lower calyx systems	25	25
Kandemir et al, 2017 ¹⁰	Turkey	Prospective RCT	Unblinded	3 years	3 months	Patients who had a single lower pole kidney stone up to 1.5 cm without contraindications to microperc and RIRS were included	30	30
Fayad et al, 2017 ¹¹	Saudi Arabia	Prospective RCT	Unblinded	3 years	3 months	Adult patients with solitary lower calyceal stones of ≤ 2 cm, as measured by multi-slice spiral CT	55	51
Zhanget al, 2019 ¹²	China	Prospective RCT	Unblinded	2 years	3 months	Patient with lower calyceal stones of 1–2 cm were enrolled into the study, and the stones were measured by multi-slice spiral CT	60	60
Shabana et al, 2021 ¹³	Canada	Cohort Retrospective	Unblinded	1 years	3 months	Patient with solitary lower calyx renal stone 1 - 2 cm in size	60	60
Koyuncu et al, 2015 ¹⁴	Turkey	Cohort Retrospective	Unblinded	3 years	3 months	Patient with lower pole stones size ≥ 2 cm	77	32
Jung et al, 2015 ¹⁵	Korea	Cohort Retrospective	Unblinded	4 years	12 months	Patients with a main stone sized 1.5 to 3.0 cm located in the lower-pole calyx	44	44
Total							637	604
							1241	



Outcome characteristics of the included studies

Total participants in 10 included studies are 1,241 participants with lower pole calyx stone size 1.0 – 3.0 cm undergo PCNL (n = 637) and FURS (n = 604) procedure. In this systematic review, outcome assessed out of those 2 procedure are stone free-rate, operative time, hospital stay, and complication. Detailed result of assessed outcome in this study summarized in Table 2.

Stone Free Rate

Out of 10 studies included, 9 studies reported stone free rate following PCNL or FURS procedure interventions. Most studies defined the stone free status as no stone detected by image studies after a median post-intervention follow-up of 3 months as presented in Table 1. Stone free rate in 9 studies after PCNL procedure range around 83.3% - 98.3% and after FURS procedure range around 78.6% - 93.2%.⁷⁻¹⁵ Our review found out that PCNL procedure has highest stone free rate (98.3%)¹² and FURS procedure has lowest stone free rate (78.6%)⁷. Out of 9 studies, 6 studies shown higher stone free rate by PCNL procedure compared against FURS procedure.^{7,8,11-14} But we also found 2 studies shown higher stone free rate by FURS procedure and 1 studies that found similar stone free rate by PCNL and FURS procedure.

Operative Time

Out of 10 studies included, 9 studies reported operative time following PCNL or FURS procedure interventions. Operative time of 9 reported studies presented in Table 2. Operative time of PCNL procedure range around 46.2 + 24.3 to 85.5 + 41.1 minutes and operative time of FURS procedure range around 55.8 + 11.4 to 123.0 + 57.4 minutes^{6-9,11-15} Our review found out that PCNL procedure has shortest operative time (46.2 + 24.3 minutes),⁷ and FURS procedure has longest operative time (123.0 + 57.4 minutes).¹⁵ Out of 9 studies, 7 studies shown shorter operative time by

PCNL procedure compared against FURS procedure.^{7-9,11-14} But we also found 2 studies shown shorter operative time with FURS procedure.^{6,13}

Hospital Stay

Out of 10 studies included, 8 studies reported hospital stay following PCNL or FURS procedure interventions. Hospital stay of 8 reported studies presented in Table 2. Hospital stay of PCNL procedure range around 0.3 + 0.04 to 5.3 + 1.20 days and hospital stay of FURS procedure range around 0.16 + 0.04 to 3.2 + 0.52 days^{6-9,12-15} Our review found out that FURS procedure has shortest hospital stay duration (46.2 + 24.3 days),¹³ and PCNL has longest hospital stay duration (5.3 + 1.20 days).¹⁵ All of 8 studies shown shorter hospital stay duration with FURS procedure compared against PCNL procedure.^{6-9,12-15}

Complications

Out of 10 studies included, 9 studies reported complications following PCNL or FURS procedure interventions. Most studies defined the complications as any intra-operative and post-operative minor and major complications, some studies also used Clavien-Dindo complications grade classification. Over-all complication of 9 studies reported presented in Table 2. Complications rate in 9 studies after PCNL procedure range around 4.4% - 25% and after FURS procedure range around 4.6% - 21.6%.^{6-9,11-15} Our review found out that PCNL procedure has highest complications rate (72%)⁹ and also lowest complications rate (4.4%)⁷. Out of 9 studies, 6 studies shown lower complications rate with FURS procedure compared against PCNL procedure.^{6,8,9,12,13,15} But we also found 3 studies shown lower complications rate with PCNL.^{7,11,14}



Table 2. Outcome assessed of PCNL compared with RIRS on lower pole calyx stone patient of the included studies.

Studies	Outcome							
	PCNL				FURS			
	Stone-Free Rate	Operative Time	Hospital Stay	Complications	Stone-Free Rate	Operative Time	Hospital Stay	Complications
Bozzini et al, 2017 ⁶	-	72.3 ± 13.8	3.7 ± 1.5	35/181 (19.3%)	-	55.8 ± 11.4	1.3 ± 0.4	30/207 (14.5%)
Armagan et al, 2015 ⁷	60/68 88.2%	46.2 ± 24.3	1.4 ± 0.72	3/68 (4.4%)	44/59 (78.6%)	60.1 ± 26.2	0.96 ± 2.4	8/59 (13.6%)
Kirac et al, 2013 ⁸	33/37 89.1%	53.7 ± 14.5	1.8 ± 0.57	6/37 (16.2%)	32/36 (88.9%)	66.4 ± 15.8	1.02 ± 0.19	4/36 (11.1%)
Coskun et al, 2021 ⁹	17/25 68%	71.7 ± 24.4	4.6 ± 3.5	18/25 (72%)	17/25 (68%)	72.8 ± 24.2	1.2 ± 0.59	3/25 (12.0%)
Kandemir et al, 2017 ¹⁰	25/30 83.3%	-	-	-	26/30 (86.6%)	-	-	-
Fayad et al, 2017 ¹¹	51/55 92.7%	71.7 ± 10.4	-	5/55 (9.1%)	43/51 (84.3%)	109.7 ± 20.8	-	5/51 (9.8%)
Zhang et al, 2019 ¹²	59/60 98.3%	68.6 ± 15.8	5.3 ± 1.20	10/60 (16.7%)	55/60 (91.7%)	93.4 ± 21.6	3.2 ± 0.52	6/60 (10%)
Shabana et al, 2021 ¹³	55/60 91.6%	68.2 ± 6.2	0.3 ± 0.04	15/60 (25%)	49/60 (81.7%)	54 ± 10.3	0.16 ± 0.04	13/60 (21.6%)
Koyuncu et al, 2015 ¹⁴	74/77 96.1%	62.5 ± 20.7	2.4 ± 0.49	5/77 (6.5%)	29/32 (90.6%)	67.5 ± 22.34	1.09 ± 0.29	3/32 (9.4%)
Jung et al, 2015 ¹⁵	37/44 84.1%	85.5 ± 41.1	3.9 ± 1.7	7/44 (15.9%)	41/44 (93.2%)	123.0 ± 57.4	2.0 ± 2.6	2/44 (4.6%)

Discussion

Currently, the management of lower pole stones includes watchful waiting, flexible ureterorenoscopy (FURS), and percutaneous nephrolithotripsy (PCNL).^{1,2,3} Choosing between FURS and PCNL sometimes depend on patient individual circumstances. Our systematic review tried to found out better procedure for patient with lower pole calyx renal stone.

Study findings of our study in line with other systematic review and meta-analysis study by Donaldson et al. that also mention PCNL has higher stone free rate compared against FURS. We also found indication that PCNL procedure shown shorter operative time compared against FURS procedure in some studies we reviewed, but FURS procedure shown shorter hospital stay duration and lower complications rate compared against PCNL procedure. So our systematic review study found out that PCNL and FURS procedure both

have their own benefit for the patient, but further analysis through meta-analysis study still needed to calculate more objective result and interpretation of the benefit between those two procedure.

Conclusions

Most of studies that included in this systematic review shown that PCNL procedure have higher stone free rate, shorter operative time, longer hospital stay and higher complications rate compared against FURS procedure.

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