



## SYSTEMATIC REVIEW

# Outcome and safety of upper pole versus non-upper pole single puncture PCNL for staghorn stones: a systematic review and meta-analysis [version 1; peer review: 2 approved with reservations]

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## Abstract

**Background:** Staghorn stones are mostly treated by percutaneous nephrolithotomy (PCNL), either with an upper-pole (UP) or non-upper (lower- or middle-) pole (NP) approach. NP access has a lower risk of bleeding and thoracic complications but may not be sufficient for complete stone clearance. UP access is advocated as the preferred approach, because of direct access to the collecting system. However, it is associated with a higher complications rate, including pneumothorax and hydrothorax, and a higher risk of bleeding. This meta-analysis aimed to describe the outcomes and safety of PCNL for staghorn stones using UP and NP approaches.

**Methods:** A systematic literature review was conducted using several databases such as: PubMed; EBSCO; Science Direct; Cochrane and Google Scholar. Data from all selected articles were extracted by two independent reviewers. Relevant parameters explored using Review Manager V5.3.

**Results:** Five comparative studies of staghorn stones involving 384 renal units were analyzed; 176 cases used the UP approach and 208 the NP approach. There was no significant difference in stone-free rate between these approaches, with 74.4% undergoing the UP approach and 71.1% the NP approach considered stone-free (OR: 1.55; 95% CI: 0.92-2.63; P=0.10). The rate of thoracic complications (hydrothorax and pneumothorax) did not differ significantly (OR: 3.14; 95% CI: 0.63-15.62; P=0.16). However, we noted that 5 of 176 patients that underwent the UP approach experienced thoracic complications. The incidence of post-procedural fever and sepsis is similar (OR: 1.18; 95% CI: 0.52-2.64; P=0.69). Neither post-procedural urine leakage (OR: 2.03; 95% CI: 0.70-5.85; P=0.19) nor requirement of blood transfusions (OR: 0.49; 95% CI: 0.14-1.76; P=0.27) differed significantly.

**Conclusion:** PCNL with UP access for staghorn stone has a similar stone-free rate to the NP approach. Thoracic complication rate which

## Open Peer Review

Approval Status

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was believed to be higher in the UP group is also deemed similar with NP access.

### Keywords

percutaneous nephrolithotomy, pcnl, upper pole access, lower pole access, staghorn stones

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## Introduction

Currently, percutaneous nephrolithotomy (PCNL) remains the mainstay of treatment of all type of renal calculi, with high a success rate and stone-free rate (SFR). The complication rate was notably low in this PCNL procedures compared with another procedure to treat any kind of renal stones. Thus, in the past few decades, nearly all open surgery for treating renal stones, whether simple stones or complex staghorn stones, have been changed to this minimally invasive procedure<sup>1</sup>.

For complex renal stones and staghorn stones, PCNL is the preferred surgical modality<sup>2</sup>. Modifications to the original technique aimed to increase both efficacy and safety of PCNL procedures to treat patients with large and complex renal stones. There are three approaches to perform PCNL for renal stones: lower pole (LP) access, middle pole (MP) access and upper pole (UP) access. The traditional LP access has been proved as the safest approach for renal collecting system access, with a lower risk of bleeding and other thorax-related complications (either hydrothorax or pneumothorax)<sup>3</sup>. However, on the other hand, this LP approach may not be sufficient for complete stone clearance in patients with complex or staghorn renal stones as well as proximal ureteral stones<sup>4,5</sup>. Due to this reason, UP access is advocated as the preferred PCNL approach for complex and staghorn renal stones. PCNL with UP access is considered to allow a higher stone-free rate due to its direct access to the intrarenal collecting system, fewer punctures and less manipulative trauma compared to LP access. However, this UP approach has a notable deficiency. UP access is believed to be associated with a higher complication rate, which is mainly related to thoracic and abdominal complications, particularly when the puncture is done above the 11<sup>th</sup> rib. We designed this meta-analysis to systematically describe the outcomes and complications of PCNL for staghorn stones in upper and non-upper pole (lower and middle) approach.

## Methods

### Search strategy

A systematic literature review was performed in August to September 2018 using several electronic databases such as: PubMed; EBSCO; Science Direct; and Cochrane to identify any relevant studies. The keywords used for this searching process were (percutaneous nephrolithotomy OR percutaneous

nephrolithotomies OR pcnl) AND (lower pole puncture OR lower pole access) AND (upper pole puncture OR upper pole access OR supracostal puncture) AND (nephrolithiasis OR urinary calculi OR renal stone OR complex urinary calculi OR staghorn stone). All keywords used were searched for their respective MeSH thesaurus (Table 1). This data searching process was not limited by date of publication, and we only included full-text articles in English. Article selection was done according to the search strategy recommended by PRISMA (a completed PRISMA checklist is available on Open Science Framework<sup>6</sup>). Only studies comparing UP access PCNL and LP access PCNL for complex and staghorn renal stones were assessed for further analysis. Participants were men and women above 18 years old with staghorn stones. Studies with paediatric subjects, patients with congenital kidney anomalies, patients with bleeding diathesis and patients with non-staghorn kidney stones were excluded from this review. PCNL procedures requiring multiple access also excluded from this study. Data from all selected articles were extracted independently by two reviewers. Any disagreements were solved by consensus. Relevant parameters were explored using Review Manager V5.3.

### Types of studies

This review used all comparative studies of UP access PCNL compared to NP access (either LP or MP access) PCNL for patients with staghorn stones. Only full-text studies were included. Unpublished articles and abstracts were excluded from the study.

### Types of interventions

Interventions used in this study was single access UP approach PCNL compared to single-access NP approach PCNL. Type of differences of lithotripsy technique, anesthesia procedures and either pre or postoperative medications were not analyzed, which was considered as a limitation of this study.

### Types of outcome measures

The primary outcome of intervention was the SFR in each group. We also analyzed perioperative and postoperative outcome, operation duration, hospital length of stay, and hemoglobin decrement. Complications rate for both groups including, pneumothorax or hydrothorax, blood transfusion requirement, postoperative fever or sepsis; and persistent urinary leakage were noted.

**Table 1. Database, search terms and number of articles retrieved.**

Database	Search strategy	Hits
PubMed	(((((percutaneous nephrolithotomy [All Fields] OR percutaneous nephrolithotomies [All Fields] OR pcnl [All Fields])) AND (lower pole puncture OR lower pole access)) AND (upper pole puncture OR upper pole access OR supracostal puncture)) AND (nephrolithiasis OR urinary calculi OR renal stone OR complex urinary calculi OR staghorn stone OR complete staghorn stone)	41
Cochrane	(percutaneous nephrolithotomy OR percutaneous nephrolithotomies OR pcnl) AND (lower pole puncture OR lower pole access) AND (upper pole puncture OR upper pole access OR supracostal puncture) AND (nephrolithiasis OR urinary calculi OR renal stone OR complex urinary calculi OR staghorn stone)	0
ScienceDirect	Idem Cochrane	35
EBSCOhost	Idem Cochrane	39

### Assessment of bias and statistical analysis

This study used Cochrane Risk of Bias assessment tools to assess interventional study's quality. These assessments were done by two authors independently. Quantitative synthesis of included studies was done using Review Manager 5.3. Odds ratio (OR) and 95% confidence intervals (CIs) were calculated for binary variables. Heterogeneity of studies was assessed using  $\chi^2$  and  $I^2$ . Fixed-effect models were used for homogenous data, and random effects analysis was considered for heterogeneous data. Forest plots were used to present meta-analysis results.

### Results

Three prospective and two retrospective comparative studies involving 384 renal units with staghorn stones (Figure 1 contains

a flow diagram), with 176 cases done using the UP approach and the other 208 cases using either lower or middle pole approaches. In this present time there was no randomized controlled study that comparing upper and lower pole approach PCNL for staghorn stone. Study characteristics are shown in Table 2.

### Quality of the studies

Quality of the studies is shown in Table 3. Three of five had 8 stars<sup>2,7,8</sup>, one study<sup>9</sup> had 7 stars, and one had 6 stars.

### Synthesis of results

All of 384 patients whom underwent PCNL procedures were included in the analysis of stone-free rate. A total of 131 out of 176 staghorn stones patients treated with UP approach PCNL

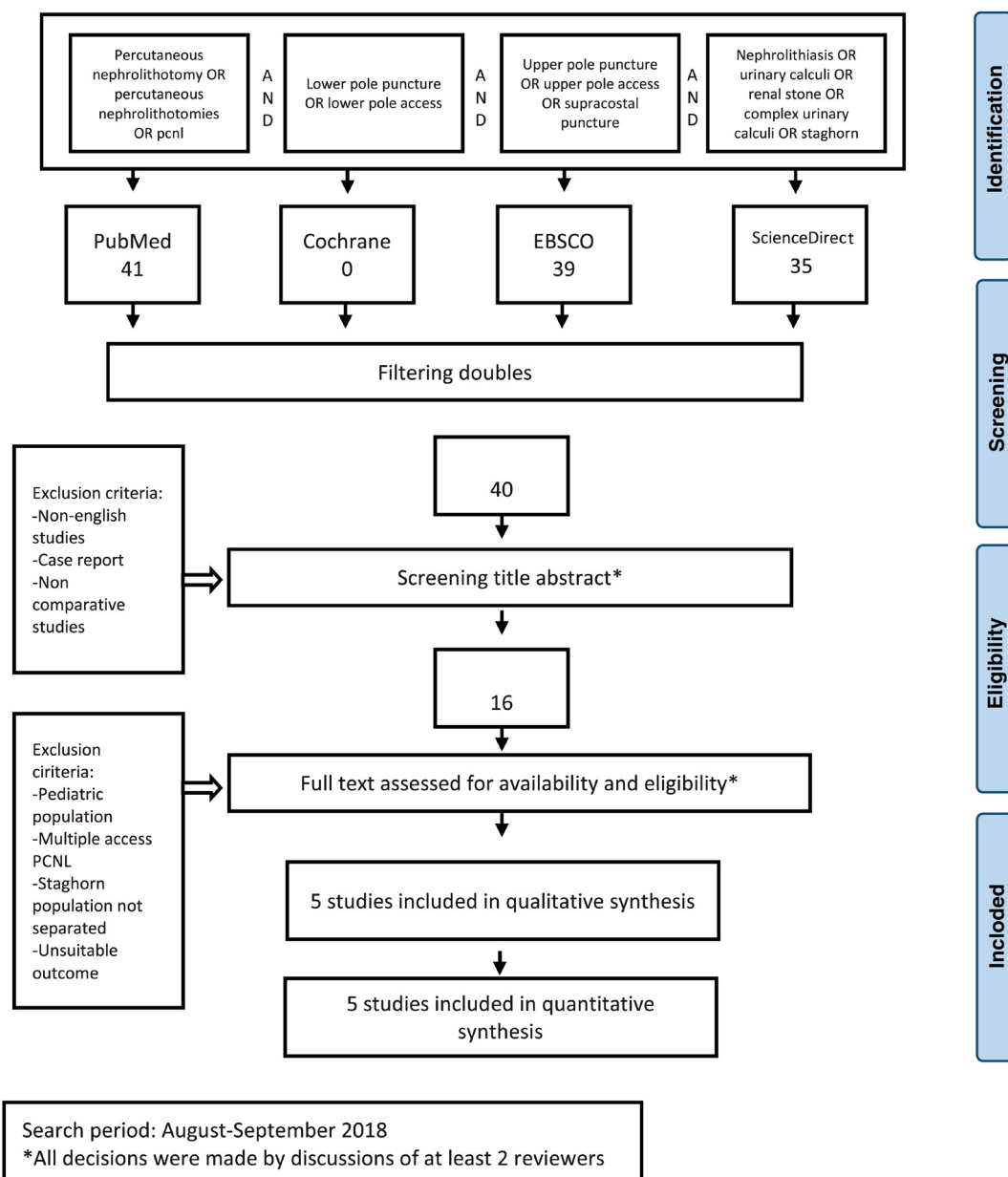


Figure 1. Study flow diagram.

**Table 2. Characteristics of studies.**

No	Study	Type of study	Group	No. cases	Age (mean)	Stone free (%)	Length of hospital stay (days)	Operative duration (min)	Estimated blood loss (ml)	Haemoglobin decrement (g/dL)	Hydrothorax or pneumothorax (%)	Fever and sepsis (%)	Required transfusions (%)	Pelviccalyceal tear (%)	Urine leakage (%)
1	Wong <i>et al.</i> (2002)	Retrospective study	Upper pole access	35	52 (25-85)*	18 (52.0)					1 (3.8)				
			Middle pole access	4			2.0 (1.0-10.0)*	174.0 (120.0-210.0)**	238 (50-800)**	1.2	0	NA	1 (2.2)	NA	NA
			Lower pole access	6		4 (40.0)					0				
2	Aron <i>et al.</i> (2004)	Prospective study	Upper pole access	69	NA	60 (87.0)		48.0 (35.0-60.0)**		6.0 (4.0-8.0)**	2 (2.9)	5 (7.2)			
			Lower pole access	33	NA	26 (79.0)	NA	74.0 (50.0-90.0)**	NA	6.5 (4.0-8.0)**	0	3 (9.1)	NA	NA	NA
3	Netto <i>et al.</i> (2005)	Retrospective study	Upper pole access	16	33	14 (87.5)	3.0 (2.0-5.0)**	86.8 (37.0-187.0)**		NA	1 (6.2)	0	2 (12.5)		4 (25)
			Middle / lower pole access	70	42.7	56 (80.0)	3.5 (1.0-10.0)**	139.1 (15.0-360.0)**	NA	NA	0	1 (1.4)	10 (14.3)	NA	15 (21.4)
4	Singh <i>et al.</i> (2015)	Prospective study	Upper pole access	43	39.84 ± 10.42	30 (69.8)	4.74 ± 1.33	71.70 ± 8.53		1.64 ± 0.59	1 (2.33)	9 (20.93)	1 (2.33)	2 (4.65)	NA
			Lower pole access	51	39.53 ± 10.423	28 (54.9)	4.69 ± 1.32	73.02 ± 8.86	NA	1.56 ± 0.53	0	8 (15.69)	5 (9.8)	5 (9.8)	
5	Blum <i>et al.</i> (2018)	Prospective study	Upper pole access	13	57 (16-84)*	9 (68.2)	126.0 (71-333)*	126.0 (71.0-333.0)*	15 (5-415)*	1.3 (0.2-5.3)**	0	0	0	NA	2 (15.38)
			Lower pole access	44	57 (24-79)*	34 (77.3)	1.0 (1.0-35.0)*	112.0 (58.0-285.0)*	10 (5-100)*	1.25 (0.2-53.4)**	0	1 (2.27)	0		0

\* median (range)

\*\* mean (range)

**Table 3. Quality of the included studies.**

No.	Author(s)	Selection				Comparability	Outcome			Total	Quality
		Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at the start of the study		Assessment of outcome	Was follow-up long enough for outcomes to occur	Adequacy of follow-up of cohorts		
1	Wong <i>et al.</i> <sup>9</sup>	Truly representative	Drawn from the same community as the exposed cohort	Secure record	Yes	Cohorts are not comparable on the basis of the design or analysis controlled for confounders	Record linkage	Yes	Complete follow-up	7	Good
2	Aron <i>et al.</i> <sup>10</sup>	Truly representative	Drawn from the same community as the exposed cohort	No description	Yes	Cohorts are not comparable on the basis of the design or analysis controlled for confounders	Record linkage	Yes	Complete follow-up	6	Good
3	Netto <i>et al.</i> <sup>7</sup>	Truly representative	Drawn from the same community as the exposed cohort	Secure record	Yes	Cohorts are not comparable on the basis of the design or analysis controlled for confounders	Record linkage	Yes	Complete follow-up	8	Good
4	Singh <i>et al.</i> <sup>8</sup>	Truly representative	No description of the derivation of the non exposed cohort	Secure record	Yes	Cohorts are not comparable on the basis of the design or analysis controlled for confounders	Record linkage	Yes	Complete follow-up	8	Good
5	Blum <i>et al.</i> <sup>2</sup>	Truly representative	No description of the derivation of the non exposed cohort	Structured interview	Yes	Cohorts are not comparable on the basis of the design or analysis controlled for confounders	Record linkage	Yes	Complete follow-up	8	

were stone-free (74.4%), compared to 148 from 208 stag-horn patients (71.1%) in NP approach PCNL (OR: 1.55; 95% CI: 0.92-2.63;  $P=0.10$ ) (Figure 2). Because of homogenous data ( $I^2=0\%$  and  $P=0.78$ ) we performed fixed effect measure for this quantitative analysis.

### Operation duration

Three<sup>7,8,10</sup> out of the four studies<sup>2,7,8,10</sup> demonstrated longer operative duration in those who underwent UP access than in NP access. The longest median operative duration was found in those who underwent MP/LP access in the study conducted by Netto *et al.*<sup>7</sup>, which was 139.1 minutes (15.0–36.0), whereas the shortest duration was in the UP access group in the study conducted by Aron *et al.*<sup>10</sup>, which was 48.0 minutes (35.0–60.0).

### Length of hospital stay (LOS)

Three studies<sup>2,7,8</sup> demonstrated similar mean or median LOS between both groups. Singh *et al.*<sup>8</sup> found the longest mean LOS ( $4.74 \pm 1.33$  vs.  $4.69 \pm 1.32$  days in the UP and LP access group, respectively) among the other studies, while the shortest median LOS was in the study conducted by Blum *et al.*<sup>2</sup> (1 [1-21] vs. 1 [1.0-35.0] days in the UP and LP access group, respectively).

### Hydrothorax or pneumothorax

Among the 176 cases of UP access PCNL, 5 (2.8%) had either hydrothorax or pneumothorax. None of the patients in the NP access group experienced this complication. In spite of this data, our quantitative analysis for this subgroup noted that there was no significant difference of thoracic complications rate between patients that underwent UP and those undergoing NP (OR: 3.14; 95% CI: 0.63-15.62;  $P=0.16$ ) (Figure 3). Because of non-heterogenous ( $I^2=0\%$  and  $P=0.71$ ) data, we used fixed-effect analysis.

### Fever or sepsis

In total, 14 of the 141 patients in the UP access PCNL group (9.9%) experienced either fever or sepsis, while 13 of the 98 NP access group (6.5%) experience the same condition postoperatively. From Figure 4 we can see that there was no significant difference in incidence fever or sepsis between these two groups of patients (OR: 1.18; 95% CI: 0.52-2.64;  $P=0.69$ ). We used fixed-effect analysis to analyze this homogenous data ( $I^2=0\%$  and  $P=0.93$ ).

### Hemoglobin decrement

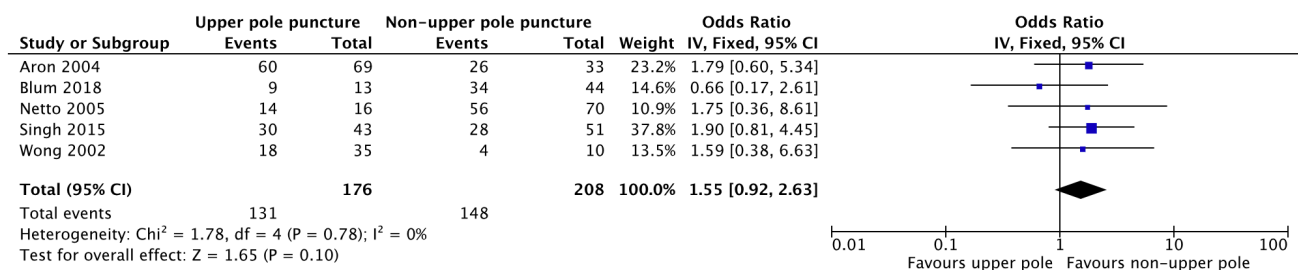
Three studies<sup>2,8,10</sup> demonstrated similar median LOS between both groups. The highest hemoglobin decrement was noticed in the study conducted by Aron *et al.*<sup>10</sup>. They found that the patient whom underwent UP- and LP-access PCNL had median hemoglobin decrement of 6.0 (4.0-8.0) and 6.5 (4.0-8.0), respectively.

### Blood transfusions

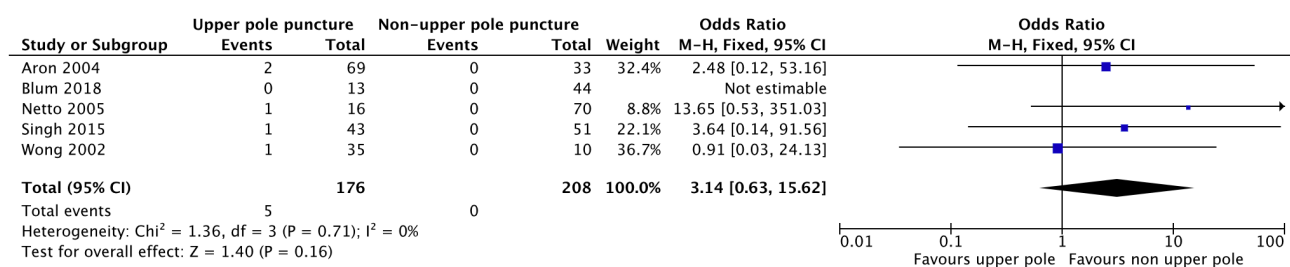
A total of 18 out of the 180 patients in both groups included in this subgroup analysis underwent blood transfusion after PCNL procedure. Of the 59 patients that underwent UP access PCNL, 3 required a blood transfusion (5.1%), while 15 of 121 patients from NP access procedure required post-procedural blood transfusions (12.4%). Although from this review we can see that NP has a notably higher requirement of blood transfusions, meta-analysis found that there was similar rate of blood transfusions requirement from both groups of patients (OR: 0.49; 95% CI: 0.14-1.76;  $P=0.27$ ) (Figure 5). Because of homogenous data ( $I^2=0\%$  and  $P=0.32$ ), we performed fixed-effect analysis.

### Persistent urinary leakage

A total of 21 patients out of 143 patients in both groups included in this subgroup analysis experienced persistent urinary leakage



**Figure 2.** Stone free rate in upper pole versus non-upper pole access percutaneous nephrolithotomy.



**Figure 3.** Thoracic complication rate in upper pole versus non-upper pole access percutaneous nephrolithotomy.

after the PCNL procedure. In total, 6 of 29 patients (20.7%) from UP access PCNL and 15 of 114 patients (13.1%) from the NP-access procedure experienced persistent urinary leakage. Although from this review we can see that the UP-access group has a notably higher urinary leakage incidence, meta-analysis found that there was similar rate of this complication from both groups of patients (OR: 2.03; 95% CI: 0.70-5.85;  $P=0.19$ ). Due to heterogeneous data ( $I^2=62\%$  and  $P=0.10$ ), we applied random-effect model (Figure 6).

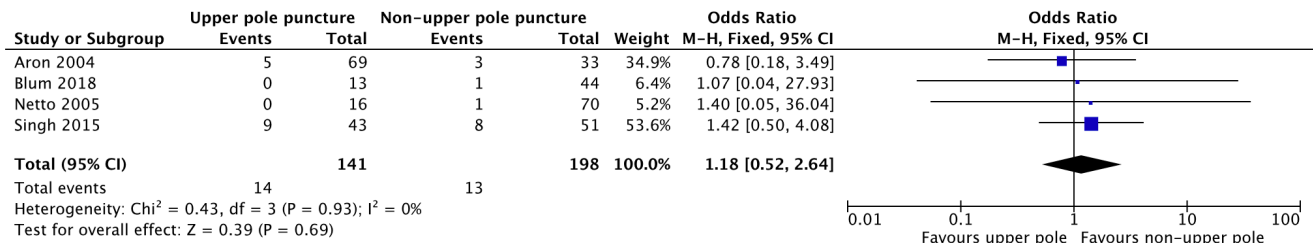
### Overview of results

There was a similar SFR between the UP and NP approaches, with 74.4% and 71.1% of PCNL procedures with UP and NP access, respectively, were considered successful after a single procedure (OR: 1.55; 95% CI: 0.92-2.63;  $P=0.10$ ). Incidence of thoracic complications such as hydrothorax and pneumothorax were also similar between the two groups (OR: 3.14; 95% CI: 0.63-15.62;  $P=0.16$ ). However, we noted that 5 of 176 patients with upper pole approach experienced thoracic complications. On the contrary, none of the patients with LP approach had these events. The incidence of post-procedural fever and sepsis is similar between these two groups of patients (OR: 1.18; 95% CI: 0.52-2.64;  $P=0.69$ ). We also found that neither

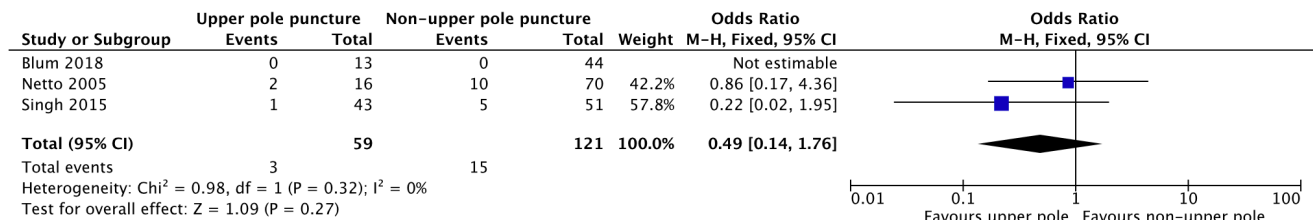
post-procedural urine leakage (OR: 2.03; 95% CI: 0.70-5.85;  $P=0.19$ ) nor requirement of transfusions (OR: 0.49; 95% CI: 0.14-1.76;  $P=0.27$ ) differs significantly between these two approaches.

### Discussion

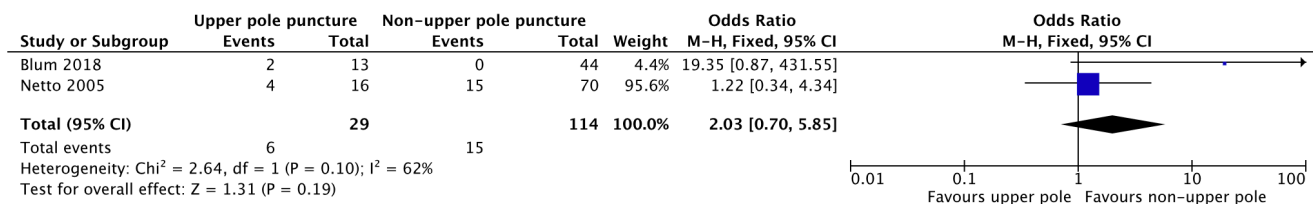
For patients with staghorn renal calculi, PCNL is the preferred modality of treatment. A successful PCNL procedure requires optimal placement of the percutaneous renal access, thus providing good access for intrarenal stone clearance procedure<sup>11</sup>. Currently UP access and LP access are the two favored approaches to performed PCNL in patients with staghorn calculi<sup>2</sup>. The current consensus among endourologist is that a prone position PCNL procedure, which done through posterior calyx approach, will give highly limited access to the upper calyx. Because of this reason, upper calyx approach was the preferred procedure to treat large and complex staghorn stones. Upper calyx access provides direct access down to most renal calyces and the ureter, and most of middle calyces can be accessed with the UP calyx approach, with the usage of flexible nephroscope. Previous literature show that the usage of UP calyx approach in patients with staghorn renal calculi will result in satisfying SFRs, less access punctures in PCNL, and less renal tissue trauma due to minimal intrarenal manipulation compared to LP



**Figure 4.** Fever or sepsis frequency in upper pole versus non-upper pole access percutaneous nephrolithotomy.



**Figure 5.** Blood transfusions in upper pole versus non-upper pole access percutaneous nephrolithotomy.



**Figure 6.** Urine leakage in upper pole versus non-upper pole access percutaneous nephrolithotomy.

access<sup>7,12–14</sup>. Mostly, the UP calyx approach is done in a supracostal fashion, which results in markedly higher rates of thoracic and other complication, such as pneumothorax and hydrothorax as well as higher risk of bleeding, especially with punctures access that made above the 11<sup>th</sup> rib<sup>7,12–20</sup>. However, despite the high risk of complications explained above, evidence suggests the use of the UP approach, as the higher SFR and better access to multiple calyces overshadows the drawbacks of this procedure<sup>7,14,21</sup>. Nevertheless, this approach should be limited to cases when there is no other available alternative. Performing LP access maybe result in decreased risk of complications, but a complete stone-free condition in some complex upper calyx calculi is limited because of limitations to the LP approach of upper calyx access<sup>22</sup>.

To completely eliminate calculi with PCNL, good access is mandatory. Ideally, PCNL access tract should provide the shortest and most straight access to mostly of the renal stones. Calculi in a single inferior calyx can be easily removed through a single LP calyx access tract. However, for complex and staghorn calculi occupying several calices in the lower pole, access through the superior calyx is thought to be beneficial<sup>10</sup>. In the present meta-analysis, of 5 studies involving 384 renal units, we did not find a significant difference in SFRs between these approaches, with SFRs of 74.4% for the UP approach and 71.1% for the NP approach (OR: 1.55; 95% CI: 0.92–2.63; P=0.10). This suggests that in staghorn calculi patients, SFRs for the UP access approach is similar to those for the NP access approach. This result is probably different from other studies<sup>12,13</sup>, maybe because we analyzed single access PCNL in patients with staghorn calculi only, while the majority of other studies rarely analyzed staghorn stone or single access PCNL alone. The advantage of UP access is its naturally direct access to the intrarenal collecting system and to the upper ureter<sup>23</sup>. Because of the linear position of the upper pole with the ureteropelvic junction, intraoperatively the PCNL wire will enter into ureter in the majority of cases. Excellent visualization of the superior calyx, pelvis, and the anterior and posterior inferior calyces of the kidney will be provided by the straight tract along the long axis of the kidney. This condition will make it easier to move and manipulate the nephroscope and forceps thus will reduces the possibility of intraoperative bleeding<sup>11</sup>. PCNL access through UP calyx is one of the most important way of ensuring better renal calculi clearance. This access can be done with either supracostal or infracostal approaches<sup>23</sup>. LP calyx is located in the lateral and anterior portion of kidney, meanwhile UP calyx is located in the medial posterior portion of the kidney. From this anatomical mapping, we can see that in patient placed in prone position the puncture access along with the kidney axis that performed from the posterior area is more effective and useful compared to anterior approach. Lower pole access approach has limited accessibility, particularly compared to the UP approach, to the visualize complete intrarenal collecting system in prone-position patients. A PCNL access through the lower pole calyx will form a more acute angle compared to upper pole calyx access due to the anatomical position of the kidney that has been stated above. Nevertheless, in some circumstances that PCNL in UP access is difficult to achieve, than a more lateral fashion of lower calyx access can also facilitate a wider angle of intrarenal access<sup>22</sup>.

The most common reason to perform LP approach is to minimize complications caused by the UP approach<sup>2</sup>. However, although studies have shown that UP is associated with intrathoracic complications, we found that the rate of thoracic complications (hydrothorax and pneumothorax) did not differ between both groups (OR: 3.14; 95% CI: 0.63–15.62; P=0.16). Although previous studies demonstrated an increasing risks of intrathoracic and other complications associated with an upper pole access<sup>24,25</sup>, in recent years these kind of complications have decreased exponentially in adult patients whom undergo PCNL for renal calculi<sup>23,24</sup>. Furthermore, even if these thoracic complications did occur, the majority of patients that experienced these complications will recover either spontaneously or by simple intervention with minimal future comorbidity<sup>26</sup>.

With these advantages, UP access is usually used as the preferred approach in selected patients with complex or staghorn renal calculi which need more than one intrarenal access. It has also been suggested that UP access is associated with increased bleeding. However, higher intraoperative bleeding in PCNL with UP access has been reported previously<sup>11</sup>. But in this present meta-analysis, we did not find an increased requirement of blood transfusions in those whom undergoing PCNL with UP approaches (OR: 0.49; 95% CI: 0.14–1.76; P=0.27). Oner *et al.*<sup>27</sup> performed 1750 PCNL procedures and found that upper calyx access is associated with a lower blood transfusion requirement and easier guidewire placement to the ureter, easier tract dilatation, and more comfortable manipulation. This suggests that UP access should be used if it facilitates stone clearance.

This meta-analysis found that there was no significant difference in terms of SFR and complications between staghorn calculi patients those underwent single UP-access PCNL and single NP-access PCNL. However, this study only included data with single PCNL access and there are only a few studies included in the present analysis. We suggest further multicenter randomized controlled trials are required to compare safety and efficacy of UP-access and NP-access PCNL for staghorn calculi patients.

## Conclusions

The present analysis found that PCNL with single UP access has similar SFR and complication rates compared to single NP approach PCNL. Further randomized clinical trials are required to compare safety and efficacy of UP-access and NP-access PCNL.

## Data availability

### Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

## Reporting guidelines

Open Science Framework: PRISMA checklist for “The outcome and safety of upper pole vs non-upper pole single puncture PCNL for staghorn stones: a meta-analysis”. <https://doi.org/10.17605/OSF.IO/DEU6P6>.

## Grant information

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# Open Peer Review

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Version 1

Reviewer Report 06 November 2020

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**Charles U. Nottingham**

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Introduction:

1. The phrasing of the first sentence has awkward phrasing and should be reworded.
2. Authors should clarify that the published data actually demonstrating these complications of UP access is actually very limited, although we in the urology community continue to restate this.

Methods:

- First paragraph of the Methods section states that only UP and LP access locations were compared, but later in this section and elsewhere in the manuscript it states that NP includes but UP and MP. Please clarify if MP access locations were included.

Results:

- "Hemoglobin decrement" section states "similar median LOS", but probably should read "similar median hemoglobin decrement". Please clarify.

Discussion:

1. First paragraph states that the prone position with posterior calyx "will give highly limited access" to the upper calyx. Did you mean to state that it gives optimal access, given that the next sentence states that UP is "preferred"?
2. Authors cite references 7 and 12-20 to describe rates of UP pneumothorax and hydrothorax in published series. However this is a large range of variability of these complications. It would be helpful for the authors to state this range in the reported rates of these complications to the reader, and they should highlight this high variability.
3. The authors state in the Introduction and Discussion that UP has higher reported rates of bleeding than LP, but they also cite examples of LP access having higher rates of bleeding. The authors should correct this phrasing to at least state that there is variability in reports of bleeding complications for LP vs UP. The authors should provide potential explanations for bleeding complication with certain types of access such as the potentially higher likelihood of liver or splenic injury with LP access.

4. Do the authors think it is UP vs NP, or supracostal vs subcostal, which is the true determinant of thoracic/pleural complications? See Lang Reference.
5. The authors need to review more of the limitations of this study. Keep in mind that many if not all of these studies included will have a surgeon selection bias regarding who received UP vs NP punctures. The surgeon will make a judgement as to the optimal access intraoperatively based on experience and impression of the patient's anatomy, and this likely has a significant impact on the complication rate. Things such as this should be acknowledged.

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### Are the rationale for, and objectives of, the Systematic Review clearly stated?

Yes

### Are sufficient details of the methods and analysis provided to allow replication by others?

Yes

### Is the statistical analysis and its interpretation appropriate?

Yes

### Are the conclusions drawn adequately supported by the results presented in the review?

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Medical and surgical management of nephrolithiasis. Medical and surgical management of LUTS due to enlarged prostate.

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Reviewer Report 29 April 2019

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**Tuo Deng**

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This study aimed to compare the effect and safety of upper pole and non-upper pole single puncture PCNL for treating staghorn stones through a meta-analysis. Five comparative studies were included in this meta-analysis, and the authors found that these two approaches have similar SFR and complication rate. This study is of interest, but I still have some major concerns about it.

1. This study aimed to compare the upper pole and non-upper pole approaches, but the searching keywords only contained “lower pole” and “upper pole”, so how about the middle pole?
2. In the Methods section, the authors did not describe how they extracted the data from eligible studies, and how did the authors deal with the missing data?
3. The Cochrane Risk of Bias assessment tools are used to assess the quality of RCTs, but the included studies in this meta-analysis were not RCTs; in addition, the contents of Table 3 seemed to be the Newcastle-Ottawa Scale, but not Cochrane Risk of Bias assessment tools; please explain it.
4. In the statistical analysis parts, the authors should define the details about the existence of heterogeneity, such as the  $I^2 > 50\%$  and  $P < 0.10$ .
5. In the flow diagram of study selection, the detailed number of excluded studies should also be indicated with the specific reasons.
6. In Table 2 of characteristics of studies, detailed study designs of included studies should be indicated, such as RCT, cohort or case-control studies, but not only the description of retrospective or prospective.
7. Table 2 should describe the baseline characteristics of all eligible studies, such as the study population, study design, gender of patients, stone size, follow-up time, and so on; but not the list of study outcomes. This is because we should first make sure the baseline characteristics of each study were comparable, then we can pool the outcomes.
8. In this study, only binary variables were pooled, and the continuous variables were compared using mean and SD. Actually, the continuous variables could also be pooled using RevMen.
9. In Figure 2, the left side of the forest plot should be “Favours non-upper pole”, but not “Favours upper pole”.
10. Is the definition of SFR the same in all included studies? And what’s the definition of SFR in this meta-analysis? What’s the time of SFR - one month or three months after operation?

11. The authors only compared the SFR and complication rate in this meta-analysis, how about the operation time and hospital stay time? These factors could also impact the recovery of patients.

12. The limitations of this meta-analysis should be pointed out in the Discussion section.

**Are the rationale for, and objectives of, the Systematic Review clearly stated?**

Partly

**Are sufficient details of the methods and analysis provided to allow replication by others?**

Partly

**Is the statistical analysis and its interpretation appropriate?**

Partly

**Are the conclusions drawn adequately supported by the results presented in the review?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Treatment of urinary stones.

**We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.**

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