SYSTEMATIC REVIEW

REVISED Supine versus prone position in percutaneous nephrolithotomy: a systematic review and meta-analysis [version 3; peer review: 2 approved]

Ponco Birowo[1], William Tendi[1], Indah S. Widyahening[2], Nur Rasyid[1], Widi Atmoko[1]

[1]Department Urology, Faculty of Medicine Universitas Indonesia / Cipto Mangunkusumo Hospital, Jakarta Pusat, DKI Jakarta, 10430, Indonesia
[2]Department of Community Medicine, Faculty of Medicine Universitas Indonesia, Jakarta Pusat, DKI Jakarta, 10430, Indonesia

v3 **First published:** 02 Apr 2020, **9**:231
https://doi.org/10.12688/f1000research.22940.1
Second version: 24 Aug 2020, **9**:231
https://doi.org/10.12688/f1000research.22940.2
Latest published: 15 Sep 2020, **9**:231
https://doi.org/10.12688/f1000research.22940.3

Abstract

Background: The decision for using supine or prone position in percutaneous nephrolithotomy (PCNL) is still debatable. The aim of this study is to compare the efficacy and safety profile of the supine and prone position when performing PCNL.
Methods: A systematic electronic search was performed using the database from MEDLINE, Cochrane library and Google Scholar from January 2009 to November 2019. The outcomes assessed were stone free rate, major complication rate, length of hospital stay and mean operation time.
Results: A total of 11 articles were included in qualitative and quantitative analysis. The efficacy of PCNL in supine position as determined by stone free rate is significantly lower than in prone position (OR: 0.74; 95% CI: 0.66 – 0.83; p<0.00001), However, major complication rate is also lower in the supine group compared with the prone group (OR: 0.70; 95% CI: 0.51 – 0.96; p=0.03). There is no statistically significant difference in the length of hospital stay and mean operation time between both groups.
Conclusion: Prone position leads to a higher stone free rate, but also a higher rate of major complication. Thus, the decision of using which position during PCNL should be based on the surgeon's experience and clinical aspects of the patients.

Keywords

Complication rate, Percutaneous nephrolithotomy, Prone, Stone free rate, Supine

Open Peer Review

Reviewer Status ✓ ✓

	Invited Reviewers	
	1	**2**
version 3 (revision) 15 Sep 2020	✓	✓ report
version 2 (revision) 24 Aug 2020		? report
version 1 02 Apr 2020	✓ report	? report

1. **Noor Buchholz**, U-merge Ltd. (Urology for Emerging Countries), London, UK
Andreas Bourdoumis, Pennine Acute Hospitals NHS Trust, Manchester, UK

2. **Mohammed S. ElSheemy**, Kasr Al-Ainy Hospitals, Cairo University, Cairo, Egypt

Any reports and responses or comments on the article can be found at the end of the article.

Corresponding author: Ponco Birowo (ponco.birowo@gmail.com)

Author roles: Birowo P: Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Visualization, Writing – Review & Editing; **Tendi W**: Data Curation, Formal Analysis, Investigation, Resources, Software, Validation, Visualization, Writing – Original Draft Preparation; **Widyahening IS**: Data Curation, Formal Analysis, Methodology, Supervision, Writing – Review & Editing; **Rasyid N**: Conceptualization, Formal Analysis, Methodology, Validation, Writing – Review & Editing; **Atmoko W**: Conceptualization, Data Curation, Formal Analysis, Methodology, Project Administration, Resources, Validation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

How to cite this article: Birowo P, Tendi W, Widyahening IS *et al.* **Supine versus prone position in percutaneous nephrolithotomy: a systematic review and meta-analysis [version 3; peer review: 2 approved]** F1000Research 2020, **9**:231 https://doi.org/10.12688/f1000research.22940.3

First published: 02 Apr 2020, **9**:231 https://doi.org/10.12688/f1000research.22940.1

REVISED **Amendments from Version 2**

In this version, we revised the manuscript in accordance with the reviewers' suggestions. In introduction section, we have revised the statement regarding the stone free rate, the risk of recurrence and the complication rate of PCNL and ESWL along with the original citation of the statement. In the method section, we have added a comment regarding the inclusion of case control study in the meta-analysis. In the result section, we have revised Figure 1 accordingly, and added a comment regarding the separate analysis of complication rate. Since Figure 1 is updated, we have revised the PRISMA file in our common database, which can be visited in the link: https://doi.org/10.17605/OSF.IO/GDH3R. Furthermore, we also revised the study characteristic table and separate the suggested details of each study included into Table 2 and Table 3 so that the table is not too large when combined. In addition, the discussion section has been re-arranged to be more logical and we also added more detail into the sections.

Any further responses from the reviewers can be found at the end of the article

Introduction

Nephrolithiasis is one of the most common urological diseases worldwide. It is defined as a condition where mineral deposits are found in the kidney, either free in the renal calyces and pelvis or attached on the renal papillae[1]. The prevalence is varied between regions, ranging between 7–13% in North America, 5–9% in Europe, and 1–5% in Asia[2]. The most common stone composition is calcium, comprising about 80% of all urolithiasis[3].

Depending on stone burden, the treatment of nephrolithiasis also has a wide range of options. Active management includes extracorporeal shockwave lithotripsy (ESWL), retrieval by ureteroscopy (URS), and percutaneous nephrolithotomy (PCNL). The current guideline generally recommends ESWL for smaller stones (up to 20 mm) and PCNL for larger stones (>20 mm) regardless of the location inside the kidney[4].

In addition, PCNL is also effective in treating rare stone cases such as calyceal diverticula stone[5]. Despite the efficacy, this procedure needs various preparations including the guiding system, the anesthesia, and the positioning of the patient[6]. The conventional position of PCNL is prone, which allows direct access to the posterior calyx with minimal risk of bowel puncture. However, this positioning method limits the possibility of switching anesthesia from regional to general. The alternative position is supine, which allows general anesthesia switching and combination technique of antegrade and retrograde approaches. Moreover, this position is also more preferred in patients with cardiac comorbidity. However, working space and the possibility of multiple channels are limited[6]. The aim of this study is to determine whether one position is more superior than the other, by comparing efficacy and safety profiles using a systematic review and meta-analysis approach.

Methods

Description of condition and intervention

The target population in this study is patients with renal stone of 20 mm or more in size who underwent PCNL. The intervention to the patients is PCNL in prone position, compared with PCNL in supine position. Prone is a classic position in PCNL procedure, described in 1976 when PCNL was first introduced. The original prone position consists of a two-stage procedure. The first stage is in supine position, where anesthesia is given and retrograde access to the upper urinary tract is established. The patient is then repositioned to a prone position, and supports are placed under the thorax and upper abdomen. All pressure points are also padded[7].

In contrast, a supine prone only needs one stage, in which the patient is placed supine with ipsilateral flank held up with a 3-liter saline bag. This original position was first introduced by Valdivia-Uria *et al.* and has been modified over time[8]. One popular modification of Valdivia position is the Galdakao modification. This position is slightly more lateral; the contralateral leg of the patient is flexed and abducted, while the ipsilateral leg is extended. A 3-liter bag is also placed to raise the flank[7].

Apart from the Valdivia position and its modifications, a complete supine position was also introduced by Falahatkar *et al.*[9] This position does not require an elevation of the flank. The patient is simply put in a supine position at the edge of the table, with legs extended. The patient's arms are stretched, abducted and supported.

The outcome of this study is the efficacy of both positions, determined by stone free rate and safety profile, determined by the occurrence of major complications.

Database searching and literature screening

A systematic search was carried out with the date last searched in 14 February 2020, using the database from MEDLINE, with keywords of "(((supine[Title/Abstract]) AND prone[Title/Abstract])) AND ((PCNL[Title/Abstract]) OR percutaneous nephrolithotomy[Title/Abstract])", and Cochrane library, with keywords of "prone in Title Abstract Keyword AND supine in Title Abstract Keyword AND PCNL in Title Abstract Keyword", and Google Scholar with keywords of "prone AND supine AND percutaneous nephrolithotomy". After we identified the articles, we removed the duplicates and further screened the articles. The reporting is based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) algorithm.

Study selection

Two reviewers (PB and WT) independently appraised the articles, and a discussion was conducted when disagreement occurred. The relevance of the articles is determined by reading through the titles and abstracts. The inclusion criteria are a comparative study between the supine and prone position in PCNL procedure in adult patients with age of 18 years old or more, the articles were written in English, and the design of the study was randomized clinical trial (RCT), cohort or case control. The exclusion criteria are non-comparative studies, studies that combine PCNL with other techniques of stone extraction such as URS or retrograde intrarenal surgery, not focused on comparing supine and prone position in PCNL, and inclusion of confounding factors such as a difference in guiding method when performing PCNL in

each position, since this difference will lead to intervention bias. The quality of each article included were then tested using Jadad scale for RCTs and Newcastle-Ottawa scale for non-RCTs[10,11].

Data extraction

Data extraction from the articles was performed by two authors (NR and WA), and any disagreement was settled by consensus. The variables extracted from the articles included the first author's name, year of publication, stone free rate, percentage of major complications, length of hospital stay, and mean operation time. Stone free condition is defined as the absence of residual fragments of ≤ 4 mm after procedure. Major complications are defined as those with a Clavien score of III or more[12].

Statistical analysis

Meta-analysis was performed by Review Manager 5.3. The results were described as odds ratio (OR) with 95% confidence interval (CI) for dichotomous variables, and as a mean difference with 95% CI for continuous variables. Heterogeneity was analyzed using a Chi square and I^2 test. The data was analyzed using the random-effect model when I^2 >25%, and fixed-effect model when I^2 is less than 25%. The analysis is considered statistically significant when p value is less than 0.05. For studies that provided the minimum and maximum value instead of standard deviation (SD) for the mean difference analysis, estimated SD were calculated with the formula derived from a study by Walter and Yao (2007)[13]. In addition, for studies that provided 95% Confidence Interval (CI) instead of SD, the value of SD was calculated using the formula described in the Cochrane Handbook[14].

Results

Literature search

Following the result of article screening and the application of exclusion criteria, a total of 156 articles were found from the three databases. After removing duplicates, a total of 131 studies were screened. Among these, 28 studies were found to be relevant based on the studies' titles and abstracts in which the full text were assessed. Eventually, there were 11 articles were included in qualitative and quantitative analysis (Figure 1).

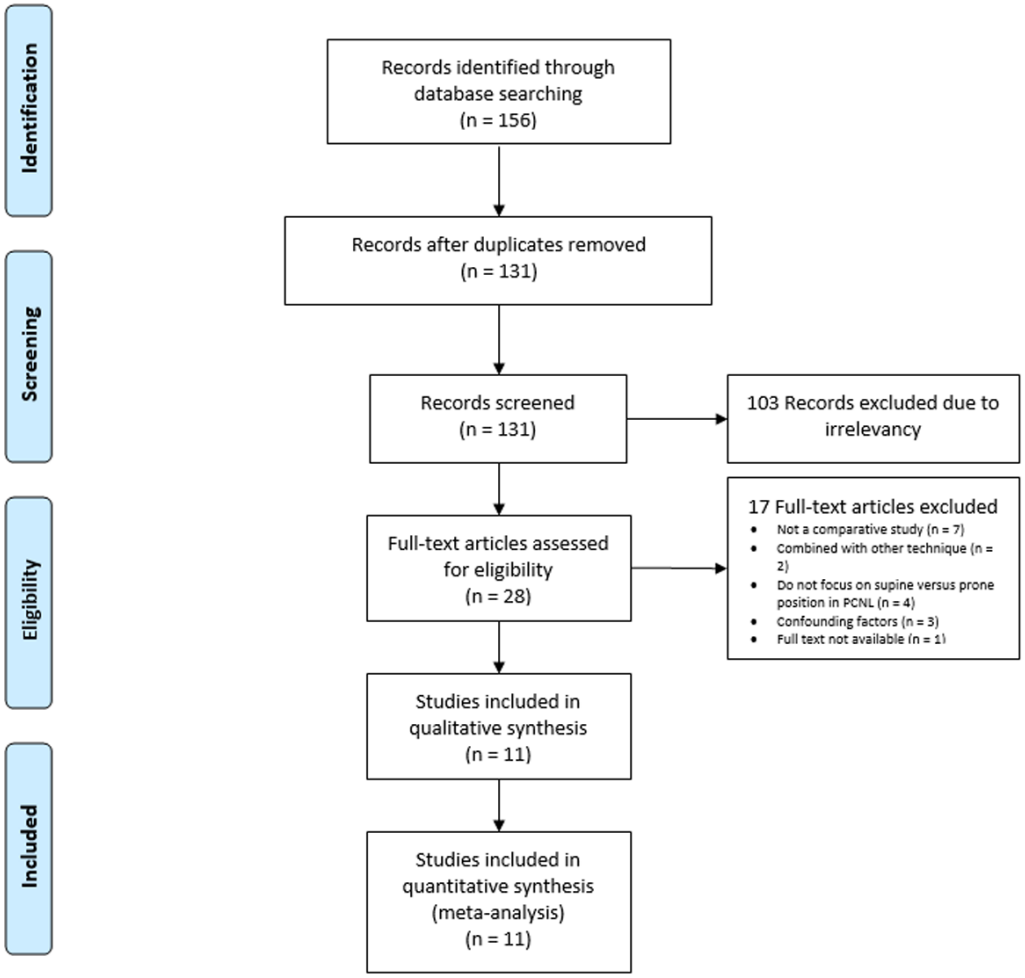

Figure 1. PRISMA method of article screening.

Study characteristics

There were 2 RCTs assessed with Jadad scale, in which one of them showed a poor quality. However, the remaining 9 studies were cohort studies and had a good quality score in Newcastle-Ottawa scale. We did not find any case control studies that fulfill our inclusion criteria (Table 1). Study characteristics, including the number of patients, mean age, stone burden, stone free rate, complication rate the definition of stone free rate and follow up time are shown in Table 2. In addition, the anomaly status of the patients and the used surgery tools along with the need of second look in the studies included are presented in Table 3.

Stone free rate

All 11 studies reported the stone free rate of both supine and prone groups. A meta-analysis of these studies showed that there was a low heterogeneity and a statistically significant lower stone free rate in the supine group (OR: 0.74; 95% CI: 0.66 – 0.83; p<0.00001; Figure 2).

Major complication rate

Major complication rate is defined as Clavien score of 3 of more in this study. There were only 5 articles that reported the complication rate using Clavien score in which there was no heterogeneity found of these studies. Figure 3 showed that there is a statistically significant lower complication rate in the supine group (OR: 0.70; 95% CI: 0.51 – 0.96; p=0.03).

The subgroup analysis of complication parameters such as visceral injuries including pleural effusion and organ perforation, the need of blood transfusion, and infection which lead to sepsis revealed that there is no significant difference between groups when analyzed separately (p=0.16; p=0.10; p=0.35, respectively). However, the combined analysis of those specific complications lead to a significant difference in which the risk is lower in the supine group (OR: 0.81; 95% CI: 0.68 – 0.97; p=0.02; Figure 4).

Length of hospital stay

There were nine studies that reported mean days of hospital stay in both groups. The forest plot in Figure 5 shows that there is no difference in the length of hospital stay between groups (Mean difference: -0.01; 95% CI: -0.27 – 0.24; p=0.92). However, there was heterogeneity in this parameter.

Mean operation time

Mean operation time was reported in all studies and the I^2 analysis showed that the studies were heterogenous. The meta-analysis in this parameter showed that there is no difference in mean operation time between these two groups (Mean difference: -2.68; 95% CI: -12.36 – 7.00; p=0.59; Figure 6).

Discussion

The authors choose stone free rate and major complication as the main outcome of this article to help identify which position is safe in PCNL and whether there is a difference in the

Table 1. Quality assessment of the articles included. RCT, randomized controlled trial.

Articles	Study design	Quality assessment	
		Jadad scale	Newcastle-Ottawa scale
Melo PAS, *et al.* (2019)[9]	Cohort	-	8
Gokce MI, *et al.* (2017)[15]	Cohort	-	8
Mahmoud M, *et al.* (2017)[16]	RCT	2	-
Wood GJA, *et al.* (2017)[17]	Cohort	-	7
Astroza G, *et al.* (2013)[18]	Cohort	-	6
Kan RW, *et al.* (2013)[19]	Cohort	-	8
Karami H, *et al.* (2013)[20]	RCT	1	-
Sanguedolce F, *et al.* (2013)[21]	Cohort	-	6
Arrabal-Martin M, *et al.* (2012)[22]	Cohort	-	7
Wang Y, *et al.* (2012)[23]	Cohort	-	8
Valdivia JG, *et al.* (2011)[8]	Cohort	-	8

Table 2. Characteristics of studies included.

Articles	Cases (n)		Mean age (years)		Stone size (mm/mm²)		Mean number of stone		Stone free rate (%)		Complication rate (%)		Definition of Stone Free Rate	Follow up time
	Supine	Prone	Supine	Prone	Supine	Prone	Supine	Prone	Supine	Prone	Supine	Prone		
Melo PAS, *et al.* (2019)	294	99	49.14	47.66	29.76	30.34	-	-	42.1	37.4	13.6	23.2	Residual stones ≤ 4 mm	1 day
Gokce MI, *et al.* (2017)	39	48	47.5	49.2	47.3	45.6	-	-	64.1	60.4	15.4	29.2	Absence of residual fragments in postoperative NCCT	30 days
Mahmoud M, *et al.* (2017)	20	20	42.35	41.15	27.1	25.7	Single or multiple	Single or multiple	80	85	15	10	Absence of residual stone	-
Wood GJA, *et al.* (2017)	28	104	45.89	44.98	-	-	-	-	71.4	63.5	28.6	39.4	Residual stones ≤ 3 mm on first postoperative CT scan	1 day
Astroza G, *et al.* (2013)	232	1079	51.8	49.8	-	-	-	-	48.4	59.2	10.4	8	-	-
Kan RW, *et al.* (2013)	25	35	67	63	36.9	44.8	-	-	46	68	24	11.4	Absence of residual stone	-
Karami H, *et al.* (2013)	50	50	44.4	41.5	28.2	28.3	2	2.3	86	92	24	20	Residual stones ≤ 3 mm	1 month
Sanguedolce F, *et al.* (2013)	65	52	53	49	20.6	18.1	Single or multiple	Single or multiple	89.2	92.3	7.7	7.6	Absence of fragments of asymptomatic residual fragment □ 2 mm	3 months
Arrabal-Martin M, *et al.* (2012)	24	32	49	47	510	530	-	-	79.2	75	29.1	31.2	-	-
Wang Y, *et al.* (2012)	6	12	44.8	43.8	36	33	-	-	83.3	91.7	0	0	No residual stone of > 4 mm	3 months
Valdivia JG, *et al.* (2011)	1138	4637	51	48.8	470.6	449.1	-	-	70.2	77	19.2	20.8	Stone free on radiography, renal ultrasound, or CT scan	30 days
Total patients	**1921**	**6168**	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. Anomaly status and the used surgery tools of included studies.

Articles	Congenital Anomalies	Intraoperative imaging modality	Sheath Caliber	Lithotripsy technique	Second Look
Melo PAS, *et al.* (2019)	No	Fluoroscopy	30 Fr	Ultrasonic lithotripter	No
Gokce MI, *et al.* (2017)	No	Fluoroscopy	30 Fr	Ballistic lithotripter	No
Mahmoud M, *et al.* (2017)	No	-	-	-	-
Wood GJA, *et al.* (2017)	No	Fluoroscopy	-	-	No
Astroza G, *et al.* (2013)	No	-	-	-	No
Kan RW, *et al.* (2013)	No	Fluoroscopy	24-30 Fr	Ultrasonic lithotripter	No
Karami H, *et al.* (2013)	No	Fluoroscopy	30 Fr	Pneumatic lithotripter	No
Sanguedolce F, *et al.* (2013)	No	-	-	-	Yes in 6 patients
Arrabal-Martin M, *et al.* (2012)	No	-	-	Ultrasonic or kinetic lithotripter	No
Wang Y, *et al.* (2012)	Solitary kidney in 23.3% (4 patients)	Fluoroscopy	18 or 26 Fr	Holmium lithotripter	No
Valdivia JG, *et al.* (2011)	1. Ectopic kidney (0.8% and 0.4% in supine and prone group, respectively) 2. Horseshoe kidney (1.2% and 2.0% in supine and prone group, respectively) 3. Malrotation kidney (2.0% and 1.2% in supine and prone group, respectively)	Fluoroscopy, ultrasound, or both	-	-	No

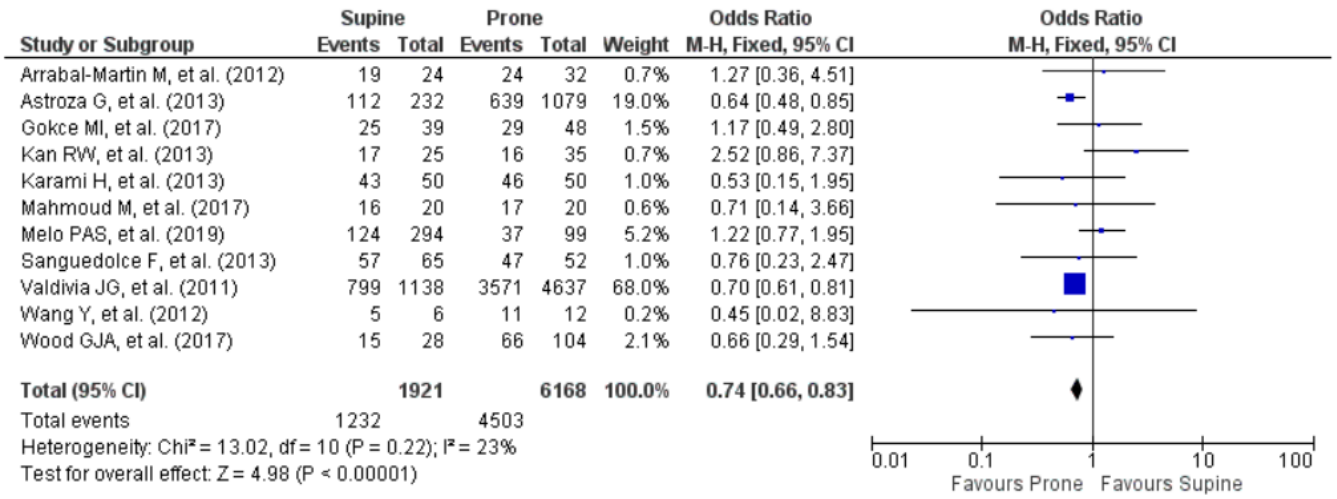

Figure 2. Forest plot comparing stone free rate in prone and supine groups.

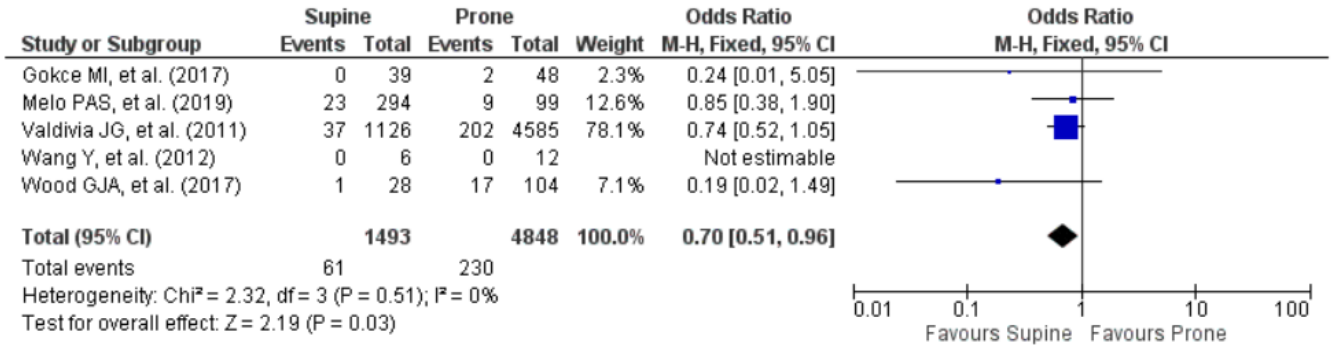

Figure 3. **Forest plot comparing major complication rate in prone and supine groups.**

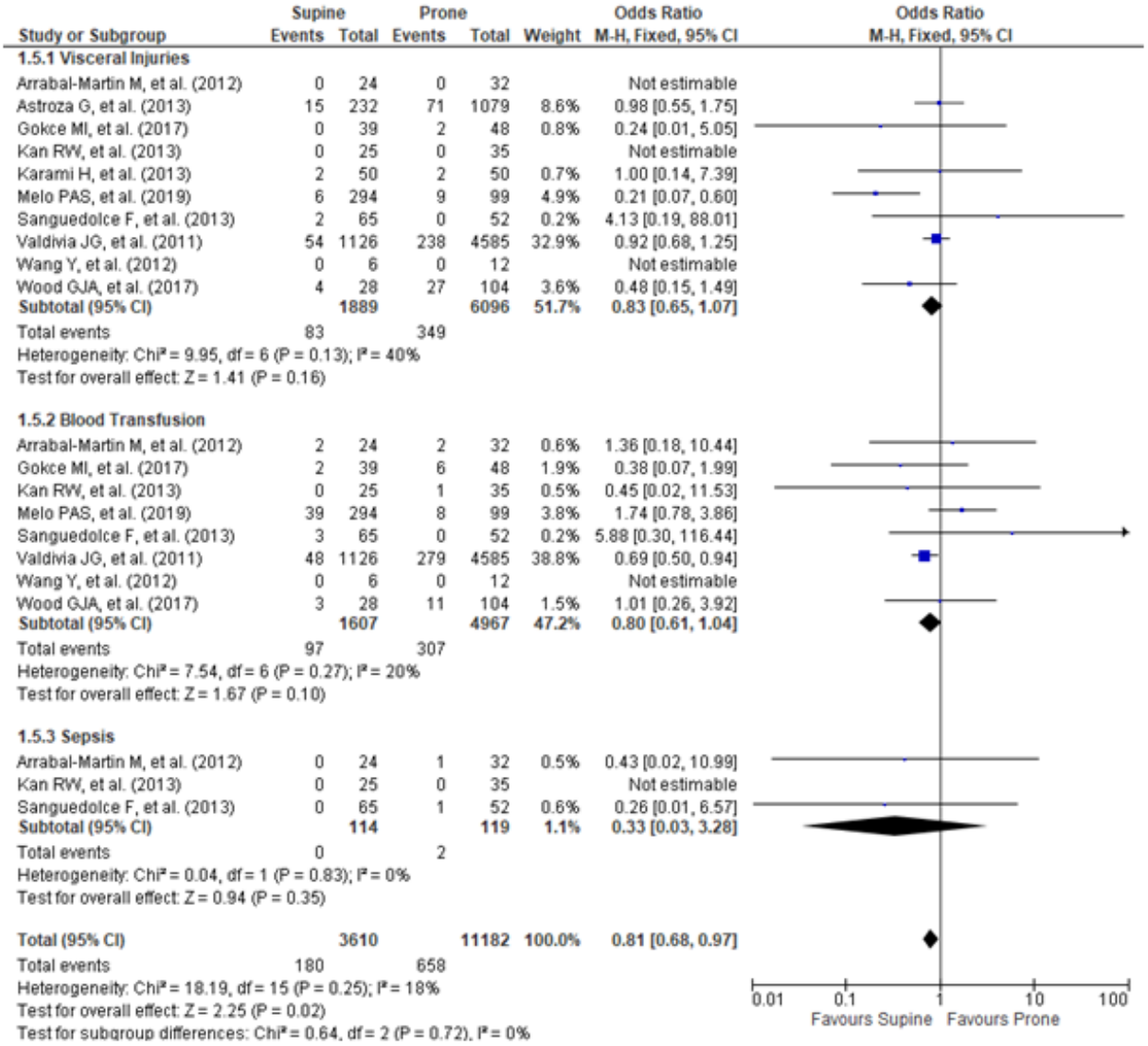

Figure 4. **Comparison of the complications subgroup between supine and prone groups.**

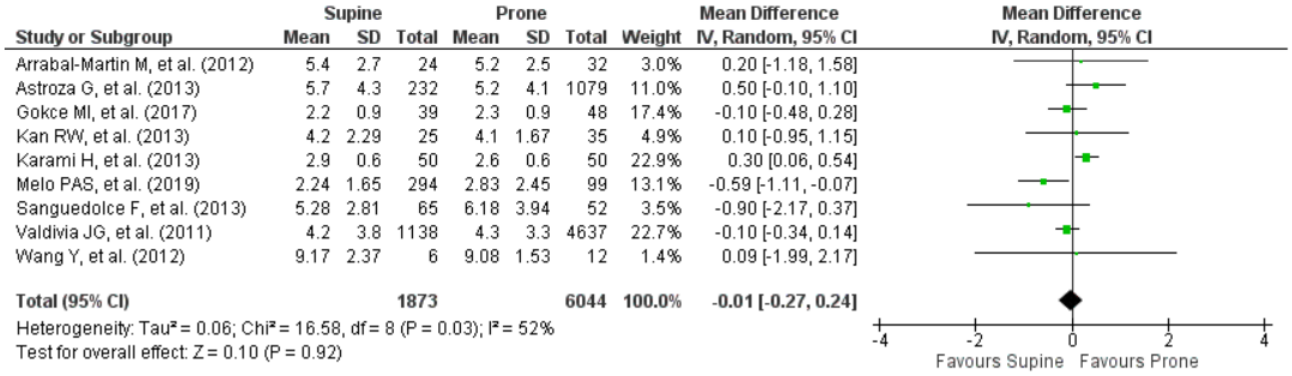

Figure 5. Forest plot comparing length of hospital stay in prone and supine groups.

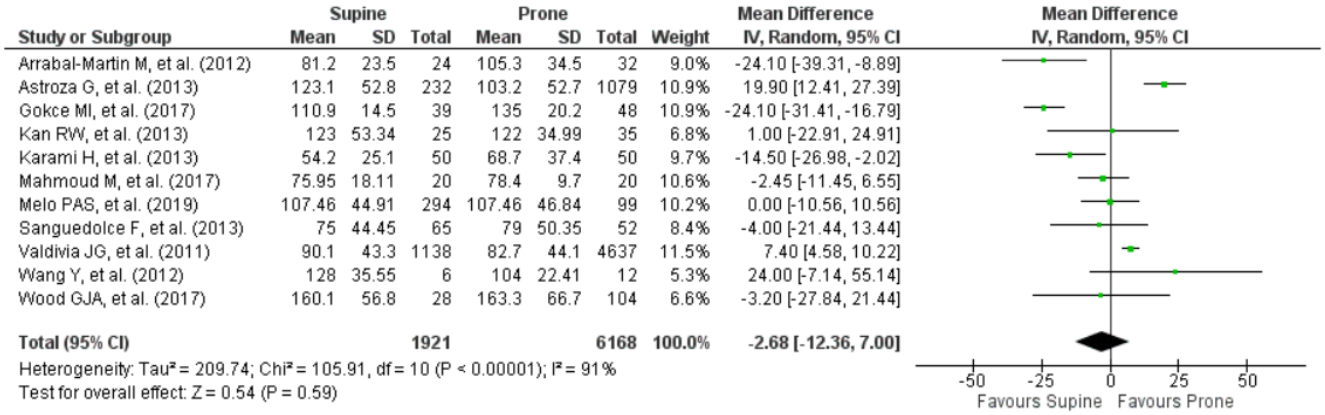

Figure 6. Forest plot comparing mean operation time in prone and supine groups.

efficacy. Regarding the stone free rate, one of the studies included in this meta-analysis mentioned the need of second look for the patients after PCNL (Sanguedolce F, *et al.*)[21]. It is in our interest that the risk of residual stones in which the second look was needed was not significantly different between supine and prone position (p=0.12). However, the pooled analysis of stone free rate revealed that the stone free rate was significantly higher in prone position. The possible explanation is that in this position, the lumbar area is fully exposed which allows a possibility of several puncture sites, and easier access to the upper pole kidney. Moreover, the working area is greater, providing enough space for instrument manipulation[7].

Nevertheless, the two-stage nature of this position usually prolongs the operating time, and a prone position makes it difficult for the anesthetists to attend cardio-respiratory emergency. The risk of ocular complications has also been described because of the increase in intra-ocular pressure[7].

Our study found that the supine position had a lower major complication rate than prone position. The subgroup analysis of the blood transfusion need, risk of sepsis and visceral injuries also showed the lower rate of complications in the supine group when compared to the prone group despite the individual analysis of each complication showed no difference between groups. This fact is in accord with the literature which revealed that the original (Valdivia) position is reportedly safe, and endoscopic instruments can be moved more freely because the puncture site of the abdominal wall is performed more laterally and away from the lumbar muscles. The tract in this position also preserves a low pressure in the renal pelvis, reducing the risk of fluid absorption. Moreover, risk of colonic puncture might be reduced because the bowel is not pressed towards the kidney. Should a rigid ureteroscopy be needed simultaneously with PCNL, a modified Valdivia position can be performed by flexing and supporting the patient's ipsilateral leg, and the contralateral leg descended. The supine position also has the advantage of easier management of cardiac and respiratory emergencies[7].

Moreover, the Galdakao-modified position allows more instrument manipulation than the original supine position. Furthermore, it also enables simultaneous retrograde access to the

kidney and there is no need to reposition thus the asepsis and antisepsis procedure needs to be performed only once[7].

In the complete supine position, the lack of flank support allows more feasible access to the upper pole of the kidney because there is no risk of cephalad sliding of the kidney, as observed in the supine position with flank support[7]. The supine position also has the advantages of easier access to the upper pole after lower pole puncture[24].

However, it should also be noted that while there are many advantages to the supine position regarding the complication rate, the state of low compressed abdomen in this position allows the kidney to move more freely, making the navigation of the instrument towards the kidney more challenging, and the chance of failed access is higher[7,8,17].

The secondary outcomes of our study are mean operation time and duration of hospital stay. According to our review, supine and prone position during PCNL share a similar result in these parameters. This result is important so that the surgeons will be able to confidently decide the position based on their experiences and the patient's comorbidities.

The previous meta-analysis by Yuan *et al*. stated that the stone free rate was higher in prone position, which was similar to our study[25]. However, the complication rate between the two groups was similar which was slightly different in our findings. Another meta-analysis performed by Falahatkar, *et al*. showed a similar complication and stone free rate between supine and prone position, but lower need of blood transfusion in the supine group which might implicate the benefit of supine position[26]. These results are somewhat similar to our study, which show a better stone free rate in the prone position, but a lower complication rate in supine position, suggesting a better safety profile in the supine position.

The limitation in our study is that the number of articles providing data of major complication rate in terms of Clavien score was limited and there were too many heterogeneities in the length of hospital stay and mean operation time variables. Therefore, the authors believe that another comprehensive study should be performed in urology centers in which the surgeons excel in both supine and prone position when performing PCNL and have a larger sample size.

The implication of this study is that it exposed the benefit and disadvantages of both supine and prone position, which in turn can be used as a decision guide for clinicians who want to perform PCNL.

Conclusion

In conclusion, the prone position leads to a higher stone free rate than supine position. However, in terms of safety profile, supine position provides a better choice than the prone position. There is no difference in both the length of hospital stay and mean operation time between prone and supine position. Therefore, it can be inferred that there is no position that has absolute superiority and it is important to note that both supine and prone position in PCNL procedure have their respective advantages and disadvantages. Thus, the decision of choosing the position when performing PCNL should be based on clinical status of the patient and the experience of the surgeon.

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 article 'Supine versus prone position in percutaneous nephrolithotomy: a systematic review and meta-analysis', https://doi.org/10.17605/OSF.IO/GDH3R[27].

Acknowledgements

The authors would like to thank you to the Cipto Mangunkusumo National Hospital for the support and permission for the authors to finish the production of this article.

References

1. Khan SR, Pearle MS, Robertson WG: **Kidney stones.** *Nat Rev Dis Primers.* 2016; **2**: 16008.
PubMed Abstract | Publisher Full Text | Free Full Text

2. Sorokin I, Mamoulakis C, Miyazawa K, *et al.*: **Epidemiology of stone disease across the world.** *World J Urol.* 2017; **35**(9): 1301–20.
PubMed Abstract | Publisher Full Text

3. Alelign T, Petros B: **Kidney Stone Disease: An Update on Current Concepts.** *Adv Urol.* 2018; **2018**: 3068365.
PubMed Abstract | Publisher Full Text | Free Full Text

4. Turk C, Skolarikos A, Neisius A, *et al.*: **EAU Guidelines on Urolithiasis**. The Netherlands: EAU Guidelines Office; 2019.

5. Turna B, Raza A, Moussa S, *et al.*: **Management of calyceal diverticular stones with extracorporeal shock wave lithotripsy and percutaneous nephrolithotomy: long-term outcome.** *BJU Int.* 2007; **100**(1): 151–6.
PubMed Abstract | Publisher Full Text

6. Ganpule AP, Vijayakumar M, Malpani A, *et al.*: **Percutaneous nephrolithotomy (PCNL) a critical review.** *Int J Surg.* 2016; **36**(Pt D): 660–664.
PubMed Abstract | Publisher Full Text

7. Karaolides T, Moraitis K, Bach C, *et al.*: **Positions for percutaneous nephrolithotomy: Thirty-five years of evolution.** *Arab J Urol.* 2012; **10**(3): 307–16.
PubMed Abstract | Publisher Full Text | Free Full Text

8. Valdivia JG, Scarpa RM, Duvdevani M, *et al.*: **Supine versus prone position during percutaneous nephrolithotomy: a report from the clinical research office of the endourological society percutaneous nephrolithotomy global study.** *J Endourol.* 2011; **25**(10): 1619–25.
PubMed Abstract | Publisher Full Text

9. Falahatkar S, Moghaddam AA, Salehi M, *et al.*: **Complete supine percutaneous nephrolithotripsy comparison with the prone standard technique.** *J Endourol.* 2008; **22**(11): 2513–7.
PubMed Abstract | Publisher Full Text

10. Cho HJ, Chung JH, Jo JK, *et al.*: **Assessments of the quality of randomized controlled trials published in International Journal of Urology from 1994 to 2011.** *Int J Urol.* 2013; **20**(12): 1212–9.
PubMed Abstract | Publisher Full Text

11. Luchini C, Stubbs B, Solmi M, *et al.*: **Assessing the quality of studies in meta-analyses: advantages and limitations of the newcastle ottawa scale.** *World J Meta Anal.* 2017; **5**(4): 80–4.
Publisher Full Text

12. Melo PAS, Vicentini FC, Perrella R, *et al.*: **Comparative study of percutaneous nephrolithotomy performed in the traditional prone position and in three different supine positions.** *Int Braz J Urol.* 2019; **45**(1): 108–17.
PubMed Abstract | Publisher Full Text | Free Full Text

13. Walter SD, Yao X: **Effect sizes can be calculated for studies reporting ranges for outcome variables in systematic reviews.** *J Clin Epidemiol.* 2007; **60**(8): 849–52.
PubMed Abstract | Publisher Full Text

14. Higgins JPT, Green S: **Cochrane Handbook for Systematic Reviews of Interventions.** Version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011.
Reference Source

15. Gokce MI, Ibis A, Sanci A, *et al.*: **Comparison of supine and prone positions for percutaneous nephrolithotomy in treatment of staghorn stones.** *Urolithiasis.* 2017; **45**(6): 603–8.
PubMed Abstract | Publisher Full Text

16. Mahmoud M, Abdel AA, Abdel AM, *et al.*: **Flank suspended supine position versus standard supine and prone position in percutaneous nephrolithotomy.** *J Endourol.* 2017; **31**: A95–A98.

17. Wood GJA, Torricelli FCM, Vicentini FC, *et al.*: **Supracostal punctures in supine percutaneous nephrolithotomy are safe.** *Can J Urol.* 2017; **24**(2): 8749–53.
PubMed Abstract

18. Astroza G, Lipkin M, Neisius A, *et al.*: **Effect of supine vs prone position on outcomes of percutaneous nephrolithotomy in staghorn calculi: results from the Clinical Research Office of the Endourology Society Study.** *Urology.* 2013; **82**(6): 1240–4.
PubMed Abstract | Publisher Full Text

19. Kan RW, Fu KK, Wong BT, *et al.*: **Percutaneous nephrostomy, nephrolithotomy and combined ureteroscopic lithotripsy using the supine approach.** *Hong Kong Med J.* 2013; **19**(2): 142–9.
PubMed Abstract

20. Karami H, Mohammadi R, Lotfi B: **A study on comparative outcomes of percutaneous nephrolithotomy in prone, supine, and flank positions.** *World J Urol.* 2013; **31**(5): 1225–30.
PubMed Abstract | Publisher Full Text

21. Sanguedolce F, Breda A, Millan F, *et al.*: **Lower pole stones: prone PCNL versus supine PCNL in the International Cooperation in Endourology (ICE) group experience.** *World J Urol.* 2013; **31**(6): 1575–80.
PubMed Abstract | Publisher Full Text

22. Arrabal-Martin M, Arrabal-Polo MA, Lopez-Leon V, *et al.*: **The oblique supine decubitus position: technical description and comparison of results with the prone decubitus and dorsal supine decubitus positions.** *Urol Res.* 2012; **40**(5): 587–92.
PubMed Abstract | Publisher Full Text

23. Wang Y, Hou Y, Jiang F, *et al.*: **Percutaneous nephrolithotomy for staghorn stones in patients with solitary kidney in prone position or in completely supine position: a single-center experience.** *Int Braz J Urol.* 2012; **38**(6): 788–94.
PubMed Abstract | Publisher Full Text

24. Sofer M, Giusti G, Proietti S, *et al.*: **Upper Calyx Approachability through a Lower Calyx Access for Prone Versus Supine Percutaneous Nephrolithotomy.** *J Urol.* 2016; **195**(2): 377–82.
PubMed Abstract | Publisher Full Text

25. Yuan D, Liu Y, Rao H, *et al.*: **Supine versus prone position in percutaneous nephrolithotomy for kidney calculi: a meta-analysis.** *J Endourol.* 2016; **30**(7): 754–63.
PubMed Abstract | Publisher Full Text

26. Falahatkar S, Mokhtari G, Terimoori. M: **An update on supine versus prone percutaneous nephrolithotomy: a meta-analysis.** *Urol J.* 2016; **13**(5): 2814–22.
PubMed Abstract | Publisher Full Text

27. Tendi W: **Supine versus Prone Position in Percutaneous Nephrolithotomy: A Systematic Review and Meta-Analysis**. 2020.
http://www.doi.org/10.17605/OSF.IO/GDH3R

Open Peer Review

Current Peer Review Status: ✔ ✔

Version 3

Reviewer Report 05 October 2020

https://doi.org/10.5256/f1000research.29538.r71389

✔ **Noor Buchholz**
U-merge Ltd. (Urology for Emerging Countries), London, UK

Competing Interests: No competing interests were disclosed.

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.

Reviewer Report 22 September 2020

https://doi.org/10.5256/f1000research.29538.r71388

✔ **Mohammed S. ElSheemy**
Urology department, Kasr Al-Ainy Hospitals, Cairo University, Cairo, Egypt

The authors responded to all queries and the manuscript is ready now to be accepted.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Urolithiasis, endourology, PCNL, Mini-PCNL, URS, SWL

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.

Version 2

Reviewer Report 26 August 2020

https://doi.org/10.5256/f1000research.28883.r70049

?

Mohammed S. ElSheemy
Urology department, Kasr Al-Ainy Hospitals, Cairo University, Cairo, Egypt

The manuscript was improved markedly as the authors replied to most of the previous comments. However, there are still remaining points that need revision.

Introduction

- In the previous version, we commented as follows: [The authors reported that: [While PCNL has higher free stone rates with a similar recurrence and complication rate compared with ESWL,...]. This should be cited. Additionally, the complication rates are different between both procedures. Similarly, the recurrence rate is different.
  - The authors replied by putting citation which was a secondary source [reference 5: Ganpule AP, et al.: Percutaneous nephrolithotomy (PCNL) a critical review. *Int J Surg.* 2016;36(Pt D):660–664.] not the original source [B. Turna, et al. Management of calyceal diverticular stones with extracorporeal shock wave lithotripsy and percutaneous nephrolithotomy; long term outcome. BJU Int., 100 (2007), pp. 151-156]. The original source should be read by authors then cited instead of the secondary source especially that the original source is available online (free access).
  - Additionally, the original source was on stones in calyceal diverticula which is totally different than the scope of the current study and also the outcome of PCNL and SWL generally which is different than the outcome of the rare condition of stones in calyceal diverticula.
  - Furthermore, even in the original study; no one can comment on the recurrence rate as the SFR was 80% in PCNL compared to only 20% in SWL; subsequently, 80% of cases in SWL were already with residual stones preventing the use of the term (recurrence).
  - Moreover, the complications in the original study were totally different as blood transfusion and chest tube were required in some cases of PCNL while SWL had milder complications.
  - Furthermore, the original study was retrospective with a huge difference in stone size (mean; 20 mm (Max. 60 mm) for PCNL vs 11 mm in SWL (max; 30 mm))

Methods

- The authors added case-control studies in the inclusion criteria. However, they were not included in the metanalysis.

Results

- Our previous comment on Figure 1 was that the authors should clarify why 103 studies were excluded out of 131. The authors replied that the explanation was presented in the text but our comment was to present that also in the figure.

- It was great to respond by adding a separate analysis for the need for blood transfusion, sepsis, and visceral injuries complications including pleural injury. However, the authors should comment on each separate analysis before commenting on the combined analysis as there was no significant difference in each separate analysis.

- The authors have added more details to Table 2; however, there are still other necessary details missing:
  - The definition of SFR.
  - If SFR was calculated after one session or after 2nd look PCNL (this was noted in one study but unknown for remaining studies).
  - If any procedure was Mini-PCNL and the caliber of the used renal track (sheath).
  - If there were congenital renal anomalies.

Discussion:

- The discussion section requires more effort especially the initial 3-4 paragraphs. The introduction then subsequent points in the discussion section should be in a logical order.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Urolithiasis, endourology, PCNL, Mini-PCNL, URS, SWL

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.

Author Response 10 Sep 2020

Ponco Birowo, Faculty of Medicine Universitas Indonesia / Cipto Mangunkusumo Hospital, Jakarta Pusat, Indonesia

Introduction

Reviewers' comment:

1. In the previous version, we commented as follows: [The authors reported that: [While PCNL has higher free stone rates with a similar recurrence and complication rate compared with ESWL,...]. This should be cited. Additionally, the complication rates are different between both procedures. Similarly, the recurrence rate is different.
    1. The authors replied by putting citation which was a secondary source [reference 5: Ganpule AP, et al.: Percutaneous nephrolithotomy (PCNL) a critical review. Int J Surg. 2016;36(Pt D):660–664.] not the original source [B. Turna, et al. Management of calyceal diverticular stones with extracorporeal shock wave lithotripsy and percutaneous nephrolithotomy; long term outcome. BJU Int., 100 (2007), pp. 151-156]. The original source should be read by authors then cited instead of the secondary source especially that the original source is available online (free access).
    2. Additionally, the original source was on stones in calyceal diverticula which is totally different than the scope of the current study and also the outcome of PCNL and SWL generally which is different than the outcome of the rare

condition of stones in calyceal diverticula.
3. Furthermore, even in the original study; no one can comment on the recurrence rate as the SFR was 80% in PCNL compared to only 20% in SWL; subsequently, 80% of cases in SWL were already with residual stones preventing the use of the term (recurrence).
4. Moreover, the complications in the original study were totally different as blood transfusion and chest tube were required in some cases of PCNL while SWL had milder complications.
5. Furthermore, the original study was retrospective with a huge difference in stone size (mean; 20 mm (Max. 60 mm) for PCNL vs 11 mm in SWL (max; 30 mm))

Authors' response:

1. Thank you very much for your kind response. We have revised the statement above and added the original citation as reference number 5 (Page 3, Introduction section, Paragraph 3).

Methods

Reviewers' comment:

1. The authors added case-control studies in the inclusion criteria. However, they were not included in the metanalysis.

Authors' response:

1. Thank you for your kind response. We did not include the case control in our meta-analysis because we did not manage to find case control studies that fulfill our inclusion criteria or in accordance with our topic. Nevertheless, we added this sentence to the manuscript. (Page 5-6, Method section, subsection Study Characteristics, Paragraph 1).

Results

Reviewers' comment:

1. Our previous comment on Figure 1 was that the authors should clarify why 103 studies were excluded out of 131. The authors replied that the explanation was presented in the text but our comment was to present that also in the figure.
2. It was great to respond by adding a separate analysis for the need for blood transfusion, sepsis, and visceral injuries complications including pleural injury. However, the authors should comment on each separate analysis before commenting on the combined analysis as there was no significant difference in each separate analysis.
3. The authors have added more details to Table 2; however, there are still other necessary details missing:
    - The definition of SFR.
    - If SFR was calculated after one session or after 2nd look PCNL (this was noted in one study but unknown for remaining studies).
    - If any procedure was Mini-PCNL and the caliber of the used renal track (sheath).
    - If there were congenital renal anomalies.

Authors' response:

1. Thank you for your recommendation, we have revised Figure 1 and put the explanation in the figure (Page 5, Figure 1). We have also updated the PRISMA

flowchart in the Open Science Framework Database accordingly (Reference number 27).
2. Thank you for your kind comment, we have added separate comment regarding the result of the component of the subgroup analysis (Page 10, Result section, subsection Major Complication Rate, Paragraph 2).
3. Thank you for the suggestion, we have added the details required separately in the table 2 and table 3. (Page 7-9, Result section, Table 2 and Table 3).

Discussion

Reviewers' comment:

1. The discussion section requires more effort especially the initial 3-4 paragraphs. The introduction then subsequent points in the discussion section should be in a logical order.

Authors' response:

1. Thank you for your kind comment. We have revised the discussion section, including adding and re-arranging the paragraph so that our conceptual of thinking in this study is in order and clearly described. (Page 11-14, Discussion section).

Competing Interests: The authors declare that there is no competing interests to disclose

Version 1

Reviewer Report 31 July 2020

https://doi.org/10.5256/f1000research.25326.r67732

?

Mohammed S. ElSheemy
Urology department, Kasr Al-Ainy Hospitals, Cairo University, Cairo, Egypt

The authors presented their meta-analyses comparing prone versus supine PCNL for the management of renal stones > 2 cm. They reported a higher SFR with prone technique but a better safety profile with supine technique. However, there are many points that require more details especially in the results and discussion section. The authors did not comment on studies heterogenousities or quality. Many points were not presented in each study (detailed in the comments on the results and discussion section). The authors did not discuss previous meta-analyses on the same issue nor clarifying the addition or difference in the current study.

Introduction:

- The authors reported that: [While PCNL has higher free stone rates with a similar recurrence and complication rate compared with ESWL,...]. This should be cited.

Additionally, the complication rates are different between both procedures. Similarly, the recurrence rate is different.

Method:

- The authors should clarify the age of patients and the design of the study (RCT or cohort) in the inclusion criteria.

Results:

- The authors did not comment on the quality of included studies as well as their heterogenicity.

- Figure 1:
  - The authors should clarify why 103 studies were excluded out of 131.

- The authors should perform a separate analysis (or at least a separate comment) for blood transfusion, sepsis, pleural
effusion or visceral injury complications.

- Table 2: the authors should add many points to describe each study adequately including:
  - Number and shape of stone
  - SFR for each study.
  - The method and timing for evaluation of SFR.
  - If SFR was calculated after first session or after 2nd look PCNL.
  - The complications for each technique (and its rate).
  - If any procedure was Mini-PCNL and the caliber of used renal track (sheath).
  - If there were congenital renal anomalies.
  - Lithotripsy technique.
  - Operative imaging modality.

Discussion:

- The authors should give more details of the included studies.

- The authors should discuss previous meta-analyses comparing both procedures. Additionally, the authors should compare the results of the present study to previous meta-analyses clarifying any difference and any addition.

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?

No

Is the statistical analysis and its interpretation appropriate?

I cannot comment. A qualified statistician is required.

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

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Urolithiasis, endourology, PCNL, Mini-PCNL, URS, SWL

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.

Author Response 15 Aug 2020

Ponco Birowo, Faculty of Medicine Universitas Indonesia / Cipto Mangunkusumo Hospital, Jakarta Pusat, Indonesia

Introduction
Reviewers' comment:
1. The authors reported that: [While PCNL has higher free stone rates with a similar recurrence and complication rate compared with ESWL,...]. This should be cited. Additionally, the complication rates are different between both procedures. Similarly, the recurrence rate is different.

Authors' response:
1. Thank you very much for the comment, we have added the citation of the statement mentioned in the introduction section: [While PCNL has higher free stone rates with a similar recurrence and complication rate compared with ESWL, this procedure also has its own preparation including a guiding system, anesthesia, and positioning of the patient]. The citation was the reference number 5, which is [Ganpule AP, Vijayakumar M, Malpani A, Desai MR. Percutaneous nephrolithotomy (PCNL) a critical review. Int J Surg. 2016; 36(Pt D): 660-4.] (Page 3, Paragraph 3, Introduction section).

Methods
Reviewers' comment:
1. The authors should clarify the age of patients and the design of the study (RCT or cohort) in the inclusion criteria.

Authors' response:
1. Thank you very much for the comment, we have revised the inclusion criteria accordingly. (Page 4, Paragraph 6, Methods section, subsection Study Selection).

Results
Reviewers' comment:
1. The authors did not comment on the quality of included studies as well as their heterogenicity.
2. Figure 1:
    - The authors should clarify why 103 studies were excluded out of 131.
3. The authors should perform a separate analysis (or at least a separate comment) for blood transfusion, sepsis, pleural effusion or visceral injury complications.
4. Table 2: the authors should add many points to describe each study adequately including:

- Number and shape of stone
- SFR for each study.
- The method and timing for evaluation of SFR.
- If SFR was calculated after first session or after 2nd look PCNL.
- The complications for each technique (and its rate).
- If any procedure was Mini-PCNL and the caliber of used renal track (sheath).
- If there were congenital renal anomalies.
- Lithotripsy technique.
- Operative imaging modality.

Authors' response:

1. Thank you very much for the comment, we have added a summary of the quality assessment of each article (Page 5, Paragraph 5, Results section, subsection Study Characteristics). Furthermore, we also showed the heterogeneity of each variable measured in this article (Page 9-11, Results section, subsection Stone Free Rate, Major Complication Rate, Length of Hospital Stay, and Mean Operation Time).
2. Thank you very much for the kind comment. The reason of which 103 articles were excluded because as we screened through all the titles and abstracts, we only found 28 articles that has the main topic of our interest, which is a study with either trial design or observational study (Page 5, Paragraph 4, Results section, subsection Literature Search).
3. Thank you very much for the suggestion, we have added a further separate analysis regarding the need of blood transfusion, sepsis, and visceral injuries complication presented in a forest plot (Page 10, Results section, Figure 4).
4. Thank you very much for the suggestion, we have added more details on the Table 2 accordingly (Page 7, Results section, Table 2).

Discussion

Reviewers' comment:

1. The authors should give more details of the included studies.
2. The authors should discuss previous meta-analyses comparing both procedures. Additionally, the authors should compare the results of the present study to previous meta-analyses clarifying any difference and any addition.

Authors' response:

1. Thank you very much for the kind comment, we have added more detail of our included studies on the discussion section (Page 11, Paragraph 3, Discussion section).
2. Thank you for the suggestion, we have added the comparison of the previous meta-analyses to our study (Page 12, Paragraph 6, Discussion section). Regarding to this addition, we have added the references accordingly (Page 15, References number 24 and 25).

Competing Interests: The authors declare that there is no competing interests to disclose

Reviewer Report 06 April 2020

https://doi.org/10.5256/f1000research.25326.r61982

Noor Buchholz
U-merge Ltd. (Urology for Emerging Countries), London, UK

Andreas Bourdoumis
Pennine Acute Hospitals NHS Trust, Manchester, UK

The authors need to be congratulated for this effort. They produced a comprehensive review on supine versus prone position in PCNL. This former method has been around for now almost 15 years, and still surgeons remain unsure whether there is a benefit in adopting the supine position over the established and older prone position. In that sense, this article may be a good decision tool.

The authors systematically reviewed the relevant literature. The reviewer misses some evidence but the authors used stringent selection criteria which may have led to their exclusion but in turn make the data more robust. An example would be:

Kachrilas S, Papatsoris A, Bach C, Kontos S, Faruquz Z, Goyal A, Masood J,BUCHHOLZ N. Colon perforation during percutaneous renal surgery: a 10-year experience in a single endourology centre. Urol Res. 2012 Jun;40(3):263-8[1].

This article shows on a large number of patients that there is no difference in complications in the right hands.

Although in most experienced hands, the differences between the two methods are minimal in all aspects, and the advantages of supine are evident to most surgeons who use it, somewhat surprisingly to me the analysed data show better safety in supine, and better stone-free rate in prone PCNL. Since there seems to be no flaw in their analysis, we will have to believe this data.

That makes it even more important to index.

References

1. Kachrilas S, Stefanos K, Papatsoris A, Athanasios P, et al.: Colon perforation during percutaneous renal surgery: a 10-year experience in a single endourology centre.*Urol Res*. 2012; **40** (3): 263-8 PubMed Abstract | Publisher Full Text

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?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Stone surgery, PCNL

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.