

## Prone vs Supine PCNL: What about the Cost?

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### ABSTRACT

**Introduction & Objectives:** Prone position has been the standard for PCNL in years, whereas the supine position has recently started to gain popularity. The study for surgical outcomes still vary and study for cost-effectiveness are still lacking. We aimed to compare the surgical outcomes and cost effectiveness of prone versus supine PCNL in our institution.

**Material & Methods:** This study was done retrospectively by analyzing medical records on 51 patients underwent PCNL in Saiful Anwar General Hospital Malang from January 2016 until October 2017. The outcomes of stone free rate, body mass index (BMI), stone size, operative time, anaesthetic time, length of stay (LOS) in hospital and complications were compared. For Cost Effectiveness Study, total cost, anesthesia and disposable equipment was recorded.

**Results and Discussion:** There was no significant difference in both groups characteristics. The supine group had lower blood loss (0.54 mg/dl vs 1.37 mg/dl,  $p=0.001$ ), shorter mean operative time (57 minutes vs 78 minutes,  $p=0.001$ ), shorter mean anesthetic time (71 minutes vs 107 minutes,  $p<0.001$ ). Supine group was associated with significantly cheaper disposable equipment used for surgery (4,985,636 IDR in prone vs 4,229,770 IDR in supine ( $p<0.001$ )) and anesthesia (353,454 IDR in prone vs 105,120 IDR in supine ( $p<0.001$ )), and cheaper total cost (17,623,363 IDR in prone vs 15,175,305 in supine ( $p = 0.038$ )).

**Conclusion:** In our study, supine position has lower blood loss, shorter operative and anaesthetic time. The supine PCNL is also more cost-effective in our institution compared to prone PCNL. We suggest that the PCNL in the supine position is a promising alternative.

### Keywords

Cost-effectiveness, Supine vs prone, PCNL.

### Introduction

Since the first description in 1976, percutaneous nephrolithotomy (PCNL) has become the golden standard for large and complex renal calculi [1]. The advantages of the PCNL procedure are: better stone free rate compared to ESWL for larger renal calculi and almost equivalent to open surgery, could be used for large kidney stone therapy (> 20 mm), could be used for inferior calix stones that are difficult to treat with ESWL, and lower morbidity compared to open surgery in both systemic response and preservation of postoperative renal function [2].

Traditionally, PCNL is done using a prone position, this is the first position used since the first introduction of PCNL techniques in 1976. This technique is a time-tested technique, has a high success rate, and low morbidity. However, this technique has several disadvantages: this technique is contraindicated for obese patients, and patients with cardiopulmonary disease. In addition, the need for a change of position for the insertion of the ureter catheter is also a disadvantage [3].

In 1987, Gabriel Valdivia introduced a supine position at PCNL aimed at addressing the above issues. Compared to prone position, supine position have several advantages: easier for the patient, lower cardiopulmonary risks, no repositioning of the

patient is necessary (associated with shorter operating times and reduced risk of trauma to the patient's nervous system), minimal radiation exposure to the operator, and ureteroscopy could be done simultaneously with PCNL [4].

Despite the above advantages, supine position also associated with increased risks of visceral organs, intra-abdominal organs, and blood vessel trauma. This raises the debate over which position is more favorable between supine PCNL and prone PCNL [3]. There are already many published literatures that compares the effectiveness of supine with prone PCNL, in which most show the same effectiveness between the two, however there are differences in the literatures about the complication rate and duration of surgery between the two positions [2].

Although the effectiveness of supine vs prone PCNL has been widely discussed, but as far as the author's knowledge, the cost-effectiveness comparison study between the two positions are still lacking. So this study aims to find out in general the cost difference between supine vs prone PCNL in our institution.

## Material and Methods

This study was a retrospective study, conducted in Saiful Anwar General Hospital Malang from January 2016 until October 2017. Medical records from 51 patients underwent PCNL were reviewed, in which 29 were performed in the supine position and 22 performed using prone position. For supine position, we used the Barts 'Flank-Free' modified supine position which offers several advantages: allows easy percutaneous access under fluoroscopy (torso only tilted to around 15°C), there are much space for placing and dilating multiple tracts (kidney lies in a fairly neutral position and hence less mobile), a fairly horizontal tract allowing low intrarenal pressures and easy washout of fragments as well as allowing RIRS in a position of relative familiarity. The lesser torso rotation compared with the Valdivia, Galdakao modified and the Barts modified Valdivia positions also means it is more comfortable for patients [5]. In our study, We performed the operation with multi operator.



**Figure 1:** Barts flank-free modified supine position. Gel pad 1 is placed under the ipsilateral pelvis and gel pad 2 under the rib cage leaving the flank free. (Documentation of supine PCNL position in Saiful Anwar General Hospital).



**Figure 2:** The ipsilateral leg is relatively extended and the contralateral leg is relatively abducted (Documentation of supine PCNL position in Saiful Anwar General Hospital).

Basic characteristic of patients were collected from medical records. It consists of sex, age, body mass index (BMI), grade of hydronephrosis, comorbidities, baseline haemoglobin, serum creatinine and stage of chronic kidney disease. We also defined the stone characteristics including number, location, composition analysis and burden. The outcomes of stone free rate, operative time, anaesthetic time, post-operative haemoglobin, transfusion rate, length of stay (LOS) in hospital and complications are also recorded. We then record the costs elements, consist of: transfusion costs, disposable equipments costs for surgery, disposable equipments costs for anaesthesia, and total costs. Those recorded data the compared between prone and supine position. The data was analyzed using SPSS software – Chi Square and Fisher's Exact tests. A P Value less than 0.05, was considered statistically

## Results

Fifty one patients enrolled in this study. The mean age were  $51.17 \pm 8.452$  years in supine group while prone group had  $50.64 \pm 12.793$  years. The mean BMI also similar in both groups ( $21.81 \pm 1.76$  vs  $21.50 \pm 1.51$  kg/m<sup>2</sup>). The patient characteristic were tabulated in Table 1. There were no significant differences in gender, age, sex, body mass index, stone location, comorbid, the presence of CKD and hydronephrosis between the two groups. Mostly stone analysis found calcium oxalate in both supine and prone group (48.3% vs 63.6%) respectively, although there were not significant statistically. Its location varied to pyelum, lower, middle, upper pole, multiple calyx and staghorn. The characteristics of stone tabulated in Table 2.

In comparison between patients treated with percutaneous nephrolithotomy (Table 3), we found shorter mean operative time in supine group ( $57.41 \pm 12.07$  minutes) than prone group ( $78.41 \pm 20.72$  minutes) with  $p = 0.001$ . Mean anaesthesia time also found shorter in supine group ( $71.72 \pm 2.906$  vs  $107.50 \pm 18.30$  minutes). These findings were significant statistically ( $p < 0.001$ ).

		Supine Group	Prone Group	P
Total Patients		29 (56.9%)	22 (43.1%)	
Sex	Male	20 (69.0%)	16 (72.7%)	0.085
	Female	9 (31%)	6 (27.3%)	
Mean Age		51.17 ± 8.452	50.64 ± 12.793	0.671
Mean BMI		21.81 ± 1.76	21.50 ± 1.51	0.406
Side	Right	15 (51.7%)	9 (40.9%)	0.587
	Left	14 (48.3%)	13 (59.1%)	
Hydronephrosis	I	3 (12%)	0 (0%)	0.264
	II	8 (32%)	8 (44.4%)	
	III	9 (36%)	4 (22.2%)	
	IV	5 (20%)	6 (33.3%)	
Previous Procedure	ESWL	0 (0%)	2 (9.5%)	0.099
	URS	5 (17.2%)	5 (23.8%)	
	PCNL	2 (6.9%)	2 (9.5%)	
	Open Surgery	5 (17.2%)	7 (33.3%)	
	No History	17 (58.6%)	5 (23.8%)	
Comorbid	Cardiovascular	10 (34.5%)	6 (27.3%)	0.638
Diseases	Respiratory	0 (0%)	1 (4.5%)	
	DM	2 (6.9%)	1 (4.5%)	
	No Comorbid	17 (58.6%)	14 (63.6%)	
Renal Anomalies	Ectopic	1 (3.4%)	0 (0%)	0.454
	Horseshoe	1 (3.4%)	0 (0%)	
	No Anomalies	27 (93.1%)	22 (100%)	
Previous Nephrostomy	Yes	4 (13.8%)	2 (9.1%)	0.606
	No	25 (86.2%)	20 (90.9%)	
Mean Pre Serum Cr		3.41 ± 4.34	1.63 ± 0.68	<0.001
CKD	Yes	7 (24.1%)	1 (4.5%)	0.117
	No	22 (75.9%)	21 (95.5%)	
Stage CKD	I	0 (0%)	0 (0%)	0.099
	II	7 (35%)	3 (18.8%)	
	III	4 (20%)	8 (50%)	
	IV	3 (15%)	4 (25%)	
	V	6 (30%)	1 (6.2%)	

**Table 1:** Basic characteristics of patients who underwent PCNL in the prone and supine positions.

		Supine Group	Prone Group	P
Stone Number	Single	10 (34.5%)	12 (54.5%)	0.169
	Multiple	19 (65.5%)	10 (45.5%)	
Stone Location	Pyelum	10 (34.5%)	8 (36.4.8%)	0.671
	Lower Pole	11 (37.9%)	8 (42.1%)	
	Middle Pole	3 (10.3%)	1 (4.5%)	
	Upper Pole	0 (0%)	1 (4.5%)	
	Multiple Calyx	4 (13.8%)	2 (9.1%)	
	Staghorn	1 (3.4%)	2 (9.1%)	
	Staghorn	1 (3.4%)	2 (9.1%)	
Stone Analysis	Calcium Oxalate	14 (48.3%)	14 (63.6%)	0.174
	Calcium Phosphate	7 (24.1%)	3 (13.6%)	
	Uric Acid	6 (20.7%)	1 (4.5%)	
	MAP	2 (6.9%)	4 (18.2%)	
Mean Stone Burden		2.621 ± 0.91	3.182 ± 1.65	0.016

**Table 2:** Stone Characteristic.

There were no significant differences between mean pre-operation hemoglobin and post operation, however the mean  $\Delta$ Hb is less in supine group than prone group ( $0.54 \pm 0.42$  vs  $1.377 \pm 1.12$ ,  $p=0.001$ ). The numbers of punctures and mean hospital stay had no significant difference.

need for transfusion with no significant statistical difference. No statistically significant differences in sepsis or urine leaked that occurred in both groups (Table 4). We also using Clavien score to classify the surgical complications, however there were no significant differences between prone and supine position (Table 5).

Although there were no significant differences in complication, most complication found in both groups were the need of blood transfusion with 13.8% in supine group and 13.6% in prone group. Both groups also had post operation anemia without the

For costs comparison, supine position was associated with significantly cheaper costs in every cost elements included in our study. Supine position was associated with fewer packs of packed red cell transfusion, cheaper transfusion costs, cheaper disposable

		Supine	Prone	P
Mean Operative Time (min)		57.41 $\pm$ 12.07	78.41 $\pm$ 20.72	0.001
Mean Anaesthesia Time (min)		71.72 $\pm$ 12.906	107.50 $\pm$ 18.30	<0.001
Stone Free Rate (%)		86.2%	90.9%	0.688
Blood Transfusion (%)		13.8%	13.6%	0.657
Mean Hospital Stay (day)		1.93 $\pm$ 0.84	2.55 $\pm$ 1.371	0.054
Stage II ESWL		13.8%	9.1%	0.688
Number of Puncture	Single	26 (89.7%)	19 (86.4%)	0.508
	Double	2 (6.9%)	3 (13.6%)	
	Multiple	1 (3.4%)	0 (0%)	
Mean PreOp Hb		13.15 $\pm$ 2.27	12.159 $\pm$ 2.94	0.578
Mean PostOp Hb		11.88 $\pm$ 2.62	11.57 $\pm$ 2.85	0.726
Mean $\Delta$ Hb		0.54 $\pm$ 0.42	1.377 $\pm$ 1.12	0.001

**Table 3:** Comparison Between Patients Treated with Percutaneous Nephrolithotomy in the Supine and Prone Positions.

	Supine Group	Prone Group	P
Total Complication	6 (20.7%)	5 (22.7%)	0.84
Fever	0 (0%)	0 (0%)	0.98
Sepsis	0 (0%)	0 (0%)	NA
Blood Tranfusion	4 (13.8%)	3 (13.6%)	0.4
Post Op Anemia without Tranfusion	2 (6.9%)	1 (4.5%)	0.72
Urine Leak	0 (0%)	0 (0%)	NA

**Table 4:** Complication.

Clavien score	Supine		Prone		P
	n	%	n	%	
I	0	0	1	4.5	0.24
II	3	10.3	2	9.1	0.88
IIIA	0	0	1	4.5	0.24
IIIB	0	0	0	0	0.21
IVA	0	0	0	0	NA
IVB	0	0	0	0	NA
V	0	0	0	0	NA
Total	3	10.3	4	18	

**Table 5:** Modified Clavien Score and Patient Position.

	Prone	Supine	P
Blood Transfusion (pack)	0.91 ( $\pm$ 1,30 (0-5))	0.17 ( $\pm$ 0,38 (0-1))	0.006
Transfusion Cost (IDR)	280,909 ( $\pm$ 404,073 (0 – 1,550,000))	53,448 ( $\pm$ 119,172 (0-310,000))	0.006
Disposable for Surgery (IDR)	4,985,636 ( $\pm$ 252,069 (4,464,400 – 5,397,500))	4,229,770 ( $\pm$ 222,082 (3,993,000 – 4,625,250))	<0.001
Disposable & Pharmacy for Anaesthesia (IDR)	353,454 ( $\pm$ 9,452 (342,000 – 367,200))	105,120 ( $\pm$ 12380 (94,900 – 119,600))	<0.001
Total Costs (IDR)	17,623,363 ( $\pm$ 4,929,840 (14,069,500 – 36,996,400))	15,175,305 ( $\pm$ 2,086,375(12,947,900-21,263,850))	0.038

**Table 6:** Costs Comparison between Prone vs Supine PCNL.

costs for surgery, cheaper disposable costs for anaesthesia and cheaper total costs (Table 6).

## Discussion

In our study, we found no significant differences in gender, age, sex, body mass index, stone location, previous procedure, comorbid, the presence of CKD and hydronephrosis between the two groups. The mean operative time were approximately 21 minutes shorter in supine group compared to prone ( $p = 0.001$ ). This result was comparable to the study conducted by Balaji et al in 2017 which found that the modified supine position has a shorter operative time of 20 minutes or more [6]. Another study by Jones et al and Liu et al also reported similar result of shorter operative times using supine position (30 and 25 minutes respectively) [5,3]. This shorter duration might be accounted for by no need for repositioning the patient (and consequently repeat prepping and draping, as well as rescrubbing and gowning), and facilitating dual access to the area, assisting with stone clearance and saving time [5].

The shorter mean operative time in supine group might also be the contributing factor to our finding that the supine group is associated with cheaper disposable cost for surgery compared to prone. With shorter operative time, there is also fewer irrigants needed in supine group. The supine group was also associated with lesser needs draping and gowning which is essential in prone position as there is the need for repositioning the patient.

We also found significantly shorter mean of anaesthesia time in supine group compared to prone group, with approximately 30 minutes difference ( $p < 0.001$ ). While the longer operative time is a significant contributor for longer anaesthesia time in prone group, the choice for anaesthesia type also contributed. In our study, every prone PCNL was done using general anaesthesia. Turning a patient prone has predictable effects such as decrease in cardiac output and associated with limitation of respiratory movement, so general anaesthesia is usually the choice for prone position [7]. The cheaper disposable & pharmaceutical used for anaesthesia may be also correlated with this choice, as 100% prone PCNL in our institution assisted with general anaesthesia. General anaesthesia was associated with higher disposable and pharmaceuticals costs compared to regional anaesthesia mainly because of the use of Fentanyl, Atracurium and endotracheal tube in which regional anaesthesia do not use.

The stone free rate between the two groups were comparable (86.2% in supine and 90.9% in prone) with  $p = 0.688$ . Various meta-analyses and systematic review also reported that the supine and prone PCNL are equally effective [3]. The systematic review by Lie et al and Mak et al also reported that there is no significant difference between the two groups in stone free rates [1,3]. However, several prospective studies reported that the supine group was associated with higher stone free rates [5].

We also found that the prone group was associated with more drop in haemoglobin after surgery compared to supine group ( $p = 0.001$ ). While the transfusion rate is comparable between the two groups,

the prone needed more blood for transfusion (0.91 PRC pack vs 0.17 in supine) with  $p = 0.006$ . Aref et al also reported the same findings in his study that reported prone was associated with more hemoglobin loss ( $-1.03$  and  $-2.18$  g/dL) with ( $p < 0.001$ ) though did not affect the blood transfusion rate ( $p = 0.069$ ). This may affect intraoperative visibility in the prone position and thus may prolong the operative time. It might be attributed to obstruction of the IVC during PCNL in the prone position and backflow of blood to the renal vein and may explain why bleeding in the prone position is more [8]. This finding might explain that the supine group was associated with cheaper costs of blood transfusion.

Total complication rate in our study were slightly increase in supine group (34.5% vs 33.8%) although there were no significant differences between two groups. This findings is not in accordance with study of Jones et al which found significantly higher rate of overall complications seen in the prone group compared with the modified supine group. The meta-analysis by Liu et al also found no significant difference in complication rates between their modified supine and prone cohorts [3]. Most complication found in both groups were blood transfusion with 27.6% in supine group and 18.2% in prone group. Study of Mak et al also shown more patients in the supine group required blood transfusion than those in the prone group (27.5% vs 7.5%) [1]. However, it should be noted that our study was conducted at a tertiary referral centre where PCNL performed on more complex stones and higher risk patients.

## Conclusion

Supine and prone PCNL are equally effective for achieving high stone free rate. However, supine position demonstrated lower blood loss, shorter operative and anaesthesia time compared to prone position. The supine position is more cost effective compared to prone in term of transfusion cost, disposable equipment costs for surgery, disposable costs for anaesthesia, and total costs. With current literatures focused on treatment outcome of prone vs supine PCNL, our study may provide the basic data for further prospective cost analysis between supine vs prone PCNL - which is still lacking, that hospital manager and clinician may find attractive.

## References

1. Mak DKC, Smith Y, Buchholz N, et al. What is better in percutaneous nephrolithotomy – Prone or supine? A systematic review. *Arab J Urol*. 2016; 14: 101-107.
2. Miano R, Scoffone C, De Nunzio C, et al. Position: Prone or supine is the issue of percutaneous nephrolithotomy. *Journ of Endouro*. 2010; 24: 931-938.
3. Liu L, Zheng S, Xu Y, et al. Systematic Review and Meta-Analysis of PCNL for patients in the Supine vs Prone Position. *Journal of Endourology*. 2010; 24: 1941-1946.
4. Basiri A, Mohammadi Sichani M. Supine percutaneous nephrolithotomy, is it really effective? A systematic review of literature. *Urol J*. 2009; 6:7 3-77
5. Jones MN, Ranasinghe W, Cetti R, et al. Modified supine versus prone percutaneous nephrolithotomy: Surgical

- 
- outcomes from a tertiary teaching hospital. *Investig Clin Urol.* 2016; 57: 268-273.
6. Balaji AR, Lakshminarayan KR, Paranjothi A. Surgical outcomes of modified supine vs prone position in percutaneous nephrolithotomy. *IOSR Journ Dent Med Sci.* 2017; 16: 41-43.
  7. Atkinson CJ, Turney BW, Noble JG, et al. Supine vs prone percutaneous nephrolithotomy: an anaesthetist 's view. *BJU Intern.* 2011; 108: 306-307.
  8. Aref AA, Salah MA, Mahmoud AA, et al. Percutaneous nephrolithotomy in the oblique supine lithotomy position and prone position: a comparative study. *Journ of Endouro.* 2014; 28: 1058-1063.