COMPARISON OF PERCUTANEOUS NEPHROLITOTOMY (PCNL) IN PRONE AND SUPINE POSITION: A SINGLE CENTRE EXPERIENCE REPORT

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ABSTRACT

Objective: *This study aims to compare outcomes of supine percutaneous nephrolithotomy to prone percutaneous nephrolithotomy as a traditional approach in Hasan Sadikin Hospital Bandung.* ***Material & Methods:*** *Data was taken from urology's database between 2003-2012, which contain data of prone position (2003-2007), and supine position (2008-2012). Three hundred forty-nine patients were included in this study. We reviewed data on demography, stone burden, operating time, stone-free rate, transfusion rate, hospital stay, and major complications.* ***Results:*** *Of 174 patients underwent prone position, and 175 patients were part of the supine position. Age means of prone position was 51.0 years old, the supine position was 50.5 years old. The number of male patients was 65.5% for prone, and 66.1% for supine. The mean stone's largest diameter of prone was 23.87 mm, supine was 22.36 mm. The operating time of prone was 107 minutes; supine was 90 minutes. The stone-free rate of prone was 94.7%; supine was 91.3%. The mean hospital stays of prone was 14.3 days; supine was 9.6 days. The transfusion rate of prone position was 8.9%, supine was 7.2%. No major complications were recorded.* ***Conclusion:*** *Higher stone-free rates are achieved with patients in the prone position during PCNL. Supine position has shorter operating time, and hospital stay, lower blood transfusion rates. The complication rate is not different between the two positions.*

Keywords: *Percutaneous nephrolithotomy, prone, supine position.*

ABSTRAK

Tujuan: *Tujuan penelitan ini adalah untuk membandingkan efektivitas posisi terlentang (supine) pada PCNL terhadap posisi tradisional yaitu posisi telungkup (prone) di RSUP Hasan Sadikin Bandung.* ***Bahan & Cara:*** *Data diambil dari data sekunder di Departemen Urologi antara tahun 2003-2012, yang terdiri dari data posisi prone (2003-2007) dan posisi supine (2008-2012). 349 pasien termasuk dalam penelitian ini. Dicatat usia, jenis kelamin, ukuran batu, lamanya operasi, angka bebas batu, angka transfusi, lamanya dirawat, dan komplikasi mayor.* ***Hasil:*** *Sebanyak 174 pasien sebagai subjek penelitian posisi prone dan 175 pasien posisi supine. Usia rerata prone dan supine berturut-turut adalah 51.0 dan 50.5 tahun. Jumlah pasien pria pada prone 65.5% dan supine 66.1%. Rerata ukuran batu terbesar pasien prone dan supine berturut-turut adalah 23.87 mm dan 22.36 mm. Rerata lamanya operasi pada posisi prone adalah 107 menit, supine 90 menit. Angka bebas batu berturut-turut adalah 94.7% dan 91.3% untuk posisi prone dan supine. Rerata lamanya dirawat untuk prone dan supine adalah 14.3 hari dan 9.6 hari. Sedangkan angka transfusi untuk prone adalah 8.9% dan 7.2% untuk supine. Tidak ada komplikasi mayor pada kedua teknik tsb.* ***Simpulan:*** *Angka bebas batu lebih tinggi didapatkan pada posisi prone. Posisi supine mempunyai waktu operasi dan lama rawat yang lebih pendek, serta angka transfusi lebih rendah. Tidak ada kejadian komplikasi mayor pada kedua teknik tersebut.*

Kata Kunci: *Nefrolitotomi perkutan, posisi prone, posisi supine.*

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INTRODUCTION

The history of percutaneous nephrolithotomy (PCNL) begins with Fernstrom and Johannson in 1976.[1] Before that, Goodwin et al., who performed percutaneous nephrostomy in hydronephrosis case in 1955.[2] After discovery of PCNL technique, it became the first line for large, complex, and staghorn stone as noted in European Association Urology (EAU) Guidelines.[3]

In 1987 Valdivia-Uria et al., conducted an initial study of supine PCNL on a cadaver, and in 1998 they reported more 500 cases using this technique.4 His technique was further improved by

Ibarluzea.[5-6] This approach is becoming increasingly popular worldwide, and its advantages are widely documented: easier anesthesia management, single positioning, and simultaneous anterograde and retrograde access to the urinary tract.[7-11]

In Indonesia, supine PCNL began to be used as an alternative PCNL approach by Ferry Safriadi at Hasan Sadikin General Hospital in 2008, which this position became a routine in many centers.

OBJECTIVE

To compare the outcomes of percutaneous nephrolithotomy (PCNL) in supine position to a prone position.

MATERIAL & METHODS

We performed an observational study with cross-sectional design analysis of patients' database who underwent PCNL between 2003-2012. Indications of surgery were renal stones ≥ 2 cm. or symptomatic calculi <2 cm in which the first-line technique failed (Extra-corporeal Shock Wave Lithotripsy/ESWL). A single operator did all the procedures. There were 349 cases, which consist of 174 prone position (2003-2007) and 175 supine position cases (2008-2012). Patient age, stone largest diameter, operating time, stone-free rate, transfusion rate, and hospital stay were collected and reviewed.

The stone's largest diameter has been assessed by measuring the maximum stone length or stone surface area on plain X-ray, intravenous pyelography (IVP), or non-contrast enhanced computed tomography (NCCT).[12] Operating time is defined as the time from when the surgeon starts the surgery until he or she leaves the procedure. Stone-free rate is defined as residual stone less than 5 mm based on ultrasound (US), X-ray, or CT post-surgery.[13] Transfusion rate is defined as blood component transfusion after surgery (usually packed red cell (PRC) if hemoglobin < 10gr%). Major surgical complication defined as Clavien-Dindo Classification ≥grade 3.[14]

In the prone technique, patients were placed in a lithotomy position, and the ureteral catheter was inserted through a rigid cystoscope to perform a retrograde pyelogram. The ureteral catheter was fixed to a Foley catheter, and then the patient was repositioned to the prone position. Contrast is passively instilled through the ureteral catheter, and with the C-arm in the upright position (with 900 angulation), the collecting system is inspected, and the target calyx is selected. We perform a perpendicular puncture with a fine needle (20G) into the target calyx under fluoroscopic guidance. When the needle is correctly positioned into the target calyx, urine, or contrast output is observed after removing the stylet. After puncture success inserted into the calyx, a surgeon puts a guidewire in. The tract was sequentially dilated to 28 Fr using Alken metal dilator. After that, Amplatz inserted, follow by nephroscope and safety guidewire. Ultrasonic stone fragmentation was used as standard equipment. Stone fragments were taken out by stone grasper. At the end of the procedure, fluoroscopy was used to see any residual stone. Nephrostomy catheter no 16 Fr left behind with 5cc balloon.

Figure 1. Supine position (Galdakao).

Supine technique description, patients were placed in an intermediate supine - lateral position with a saline bag placed to raise the flank The ipsilateral leg was extended and the contralateral leg was abducted and flexed, achieving a modified lithotomy position. The surgeon inserted the catheter ureter through a rigid cystoscope to perform retrograde pyelography. The puncture area is between 12th rib and Iliac Crest in craniocaudal, posterior linea axillaris in the ventral side. The trajectory angle depends on the inferior/media calyx position under fluoroscopic guidance. As a prone technique, we use 'bull's eye' or triangular method for percutaneous renal access - the same steps as a prone technique for tract dilatation.

Differences between the two groups were analyzed using the Chi-Square and t-test with $p < 0.05$ being considered as significant. The statistical software used was IBM SPSS version [20].

RESULTS

We analyzed 349 PCNL with complete data: 174 patients underwent PCNL in prone, 175 in a supine position. Table 1 shows the pre-operative characteristics of those patients.

Table 1 shows the baseline data of patients who underwent PCNL; the mean age between the two groups was 51.04 and 50.52 years old, which was no statistical difference. Patient gender between prone and supine was proportional unless male to female ratio about 2:1. In prone, the right site was more often than the left side, and the supine position was vice versa. No difference of mean stone largest diameter between prone versus supine; 23.87 mm and 22.36 mm.

In table 2 shows operative time in the prone position was longer than supine, even no significant in statistic analysis. The stone-free rate between both positions was 94.7% and 91.3%. The blood transfusion rate in supine was less than a prone position. Hospital stay in the prone position was longer than supine, but not statistically significant. No major complications (Clavien-Dindo ≥ grade 3) were recorded between prone and supine positions.

Comparing our results to other supine studies shows that a number of patients were more than their study. The stone-free rate was equal, but in blood transfusion rate and hospital stay were more and longer than their study. No major complications recorded in our study, but De Sio, Hoznek, and Manohar have reported major complications.[6-8]

Table 1. Baseline characteristic of patients undergoing PCNL.

	Prone	Supine	p-value
Patients	174	175	
Age (years), mean ± SD	51.04±11.54	50.52±12.00	0.77
Gender			0.87
Male, %	65.5%	66.1%	
Female, %	35.5%	33.9%	
Site of the surgery			0.02
Right, %	62.1%	41.8%	
Left %	37.9%	58.2%	
Stone largest diameter (mm), mean ± SD	23.87±8.6	22.36±7.4	0.93

Table 2. Peri-operative results in both positions.

	Prone	Supine	Total	p-value
Number of PCNL, n	174	175	349	
Operative time (min), mean (±SD)	107.81± 14.00	90.97 ± 7.80	91.25 ± 26.91	0.39
Stone-free rate, %	94.7%	91.3%	93%	0.80
Blood transfusion rate, %	8.9%	7.2%	8.05%	0.67
Hospital stay (day), mean (SD)	14.36 ± 6.22	9.66 ± 7.58	12.01 ± 6.9	0.49
Major complications (Clavien-Dindo ≥ III), %	0%	0%	0%	1.00

Table 3. Supine position comparison.

	Safriadi	De Sio	Hoznek	Manohar
Number of PCNL, n	175	75	47	62
Operative time (min)	77.5	43	123.5	46
Stone-free rate, %	91.3%	88.7%	97.9%	95%
Blood transfusion rate, %	7.2%	0%	2.12%	3.2%
Hospital stay (day), mean	9.66	4.3	3.4	5
Major complications, %	0%	2.5%	8.5%	6.4%

DISCUSSION

Controversy in ideal positioning for PCNL remains debatable. Recently, two meta-analyses showed similar results between prone and supine positions. There is no difference between these two positions.[15-16] Yuan's study reports that PCNL in the prone position has a higher stone-free rate than the supine position (77.7% vs. 74.3%). But the supine position has shorter operating times and fewer blood transfusions.[15] Falahatkar showed a similar stone-free rate, operation time, hospital stay, and complication rate in both approaches.[16]

Positioning in our center was based on surgeon preference and patients' needs. At the beginning of PCNL, we performed a prone position. But, as time has progressed, supine procedures have significantly overtaken prone methods. This trend was also observed by Sofer et al.[17] Some surgeons preferred to use supine based on the study of Scoffone et al. which suggested that supine was the most beneficial position.[9]

The mean age was lower in the supine group, and there was a higher number of male patients in the supine group. The mean age of both groups was 50 years old, De Sio in his study involving 75 patients obtained younger a mean age was 39.4 years old.[7] The number of cases in men was two times more than women, this was inversely proportional to the study of Melo et.al which female as his patients were more dominant.[18]

The kidney side was different between the prone and supine position, wherein the prone position, stones were more on the right side, while in supine was on the left side. This was the same as a Melo study. The largest stone size in this study was around 23mm, smaller than Melo's et al., which was 30mm.[18]

The operating time was longer in the prone position than supine. In the prone position, we must re-position the patient after retrograde pyelography (RPG) and re-drapping. But the prone position has a slightly better stone-free rate (94.7% vs. 91.3%) because of easier access to the entire Calix and more space to perform multi puncture.

The supine position might keep the intrarenal pressure at a lower level because of the descending position of the percutaneous tract. This factor could be associated with the collapse of the collective system and the consequent decrease of vision during the procedure.[7] There is also a narrower area for trocar insertion and instrument movements compared with the prone position.[7] This is in accordance with other studies.[16]

The blood transfusion rate was lower in the supine compared to the prone position, likewise in the Yuan and Falahatkar studies.[15-16]

The hospital stay was quite longer than other studies, which mean hospital stay about 3-5 days.[6-8] This discrepancy because most of our patients should be improved their general condition before surgery. If patients without co-morbid, we noted hospital stay 3.5 days.[19]

Another advantage listed for the supine position is a longer distance between the percutaneous tract and the colon when it has been compared with the prone position.[20] This would be the result of the movement of the intra-abdominal organs when the abdominal wall is compressed during the prone position. In this study, there was no major complication including colon injury reported in either position. De Sio, Hoznek, and Manohar studies reported 2.5%, 8.5%, and 6.4% of major complications.

This study is not without limitations. Retrospective study and lack of randomization is the main concern. Certainly, a prospective with randomized study and have a standardized protocol of perioperative care would be ideal.

CONCLUSION

Higher stone-free rates are achieved with patients in the prone position during PCNL. Supine position has shorter operating time, and hospital stay, lower blood transfusion rate. The complication rate is not different between the two positions.

REFERENCES

1. Fernstrom I, Johansson B. Percutaneous pyelolithotomy. A new extraction technique. Scand J Urol Nephrol. 1976; 10(3): 257-9.
2. Goodwin WE, Casey WC, Woolf W. Percutaneous trocar (needle) nephrostomy in hydronephrosis. J Am Med Assoc. 1955; 157(11): 891-4.
3. Turk C, Petrik A, Sarica K, Seitz C, Skolarikos A, Straub M, et al. EAU Guidelines on Interventional Treatment for Urolithiasis. Eur Urol. 2016; 69(3): 475-82.
4. Valdivia Uria JG, Lachares Santamaria E, Villarroya Rodriguez S, Taberner Llop J, Abril Baquero G, Aranda Lassa JM. [Percutaneous nephrolithotomy: simplified technic (preliminary report)]. Arch Esp Urol. 1987; 40(3): 177-80.

5. Ibarluzea G, Scoffone CM, Cracco CM, Poggio M, Porpiglia F, Terrone C, et al. Supine Valdivia and modified lithotomy position for simultaneous anterograde and retrograde endourological access. BJU Int. 2007; 100(1): 233-6.
6. Hoznek A, Rode J, Ouzaid I, Faraj B, Kimuli M, de la Taille A, et al. Modified supine percutaneous nephrolithotomy for large kidney and ureteral stones: technique and results. Eur Urol. 2012; 61(1): 164-70.
7. De Sio M, Autorino R, Quarto G, Calabro F, Damiano R, Giugliano F, et al. Modified supine versus prone position in percutaneous nephrolithotomy for renal stones treatable with a single percutaneous access: a prospective randomized trial. Eur Urol. 2008; 54(1): 196-202.
8. Manohar T, Jain P, Desai M. Supine percutaneous nephrolithotomy: Effective approach to high-risk and morbidly obese patients. J Endourol. 2007; 21(1): 44-9.
9. Scoffone CM, Cracco CM, Cossu M, Grande S, Poggio M, Scarpa RM. Endoscopic combined intrarenal surgery in Galdakao-modified supine Valdivia position: a new standard for percutaneous nephrolithotomy? Eur Urol. 2008; 54(6): 1393-403.
10. Shoma AM, Eraky I, El-Kenawy MR, El-Kappany HA. Percutaneous nephrolithotomy in the supine position: technical aspects and functional outcome compared with the prone technique. Urology. 2002; 60(3): 388-92.
11. Steele D, Marshall V. Percutaneous nephrolithotomy in the supine position: a neglected approach? J Endourol. 2007; 21(12): 1433-7.
12. Worster A, Preyra I, Weaver B, Haines T. The accuracy of noncontrast helical computed tomography versus intravenous pyelography in the diagnosis of suspected acute urolithiasis: a meta-analysis. Ann Emerg Med. 2002; 40(3): 280-6.
13. Somani BK, Desai M, Traxer O, Lahme S. Stone-free rate (SFR): a new proposal for defining levels of SFR. Urolithiasis. 2014; 42(2): 95.
14. Bolliger M, Kroehnert JA, Molineus F, Kandioler D, Schindl M, Riss P. Experiences with the standardized classification of surgical complications (Clavien-Dindo) in general surgery patients. Eur Surg. 2018; 50(6): 256-61.
15. Yuan D, Liu Y, Rao H, Cheng T, Sun Z, Wang Y, et al. Supine Versus Prone Position in Percutaneous Nephrolithotomy for Kidney Calculi: A Meta-Analysis. J Endourol. 2016; 30(7): 754-63.
16. Falahatkar S, Mokhtari G, Teimoori M. An Update on Supine Versus Prone Percutaneous Nephrolithotomy: A Meta-analysis. Urol J. 2016; 13(5): 2814-22.
17. Sofer M, Tavdi E, Levi O, Mintz I, Bar-Yosef Y, Sidi A, et al. Implementation of supine percutaneous nephrolithotomy: a novel position for an old operation. Cent European J Urol. 2017; 70(1): 60-65.
18. Melo PAS, Vicentini FC, Perrella R, Murta CB, Claro JFA. 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.
19. Ramadhan RM, Safriadi, F. Supine Percutaneous Nephrolitotripsy in Hasan Sadikin Hospital. Bandung: Universitas Padjadjaran; 2013.
20. Astroza G, Lipkin M, Neisius A, Preminger G, De Sio M, Sodha H, 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.