The Impact of Body Mass Index on Perioperative Outcomes in Patients Undergoing Percutaneous Nephrolithotomy

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Abstract

Background: To date, percutaneous nephrolithotomy (PCNL) is the gold standard treatment for patients with large renal calculi (RC). Whether obesity has an adverse effect on its success remains controversial.

Objective: To compare the perioperative outcomes of PCNL among Thai individuals with various body mass indices (BMI).

Material and method: A retrospective, cross-sectional study was conducted among 205 patients who underwent PCNL in Ramathibodi Hospital between January 2011 and August 2019. The patients were classified into normal weight (n=98, BMI 18.5 - 24.9 kg/m^2); overweight (n=76, BMI 25.0 - 29.9 kg/m^2); and obese group (n=31, BMI ≥30.0 kg/m^2). Perioperative outcomes were statistically compared between groups.

Results: Stone-free status in the obese group was not different from the normal weight and overweight group (64.5%, 58.2% and 50.0% respectively, p=0.338). There were no significant differences in blood loss (p=0.966), operative time (p=0.663), percentage change of eGFR (p=0.259), length of stay (p=0.381) and postoperative complications (p=0.435) between the three groups.

Conclusion: BMI did not affect the perioperative outcomes of PCNL. Its outcomes in obese patients were not different from those of normal-weight patients.

Keywords: Percutaneous nephrolithotomy, body mass index, renal calculus, stone-free status

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ผลของดัชนีมวลกายต่อการผ่าตัดนิ่วในไต ด้วยวิธีส่องกล้องผ่านผิวหนัง

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ภาควิชาศัลยศาสตร์ คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล

บทคัดย่อ

ภูมิหลัง : ปัจจุบันการผ่าตัดด้วยการส่องกล้องผ่านผิวหนัง (PCNL) เป็นวิธีมาตรฐานสำหรับการรักษานิ่วในไตขนาดใหญ่ ยังคงมีข้อถกเถียงเกี่ยวกับผลกระทบของโรคอ้วนต่อการผ่าตัดนี้

วัตถุประสงค์ : เพื่อประเมินผลของดัชนีมวลกาย (BMI) ต่อผลการการผ่าตัด PCNL

วัสดุและวิธีการ : เป็นการศึกษาย้อนหลังแบบตัดขวางในผู้ป่วย 205 รายที่ได้รับการผ่าตัดนิ่วในไตด้วยวิธี PCNL ที่โรงพยาบาลรามาธิบดี ระหว่าง ม.ค.2554 - ส.ค.2562 โดยแบ่งเป็น 3 กลุ่มตามระดับ BMI คือ น้ำหนักปกติ 98 ราย (BMI 18.5 - 24.9 กก./ตร.ม.), น้ำหนักเกิน 76 ราย (BMI 25.0 - 29.9 กก./ตร.ม.) และอ้วน 31 ราย (BMI ≥30.0 กก./ตร.ม.) เปรียบเทียบทางสถิติของผลการผ่าตัดทั้ง 3 กลุ่ม

ผลการศึกษา : อัตรานิ่วหมดหลังผ่าตัดในกลุ่มอ้วนไม่แตกต่างจากกลุ่มน้ำหนักปกติและน้ำหนักเกิน (ร้อยละ 64.5, 58.2 และ 50.0 ตามลำดับ, p=0.338) ไม่พบความแตกต่างของผลการผ่าตัดทั้ง 3 กลุ่มในด้านปริมาณการเสียเลือดระหว่างผ่าตัด (p=0.966), ระยะเวลาผ่าตัด (p=0.663), อัตราการเปลี่ยนแปลงการทำงานของไตหลังผ่าตัด (p=0.259), จำนวนวันนอนโรงพยาบาล (p=0.381) และภาวะแทรกซ้อนหลังผ่าตัด (p=0.435)

สรุป : ระดับของดัชนีมวลกายไม่มีผลกระทบต่อผลการผ่าตัด PCNL ผลการรักษาในผู้ป่วยที่อ้วนมีประสิทธิภาพและความปลอดภัยไม่แตกต่างจากผู้ป่วยน้ำหนักปกติ

คำสำคัญ : การผ่าตัดนิ่วในไตด้วยวิธีส่องกล้องผ่านผิวหนัง, ดัชนีมวลกาย, อัตรานิ่วหมดหลังผ่าตัด

Introduction

Despite the increasing awareness of the health problems associated with fatness, its incidence is rising persistently and the degree of overweight is rising in every part of the world. The prevalence of obesity in Thailand by the World Health Organization (WHO) definition is 23.9%.[1] Obesity has been correlated with a high incidence of renal calculi (RC).[2] It is not only an independent risk factor for perioperative complications such as atelectasis, wound infection and venous thromboembolism[3-5], but also increases the difficulty of endoscopic procedures.[6,7]

Currently percutaneous nephrolithotomy (PCNL) is the gold standard for removal of large RC, but obesity is commonly considered to exert an adverse effect on its success. Several studies demonstrated that PCNL is a safe and efficacious treatment in obese patients.[8-13] However, some researchers found that obesity increased operative time, risk of complication, length of stay (LOS), re-treatment rate and decreased stone-free rate (SFR).[14-15] This controversial has not been investigated in Thai patients. This study aimed to compare the perioperative outcomes of PCNL among Thai individuals with various body mass indices (BMI).

Material and method

A retrospective, cross-sectional study was conducted among 205 patients who underwent PCNL in Ramathibodi Hospital between January 2011 and August 2019. All procedures were performed by three high-experienced endourologists. Inclusion criteria were patients aged over 18 years who had a complete or partial staghorn RC. The exclusion criteria were inadequate preoperative computerized tomography (CT) imaging and insufficient clinical data. According to their BMI, the patients were classified into three groups by WHO definition: normal weight group (18.5 - 24.9 kg/m^2); overweight group (25.0 - 29.9 kg/m^2) and obese group ($\geq$30.0 kg/m^2).[4]

Preoperative data included patients' demographics, stone size, stone side, hemoglobin (Hb) and estimated glomerular filtration rates (eGFR). Primary outcome was stone-free status assessed by 30-days postoperative CT scan showing clinically insignificant stone fragment diameter <4 mm (asymptomatic, non-infectious and non-obstructive) or absence of residual stone. Secondary outcomes were intraoperative blood loss, operative time, percentage change of eGFR (between preoperative and postoperative day 1), LOS and postoperative complications by modified Clavien classification.[16] All CT imaging were assessed by two urology residents who performed one measurement per patient. Stone size was calculated in coronal view.

After cystoscopy was performed in the supine frog-leg position and a 6F ureteral catheter was inserted, the patient was turned to the prone position. The pelvo-calyceal system was accessed for the PCNL procedure by using the Bull's eye technique. Alken metal dilators were used to dilate the tract and an Amplatz sheath was inserted. Nephroscopy was obtained by using a rigid 26F nephroscope (Karl Storz, Munich, Germany). The stones were fragmented

with an ultrasonic lithotripter and continuous suction. The residual stone fragments were sought by fluoroscopy and flexible nephoscopy. A temporary 22F nephrostomy tube was placed at the end of the operation. The ureteral catheter was routinely retained for 1–2 days postoperatively. Prophylactic antibiotics (typically third-generation cephalosporin) or susceptible antibiotics with urine culture were given at the time of anesthetic induction and continued until the patient was discharged.

Statistical analysis was performed using STATA version 14.1 (STATA Corp., Texas, USA). The data was compared between three groups by using Kruskal-Wallis test for continuous variables and Fisher's exact test for categorized variables. A p-value of <0.05 was considered statistically different. The study protocol was approved by the Institutional Ethics Committee.

Results

During the study period, there were 243 patients with large renal calculi underwent PCNL. Fifteen patients were excluded due to inadequate imaging studies and 23 patients had insufficient clinical data, there were 205 patients enrolled for analysis. The mean age was 58.5 years (range,18-85) and 110 patients were female. The mean BMI was 25.8 kg/m 2 (range, 14.5-43.4) and the average stone size was 534 mm^2. We found 98 patients with normal weight, 76 who were overweight, and 31 who were obese. The patients' demographic data revealed no significant differences between the three groups, except the pre-operative eGFR (Table 1). Postoperative stone clearance in the obese group was higher than those of the normal weight and the overweight group (64.5%, 58.2% and 50.0% respectively), but this difference was not significant (p=0.338). Likewise, the average estimated blood loss (EBL) in the three groups was not significantly different (obese 323 ml, overweight 299 ml and normal weight 297 ml, p=0.966). The mean operative time was slightly higher in the normal weight group than the obese and the overweight groups (155±122 *vs* 132±53 *vs* 131±66 minutes, p=0.663). There were no significant differences in LOS and percent change in eGFR between the three groups (p=0.381 and p=0.259 respectively). Three patients in the normal weight group, two patients in the overweight group and one patient in the obese group developed urosepsis. Three patients in the normal weight group and one patient in the overweight group developed arterial pseudoaneurysm. However, the overall postperative complications did not demonstrate significant difference between groups (p=0.435) (Table 2).

Table 1. The characteristics of the patients comparing between 3 BMI groups (n=205).

Patient Characteristics	Normal weight (n=98)	Overweight (n=76)	Obese (n=31)	p-value
Age (years)				
mean ± SD	58.6 ± 12.4	58.3 ± 10.4	58.7 ± 12.3	0.936
(min-max)	(18 - 80)	(32 - 76)	(28 - 83)	
BMI (kg/m^2)				
mean ± SD	22.0 ± 3.1	27.3 ± 2.9	33.6 ± 5.1	0.026
(min-max)	(18.3 - 24.9)	(25.1 - 29.2)	(30.0 - 40.0)	
Gender n (%)				
male	52 (53.1)	34 (44.7)	9 (29.0)	0.061
female	46 (46.9)	42 (55.3)	22 (70.9)	
Stone size (mm^2)				
mean ± SD	557 ± 459	602 ± 395	489 ± 296	0.372
(min-max)	(32 - 2,000)	(42 - 1,889)	(46 - 1,170)	
Stone side n (%)				
Left	47 (47.9)	50 (65.8)	20 (64.5)	0.051
Right	51 (52.0)	26 (34.2)	11 (35.4)	
Smokers n (%)	11 (11.2)	11 (14.5)	4 (12.9)	0.812
Preoperative Hb (mg/dl)				
mean ± SD	13.1 ± 1.7	13.1 ± 1.7	12.9 ± 1.3	0.694
(min-max)	(7.9 - 17.6)	(8.8 - 16.2)	(10.5 - 14.9)	
Preoperative eGFR (mg/dl)				
mean ± SD	77.4 ± 22.9	81.4 ± 22.1	70.4 ± 26.8	0.033
(min-max)	(22-110)	(22-143)	(21-120)	
ASA classification n (%)				
class 1	92 (93.9)	71 (93.4)	28 (90.3)	0.621
class 2	6 (6.1)	4 (5.3)	3 (9.7)	
class 3	0 (0.0)	1 (1.3)	0 (0.0)	

Table 2. Perioperative outcomes of PCNL comparing between 3 BMI groups (n=205).

Outcomes	Normal weight (n=98)	Overweight (n=76)	Obese (n=31)	p-value
Stone-free status n (%)	57 (58.2)	38 (50.0)	20 (64.5)	0.338
Estimated blood loss (ml)				
mean ± SD	297 ± 319	299 ± 337	323 ± 346	0.966
(min-max)	(10 - 1,000)	(10 - 1,200)	(10 - 1,200)	
Operative time (minutes)				
mean ± SD	155 ± 122	131 ± 66	132 ± 53	0.663
(min-max)	(40 - 500)	(40 - 500)	(60 - 300)	
% change in eGFR	7.8 ± 12.1	9.1 ± 14.0	8.2 ± 7.1	0.259
Postoperative complications n (%)				
Overall	35 (35.7)	21 (27.6)	8 (25.8)	
Fever (Clavien-Dindo grade 1)	21 (21.4)	15 (19.7)	5 (16.1)	0.435
Blood transfusion (Clavien-Dindo grade 2)	8 (8.2)	3 (3.9)	2 (6.4)	
Pseudoaneurysm (Clavien-Dindo grade 3A)	3 (3.1)	1 (1.3)	0 (0.0)	
Sepsis (Clavien-Dindo grade 4B)	3 (3.1)	2 (2.6)	1 (3.2)	
Length of stay (days)				
mean ± SD	8.3 ± 6.5	7.0 ± 3.0	7.5 ± 2.3	0.381
(min-max)	(4 - 42)	(4 - 20)	(5 - 16)	

Discussion

Obesity has been associated with the development of chronic kidney disease and kidney stones.[17,18] Pigna et al[19] demonstrated that the total body adipose tissue and trunk fat are risk factors for uric acid stone formation. Moreover, the overweight and the super-obese patients require a complex perioperative anesthesia because of the metabolic and pharmacologic disorders.[20] Worse outcomes have been recorded for obese patients undergoing PCNL. In 1997, Faerber and Goh[14] retrospectively studied in 530 patients receiving PCNL and showed that the super -obese group (BMI ≥40.0 kg/m^2) had longer LOS and higher rate of complications than the normal weight group. Fuller et al[15] analyzed the PCNL outcomes in 3,709 patients and found lower SFR, longer operative time and higher re-treatment rate in the obese patients.

Contrarily, other studies revealed that BMI did not affect the outcomes of PCNL in terms of SFR [8-13, 21], operative time[9.13.21], fluoroscopic time[9], Hb level[12,13], transfusion rate[8], analgesic use[13], LOS[8,9,11,13] and complications.[9-13,21] These were similar to our results that found no significant differences in SFR, intraoperative blood loss, operative time, percentage change of eGFR, LOS and postoperative complications among the normal weight, overweight and obese patients. Likewise, a recent systematic review and meta-analysis about the effect of obesity on the outcomes of PCNL in RC treatment demonstrated no obvious differences in SFR and complication rates.[22] Interestingly, the LOS was shorter among obese patients than among normal-weight patients and the operative time was longer among super-obese individuals than among normal-weight individuals.[22]

Our study had some limitations. It was retrospective in nature that might be biased by management strategies and patient allocation, represented by the significant difference of pre-operative eGFR between the three groups. Furthermore, the surgeons who performed PCNL were not the same ones and might be biased by the surgeon experience. However, to the best of our knowledges, this is the first study to answer this controversial issue among Thai patients. We also extended the outcome measurement into the percentage change of eGFR that has not been reported in previous studies.

Conclusion

PCNL is safe and effective for the management of RC in obese patients. Its perioperative outcomes were not affected by BMI.

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