Safety and Feasibility of Tubeless Percutaneous Nephrolithotomy with Expanded Indication

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Objective: *The aims of this study were to compare perioperative outcomes of expanded indications of tubeless PCNL versus tubed PCNL.*

Material and Method: *Between May 2011 and August 2014, 192 PCNL cases (118 tubeless/74 tubed) in Siriraj Hospital were reviewed. There were no any specific criteria for selecting patients to tubeless group. Patient demographics data, operative and perioperative outcomes were evaluated and complications were classified by using Clavien score system.*

Results: *Baseline characteristics were well balanced between both groups. The operative time was shorter in tubeless PCNL (75 vs. 120 min; p = 0.001) even though the puncture approaches were similar between two techniques. Pain score, morphine usage, hematocrit change and stone-free rate were comparable in both groups. In tubeless PCNL group, there were significantly lower incidence of fever (53% vs. 75%; p = 0.002) and Clavien score (1.4±0.9 vs. 1.8±0.8; p = 0.005), and shorter length of hospital stay (4 vs. 7 days; p = 0.001). Clavien scores of tubeless and tubed PCNL according to clinical factors (Age ≥60 years, previous kidney surgery, BMI ≥30 kg/m^2, staghorn stone and supracostal approach) were not statistically significant between two groups.*

Conclusion: *Tubeless PCNL with ureteric stent in all patients had favorable outcomes with no increasing complications when compared with tubed PCNL. It is a safe and effective procedure for management of nephrolithiasis in experienced surgeon.*

Keywords: *Percutaneous nephrolithotomy, Tubeless, Expanded indication, Safety, Efficacy*

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Since 1970s, the surgical technique of large and complex renal calculi has been improved with the introduction of percutaneous nephrolithotomy (PCNL) adjunct to open kidney surgery[1] and it has become the operation of choice[2]. At the end of PCNL procedure, temporary nephrostomy tube is usually left in the renal pelvis for urinary drainage, tamponade of bleeding or permitting a second look procedure[3,4]. In 1997, Bellman et al had first reported 50 patients that performed tubeless percutaneous renal surgery and founded that it was quite safe procedure and offers numerous advantages. Percutaneous nephrostomy placement could be omitted to shorten hospitalization, reduce postoperative pain and analgesic requirement[5]. After that, several studies had reported the results with tubeless PCNL[6-8].

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The placement of ureteral stent in substitute of nephrostomy tube, tubeless PCNL, was typically done in cases with no significant intra-operative bleeding, no collective system perforation and no complete staghorn stones. In this study, we want to compare perioperative outcomes of expanded indications of tubeless PCNL versus tubed PCNL, and to determine factors that influence tubeless PCNL outcomes.

Material and Method

A total of 192 medical records of the consecutive patients who underwent PCNL at Siriraj Hospital between May 1, 2011 and August 31, 2014 were retrospectively reviewed. All patients underwent intravenous pyelography or non-contrast computerized tomography to access stone size, stone location. The patient was in prone position. Renal access was done by fluoroscopic guidance. The percutaneous tract was dilated by balloon dilator or fascial dilator (depends on surgeon preference). Amplatz sheath was placed and rigid nephroscopy was applied. Ultrasonic lithotripter

was used for stone fragmentation. The patients were classified into tubeless PCNL group or tubed PCNL group. One of the surgeons performed tubeless PCNL for all patients, despite of significant bleeding, collecting system injury or residual stone. Double-J ureteric stent no.6 was indwelled by antegrade fashion at the end of every PCNL procedure, and sutured the skin at nephrostomy site. Other surgeons performed tubed PCNL on regular basis by using tube drain 24-28 Fr.

Patient demographic data including age, body mass index (BMI), comorbidity, history of previous ipsilateral kidney surgery (previous open kidney surgery and PCNL) and history of recent anticoagulant/ antiplatelet usage were recorded. The stone burden was measured as stone surface area (two dimensional areas: mm^2), calculated by length and width of stone on pre-operative plain KUB film. Surgical factors were type of puncture approach (supracostal or infracostal) and operative time. Postoperative data including postoperative fever, urosepsis, blood loss (defined as decrease of hematocrit at post operative day 1), pleural complication, postoperative pain score (day 0 and day 1), morphine usage, stone-free rate and length of hospital stay were analyzed. The complications were classified by using Clavien score system for percutaneous nephrolithotomy[9]. Residual stone was defined as stone fragment visualized by plain film KUB at postoperative periods. SPSS version 15 was used to analyze the collected data. Outcomes between 2 groups were compared with Chi-square or Fisher's exact test for categorical variable and independent t-test or Mann Whitney U test for continuos variable. Significance was set as *p*-value less than 0.05.

Results

There were 192 PCNL cases, 74 underwent tubed PCNL and 118 underwent tubeless PCNL respectively. Patient demographic data were well balanced between 2 groups (Table 1). The mean age in Tubed PCNL was 55.2 years and 52.6 years in tubeless PCNL. The mean BMI was 25 kg/m^2 in both groups. More patients in tubed PCNL underwent prior ipsilateral kidney surgery (25% vs. 18%), while more supracostal puncture approach was done in patients in tubeless PCNL group (26% vs. 18%; *p*-0.24). The number of patients with comorbidities and anticoagulant/ antiplatelet usage were non-statistically higher in tubed PCNL group. Stone characteristics were similar between both groups; mean stone size in tubed PCNL was slightly larger (715 vs. 620 mm^2; *p*-0.19) but staghorn stone was more common in tubeless PCNL (42% vs. 40%; *p*-0.48).

Operative outcomes were better in tubeless PCNL group; operative time (75 vs. 120 min; $p = 0.001$), and length of hospital stay (4 vs. 7 days; $p = 0.001$) were significantly shorter. The incidence of postoperative fever (53 vs. 75%; $p = 0.002$) and Clavien score (1.4 ± 0.9 vs. 1.8 ± 0.8; $p = 0.005$) were also lower as shown in Table 2. In addition, postoperative urosepsis was also less common. There were no differences in the changing of hematocrit, pleural complications, pain score, morphine usage and stone-free rate between the two groups.

Clavien score of tubed and tubeless PCNL according to age ($\geq$60 years), type of stone (staghorn stone), obesity (BMI $\geq$30 kg/m^2), previous kidney surgery and type of renal access (supracostal approach) showed that there were not statistically different between 2 groups (Table 3).

In tubed PCNL group, one patient suffered from bleeding that was treated by selective angioembolization, while three patients developed pleural effusion. Two of them were treated by intercostals drainage placement and 1 patient was treated with conservative treatment.

In tubeless PCNL group, there were 6 patients who developed pleural effusion; five were successfully treated with conservative treatment, while only one patient needed pleural tapping. Two patients were diagnosed with perinephric collections which resolved

Table 1. Patient demographic data

Demographic data	Tubeless PCNL (118 pt)	Tubed PCNL (74 pt)	*p*-value
Age (year)	52.6 ± 12.7	55.2 ± 11.2	0.15
BMI (kg/m^2)	25.5 ± 4.1	25.7 ± 4.9	0.75
Previous kidney surgery (%)	18.6	25.7	0.24
Anticoagulant/antiplatelet usage (%)	11	12	0.80
Comorbidity (%) (DM, HT, cardiovascular, CKD)	50	63.5	0.06

Table 2. Perioperative outcomes of tubeless PCNL vs. tubed PCNL

Perioperative outcomes	Tubeless PCNL (118 pt)	Tubed PCNL (74 pt)	*p*-value
Operative time (min)	75	120	0.001
Postoperative fever (%)	53	75	0.002
Postoperative urosepsis (%)	4.2	9.5	0.21
Stone free rate (%)	48	45	0.75
Pleural complication (%)	5.1	2.7	0.71
Hct drop (%)	3 (0-15)	4 (0-13.5)	0.92
Visual pain score day 0 (0-10)	3 (0-8)	4.5 (0-10)	0.30
Visual pain score day 1 (0-10)	2 (0-10)	3 (0-8)	0.06
Morphine usage (mg)	2 (0-15)	3 (0-18)	0.17
Clavien score (0-5)	1.4±0.9	1.8±0.8	0.005
Length of hospital stay (days)	4 (1-17)	7 (4-31)	0.001

Table 3. Clavien scores of tubeless & tubed PCNL according to clinical factors

Clinical factors	Tubeless PCNL	Tubed PCNL	*p*-value
Age ≥60 years	1.5±1.0	1.8±0.7	0.20
Previous kidney surgery	1.3±1.0	1.9±0.9	0.06
BMI ≥30 kg/m^2	1.5±1.1	1.7±0.9	0.56
Staghorn stone	1.5±0.9	1.8±0.8	0.13
Supracostal approach	1.7±0.9	2.0±0.7	0.33

spontaneously. In addition, 1 patient had bleeding complication that required selective angioembolization, 1 patient suffered from postoperative deep vein thrombosis which resolved with anticoagulant and 1 patient had intraoperative collecting system perforation which required no need to place of nephrostomy tube.

Discussion

PCNL has become the standard treatment of large and complex renal calculi. Tubeless PCNL was associated with less morbidity; shorter hospital stay, less postoperative pain and analgesic requirements. The findings in our study were similar to previously reported outcomes with shorter length of hospital stay, lesser pain scores and lesser morphine usage.

Earlier studies demonstrated that there was no different in operative blood loss, post operative urinoma or perinephric collection[10,11], but those studies excluded patients that developed significant intra-operative bleeding or perforation in tubeless PCNL group. The results of tubeless PCNL in patients with expanded indications, irrespective of the presence of significant bleeding or collecting system perforation[12], also showed that it was a safe procedure in this setting.

In this study, we did not pre-specify any pre-operative or intra-operative exclusion criteria, the tubeless PCNL surgeries were done in all patients. With expanded indications, the surgeries did not result in the increase of any of the serious complications. It might be implied that ureteral stent could drain urine adequately after PCNL procedure. Moreover, Clavien score, which represents overall complication, was lower in tubeless PCNL group, mostly due to less postoperative fever and shorter operative time in tubeless PCNL group. Additionally, clavien score according to clinical factors (Age ≥60 years, previous kidney surgery, BMI ≥30 kg/m^2, staghorn stone and supracostal approach) showed that there were similar in perioperative complication between tubed and tubeless PCNL.

Average length of hospital stay in tubeless PCNL in this study was 4 days, which seems to be longer than other previous reports. This result could be explained by the fact that the incidence of postoperative fever was quite high. And it was the problem that we concerned. All patients who had fever were investigated for blood and urine culture. And 72 hours were needed to ensure that there was no serious infection before the patients to be discharged.

Since this was a retrospective study, the most important confounding factor was a bias from selecting patients to either tube or tubeless PCNL group. In view of the fact that only one surgeon performed the tubeless PCNL procedure to all patients, while other surgeons did tube PCNL to almost every case, the selection bias was reduced in away. Furthermore, it is important to take surgeon expertise into account for the results. Even though all the surgeon's skills were comparable, the one who did tubeless PCNL had more experiences.

Conclusion

Tubeless PCNL with ureteric stent had favorable outcomes with no increase in complications compared with tubed PCNL in expanded indications for large renal calculi. It is a safe and effective procedure for the management of nephrolithiasis in experienced hands.

What is already known on this topic?

Nowadays, the contraindications for tubeless PCNL are active bleeding and collecting system perforation while aging, previous kidney surgery, staghorn stone, supra costal access and patients who has high body mass index are selectively to undergo this procedure.

What this study adds?

The study revealed the feasibility and safety of expanded indications for those patients as aforementioned to undergo tubeless PCNL.

Potential conflicts of interest

None.

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ความปลอดภัยและความเป็นไปได้ของการไม่ใส่สายระบายที่ไตภายหลังการผ่าตัดนิ่วในไตออกด้วยการส่องกล้องผ่านแผลเจาะที่ผิวหนังและไม่ใส่สายระบายจากไตภายหลังการผ่าตัด

วิเชียร ศิริธนะพล, ศิรส จิตประไพ, ธวัชชัย ทวีมั่นคงทรัพย์, ไชยยงค์ นวลยง, เอกรินทร์ โชติกวาณิชย์

วัตถุประสงค์: *เพื่อศึกษาเปรียบเทียบผลลัพธ์ของการรักษานิ่วไตโดยวิธีการส่องกล้องสลายนิ่ว โดยวิธีการส่องกล้องสลายนิ่วผ่านแผลเจาะที่ผิวหนังระหว่างกลุ่มที่ใส่และไม่ใส่สายระบายที่ไตภายหลังการผ่าตัด*

วัสดุและวิธีการ: *เป็นการศึกษาเชิงพรรณนาแบบย้อนหลัง (retrospective study) จากเวชระเบียนผู้ป่วยที่ได้รับการเจาะผ่านทางผิวหนังเพื่อส่องกล้องและกรอเอานิ่วในไตออกทุกรายในโรงพยาบาลศิริราชระหว่างเดือนพฤษภาคม พ.ศ. 2554 ถึง เดือนสิงหาคม พ.ศ. 2557 จำนวน 192 คน จำแนกเป็นไม่ใส่สายระบายที่ไต 118 ราย ใส่สายระบายที่ไต 74 ราย โดยศึกษาข้อมูลทั่วไปของผู้ป่วยที่เกี่ยวข้องกับการผ่าตัดภาวะแทรกซ้อนที่เกิดขึ้นกับผู้ป่วยตามระบบคะแนนความเสี่ยง (Clavien score system) และผลลัพธ์ของการผ่าตัด*

ผลการศึกษา: *พบว่าข้อมูลทั่วไปของผู้ป่วยที่ได้รับการผ่าตัดทั้ง 2 วิธีไม่มีความแตกต่างกันอย่างมีนัยสาคัญทางสถิติ ได้แก่ อายุ, BMI, previous kidney surgery, anticoagulant/antiplatelet usage, comorbidity ในแง่ของความปลอดภัยพบว่ากลุ่มที่ไม่ได้ใส่สายระบายที่ไตพบว่ามีไข้หลังการผ่าตัดน้อยกว่าอย่างมีนัยสาคัญ (53% vs. 75%) และมีค่า Clavien score ที่น้อยกว่า (1.4±0.9 vs. 1.8±0.8) ระดับความเจ็บปวดหลังส่องกล้อง การใช้ยามอร์ฟีน ค่าความเข้มข้นของเลือดที่ลดลงและอัตราการปลอดนิ่วทั้งหมดไม่มีความแตกต่างกันอย่างมีนัยสำคัญของทั้งสองกลุ่ม นอกจากนั้นระยะเวลาที่ใช้ในการผ่าตัดในกลุ่มที่ไม่ใส่สายระบายที่ไตใช้เวลาสั้นกว่ากลุ่มที่ใส่สายระบายที่ไตอย่างมีนัยสำคัญ (75 นาที vs. 120 นาที) และมีระยะเวลาการนอนโรงพยาบาลที่สั้นกว่าอย่างมีนัยสำคัญทางสถิติ (4 วัน vs. 7 วัน) ค่า Clavien score ของทั้งสองกลุ่มเมื่อประเมินในกลุ่มที่อายุมากกว่าหรือเท่ากับ 60 ปี, กลุ่มที่มีประวัติเคยผ่าตัดไตมาก่อน, กลุ่มที่ BMI มากกว่า 30, กลุ่มที่เป็นนิ่วแบบเขากวางและกลุ่มที่มีวิธีการเจาะไตเหนือชายโครงนั้นพบว่าไม่มีความแตกต่างกันของทั้งสองกลุ่ม*

สรุป: *การเจาะผ่านทางผิวหนังเพื่อส่องกล้องและกรอนำนิ่วในไตออกโดยไม่ใส่สายระบายให้ผลการรักษาที่ปลอดภัย และมีความเป็นไปได้ในการนำมาใช้ เพราะมีภาวะแทรกซ้อนที่ไม่แตกต่างกับวิธีใส่สายระบายในไตและมีอัตราการนอน โรงพยาบาลรวมถึงระยะเวลาที่ใช้ในการผ่าตัดน้อยกว่าวิธีแบบดั้งเดิม แสดงให้เห็นว่าเป็นวิธีที่ปลอดภัย และมีประสิทธิภาพในการรักษาภาวะนิ่วในไตโดยศัลยแพทย์ที่มีประสบการณ์*