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Exit strategy after percutaneous nephrolithotomy: impact of tube size with early removal compared to tubeless percutaneous nephrolithotomy — the debate continues

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Abstract. ***Background.*** *Many studies have demonstrated the efficacy and safety of tubeless and totally tubeless percutaneous nephrolithotomy (PCNL), trying to avoid putting a nephrostomy tube (NT) to decrease patient discomfort and shorten hospital stay. However, given that nephrostomy tube serves a safety backup plan for adverse events like residual stone and intraoperative bleeding, it is worth investigating different tube size if we want to bridge the night (early tube removal) and compare it to tubeless PCNL. The purpose was to evaluate the effect of tube size (with early removal) on postoperative course compared to NT free.* ***Materials and methods.*** *During the period from December 2020 to June 2022, 177 patients with renal stones were selected to undergo PCNL and were prospectively followed up. At the end of procedure, the patients were randomly distributed into 3 groups. Group A, those with placement of an 18Fr NT, group B, those with placement of an 8Fr tube and group C, nephrostomy-free. For group A and B, the nephrostomy was left in place for 1 day. For group C, manual compression was applied to the flank for few minutes and the skin puncture was closed with one stitch. The groups were compared for post-operative hematocrit drop, urine leakage, need for additional analgesia and any other postoperative events.* ***Results.*** *The mean age for group A was 34.110 ± 6.919 years, group B was 38.670 ± 9.935 years and group C was 37.270 ± 10.657 years (F = 3.567, p = 0.03). The post hoc Tukey analysis showed a significant difference between groups A and B (p = 0.036), however, no differences were recorded between groups A and C (p = 0.203) or B to C (p = 0.714). The present study showed that the mean stone burden was 34.03 ± 5.40 mm for group A, 33.43 ± 5.60 mm for group B and 33.43 ± 4.90 mm for group C, with no significant differences (p = 0.773). The post hoc Tukey analysis showed no significant difference between groups A and B (p = 0.818), A and C (p = 0.815), B and C (p = 0.857). The male percentage was 52.3, 58.7 and 55.1 % for group A, B and C, respectively. In this study, the duration of hematuria was 6.28 ± 2.94 hours for group A, 8.80 ± 3.45 hours for group B and 13.67 ± 2.40 hours for group C, these results were statistically significant (p < 0.0001). The post hoc Tukey analysis showed a significant difference between groups A and B (p = 0.0002), A and C (p = 0.0000), groups B and C (p = 0.0000). In the current study, the mean postoperative hematocrit drop for group A was 0.60 ± 0.14 mg/dl, 0.82 ± 0.20 mg/dl for group B and 1.33 ± 0.25 mg/dl for group C. These results were statistically significant (p < 0.0001). The post hoc Tukey analysis showed a significant difference between groups A and B (p = 0.0002), A and C (p = 0.0000), groups B and C (p = 0.0000).* ***Conclusions.*** *Large bore NT (18Fr) for short duration (one day) provide superior bleeding control and comparable postoperative analgesic requirement and urine leak when compared to small bore NT (8Fr) and NT free. It also keeps the chance for second look nephroscopy if needed.*

Keywords: *exit strategy; percutaneous nephrolithotomy; nephrostomy tube size; tubeless*

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Introduction

Percutaneous nephrolithotomy (PCNL) is the gold standard treatment for staghorn stones, large renal stones, and complex renal calculi. Over the past 30 years, continual improvement in PCNL surgery was done [1].

PCNL has evolved considerably as a result of continued search for improvement in technology and surgical skills toward minimizing postoperative pain and morbidity [2].

As the standard of care, placement of a nephrostomy tube (NT) has historically been adopted to minimize postoperative complications [3].

The main purpose of the tube is maintaining adequate drainage of the kidney. However, substantial postoperative pain after PCNL is caused by nephrostomy tubes. This had led to using of smaller tubes and introduction of "tubeless" approach which places a ureteral stent or catheter after PCNL [4].

Several randomized controlled trials and their meta-analysis have shown that the tubeless or the totally tubeless involving no drainage can significantly reduce postoperative pain, urinary leakage, and hospital stay compared with NT placement [5, 6].

The main disadvantages of nephrostomy-free technique included affection of the decision to omit placement of the nephrostomy tube by intraoperative events, loss of the tamponade effect of the nephrostomy tube and losing the tract for second look PCNL in case of residual stones [7].

The decision to insert a NT should be individualized and based on surgeon experience and judgment. Six main indications for nephrostomy tube placement are:

1) more than two access tracts,
2) significant perforation of the collecting system,
3) the need for second look nephroscopy,
4) significant intraoperative bleeding,
5) complicated procedure,
6) chance of intrathoracic violation [8].

Early tube removal after PCNL results in an equivalent analgesic requirement, hospital stay, and clearance rates, lower incidence of early hematuria, and preserves the option of check nephroscopy in case of residual fragments [4].

In PCNL, performing the standard placement of a NT, "tubeless" or totally tubeless is an ongoing matter of debate [3].

The purpose. To evaluate effect of tube size (with early removal) on postoperative course compared to NT free.

Materials and methods

Study setting and design

During the period from December 2020 to June 2022, 177 patients with renal stones were selected to undergo PCNL and were prospectively followed up. An informed consent was signed by all patients.

Pre-operative exclusion criteria were the patients under anticoagulant or antiplatelet medications, pediatric patients (age 15 years), serum creatinine (2 mg/dl) and obstructed infected kidneys.

Technique of PCNL

Preoperative urinary tract infections were treated with culture specific antibiotics. Under the effect of general anesthesia and after placement of a ureteral catheter, percutaneous renal access was performed using C-arm fluoroscopic guidance.

All planed tracts were placed to the desired calices and guidewires were fixed prior to dilatation of any tract. Dilation was performed using single step Amplatz dilator to 30 French (F). The nephroscope passed through an Amplatz sheath. Pneumatic lithotripters were used for stone fragmentation.

Intraoperative fluoroscopy was used for detection of residual stones. Flexible nephroscopy was used to retrieve calyceal stones away from the tract and to confirm stone free status. A 6 f JJ stent is placed under fluoroscope control.

This study included only patients who had undergone non-complicated PCNL via a single tract without intraoperative evidence of residual stones. At the end of procedure, the patients were randomly distributed into 3 groups.

Group A, those with placement of an 18Fr tube, group B, those with placement of an 8Fr NT and group C, nephrostomy-free.

For group A and B, the nephrostomy was left in place for 1 day. For group C, manual compression was applied to the flank for few minutes and the skin puncture was closed with one stitch.

The nephrostomy tube was removed after clamping the NT for 3 hours and no pain develop. Post-operative analgesic medication was nefopam 20 mg and paracetamol 1 g every 8 hours. All patients were discharged after 24 hours unless they develop complications, in such case, they were kept in hospital for an extra day.

The groups were compared for post-operative hematocrit drop, urine leakage, need for additional analgesia and any other postoperative events.

Ethics

This work was approved by the Alyarmook Teaching Hospital, Urology Department local ethical committee according to code number (33), 2/1/2020.

Statistical analysis

Statistical analysis was done using Statistical Package for Social Sciences, version 26 (SPSS). Categorical variables were compared using Chi-square test and continuous variables were compared using t-test. P value < 0.05 was considered statistically significant.

Results

This study included 177 patients with renal stones who underwent standard PCNL.

These patients were randomly divided into 3 groups: group A, those with 18Fr NT (n = 65 patients), group B, those with 8Fr NT (n = 63 patients) and group C, those without NT (n = 49 patients).

The mean age for group A was 34.110 ± 6.919 years, group B was 38.670 ± 9.935 years and group C was 37.270 ± 10.657 years ($F = 3.567$, $p = 0.03$). The post hoc Tukey analysis showed a significant difference between groups A and B ($p = 0.036$), however, no differences re-

corded between groups A and C (p = 0.203) or groups B to C (p = 0.714).

The present study showed that the mean stone burden was 34.03 ± 5.40 mm for group A, 33.43 ± 5.60 mm for group B and 33.43 ± 4.90 mm for group C with no significant differences (p = 0.773). The post hoc Tukey analysis showed no significant difference between groups A and B (p = 0.818), groups A and C (p = 0.815) and groups B to C (p = 0.857). The male percentage was 52.3, 58.7 and 55.1 % for group A, B and C, respectively (Table 1).

In this study, the duration of hematuria was 6.28 ± 2.94 hours for group A, 8.80 ± 3.45 hours for group B and 13.67 ± 2.40 hours for group C patients, these results were statistically significant (p < 0.0001). The post hoc Tukey analysis showed a significant difference between groups A and B (p = 0.0002), groups A and C (p = 0.0000) and groups B to C (p = 0.0000). In the current study, the mean postoperative hematocrit drop in mg/dl for group A was 0.60 ± 0.14 mg/dl, 0.82 ± 0.20 mg/dl for group B and 1.33 ± 0.25 mg/dl for group C. These results were statistically significant (p < 0.0001). The post hoc Tukey analysis showed a significant difference between groups A and B (p = 0.0002), groups A and C (p = 0.0000) and groups B to C (p = 0.0000) (Table 2).

Regarding postoperative pain, group A showed 9 (13.8 %) patients required extra doses of analgesia while 5

Table 1. The age and stone burden distribution in each group

Variables		No.	Mean ± SD	F ratio of ANOVA (p value)	Post hoc Tukey analysis
Age (years)	Tube size 18Fr (group A)	65	34.110 ± 6.919	3.567 (0.03)	A: B (p = 0.036) A: C (p = 0.203) B: C (p = 0.714)
	Tube size 8Fr (group B)	63	38.670 ± 9.935		
	Tubeless 0Fr (group C)	49	37.270 ± 10.657		
Stone burden (mm)	Tube size 18Fr (group A)	65	34.03 ± 5.40	0.257 (0.773)	A: B (p = 0.818) A: C (p = 0.815) B: C (p = 0.857)
	Tube size 8Fr (group B)	63	33.43 ± 5.60		
	Tubeless 0Fr (group C)	49	33.4 ± 4.9		

Table 2. The distribution of postoperative complications in each group

Indicators		No.	Mean ± SD	F ratio of ANOVA (p value)	Post hoc Tukey analysis
Hematuria duration (hours)	Tube size 18Fr (group A)	65	3.567 (0.03)	85.4 (< 0.0001)	A: B (p = 0.0002) A: C (p = 0.0000) B: C (p = 0.0000)
	Tube size 8Fr (group B)	63	8.80 ± 3.45		
	Tubeless 0Fr (group C)	49	13.67 ± 2.40		
Hematocrit drop (mg/dl)	Tube size 18Fr (group A)	65	0.257 (0.773)	182.6 (< 0.0001)	A: B (p = 0.0000) A: C (p = 0.0000) B: C (p = 0.0000)
	Tube size 8Fr (group B)	63	8.80 ± 3.45		
	Tubeless 0Fr (group C)	49	13.67 ± 2.40		

Table 3. Pain management and urine leak in the study

Variable			No. (%)	P value
Urine leak	Group A	Yes	4 (6.15)	0.5
		No	61 (93.85)	
	Group B	Yes	5 (7.94)	0.6
		No	58 (92.06)	
	Group C	Yes	1 (2.04)	0.8
		No	48 (97.96)	
Pain management	Group A	Standard dose	56 (86.2)	0.09
		Extra dose	9 (13.8)	
	Group B	Standard dose	58 (92.1)	0.7
		Extra dose	5 (7.9)	
	Group C	Standard dose	47 (95.7)	0.08
		Extra dose	2 (4.1)	

(7.3 %) patients in group B and 2 (4.1 %) patients required extra doses of analgesia in group C. These differences values were not significant (p = 0.5, 0.6, 0.8), respectively.

Regarding the postoperative urine leakage, 4 (6.15 %) patients for group A, and 5 (7.94 %) patients for group B while one (2.04 %) patient developed leakage for group C. These results were not significant (p = 0.09, 0.7, 0.08) respectively (Table 3).

Discussion

Many studies have demonstrated the efficacy and safety of tubeless and totally tubeless PCNL [2, 9], trying to avoid putting a nephrostomy tube to decrease patient discomfort and shortening hospital stay. However, giving that nephrostomy tube serve a safety backup plan for unwanted events like residual stone and intraoperative bleeding, it is worthy to investigate different tube size if we want to bridge the night and compare it to tubeless PCNL.

In regard to postoperative analgesic use, the present study showed no statistical difference between the three study groups, which is different from those results published by Abdelgawad et al. [10], who showed that large NT need more analgesic requirements, and those by Zeng et al. [4] who showed significant difference favoring NT free. On the other hand, our results are comparable to results by Chen et al. [11] and Poudyal et al. [12] who showed no statistical difference between their study groups.

These findings may be attributed to the fact that pain threshold is variable between patients and giving that male percentage is higher in our patients and males tend to tolerate pain better than female patients [13]. Other factor may be the short duration of NT (24 hours) which might give this advantage of negligible pain difference between the groups.

Regarding postoperative urine leak, our study showed superiority of NT free group, however, no statistically significant difference was found. These results are different to those of Poudyal et al. [12] and Zhao et al. [7] who showed statistically significant difference between these groups while it is similar to results of Chen et al. [11] and Cormio et al. [14] who found no statistical difference between their study groups.

The present study findings may be due to the short duration of NT will provide faster closure of tract and short duration of urine leak after NT removal.

The present study showed that large NT associated with least hematuria duration compared to other groups. These results were different from studies published by Bhat et al. [15] who showed no difference between both groups.

Regarding postoperative hematocrit decrease, large bore NT group showed the least drop in Hemoglobin as compared to other groups. These results are similar to research done by Cormio et al. [14] while different from results published by Chen et al. [11] who showed no difference between those groups.

The large size NT provide better tamponade to the tract and give better hemostasis which may explain the fore mentioned results.

Conclusions

Large bore NT (18Fr) for short duration (one day) provide superior bleeding control and comparable postoperative analgesic requirement and urine leak when compared to small bore NT (8Fr) and NT free. It also keeps the chance for second look nephroscopy if needed.

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Стратегія виходу після черезшкірної нефролітотомії: вплив розміру трубки на раннє видалення порівняно з бездренажною черезшкірною нефролітотомією — дебати тривають

Резюме. Актуальність. Багато досліджень, у яких намагалися уникнути встановлення нефростомічної трубки (НТ), щоб зменшити дискомфорт пацієнта та скоротити перебування в лікарні, продемонстрували ефективність і безпеку бездренажної та повністю бездренажної черезшкірної нефролітотомії (ЧШНЛ). Однак, враховуючи, що нефростомічна трубка слугує резервним планом безпеки при небажаних подіях, як-от залишковий камінь та інтраопераційна кровотеча, варто розглянути інший розмір трубки, якщо ми хочемо подолати ніч (раннє видалення трубки), і порівняти цей варіант із бездренажною ЧШНЛ. **Мета:** оцінити вплив розміру трубки (при ранньому видаленні) на післяопераційний перебіг порівняно з бездренажною ЧШНЛ. **Матеріали та методи.** У період з грудня 2020 р. по червень 2022 р. 177 пацієнтів із сечокам'яною хворобою були відібрані для проходження ЧШНЛ та перебували під проспективним спостереженням. Наприкінці процедури вони були випадковим чином розподілені на 3 групи. Група А — з розміщенням НТ розміром 18Fr, група В — НТ розміром 8Fr і група С — без нефростоми. У групах А і В нефростому залишали на одну добу. У групі С застосовувалося ручне стиснення бокової ділянки протягом декількох хвилин, а прокол шкіри був закритий одним швом. Групи порівнювали щодо післяопераційного зниження рівня гематокриту, витоку сечі, потреби в додатковому знеболюванні та будь-яких інших післяопераційних подій. **Результати.** Чоловіків було 52,3; 58,7 і 55,1 % у групах А, В і С відповідно. Тривалість гематурії становила 6,28 ± 2,94 години для групи А, 8,80 ± 3,45 години для групи В і 13,67 ± 2,40 години для групи С. У той же час середнє післяопераційне зниження рівня гематокриту у групі А дорівнювало 0,60 ± 0,14 мг/дл, у групі В — 0,82 ± 0,20 мг/дл та 1,33 ± 0,25 мг/дл у групі С ($p < 0,001$). **Висновки.** НТ великого діаметра протягом короткого періоду (одна доба) забезпечує чудовий контроль кровотечі, витоку сечі та післяопераційної потреби в аналгетиках, порівнянний з таким при використанні НТ малого діаметра та режиму без НТ. Це також зберігає можливість повторної нефроскопії, якщо це необхідно.

Ключові слова: стратегія виходу; черезшкірна нефролітотомія; розмір нефростомічної трубки; бездренажна процедура