Introduction

Percutaneous nephrolithotomy (PCNL) is the recommended management for renal stones > 2 cm. PCNL has significantly reduced morbidity and mortality, but infection and bleeding are still the most common complications [1]. Other postoperative complications include a reduction in outflow leading to increased intra-renal pelvic pressure (IRP). Persistent high IRP leads to systemic fluid absorption, pyelo-tubular backflow, and forniceal rupture leading to stone and debris formation. In addition, debris and bacteria released from stone lead to bacteremia, postoperative fever, and septicemia [2]. The incidence of post-PCNL sepsis was significant among those patients. Stone burden, prolonged surgery duration, prone position during surgery, and the use of pneumatic lithotripsy were significant variables. Clinical evaluation of IRP is essential to prevent postoperative complications, mainly fever.

Materials and methods

In a clinical study conducted at the Department of Urology, among subjects have nephrolithiasis undergoing PCNL. Preoperatively, patients were assessed and demographic parameters of the patients, history, and physical examination were documented. CT KUB or CT IVU was obtained for all. The stone burden was calculated (area). Investigations were done including urine culture sensitivity. Individuals who have grown in the culture of urine were prescribed seven days of oral antibiotics. All the procedures were performed by experienced urologists. All the procedures were done under spinal anesthesia. A prophylactic antibiotic (ceftriaxone 1 g) was given. A Foley catheter was inserted and the ureteral catheter was secured. The transpapillary puncture was done under fluoroscopic guidance. The stone was fragmented and removed by irrigation flow. Postoperatively, individuals were treated with IV fluids, antibiotics, and analgesics with a proton pump inhibitor. Patients were discharged after 72 hours or when they were clinically stable. Postoperative complications are categorized according to the modified Clavien-Dindo classification [5–10]. Data analysis was done using the SPSS20 (IBM Corp., NY, USA). For baseline characteristics, we used the chi-square test or Fisher’s exact test in categories and the t-test or Mann-Whitney U test for continuous data. A p-value < 0.05 was considered significant.

Results

A total of 50 patients were treated with PCNL. Male to female ratio was 2:1. IRP elevated more than 35 mmHg was seen in 40 (80 %) and 10 (20 %) had less than 35 mmHg. Mean age and mean BMI were 45. Mean age and mean BMI were 45. Mean age and mean BMI were 45. Mean age and mean BMI were 45.
The majority of the patients underwent mini-PCNL (n = 45) and hence there was no significant difference. A total of 44 patients underwent PCNL by using pneumatic lithotripsy and the remaining 6 underwent PCNL using shock pulse. A significantly high number of patients (n = 37) patients in the prone position had raised IRP > 35 mmHg. Thirty-two patients developed postoperative fever (Fig. 1). As depicted in Table 2, GI complications, according to Clavien-Dindo classification, were found in 68 %, GII in 24 %, and 8 % had GIII. However, no grade IV was recorded.

Discussion

With the dramatic raising in stone disease occurrences, the use of PCNL to manage a large stone has continued to rise [11]. The success of stone surgery is measured by the duration of surgery, stone-free rate, hospital stay, complications, and cost-effective. Infectious after PCNL are most common and bacteremia is the most of the cases determined. Although these lead to sepsis are rare, which potentially end with life-threatening outcomes [12].

During PCNL, continuous pressurized irrigation is used to washout blood clots and debris for active removal of the stone fragments after lithotripsy [13, 14]. There are different studies documented post-PCNL high-grade fever, the incidence ranged between 10 to 32 %. In this work, a postoperative fever was recorded in 32 cases. The high rate of fever was reported by Gutierrez et al. [3] and Troxel and Low [15].

In one randomized single-blind trial by Omar et al. [16] randomized cases that high-pressure irrigation elevated the risk of complications.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>IRP &gt; 35 mmHg (n = 34)</th>
<th>IRP &lt; 35 mmHg (n = 16)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female, %</td>
<td>80</td>
<td>20</td>
<td>0.1</td>
</tr>
<tr>
<td>Mean age, years</td>
<td>42.15 ± 12.89</td>
<td>38.67 ± 14.39</td>
<td>0.9</td>
</tr>
<tr>
<td>Mean BMI, kg/m²</td>
<td>25.32 ± 4.20</td>
<td>25.45 ± 3.30</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complications</th>
<th>Elevated IRP</th>
<th>Normal IRP</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI</td>
<td>26</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>GII</td>
<td>10</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>GIII</td>
<td>2</td>
<td>2</td>
<td></td>
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<tr>
<td>GIV</td>
<td>0</td>
<td>0</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Figure 1. A — types of PCNL, B — types of lithotripsy, C — patients’ position, D — accompanied fever
Trokel with Low [15] measured IRP using a ureteral occlusion balloon catheter and a urodynamic system. In contrast, they did not record any association of IRP 30 mmHg or greater with postoperative fever [15, 16]. Cheng Wu et al. [17] found a significant association between higher IRP and increased incidence of postoperative fever where 43.83% (100/228) patients had IRP > 30 mmHg and 28 patients developed a fever. They analyzed that the longer accumulated period of IRP > 30 mmHg for > 60 sec predicted the fever.

The female sex is recognized to be a risk for post-PCNL fever development [18]. In this study, male to female ratio was 2 : 1 among raised IRP group and was not a risk for developing a fever.

A comparative study of mini-PCNL and standard PCNL by Zhong Wen et al. [20] and Cheng Wu et al. [17] showed that mini-PCNL was correlated with higher IRP and significantly associated with postoperative fever. In this study the majority of cases were mini-PCNL and we could not find statistical significance among them.

Liangren Liu et al. [18] in their systematic review and meta-analysis including 389 patients found that PCNL in the supine position spends a shorter time than the prone, but both situations have insignificant influence. Falahatkar et al. [21] mentioned in their prospective analytical cross-sectional study, fever was associated with 7.5% (25/330) which was not found significant. The patients with supine, access sheath remains angled horizontally when compared with prone, which falls pressure in the collecting system that facilitates the stone fragments to get out through the sheath.

This study was done in only one center within a short period and with a relatively small patient number. This study failed to compare mini PCNL and standard PCNL and different energy sources on postoperative fever due to disparity in the number of cases.

An elevated stone development and burden correlated with long surgery time, the position of the patient during the operation, and lithotripsy types. Postoperative complications including fever and bleeding most common after percutaneous nephrolithotomy, however, it has significantly dropped morbidity and mortality.

Limitations of the study. This study was done in only one center within a short period and with a relatively small patient number. This study failed to compare mini PCNL and standard PCNL and different energy sources on postoperative fever due to disparity in the number of cases.

Conclusions
An increased stone burden, prolonged duration of surgery, prone position, and pneumatic lithotripsy during PCNL represent a significant risk for postoperative infective complications development especially fever.

References
15. Troxel SA, Low RK. Renal intrapelvic pressure during percutaneous nephrolithotomy and its correlation with the develop-

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Післяоперационні наслідки черезшкірної нефролітотомії

Резюме. Актуальність. Фактори ризику післяоперационних ускладнень під час черезшкірної нефролітотомії (ЧШНЛ) включають каменеутворення, передоперационний мікробіологічний статус сечі, супутні хвороби, вік, тривалість втручання, гіпертензія і анемія. Дослідження спрямоване на оцінку наслідків цих ускладнень. Матеріали та методи. Це ретроспективне дослідження було проведено за участю пацієнтів, яким проводилося ЧШНЛ під відкритим контролем протягом одного року. Реєстрували демографічні дані, індекс маси тіла, каменеутворення, цілісність і кількість каменів, тривалість операції та післяоперационні ускладнення. Результати. Із 50 хворих у 32 (64%) розвинулася лихоманка. Кількість лейкоцитів була вірогідно високою у цих пацієнтів. Вік хворих, індекс маси тіла та перебування в лікарні були незначними змінами. Каменеутворення, тривала операція та пневматична теастромія вважалися вагомими змінними. Висновки. По- силення каменеутворення, тривала операція та пневматична теастромія під час ЧШНЛ є суттєвими факторами ризику розвитку післяоперационних ускладнень, головним чином лихоманки.

Ключові слова: нирковий камінь; черезшкірна нефролітотомія; лихоманка; пневматична теастромія