Evaluation and Comparison of S.T.O.N.E. and GUY's Scoring Systems for Predicting Percutaneous Nephrolithotomy Outcomes in Supine Position

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Abstract

Abstract Percutaneous nephrolithotomy (PCNL) was applied in the prone position. But also, in recent years supine positions was applied in patients with kidney stones. Predicting how much renal stones can be cleared after surgery and possibility of complications is an important question for both surgeons and patients. Therefor different scoring systems are used to predict stone-free and complication rates before surgery. Patients and Methods: Between 2018 and 2920, 80 patients with renal stone who underwent PCNL in the supine position were evaluated preoperatively by S.T.O.N.E. and Guy's scoring systems. The predictions of both scoring systems for stone-free and complication rates in patients who underwent PCNL in the supine position were evaluated. Also, these scoring systems were compared among themselves for reliability. Result: In both scoring systems, there was a statistically significant difference between postoperative stone-free (SF) and residual stone (RS) patients and in predicting the likelihood of complications in patients. No statistically significant difference was found between the two scoring systems in predicting the stone-free rate. Conclusion: Our findings revealed that S.T.O.N.E. nephrolithometri and Guy's score systems can be used effectively to predict stone-free rate, complications and operation duration in supine position PCNL for renal stones.

Introduction

Percutaneous nephrolithotomy (PCNL) is a gold standard method in the treatment of large renal stones. This technique, first described by Fernstrom and Johansson in 1976 [1], has been modified and developed to date to optimize the stone-free rate and reduce complications.

The first experiences of PCNL started in the prone position [2], and this position has been widely used until recent years. However, in recent years, different positions such as prone flexed [3], lateral [4], split-leg [5], supine [6,7] and modified supine [8,9] have been tried.

Prone PCNL can cause respiratory and circulatory problems, especially in obese patients. It can also cause problems such as vascular, peripheral nerve and cervical spine injuries, tracheal compression.

The supine position [6] defined by Valdivia for the first time was later modified by Barts [9] so that the nephroscope could be manipulated more easily. Two different meta-analyzes have shown supine PCNL to be as effective as prone PCNL when comparing stone-free rates, transfusion and complications and it was noted to be significantly quicker than the prone position [10,11].

There are several variables that may affect the postoperative outcomes of PCNL, such as renal anatomy, stone burden, location of the stone, skeletal abnormalities and surgeon's experience [12]. The requirement to standardize of outcomes PCNL has led to the development of scoring systems [13]. Thanks to the scoring systems, it has been possible for us to accurately predict the outcomes of PCNL. At the same time, we had

the chance to inform the patients about the success of surgery and possible complications postoperatively [14,15].

Used for this purpose S.T.O.N.E. nephrolithometry score evaluates the renal stones of the patients according to five variables including stone size (S), tract length (skin to stone distance)(T), degree of obstruction (O), number of involved calices (N) and stone essence or density (E) [16]. Guy's stone score (GSS) categorizes renal stones in to four grades (Grade I,II,III,IV) according to the characteristics of patients and imaging [14]. In addition, scoring systems such as Clinical research Office of the Endourological Society (CROES) and Seoul National University Renal Stone Complexity (S-ReSC) are used to predict postoperative stone-free rate.

We evaluated the patients in our study group according to S.T.O.N.E. and GSS scoring systems and aimed to compare the effectiveness of these scoring systems in predicting the stone-free rate and complications in patients who were performed PCNL in the supine flank free position.

Patient and Method

After approval from the ethics committee of Okmeydanı Training and Research Hospital (Nov,17,2020-416), 80 patients who had percutaneous nephrolithotripsy (PCNL) in complete supine flank-free position between Jan. 2018 and Dec. 2020 were included in our study group and retrospectively reviewed. Patients with kidney anomalies were excluded.

Preoperative history, physical examination, and routine laboratory tests of all patients were performed, and negative urine cultures were obtained. Stone sizes, localization of stones and renal tract were evaluated with non-contrast computerized tomography (CT).

Kidney stones were scored preoperatively with S.T.O.N.E. nephrolitometry and Guy's stone scoring systems.

PCNL was performed in complete supine flank-free position under general anesthesia. The position was supported with gel pads by putting under the ipsilateral chest and hip. A ureter catheter was placed with a cystoscope and access was obtained under fluoroscopic. After tract dilation, the stones were fragmented by using 14 F mini perc. The stones of all our patients were fragmented with a single access. Holmium laser was used for stone fragmentation. Pieces of stones were taken out with a Dormia basket. No additional procedure such as RIRC was used to our patients for stone fragmentation. At the end of the procedure, JJ stent or nephrostomy tube was placed.

Demographic characteristics of the patients such as age, gender and body mass index (BMI), operation time and side, mean blood loss, intraoperative stone-free status were recorded postoperatively. In addition, postoperative complications were recorded according to Clavien grades. Stone-free status of the patients was checked again with urinary system radiography or CT in the postoperative 1st month.

Patients whose stones had been completely cleared or had residual stone size smaller than 4 millimeters were accepted as stone-free.

The patients were divided into two groups as stone-free (SF) and have residual stone (RS). It was evaluated whether both scoring systems could predict post-operative stone-free rate and complications in patients with PCNL in the supine position and the values of both scoring systems in predicting the stone-free rate were compared.

Statistical Analysis

NCSS (Number Cruncher Statistical System) Statistical Software (Utah, USA) program was used for statistical analysis. While evaluating the study data, descriptive statistical methods (mean, standard deviation, median, frequency, ratio), Shapiro Wilk test and box plot graphs were used for the normal distribution of variables. Student t test for comparing normally distributed variables between groups; Mann Whitney U test was used for intergroup comparisons of variables that did not show normal distribution. ROC analysis was used to evaluate the scores. Significance was evaluated at the $p < 0.05$ level.

Results

80 patients who were applied PCNL in supine flank-free position were included in our study group. The ages of the patients were between 17 and 71 and the mean age was found 45.2 ± 13.71. Body mass indexes (BMI) ranged from 23.30 to 34.13 and mean BMI was found to be 27.39 ± 2.8 kg / m2. The renal stones of the patients in the study group were measured between 380-620 mm2 (mean: 497.75 ± 58.42 mm2).

The operation time was 60-170 (mean: 95 ± 29.5) minutes.

In 34 of 80 patients with kidney stones (42.5%) were postoperative stone-free (SF), and in 46 patients (57.5%) were detected postoperative residual stones (RS).

The demographic characteristics of both groups are shown in table 1.

There was no statistically significant difference between the groups for age, BMI, and stone burden ($p > 0.05$).

The S.T.O.N.E. nephrolitometry scoring system showed a statistically significant difference between both groups ($p = 0.017$; $p < 0.05$). S.T.O.N.E. score mean value of cases with residual stones in the kidney were significantly higher than stone-free patients.

Guy's score values was found statistically significant difference between the groups

($p = 0.006$; $p < 0.05$). It was observed that the mean values of Guy's score in patients with residual stones in the kidney were statistically significantly higher than the mean values of stone-free patients.

Also, operation duration showed a statistically significant difference between the groups in both scoring systems.

Distribution of our patients according to the S.T.O.N.E. nephrolitometry scoring and Guy's scoring systems is shown in Table 2.

In addition, the area under the ROC Curve according to S.T.O.N.E. scoring system was found 69,2%. The area under the ROC curve obtained according to Guy' scoring system was found 72,3%. ROC curve results were compared for scoring systems according to both patient groups (Table 5) and there was no significant difference between the two ROC curves

($p > 0.05$). (Figure 1)

Complication rates according to the modified Clavien classification system is shown table 3.

Both scoring system mean value of patients with high grade modified Clavien classification system were found significantly higher than patients with low grade modified Clavien classification system (Table:4).

A statistically significant positive correlation was found between complications and both scoring systems. (Figure 2,3)

Discussion

Imaging methods applied before the surgical treatment of kidney stones give information about the size and location of the stone, pelvicalyceal anatomy and the relationship of the kidney with neighboring organs and guide the surgical technique [17,18]. Also, preoperative imaging methods provide prediction about postoperative stone-free status [19,20].

Scoring systems developed to standardize the terminology regarding stone complexity help us predict post-operative stone-free rate and complications [14,21].

In the S.T.O.N.E. nephrolithometry score system are evaluated parameters such as the size, location and obstruction of stone in the kidney. In the Guy's stone score system, kidney anomalies are recorded along with the number and localization of the stone.

The ideal scoring system should be repeatable, easily used in daily practice, include the findings of imaging method and predictive of postoperative stone-free rate (SFR) and complication rate (CR) [14]. There are many studies in the literature using these scoring systems.

Labadie et al. in their series of 246 patients, revealed a significant relation between S.T.O.N.E. nephrolithometry score, GSS and SFR [22]. In this study, area under ROC curve value was mesured 0.67 for S.T.O.N.E. nephrolithometry score and 0.63 for GSS. In our study, these values was found 0.69 for S.T.O.N.E. nephrolittometry score and 0.72 for GSS, and no significant difference was found between two ROC curves.

Noureldin et al. compared GSS and S.T.O.N.E. nephrolithometry scoring systems and found both scoring systems effective in predicting SFR, blood loss, operation time and hospitalization time [23].

Farhan et al. found a significant correlation between score and SFR, operation time but they did not find significant relation between S.T.O.N.E score and CR [24]. Also, Akhaverin et al. reported similar results between S.T.O.N.E score and SFR [25].

In contrast, Kumsar et al. GSS and S.T.O.N.E. scoring system may be used as effective instruments particularly for predicting postoperative complications [26].

A meta-analysis comprised of 389 patients revealed that prone and supine positioning for PCNL had equivalent stone-free rates [27]. However, supine position provides advantages such as shorter operation time, better airway access for anesthetists and the ability to perform simultaneous retrograde intra-renal surgery (RIRS). Because of these advantages, we performed supine PCNL and used S.T.O.N.E. and Guy's score systems in renal stones before surgery. We found that both scoring systems were effective in predicting SFR, complications and operation times. Also, we could not find any statistically significant difference between the two scoring systems in predicting stone-free rate.

Conclusion

Our findings revealed that S.T.O.N.E. nephrolithometry and Guy's score systems can be used effectively to predict stone-free rate, complications and operation duration in supine position PCNL for renal stones. At the same time, no difference was found in the effectiveness of both scoring systems. Larger series are needed to demonstrate the effectiveness of scoring systems in the supine position PCNL. So, these systems can guide the clinician to predict postoperative PCNL outcomes.

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