The Evaluation of Hemoglobin Fluctuation After Percutaneous Nephrolithotomy

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The aim of this study was to evaluate the fluctuation of haemoglobin value after performing percutaneous nephrolithotomy (PCNL) in the treatment of kidney stones. We conducted a retrospective study and we included 327 patients who underwent PCNL for renal lithiasis. We evaluated the risk factors for bleeding: location of stones, complexity of lithiasis, length of postoperative hospitalization days, variation of post-operative laboratory constants (haemoglobin, haematocrit). Patients were divided into two age groups: group A (patients under 70 years old) and group B (patients over 70 years). Gender distribution was: 171 female and 156 male. In most of the cases, the stones were located in the renal pelvis (133 cases), multiple lithiasis (105 cases) and staghorn stones (48 cases). There was no statistical difference between the patient’s groups concerning the decrease of post-operative Hgb concentration and complexity of the lithiasis, p = 0.10. The average length of post-operative hospitalisation was 3.91 +/- 1.78 SD days in patients who did not have significant hemorrhage and 6.40 +/- 2.35 SD days in patients with intra- and post-operative haemorrhage. The postoperative Hgb levels correlated with post-operative days of hospitalization in elderly patients (r = 0.44, p = 0.0001). Stone complexity, the size, number or localization of the stones, were not risk factors for the decrease of haemoglobin level after PCNL. Decreased postoperative haemoglobin values can led to increased number of hospitalization days.

Keywords: PCNL, renal stone, haemoglobin, bleeding, postoperative complications

Percutaneous nephrolithotomy (PCNL) represents the gold standard technique in kidney lithiasis treatment [1]. Bleeding is the most common and fearful complication during or after percutaneous nephrolithotomy [2] and may be secondary to blood vessel injuries after percutaneous renal access, dilation of the nephrostomy tract, insertion of the nephroscope sheath or extraction of the stones [3].

The most important risk factors of PCNL associated with intra- or post-operative haemorrhage are the presence of staghorn stones or multiple lithiasis [4], multiple access or punction of the calyces or tract dilatation [2,5]. The literature also reports other risk factors associated with bleeding, such as advanced age, prolonged surgery time, associated urinary tract infection or diabetes [6-12]. In most of the cases, the management of bleeding after percutaneous nephrolithotomy is conservative, but the surgical approach may be required in 0.8% of the cases [13-16].

The objective of this study was to evaluate the fluctuation of haemoglobin value after performing percutaneous nephrolithotomy, considering the risk factors for bleeding (size of the stones, number or localisation of the stones or the presence of staghorn stones).

Experimental part

Methods

We conducted a retrospective study over a 2-year period (January 2016 - December 2017) and we included 327 patients who underwent PCNL for renal lithiasis at the Urology Clinic, Mures County Hospital, Târgu Mures, Romania. All patients were evaluated based on pathological findings, clinical examination, medical imaging (ultrasound, radiography, intravenous pyelography and/or computed tomography), and laboratory examinations. The haemoglobin (Hgb) and haematocrit levels were determined preoperatively and 24 hours postoperatively. More than 1g/dL decrease of haemoglobin after PCNL was considered significant.

Patients were divided into two age groups: group A (Gr A) comprised patients under the age of 70 years and group B (Gr B) elderly patients over 70 years. Pre- and post-operative data were collected and analysed according to the variation of the haemoglobin value taking into consideration the patient’s age, gender, location of stones, complexity of lithiasis (staghorn stones and multiple lithiasis), length of hospitalisation and modification of pre and post-operative laboratory constants (haemoglobin, haematocrit).

The stone-free rate was established postoperatively through clinical, ultrasound and radiological assessment of patients.

The surgical technique

Under spinal anesthesia, in the lithotomy position we inserted an ureteral catheter of size 5 Ch. The calyceal system was visualized by using contrast introducedrought the ureteral catheter. A percutaneous punction of the inferior calyces under the C-arm scopy unit and a hydrophilic guide wire was inserted. We performed the dilatation of the tract with 9-24 Ch Alken dilators, and we used a 26-Ch nephroscope for nephroscopy. Stone fragmentation was performed with an ultrasonic lithotripter, and the stones were removed. After the intervention, in most of the cases we inserted a 20-Ch nephrostomy tube under fluoroscopy guide.

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Results and discussions

This study included 327 patients with renal lithiasis who underwent PCNL. Gender distribution was: 171 (52.29%) female and 156 (47.70%) male. Patients were divided into two age groups: GrA 263 patients (under 70 years old) and GrB 64 patients (over 70 years old). The mean age of patients was 48.73 +/- 10.60, standard deviation (SD) for GrA and 72.56 +/- 2.89 SD for GrB. (Table I)

In most of the cases, the stones were located in the renal pelvis, but also, there were a significant number of cases with complex renal stones: 105 cases of multiple lithiasis and 48 cases of staghorn stones. (Table I)

Most patients, 320 cases, had normal pre-operative hemoglobin (Hgb) concentration (over 12 g/dL), but seven patients had a concentration of Hgb under this value on admission (6 in GrA and 1 in GrB). However, there were no statistically significant differences between the two age groups, p = 0.72 (Chi-square test). 81 (24.70%) patients had significant intra and postoperative hemorrhage complications, 60 (18.75%) cases in Gr A, and 21 (6.56%) cases in Gr B. Concerning the risk of intra-or post-operative bleeding and the decrease of post-operative Hgb concentration, was no statistical differences between the two groups of patients, p = 0.10.

We considered the localization of the stones as a risk factor for bleeding, and we noticed that this complication was more frequent in cases of lithiasis localised in the renal pelvis, but without statistically significant differences between the two age groups (Table 2). Concerning the cases with complex lithiasis, 29 (31.9%) patients presented multiple lithiasis and 10 (11%) staghorn stones, but there were no statistically significant differences related to bleeding between the two age groups (Table 2). Applying the Student-test, we found an average pre-operative Hgb concentration of 14.33 g/dL in younger patients, which was higher than the average pre-operative Hgb concentration in elderly patients 13.85 g/dL (p = 0.01).

The average length of post-operative hospitalisation was 3.91 +/- 1.78 SD days in patients who did not had significant hemorrhage and 6.40 +/- 2.35 SD days in patients with intra- and post-operative haemorrhage. We applied the Mann-Whitney test to compare the average days of postoperative hospitalisation in the two groups. Applying the Student-test, we found an average pre-operative Hgb concentration of 14.33 g/dL in younger patients, which was higher than the average pre-operative Hgb concentration in elderly patients 13.85 g/dL (p = 0.01).

The surgical protocol used in this study is in concordance with literature data; percutaneous access to the pyelocaliceal system is performed under fluoroscopic guidance at the posterior axillary line below the 12th rib, and the site of puncture is chosen based on localization of the stone and complexity of lithiasis (medium or inferior calyx) [19]. In our study, the inferior calyx was accessed in most of the cases, and the energy source for fragmentation of stones was ultrasonic in all of the cases. Radfar et al reported no significant difference regarding success rate and frequency of bleeding complications between pneumatic and ultrasonic lithotripsy [20].

In a study comprising 694 patients with kidney stones treated by PCNL, Akman et al reported that intra- or post-operative bleeding depends on several factors such as multiple tracks, staghorn calculi, diabetes and prolonged surgery [21]. As in the case of all surgical manoeuvres, bleeding is one of the most common complications of PCNL, with an incidence of 2-45% [20], requiring blood transfusion in 3 to 23% of the cases [18]. In case of patients who had significant bleeding, there was no statistically significant difference concerning the relationship between bleeding frequency and localization or complexity of the stones (p>0.05).

Previous reports describe bleeding as a common complication after PCNL for staghorn stones and multiple stones due to multiple tracks or multiple manoeuvres performed [18,19]. In our study, bleeding occurred in 31.9% of cases with multiple stones and 11% of cases with staghorn stones, but without significant difference between age groups.

| Characteristics | Number of patients | Total |
|-----------------|--------------------|-------|
| No. of patients (GrA: GrB) | 263/64 | 327 |
| Age (years), mean (range) | 48.73 +/- 10.60SD/72.56 +/- 2.89SD | 54.13 +/- 13.60SD |
| Gender: | | |
| Male | 136/37 | 156 |
| Female | 129/27 | 171 |
| Stone position: | | |
| Renal pelvis | 27/10 | 37 |
| Inferior calyx | 2/1 | 3 |
| Middle calyx | 1/0 | 1 |
| Superior calyx | | |
| Stone complexity: | | |
| Multiple stones | 42/6 | 105 |
| Staghorn | | 48 |
| Number of stones: | | |
| Single | 90/15 | 222 |
| Multiple | 60/21 | 105 |
| Number of patients who presented decrease of haemoglobin: | | 81 |

Table 1

Patients characteristics
Regarding pre- and postoperative mean Hgb levels, a difference was found between the two age groups, where elderly patients had lower levels (p<0.05). Low pre- and postoperative Hgb levels correlated with prolonged postoperative hospitalization days (p=0.0001).

In our study, treatment of bleeding was conservative in most cases, including closure of the nephrostomy tube, fluid administration and haemostatics. In 32 cases (10%) blood transfusion was required, in 12 cases (3.75%) surgical haemostasis was performed, and there were no deaths after PCNL. In cases of severe bleeding, without the possibility of performing haemostasis, angiography and arterial embolization may be required (0.3 to 1.4% of the cases) [18,22]. The severity of the bleeding depends also on the comorbidities of the patients [23-26] and the current therapeutic scheme [27-28].

In all of the cases included in this study, we monitored Hgb levels at 24 hours postoperatively and repeated the test in cases of prolonged bleeding. The nephrostomy tube was suppressed after 48 hours to 5 days, depending on the patient’s evolution and recurrence of postoperative bleeding. Abdominal ultrasound and pyelography examinations were performed after the procedure.

In a study involving 2200 patients with PCNL, the results were analyzed concerning the gender, age, comorbidities, size of stones, number of nephrostomy tracks and surgery duration and those factors were not correlated with the risk of postoperative bleeding [29,30].

Lower invasiveness of PCNL compared to open surgery leads to a decrease in the duration of postoperative hospitalisation (6.4 +/- 4.2 SD days) and faster socio-professional integration (2.5 +/- 0.8 SD weeks) [31]. In our case, the median duration of postoperative hospitalization was 3.91 +/- 1.78 SD days in patients who did not had intra- or post-PCNL bleeding, and 6.40 +/- 2.35 SD in those with bleeding, but there was no statistically significant difference between younger and elderly patients. The stone free rate was 78.9%, comparable to the literature.

The limitations of the study are the low number of elderly patients compared to younger patients and the lack of quantitatively estimated (in mL) blood loss.

Conclusions

Percutaneous nephrolithotomy is an effective and safe endoscopic procedure both in young and elderly patients, without significant differences regarding the risk of bleeding between the two age groups. Stone complexity, the size, number or localization of the stones were not risk factors for the decrease of haemoglobin level after PCNL. Decreased postoperative hemoglobin levels led to increased number of hospitalization days in both age groups, but without significant differences between younger and elderly patients.

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Table 2

| Variable | GYA | GBE | P value |
|----------|-----|-----|---------|
| No. of patients | 60 | 21 | - |
| Gender (male-female) | 27:33 | 14:7 | p=0.32 |
| Mean age (years) | 45.43 +/- 7.60 SD | 73.52 +/- 2.73 SD | p=0.32 |
| Stone position: | 26 (38.2%) | 13 (56.5%) | - |
| Renal pelvis | 9 (13.2%) | 3 (13.0%) | p=0.35 (GYA), p=0.67 (GB) |
| Inferior calyx | 1 | 0 | - |
| Middle calyx | 8 (11.5%) | 2 (8.7%) | p=0.23 (GYA), p=0.89 (GB) |
| Stone complexity: | 24 (35.4%) | 3 (21.7%) | p=0.82 (GYA), p=0.81 (GB) |
| Nephrostomy tube | 8 | 2 | - |
| Multiple lithiasis | 36 | 16 | - |
| Single | 24 | 15 | - |
| No. of stones: | - | - | - |
| Pre-operative Hgb | 14.33 +/- 1.49 SD | 13.65 +/- 1.27 SD | p=0.01 |
| Post-operative Hgb | 12.89 +/- 2.10 SD | 12.03 +/- 1.79 SD | p=0.004 |
| Pre-operative Htc | 42.49 +/- 4.29 SD | 41.48 +/- 4.71 SD | p=0.22 |
| Post-operative Htc | 38.81 +/- 4.76 SD | 37.71 +/- 4.59 SD | p=0.09 |
| Days of hospitalisation after PCNL in patients without haemorrhage | 3.42 +/- 1.79 SD | 4.41 +/- 1.77 SD | p=0.75 |
| Days of hospitalisation after PCNL in patients with haemorrhage | 6.11 +/- 2.13 SD | 6.68 +/- 2.38 SD | p=0.49 |

Table 2: COMPARISON OF THE STUDIED VARIABLES IN THE TWO AGE GROUPS
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