The Evaluation of Hemoglobin Fluctuation After Percutaneous Nephrolithotomy

ORSOLYA MARTHA[1,2], DANIEL PORAV HODADE[1,2], IOAN SCARNECIU[3,4], VERONICA GHIRCA[2]*, LAURIAN MAXIM[3,4], ALEXANDRU LACULICEANU[4], CALIN PAVEL COBELSCHI[3,4], CAMELIA SCARNECIU[3,4], FLORENTINA GHERGHICEANU[5], CIPRIAN TODEA MOGA[1,2]

[1]Urology Clinic, Mures County Hospital, 50 Dr. Gheorghe Marinescu Str., 540136, Targu Mures, Romania
[2]University of Medicine, Pharmacy, Science and Technology, 38 Gheorghe Marinescu Str., 540139, Targu Mures, Romania
[3]University of Medicine and Pharmacy Transilvania, 56 Nicolae Balcescu Str., 500019, Brasov, Romania
[4]Clinical Emergency County Hospital, 25-27 Bucuresti Road, 500326, Brasov, Romania
[5]Carol Davila University of Medicine and Pharmacy Bucharest, 37 Dionisie Lupu Str., 020021, Bucharest, Romania

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 litiasis, 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 (rr = -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 calycs 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, Tirgu 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 introduced trought the ureteral catheter. A percutaneous punction of the inferior calycs 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.

* email: veronica.ghirca@yahoo.com

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 Gr.A and 72.56 +/- 2.89 SD for Gr.B. (Table I)

In most of the cases, the stones were located in the renal pelvis, but also, there were a significant number of cases withcomplex 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 Studentt-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 according to the age of patients and we obtained p = 0.35, a statistically insignificant value, without significant differences between the average days of hospitalisation in the two groups.

The postoperative Hgb value in elderly patients (Gr.B) was correlated with the length of post-operative hospitalisation days (rr = -0.44, p = 0.0001). Thus, the lower this value was, the duration of post-operative hospitalisation was longer. While analyzing these results, we noticed approximately the same variations of pre- and post-operative Hgb values, as well as their correlation with the duration of hospitalisation, which occurred in both groups of patients and there were no significant differences between the two groups (Table 2).

Percutaneous nephrolithotomy (PCNL) is a minimally invasive, effective surgical procedure involving the fragmentation and extraction of renal stones [3]. The benefits of this surgical procedure compared to classic surgery procedures include reduced length of hospitalisation, small incision with faster healing, lower intensity of postoperative pain, more rapid socio-professional reintegration [17], but it is more invasive compared to ESWL or ureteroscopy, with a complication rate between 3 -18% [18].

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 GrA/GrB	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:	129/27	
Male	134/37	156
Female		171
Stone position:	101/32	
Renal pelvis	27/10	133
Inferior calyx	2/1	37
Middle calyx	1/0	3
Superior calyx		1
Stone complexity:	90/15	
Multiple stones	42/6	105
Staghorn		48
Number of stones:	173/49	
Single	90/15	222
Multiple	60/21	105
Number of patients who presented decrease of haemoglobin:		81

Table 1
PATIENTS CHARACTERISTICS

Variable	GrA	GrB	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:			
Renal pelvis	26 (38.2%)	13 (56.5%)	p=0.97(GrA),p=0.34(GrB)
Inferior calyx	9 (13.2%)	3 (13.0%)	p=0.35(GrA),p=0.67(GrB)
Middle calyx	1	0	-
Stone complexity:			
Staghorn	8 (11.8%)	2 (8.7%)	P=0.33(GrA),p=0.89(GrB)
Multiple lithiasis	24 (35.4%)	5 (21.7%)	P=0.82(GrA),p=0.81(GrB)
No. of stones:			
Single	36	16	
Multiple	24	15	
Bleeding	60	21	P=0.10
Laboratory data (mean, range):			
Pre-operative Hgb	14.33+/-1.49 SD	13.85+/-1.27 SD	**P=0.01**
Post-operative Hgb	12.89+/-3.10 SD	12.03+/-1.79 SD	**P=0,004**
Pre-operativeHTC	42.49+/-4.29 SD	41.48+/-3.71 SD	P=0.22
Post-operativeHTC	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	6.69+/-2.58 SD	P=0.49

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

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.

References

1.PREMINGER, G.M., ASSIMOS, D.G., LINGEMAN, J.E., NAKADA, S.Y., PEARLE, M.S., WOLF, J.S., J Urol, **173**, 2005, p. 1991.

2.TURNA, B., NAZLI, O., DEMIRYOGURAN, S., MAMMADOV, R., CAL, C., Urology, **69**, no. 4, 2007, p. 603.

3.BOJA, R. Chirurgia percutanata reno-ureterala, Ed. Leda &Muntenia, **6**, 2000, p. 254.

4.SRIVASTAVA, A., SINGH, K., SURI, A., DUBEY, D., KUMAR, A., KAPOOR, R., MANDHANI, A., JAIN, S., Urology, **66**, no. 1, 2005, p. 38.

5.EL-NAHAS, A.R., SHOKEIR, A.A., EL-ASSMY, A.M., MOHSEN, T., SHOMA, A.M., ERAKY, I., et al. J Urol, **177**, 2007, p. 576.

6.KEOGHANE, S.R., CETTI, R.J., ROGERS, A.E., WAHNSLEY, B.H., BJU Int, **111**, no. 4, 2013, p. 628.

7.NOURALIZADEH, A., ZIAEE, S.A., HOSSEINI SHARIFI, S.H., BASIRI, A., TABIBI, A., SHARIFIAGHDAS, F., ZAHI, H., NIKKAR, M.M., LASHAY, A., AHANIAN, A., SOLTANI, M.H., Scand J Urol, **48**, no. 1, 2013, p. 110.

8.BUMBU, A., PASCA, B., TIT, D. M., BUNGAU, S., BUMBU, G., Farmacia, **64**, no. 3, 2016, p. 419.

9.TIT, D.M., PALLAG, A., IOVAN, C., FURAU, G., FURAU, C., BUNGAU, S., Iran J Public Health, **46**, no. 11, 2017, p. 1128.

10.ABDEL-DAIM, M.M., EL-TAWIL, O.S., BUNGAU, S.G., ATANASAOV, A.G., Oxid Med Cell Longev, **2019**, 2019, ID 4179676. https://doi.org/10.1155/2019/4179676

11.RADULESCU, A., MADAN, V., AUNGURENCI, A., BRATU, O., FARCAS, C., DINU, M., MISCHIANU, D. Romanian Journal of Military Medicine, **118**, no. 3, 2015, p. 20-22.

12.SPINU, D., BRATU, O., POPESCU, R., MARCU, D., RADULESCU, A., MISCHIANU, D. Romanian Journal of Military Medicine, **118**, no. 3, 2015, p. 12-15.

13.MILLER, N.L., MATLAGA, B.R., LINGEMAN, J.R., J Urol, **178**, no. 1, 2007, p. 15.
14.KESSARIS, D.N., BELLMAN, G.C., PARDALIDIS, N.P., SMITH, A.G., J Urol, **153**, no. 3, 1995, p. 604.
15.SOCEA, L.I., VISAN, D.C., BARBUCEANU, S.F., APOSTOL, T.V., BRATU, O.G., SOCEA, B., Rev. Chim. (Bucharest), **69**, no. 4, 2018, p. 795-797.
16.TICA, O.A., TICA, O., ANTAL, L., HATOS, A., POPESCU, M.I., PANTEA STOIAN, A., BRATU, O.G., GAMAN, M.A., PITURU, S.M., DIACONU, C.C., Farmacia, **66**, no. 6, 2018, p. 972-976.
17.LEE, J.K., KIM, B.S., PARK, Y.K. Korean J Urol, **54**, 2013, p. 448.
18.LEE, W.J., SMITH, A.D., CUBELLI, V., BADLANI, G.H., LEWIN, B., VERNACE, F., et al., AJR Am J Roentgenol, **148**, 1987, p. 177.
19.MICHEL, M.S., TROJAN, L., RASSWEILER, J.J., Eur Urol, **51**, no. 4, 2007, p. 899.
20.RADFAR, M.H., BASIRI, A., NOURALIZADEH, A., SHEMSHAKI, H., SARHANGNEJAD, R., KASHI, A.H., NAROUIE, B., SOLTANI, A.M., NASIRI, M., SOTOUDEH, M., Eur Urol Focus, **3**, no. 1, 2017, p. 82.
21.AKMAN, T., BINBAY, M., SARI, E., YURUK, E., TEPELER, A., AKCAY, M., MUSLUMANOGLU, A.Y., TEFEKLI, A., J Endourol, **25**, no. 2, 2011, p. 327.
22.SAID, S.H.A., AL KADUM HASSAN, M.A., ALI, R.H.G., AGHAWAYS, I., KAKAMAD, F.H., MOHAMMAD, K.Q., Arab J Urol, **15**, no. 1, 2017, p. 24.
23.DIACONU, C.C., ARSENE, D., PARASCHIV, B., BALACEANU, A., BARTOS, D., Acta Endocrinologica, **IX**, no. 4, 2013, p. 637-642.
24.BALACEANU, A., DIACONU, C., MATEESCU, D., STANICA, A., Medical Ultrasonography, **12**, no. 4, 2010, p. 345-348.
25.DIACONU, C., DUMITRU, N., FRUNTELATA, A., LACAU, S., BARTOS, D., Acta Cardiologica Sinica, **31**, no. 1, 2015, p. 83-86.
26.PARASCHIV, B., TOMA, C.L., DIACONU, C.C., Archivos de Bronconeumología, **49**, no. 7, 2013, pp. 315-316.
27.BARTOS, D., DIACONU, C., BADILA, E., DARABAN, A.M., Farmacia, **62**, no. 5, 2014, p. 811-823.
28.MANEA, M., MARCU, D., PANTEA STOIAN, A., GAMAN, M.A., GAMAN, A.M., SOCEA, B., NEAGU, T.P., STANESCU, A.M.A., BRATU, O.G., DIACONU, C.C., Rev. Chim. (Bucharest), **69**, no. 11, 2018, p. 4180-4184.
29.KESSARIS, D.N., BELLMAN, G.C., PARDALIDIS, N.P., SMITH, A.G., J Urol, **153**, no. 3, 1995, p. 604.
30.TIGLIS, M., NEAGU, T.P., ELFARA, M., DIACONU, C.C., BRATU, O.G., VACAROIU, I.A., GRINTESCU, I.M., Rev Chim (Bucharest), **69**, no. 10, 2018, p. 2877-2880.
31.AL-KOHLANY, K.M., SHOKEIR, A.A., MOSBAH, A., MOHSEN, T., SHOMA, A.M., ERAKY, I., EL-KENAWY, M., EL-KAPPANY, H.A., J Urol, **173**, no. 2, 2005, p. 469.

Manuscript received: 15.05.2019