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Original Research Article

The efficacy of percutaneous nephrolithotomy in elderly patients

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Abstract

The aim of this study is to highlight the importance of percutaneous nephrolithotomy (PCNL) in the treatment of renal stones in elderly patients. We performed a ten-month retrospective study in 200 patients with kidney stones who underwent percutaneous nephrolithotomy during June 2016 - April 2017. The patients were divided in Group1 (178 patients under the age of 70 years old) and Group 2 (22 patients older than 70). The stones were mostly localized in the renal pelvis (142), inferior calyx (46) and ureteropelvic junction (4) and 28 cases with staghorn calculi. The renal stone was larger than 2 cm in 76%, less than 2 cm in 13%of the cases and 11% had multiple lithiasis. Intraoperative complications were: migrating fragments (22%), hemorrhage (12%), lesions of the renal pelvis and difficulties of percutaneous accessor dilatation (6%). The postoperative complications were: bleeding (20%), obstruction caused by stone fragments (22.5%), hydronephrosis (18%), fistula (13%). There were no significant correlations between intraoperative and postoperative complications and the two groups of patients (p > 0.05). The average length of stay in hospital after PCNL was 5.58 +/- 2.69 days SD. Stone-free rate was: 77.5%.PCNL is a safe and effective method used to treat large and complex stones that can be applied to both young and elderly patients. Intra and postoperative complications may occur in both age groups but this is not a decisive factor regarding therapeutic choice.

Keywords: PCNL, renal stone, Steghorn calculi, postoperative complications

INTRODUCTION

The prevalence of nephrolithiasis in the United States has doubled over the past three decades. This increase has also been observed in most European countries and Southeast Asia (Sakhaee et al., 2012).

The prevalence of nephrolithiasis is the highest in Caucasian males (Lieske et al., 2006), where the incidence of kidney stones rises to approximately 3 out of 1,000 cases a year, in people aged 40- 60 years, and then declines (Hiatt et al., 1982). In females, the incidence rate is higher in their late 20s, decreasing by the age of 50, and remains relatively constant thereafter (Lieske et al., 2006).

In Germany the incidence of nephrolithiasis increased from 4% to 4.7% during 1979 to 2001 (Trinchieri, 2008). A surprisingly high prevalence of urolithiasis 15% was observed in the rural population of Thebes in Greece. (22) In Iceland the age-standardized prevalence of the 30-79 year-old age-group was 4.3% for men and 3.0% for women, with no significant increase over time. The incidence was 562 per 100 000 cases per year (Indridason et al., 2006). In Romania the incidence was 100 per 100.000 casesperyear (Glowacki et al., 1992).

The increased incidence of lithiasis is associated with race, ethnicity, place of residence, improved living

standards and has become more and more recognized as a systemic disorder associated with chronic kidney disease, increased risk for coronary artery disease, hypertension, type 2 diabetes and systemic inflammatory response syndrome. Without medical treatment lithiasis can become a chronic disease in 10 years, with an approximately 50% recurrence rate (Parman, 2004).

The risk factors for developing kidney stones can be categorized into three groups: pre-ecological (diet and environmental factors) and endogenous causes (metabolic dysfunctions, endocrine diseases like hyperparathyroidism, tumors, gastric hypoacidity, etc.), renal causes (kidney dysfunction, Tubular disorders), and post-natal causes (malformations and urinary obstruction, bacterial infections) (Nemes-Nagy et al., 2015).

Percutaneous nephrolithotomy allows the fragmentation and extraction of large kidney stones. This procedure has a higher morbidity than Extracorporeal Shock Wave Lithotripsy (ESWL) or Urethroscopy, therefore it is only used in case of complex stones, representing the treatment of calculus exceeding 2-2.5cm (Novick and Jones, 2006).

The progress of minimally invasive treatment alternatives and the development of instruments for ureteroscopy assure the achievement of higher performances, especially in both ureteral and renal lithiasis (Tiselius et al., 2006).

Objectives

This study aims to highlight the importance of percutaneous nephrolithotomy (PCNL) in the treatment of renal stones in elder patients and evaluation of the most important complications that can occur after performing this procedure.

METHODS

We performed a retrospective study during a period of 10 months (June 2016- April 2017) comprising patients who were admitted to the Urology Clinic, TirguMures, Romania. We included 200 patients with renal stones who had the indication of percutaneous nephrolithotomy.

We performed 263 procedures and compared the intraoperative, post-operative results and complicationsin patients younger and older than 70 years of age.

Inclusion criteria and the classification of the obtained data in this study were:

- patientsolder than 18 years with renal stones located in the lower calyx, renal pelvis and ureteropelvic junction.
- the size of the kidney stone≥ 20 mm;<20 mm (stone size was calculated by taking into consideration the sum of the maximum diameters) and multiple lithiasis.

the frequency of occurrence of intraoperative and postoperative complications according to age groups and size of the stone.

- age-groups: under the age of 70 and over 70 years old.
- number of daysspent in the hospital (under and over 5 days according to the age groups and type of complications).

All patients signed an informed consent form prior to surgery.

The choice of procedure was decided according to the surgeons' or patients' preferences after giving detailed information to the patient about each procedure. Patients with renal anomalies were excluded from our study.

The protocol used for the selection of patients consisted of:

- history
- abdominal ultrasound
- intravenous pyelogram (IVP) and/or computed tomography (CT)
- complete blood count, biochemical, and coagulation parameters
- urine cultures

Surgical technique

A 5 Ch ureteral catheter and an 18 Ch urethral catheter were inserted in lithotomy position under spinal anesthesia. The calyceal system was visualized by using contrast material introduced into the ureteral catheter. Intrarenal access was achieved by using a percutaneous access needle under C-armed scopy unit. A hydrophilic guide wire was inserted. Dilatation was performed by the use of9-24 Ch Alkendilators and anephroscope sheath (sPNL) was inserted. A 26-Chnephroscope (Karl Storz, Germany) was used for nephroscopy. Fragmentation was performed by the aid of an ultrasonic lithotripter, and stones were removed by using a stone extraction device. The intervention in almost all cases was finalized with the insertion of a 20-Ch nephrostomy tube under fluoroscopy.

Statistical analysis

We used the Statistical Package for Social Sciences (SPSS, version 22, Chicago, IL, USA) to perform statistical analysis. Data were labelled as nominal or quantitative variables. The frequencies of nominal variables were compared to a chi-square or Fisher test. The level of statistical significance was set at $p<0.05$.

RESULTS

In the first part of the study we performed descriptive statistics based on the collected data. Out of the total 200 investigated patients 106 (53%) were man and 94 women

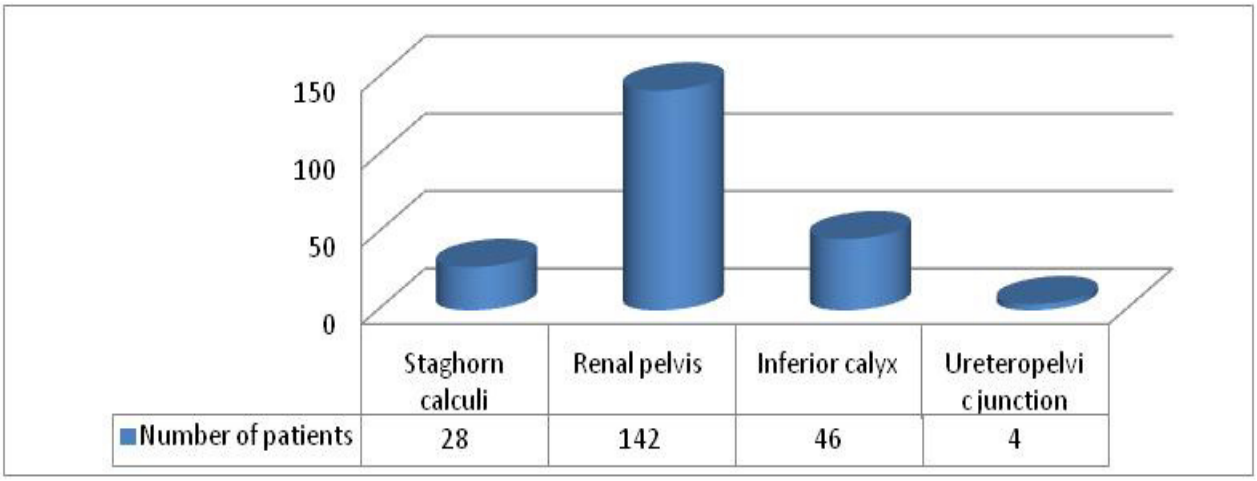

Figure 1. The location of the stone

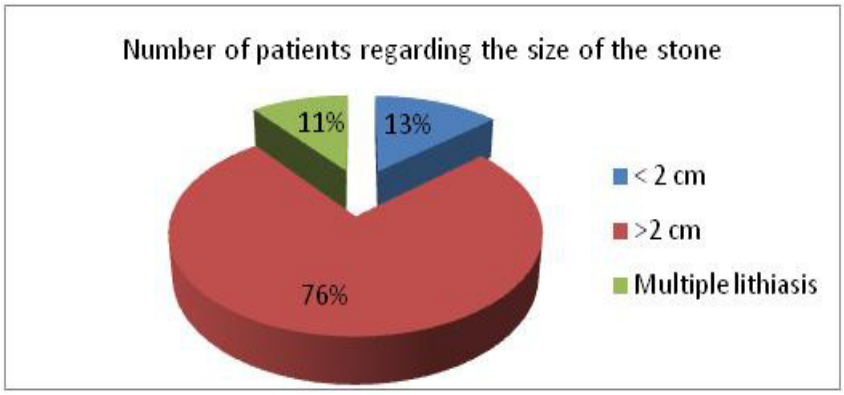

Figure 2. The distribution of patients according to the size of the stone

(47%). Concerning their origin, we observed that the majority of the patients (124), came from an urban area and only 76 came from a rural area.

Regarding theirage, we observed that most of the patients were under 70 years old and patients were older than 70 in 22 cases. The mean age of the patients was 53.65 years old (12.18 Standard Deviation- SD) ranging between 25 - 81 years old.

Imagistic investigations (ultrasound, intravenous urography, computed tomography) showed that the most frequent location of stones was in the renal pelvis, followed by the inferior calyx (Figure 1). We also had to extract 28 staghorncalculi by applying this procedure. The stones located in the ureteropelvic junction were fragmented after repositioning in the renal pelvis with the urethral catheter during the first step of the procedure.

Concerning the size of the stone we divided the patients in three groups: stones larger than 2 cm, less than 2 cm and multiple lithiasis (Figure 2).

In all cases included in the study the indication for and performed treatment was percutaneous nephrolithotomy.

Regarding the intraoperative complications in most of the cases (44) we were confronted with the migration of stone or stone fragments, hemorrhage in 24 cases or the impossibility of percutaneous access of the inferior calyx or the inabilityor difficulty of dilatation of the nephrostomy tract, in 10 cases. (Figure 3, Table 1)

The most frequent postoperative complications observed in the study groupswere residual fragments in 45 cases, hemorrhage in 40 cases, hydronephrosis in 36 cases and lumbar fistula in 26 cases, after the migration of a fragment into the urether (Figure 4, Table 2)

The average length of stay in hospital before surgery was 1.83 days (1.54 standard deviation) and after surgery was 5.58 days (2.69 standard deviation). In most of the cases the cause of the prolonged hospitalization for both age-groups was haematurria and the obstructed complications (hydronephrosis, residual fragments, fistula). (Table 3 and 4).

The stone-free rate was established after a three-monthmedical follow-up subsequent to surgery according to the abdominal ultrasound result and radiological examination, which proved to be 77.5%.

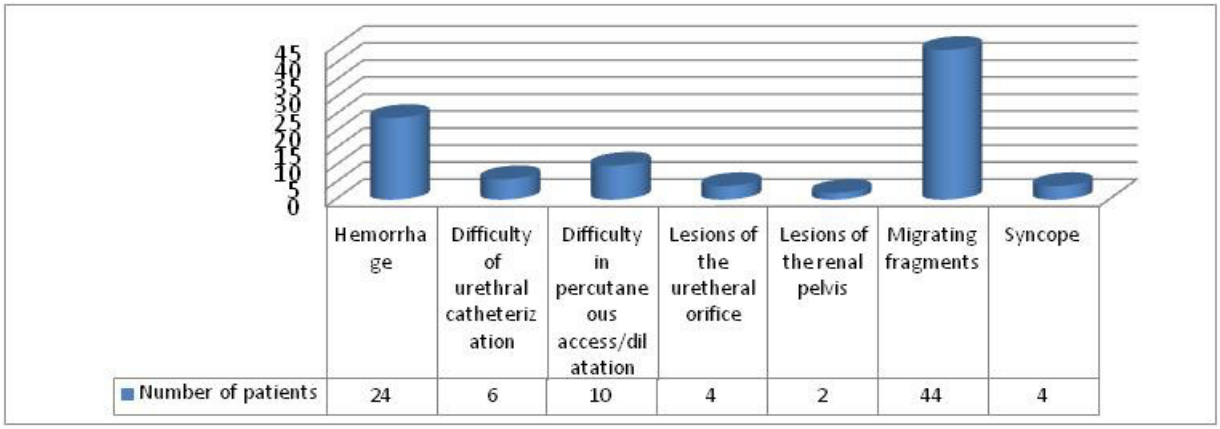

Figure 3. Intraoperative complications

Table 1. Intraoperative complications according to age-group, location and size of the stone.

				Intraoperative complications				
Stone data	**No. of patients**	**Age group (years)**	**No. of patients**	**Hemorrhage (No. of patients, %)**	**Migrating fragments (No. of patients, %)**	**Difficulty in percutaneous access or dilatation (No. of patients, %)**	**Lesions of the renal pelvis (No. of patients, %)**	**Difficulty of urethral catheterization (No. of patients, %)**
Location	142	Over 70	14	0	3 (21.4%)	0	0	0
Renal pelvis		Under 70	128	12 (10.2%)	18 (14.1%)	7 (5.5%)	2 (1.6%)	4 (3.1%)
P value				0.21	0.46	0.37	0.63	0.50
Inferior calyx	46	Over 70	9	0	3 (33.3%)	0	0	0
		Under 70	37	2 (5.4%)	10 (27%)	1 (2.7%)	0	0
P value				0.47	0.70	0.61	-	-
Ureteropelvic junction	4	Over 70	0	0	0	0	0	0
		Under 70	4	0	0	0	0	0
P value				0.76	0.18	0.37	0.61	0.38
Staghorn stone	28	Over 70	4	2 (50%)	2 (50%)	0	0	0
		Under 70	24	7 (29.1%)	8 (33.3%)	2 (8.3%)	0	2 (8.3%)
P value				0.01	0.52	0.54	0.61	0.54
The size of the stone	152	Over 70	15	2 (13.3%)	5(33.3%)	0	0	0
< 2 cm		Under 70	137	8(5.8%)	27(19.7%)	9(6.6%)	2 (1.5%)	5(3.6%)
P value				0.54	0.71	0.67	-	0.67
> 2 cm	27	Over 70	4	0	1(25%)	0	0	0
		Under 70	23	2(8.7%)	4(17.4%)	1(4.3%)	0	1(4.3%)
P value				0.26	0.21	0.30	0.63	0.45
Multiple lithiasis	21	Over 70	3	0	1(33.3%)	0	0	0
		Under 70	18	3(16.7)	4(22.2%)	0	0	0
P value				0.44	0.67	-	-	-

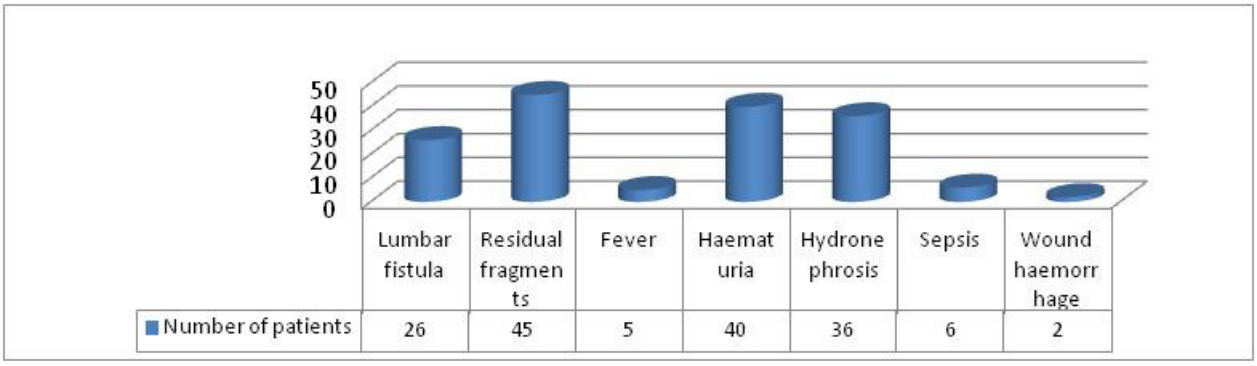

Figure 4. Postoperative complications

Table 2. Postoperative complications according toage-group, location and size of the stone

Postoperative complications									
Stone data	**No of pati-ents**	**Age group (years)**	**No. of patients**	**Hemorrhage (No. of patients, %)**	**Residual fragments (No. of patients, %)**	**Hydronephrosis (No. of patients, %)**	**Fistula (No. of patients, %)**	**Fever (No. of patients, %)**	**Sepsis (No. of patients, %)**
Location		Over 70	14	5 (35.7%)	7(50%)	4(28.6%)	1(7.1%)	0	1(7.1%)
Renal pelvis	142	Under 70	128	25(19.5%)	12(9.3%)	14(10.9%)	11(8.5%)	3(2.3%)	3(2.3%)
P value				0.15	0.047	0.38	0.36	0.56	0.30
Inferior calyx	46	Over 70	9	3(33.3%)	3(33.3%)	2(22.2%)	0	0	0
		Under 70	37	6(16.2%)	8(21.6%)	4(10.8%)	4(10.8%)	0	0
P value				0.24	0.14	0.36	0.30	-	-
Ureteropelvic junction	4	Over 70	0	0	0	0	0	0	0
		Under 70	4	0	1(25%)	2(50%)	2(50%)	0	0
P value				-	-	-	-	-	0.37
Staghornstone	28	Over 70	4	1(25%)	4(100%)	2(50%)	2(50%)	0	0
		Under 70	24	0	10(41.7%)	8(33.3%)	6(25%)	2(8.3%)	0
P value				0.01	0.31	0.52	0.30	0.54	0.65
Stone size		Over 70	15	3(20%)	9(60%)	4(26.7%)	3(20%)	0	1(6.7%)
< 2 cm	152	Under 70	137	16(11.7%)	42(30.7%)	30(21.9%)	26(19%)	3(2.2%)	3(2.2%)
P value				0.54	0.96	0.44	0.44	-	-
> 2 cm	27	Over 70	4	0	1(25%)	0	0	0	0
		Under 70	23	2(8.7%)	6(26.1%)	3(13%)	3(13%)	0	2(8.7%)
P value				0.35	0.02	0.67	0.92	0.56	-
Multiple lithiasis	21	Over 70	3	3(100%)	3(100%)	2(66.7%)	0	0	0
		Under 70	18	8(44.4%)	6(33.3%)	5(27.8%)	4(22.2%)	2(11.1%)	0
P value				0.07	0.03	0.18	0.36	0.54	-

Table 3. The frequency of intraoperative complications according to the days of hospitalization and age groups.

Intraoperative complications								
Days of hospitalization	**No. of patients**	**Age groups (years)**	**No. of patients**	**Hemorrhage (number of patients, %)**	**Migrating fragments (number of patients, %)**	**Difficulty in percutaneous access or dilatation (No. of patients, %)**	**Lesion of the renal pelvis (No. of patients, %)**	**Difficulty of ureteral catheterization (No. of patients, %)**
More than 5 days	80	Over 70	11	2(18.2%)	5(45.5%)	0	0	0
		Under 70	69	13(18.8%)	25(36.2%)	0	1(1.4%)	2(2.9%)
P value				0.95	0.55	0.68	0.56	0.56
Less than 5 days	120	Over 70	11	0	2(18.2%)	1(9.1%)	0	0
		Under 70	109	0	10(9.2%)	5(4.6%)	9(8.3%)	4(3.7%)
P value				-	0.34	0.32	-	0.51

Table 4. The frequency of postoperative complications according to the length of stay in hospital and age groups.

Postoperative complications									
Days of hospitalization	**No. of patients**	**Age groups (years)**	**No. of patients**	**Hemorrhage (No. of patients, %)**	**Residual fragments (No. of patients, %)**	**Hydronephrosis (No. of patients, %)**	**Fistula (No. of patients, %)**	**Fever (No. of patients, %)**	**Sepsis (No. of patients, %)**
More than 5	80	Over 70	11	6(54.5%)	11(100%)	6(54.5%)	3(27.3%)	0	0
		Under 70	69	24(34.8%)	38(55.1%)	30(43.5%)	25(36.2%)	4(5.8%)	0
P value				0.20	0.05	0.49	0.56	0.41	-
Less than 5	120	Over 70	11	0	2(18.2%)	0	0	0	1(9.1)
		Under 70	109	2(1.8%)	16(14.7%)	8(7.3%)	8(7.3%)	1(0.9)	5(4.6%)
P value				0.65	0.75	0.35	0.35	0.75	0.51

DISCUSSIONS

The majority of the recent studies have focused onlowering morbidity rate and improving the patients' postoperative comfort without sacrificing the efficacy and safety of the procedure (Pietrow et al., 2003). According to this fact, there are multiple alternatives regarding the intraoperative surgical attitude towards patient positioning on the operating table or the type of lithotripsy. Patient positioning alternatives on the operating table can be: dorsal decubitus, lateral decubitus, gynecological lithotomy, and ventral decubitus (Rana and Mithani, 2007). In our cases we chose the ventral decubitus intraoperator position for all types of procedures.

Our procedural protocols are in accordance with the literature, the percutaneous access of the pyelocaliceal system is performed under fluoroscopic guidanceat the level of the posterior axillary line, between the 7th rib and the iliac crest. (11;21) The site of the percutaneous puncture is chosen by taking into account the localization of calculi and the complexity of the lithiasis, which is subcostal, supracostal or combined. The endoscopic approach allows complete stone clearancein the initial phase or after a prior in situ fragmentation through various disintegration techniques: electromechanical, electrohydraulic, laser, ultrasound, and ballistic lithotripsy (Liu and Yan, 2005). In most cases, we applied the method of ultrasound lithotripsy. There were no significant differences in the success rate and frequency of complications between pneumatic and ultrasonic lithotripsy (Radfar et al., 2017).

The morbidity of open surgery has been reported extensively in the literature, including fever (26-29%), blood transfusion (14-70%), pneumothorax (5%), hemorrhage (4%), septic complications (11%), urinary or lumbar fistula (1%), postoperative hernia (2%), thromboembolic complications (2%) with an average length of hospitalization time 11 - 16 days. However, using a minimally invasive modern approach, morbidity decreases: fever (12-64%), blood transfusion (5-53%),

pneumothorax (2%), septic complications (2%), and average length of hospitalization time 9.5 days (Kim et al., 2003). Michel et al. reported in a study conducted in more than 1,000 patients who underwent percutaneous nephrolithotomy complication rates up to 83%. The most frequently occurring complications were: hemorrhage (11.2-17.5%), lesions of the pyelocalyceal system (7.2%), fever (21%-32.1%), and septicemia (0.3-4.7%). The authors concluded that one of the most important consideration for achieving successful outcomes in PNL with minimal major complications is the correct selection of patients (Michel et al., 2007).

In our study the most frequent intraoperative complications were represented by migrating fragmentsin 22% of the cases, hemorrhage in 12%, lesions of the renal pelvis and difficulties of percutaneous renal puncture or dilatation in 6%. Renal hemorrhage is one of the most common and worrisome complication of PCNL (Turna et al., 2007). Akman et al., reported in a study performed in 694 patients who were applied the PCNL technique that the increased blood loss during PCNL depends on multiple factors (multiple access tracts, staghorn calculi, diabetes, prolonged length of operative time), but not on the surgical experience (Akman et al., 2011). Our statistical analysis showed thatthere were no significant differences between the two groups of patients (under and over 70 years old) concerning the frequency of intraoperative complications associated with the anatomical position of the stone ($p > 0.05$).

Concerning our study, we found that one of the most often occurring postoperative complicationwas bleeding in 20% of the cases: 9 patients (33.3%) in group 1 (older than 70years) and 31 cases (16%) in group 2 (under the age of 70years old). In most of these patients bleeding after PCNL was minor, and responded to appropriate treatment, after the placement of a nephrostomy tubeand proper hydration the complication remitted spontaneously. We did not observe any statistical association between hemorrhagic complications and the two groups (younger or older than 70 years), $p>0.05$. In the postoperative complications category obstructions occurred frequently, in 22.5% of the cases. This type of complication was represented by stone fragments which migrated into the ureter and produced pain, hydronephrosis (4% in patients over 70 years old and 14% in patients younger than 70) or fistula (1.5% in patients over 70 and 11.5 % in patients under 70 years old).In most of the cases, obstruction as complication occurred in patients with stones localized in the renal pelvis, producing hydronephrosis in 28.6% of the patients over 70 years old and in 10. 3% in patients under 70 and fistula in 7.1% in the first group of patients compared to 8.59% in the second group. We didnot observe any statistical correlation between obstructed cases and age groups ($p>0.05$). The complicationdue to obstruction was resolved by placing a JJ stent into the ureter.

PCNL is a safe and effective procedure for removing large, complex and/or multiple renal calculi but it is not devoid of complications. Bleeding is a dangerous and life-threatening complication that can occur during or after PCNL because of needle passage, tract dilatation or nephrostomy (Said et al., 2017). The incidence of hemorrhage as a complication after PCNL can be different, from 2% to 45% (23), 8.5% (Said et al., 2017).

Concerning staghorn stones, we noticed a higher percentage of intraoperative bleeding complications in comparison with the other types of stones (50% in patients over 70 years old and 29.1% in patients under 70), but it was no statistically significant difference between the age groups concerning this complication ($p>0.05$). All patients over 70 years old (4 cases) with PCNL and staghorn stones had residual fragments compared to 41.7% in patients under 70 years old. Obstruction was more common in cases with single localization of the stone or smaller-size stones (hydronephrosis in 50% of patients over 70 years old and 33.3% of patients under 70 and fistula in 50% of patients belonging to the first group vs. 25% of patients comprised in the second group of age). Al- Kohlany et al. reported that the most frequent complications after PCNL on staghorn stones were hemorrhage and pleural, ureteral or vascular injuries in 16 cases 3% (Al-Kohlany et al., 2005). The occurrence of intraoperative pelvicalyceal perforations and the presence of complex stones are recognized as risk factors for post-PCNL bleeding (Said et al., 2017).

We monitored the haemoglobin level immediately after PCNL in all patients and tested again later if we foundit indicated. The nephrostomy tube was removed after 24-48 hours, but before removal an abdominal ultrasound and radiography were performed.

Patients' quality of life subsequent to an intervention also has an important role, the time of return to normal daily activity after NLP was reduced to 21-30 days compared to open surgery (44- 54 days) (Kessaris et al., 1995). The advantages of PCNL in the treatment of staghorn stones are lower morbidity, shorter operation time (127+/- 30 minutes), shorter length of hospitalization (6.4+/- 4.2) and earlier return to work (2.5 +/- 0,8 weeks) (Al-Kohlany et al., 2005). In our study, the average number of hospitalization days after PCNL was 5.58 +/- 2.69 SD. In most of the cases patients needed less than 5 days (60% of the cases). The prolonged duration of hospitalization (more than 5 days) was in most of the cases due to complications like hemorrhage and obstruction that needed adjuvant treatment.

PCNL is a valuable treatment option for complete staghorn stone removalin comparison with a stone-free approaching of open surgery (74% vs 82%) (Al-Kohlany et al., 2005). Turna et al., reported in 2007 a stone-free rate of 85.4% in 193 cases of PCNL. (23) In our study the stone-free rate was: 77.5%.

The limits of the current study are represented by the retrospective type of study, the low number of elderly

patients and the experience of a single center.

CONCLUSIONS

PCNL is a safe and effective method of treatmentfor large and complex stones that can be performed in both young and elderly patients. Intra and postoperative complications may occur in both age groups but this is not a decisive factor in the choice of therapeutic attitude, not even in patients older than 70 years.

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Founding source: none

Author's contribution

Ciprian Todea-Moga, Orsolya Martha, Calin Chibelean, Veronica Ghirca, Daniel Porav-Hodade - the contribution to the manuscript was concerning to the design, writing, collecting data, statistical analysis, tables, figures and final manuscript proof.

Conflict of Interest

The authors declared no conflict of interest.

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