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Original Article

Comparison of intraoperative and postoperative complications based on ASA risks in patients who underwent percutaneous nephrolithotomy

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ABSTRACT

Objective: In this study we aimed to evaluate intraoperative and postoperative complications which developed according to pre-operative American Society of Anesthesiologists (ASA) risk criteria in patients who had undergone percutaneous nephrolithotomy (PNL).

Material and methods: Five hundred and sixty patients who had undergone PNL between 2002 and 2014 were included in the study. Patients operated on the ipsilateral kidney, those with solitary kidney or the cases who had previously undergone more than one access were excluded from this study. Preoperative anesthesia risks were determined according to preoperative classification developed by ASA. Postoperative complications were evaluated using Clavien Complication Grading Scale.

Results: The mean age of the cases was 47±14 years. The 57% (n=319) of the cases were male, 241 (43%) of them were female. The average indwell time of nephrostomy catheter was 2.88±1.00 (1-8), and length of hospital stay was 4.91±1.54 (2-17) days. When the cases were assessed according to ASA risk groups, intraoperative complications were observed in 9 (5.5%) ASA I, 27 (8.6%) ASA II, and 18 (22%) ASA III patients and and distribution of the patients was statistically significant (p<0.001). When intraoperative complications were evaluated one by one, intraoperative hypotension developed in ASA I (n=3; 1.8%), ASA II (n=20; 6.4%) and ASA III (n=11; 13.4%) risk groups and this distribution (p=0.002) of patients was statistically significant. When assessed according to Clavien Postoperative Scale, postoperative complications developed (p=0.053) in ASAI (n=24; 14.7%), ASA II (n=27, 8.6%) and ASA III (n=13; 15.9%) risk groups, and this distribution of the patients was not statistically significant. In postoperative complications, Grade 3a complications developed in ASA I (n=12; 7.4%), ASA II (n=19; 6%) and ASA III (n=8; 9.8%) risk groups and this distribution was not seen to be statistically significant (p=0.485).

Conclusion: A statistically significant difference observed regarding intraoperative complications in the groups formed according to ASA risk criteria, on Clavien Grading scale no statistically significant difference was observed as for postoperative complications. In this context, we considered that ASA risks are major risk factors for PNL operations in terms of intraoperative complications.

Keywords: ASA; Clavien; percutaneous nephrolithotomy; postoperative complications.

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Introduction

Percutaneous nephrolithotomy (PNL) is a minimally invasive surgical method used in the treatment of renal stones. It is an effective, and safe method in the treatment of kidney stones with different compositions, and from its first introduction into urological practice in the year 1976, it has replaced open nephrolithotomy in the treatment of upper urinary system stones.[1] Though urologists have recently developed their own techniques in order to decrease morbidity, and increase safety, and effectiveness of PNL, from time to time potentially serious complications can develop. Although various classification systems have been developed to terminate confusion of concepts during classification of postoperative complications, nowadays Modified Clavien System which was developed in the year 1992, and modified in 2004 has been used extensively.[2,3] Preoperatively, all patients are subjected to an evaluation system developed by American Society of Anesthesiologists (ASA) which preoperatively classifies patients based on an assessment system acceptedly useful for the determination of anesthetic approach, and

especially for monitorization of the patients. Initially ASA classified physical condition of the patients which is one of the components of the surgical risk,[4] and with time the patients were divided into various categories. However, use of only one indicator of the operative risk was not considered.[5]

In this study, we aimed to evaluate intraoperative complications based on ASA risk groups, and postoperative complications using Modified Clavien System.

Material and methods

In this retrospective study 560 patients who had undergone PNL in our clinic between 2002-2014 were analyzed. Preoperatively, consent forms of all patients included in the study were obtained, and the study was designed in compliance with Helsinki Declaration. The patients who had been operated from ipsilateral kidney, those with solitary kidneys, and cases who experienced more than one access were excluded from the study.

Preoperatively all patients were evaluated based on assessments of whole blood counts, parameters of coagulation, liver enzymes, renal function tests, chest radiograms, and electrocardiographic examinations, and any surgical contraindication was ruled out. After all these tests, anamnesis, and physical examination, an anesthesiologist personally communicated with patients. Preoperatively, in consideration of medical history, and current health state of the patients, all patients were subjected to an evaluation system developed by American Society of Anesthesiologists (ASA) which preoperatively classifies patients based on an assessment system acceptedly useful for the determination of anesthetic approach, and especially for monitorization of the patients (Table 1). Renal stones were evaluated using kidney-ureter-bladder radiography (KUBR), intravenous pyelography (IVP) or non-contrasted spiral abdominal computed tomography (CT). For the final preoperative evaluation of renal stone(s) KUBR was obtained in the morning of the surgery. For the detection of urinary system infection, complete urinalysis was performed on all patients. The patients with suspect urinary tract infection was evaluated by urine cultures before their inclusion in the list of surgery Antiaggregant drug users discontinued their drugs at least one week before operation. All patients without penicilline allergy received 1 gr IV ceftriaxone as a prophylaxis just before the operation. Demographic data of all patients were evaluated regarding their gender, and age, the time of nephrostomy catheter removal, hospital stay, intraoperative, and postoperative complications. Postoperative complications were evaluated using Clavien Complication Scale (Table 2). Clavien 3a, 3b, 4a, 4b, and 5 were classified as major complications.

Percutaneous nephrolithotomy operation was performed under general anesthesia in all patients. The patients were monitorized from the start of the operation till its termination, and their pulse rates, blood pressure, oxygen saturation, and electrocardiography (ECG) results were recorded. With the patients in the lithotomy position, a 6 Fr ureteral catheter (Indovasive 6 Fr open end ureteral catheter, Biorad Medisys Pvt. Ltd, Bangalore, India) was inserted through the affected ureter. Then the patient was laid in the prone position, and his/her chest was supported with pillows to achieve a smooth mechanical ventilation. Following suitable intracalyceal access, in all patients access tract was dilated using Amplatz® dilators (Amplatz Renal Dilator Set, Cook Urological Inc., Indiana, USA) up to 24-30 F, and a 24-30 Fr renal sheath (Marflow 24-30F Amplatz Sheath, Marflow AG, Zürich, Switzerland) was placed. For stone fragmentation pneumatic lithotriptor (Lithoshock pneumatic lithotripter, EMD Medical Technologies, Turkey) was used. At the end of the operation, nephrostomy catheters were implanted in all patients, and application of standard PNL technique was completed.

Statistical analysis

Statistical analysis of the study was performed using Statistical Package for the Social Sciences (IBM SPSS Statistics; Armonk, NY, USA) 19.0 package program. Descriptive statistics for continuous variables were expressed as mean and standard deviation, while for categoric variables with frequencies, and percentages. For intergroup comparisons of categoric variables Pearson chi-square, Yates chi-square, and Fisher's exact test were used. For all statistical analyses p values below 0.05 were considered to be statistically significant.

Results

A total of 560 cases were included in our retrospective study. The ages of the cases ranged between 10, and 83 years with a mean age of 47±14 years. Patient population consisted of 319 (57%) male,and 214 (43%) female patients. Median length of catheter stay was 3 days, and mean hospital stay 4.91±1.54 (range, 2-17 days) days. We performed lower (n=331; 59.1%), middle (n=214; 38.2%), and upper calyceal (n=15; 2.7%) accesses. (Table 3). The patients were classified in categories of ASA I (n=163; 29.1%), ASA II (n=315;56.3%), ASAIII (n=82; 14.6%). In a total of 76 (13.6%) patients complications developed. The patients who developed complications were in the risk groups of ASA1 (n=27; 4.8%), ASA II (36; 6.4%), and ASA III (n=23; 4.1%). In 506 (90.4%) patients, intraoperative complications were not detected, while development of intraoperative complications were observed in 54 (9.6%) patients. Intraoperative complications included intraoperative hypotension (n=34; 61%), hypertension (n=18; 3.2%), bradycardia (n=13;

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2.3%), and lower O_2 saturation (n=5; 0.9%) (Table 4). The distribution of the number of intraoperative complications among ASA risk groups was statistically significant (p<0.001) Indeed, in 9 (5.5%) ASA I, 27 ASA II (8.6%), and 18 ASA III (18; 22%) patients intraoperative complications developed. Intraoperative complications were evaluated one by one. Intraoperative hypotension developed in 3 (1.8%), ASA I, 20 ASA II (20; 6.4%), and 11 ASA III (13.4%) patients, and distribution among risk groups was statistically significant (p=0.002). Postoperative complications developed in 64 (11.4%) patients, while any postoperative complication was not detected in 496 (88.6%) patients. Postoperative fever (n=29; 5%), need for blood transfusion (n=21; 4%), urinary system infection (n=7; 1.2%), respiratory distress (n=4; 0.7%), perirenal hematoma (n=3; 0.5%), wound site wetting (n=33; 5.8%), and development of clot colic (n=8; 1.4%) were seen in respective number of patients (Table 4). When evaluated according to Clavien Postoperative Complication Scale, postoperative complications were observed in corresponding number of patients in the risk groups as follows: ASA I (n=24; 14.7%), ASA II (n=27; 8.6%), and ASAIII (n=24; 14.7%), (p=0.053), and this distribution of patients was not statistically significant. Despite lower complication rates in ASA II risk group, we concluded that similar complication rates in ASA I, and ASA III groups resulted in statistically insignificant outcomes which hardly passed over the limit of significance (p<0.05). Still according to Clavien Postoperative Complication Scale, Grade 3a complication developed in 39 (7%) patients. Thirty-six (6.4%) patients required implantation of double-J catheterization, and in 3 (0.5%) patients perirenal hematoma was seen. Grade 3 a complications developed in 12 (7.4%) ASA I, 19 (6%) ASA II, and 8 (9.8%) ASA III patients (p=0.485), while this distribution of 3 a complications was not statistically significant (Table 5).

Discussion

Percutaneous nephrolithotomy (PNL) is a distinguished method currently used in the stone disease which can be employed in most of the renal stones with higher success rates. Percutaneous nephrolithotomy is preferred in the treatment of complex, large, and staghorn stones.[6] Despite higher success rates, this minimally invasive technique which can be applied for every renal stones, can cause development of acceptedly serious complications from time to time.

A standardized classification system for the evaluation of the outcomes of percutaneous nephrolithotomy, and complications has not been established yet. For the evaluation of endourological surgery Clavien scoring system has been widely used.[7,8] In a study performed in the year 2006 on more than 1000 cases, the most frequently encountered complications of PNL were ex-

Table 1. ASA scoring system

ASA-I	Normal healthy individual
ASA-II	Patient with a mild degree of systemic disorder
ASA-III	The patient with a non-debilitating disease restricting only his/her activity,
ASA-IV	A patient with severe completely debilitating systemic disease that is a constant threat to life
ASA-V	A dying patient who is not expected to survive for more than 24 hours, and undergoes surgical intervention as last hope

Table 2. Modified Clavien classification of surgical complications

Grade 1	Normal postoperative changes which do not require drug therapy, surgical, endoscopic, and radiological interventions
Grade 2	Conditions which require drugs other than Grade 1 (blood transfusions, TPN, antihypertensives etc.)
Grade 3	Conditions requiring surgical, endoscopic or radiological interventions
a	Interventions not requiring general anesthesia
b	Interventions requiring general anesthesia
Grade 4	Life-threatening complications (ie. CNS complications requiring intensive care)
a	Loss of single organ function (Dialysis)
b	Loss of multiple organ functions
Grade 5	Death of the patient
'd'	If the patient has complication(d), then the letter 'd' is added beside the Grade

Table 3. Demographic, and clinical findings of patients

		n	%
Gender	Female	241	43
	Male	319	57
Intrarenal access	Lower calyx	331	59.1
	Middle calyx	214	38.2
	Upper calyx	15	2.7
Mean age (range) years	47±14	(10-83)	
Mean indwell time of the nephrostomy tube (days)	3	(0-8)	
Mean length of hospital stay (days)	4.91±1.54	(2-17)	

Table 4. Intra-, and postoperative complications

Number (%) of patients who developed intraoperative complications	
Hypotension	34 (6.1%)
Hypertension	18 (3.2%)
Bradycardia	13 (2.3%)
Decreased O_2 saturation	5 (0.9%)
Number (%) of patients who developed postoperative complications	
Fever	29 (5%)
Blood transfusion	21 (4%)
Urinary system infection	7 (1.2%)
Respiratory distress	4 (0.7%)
Perirenal hematoma	3 (0.5%)
Wound site wetting	33 (5.8%)
Clot colic	8 (1.4%)

Table 5. Complication rates based on preoperative ASA risks

	ASA 1	ASA 2	ASA 3	p
n	163 (29.1%)	315 (56.3%)	82 (14.6%)	
Intraoperative complications	9 (5.5%)	27 (8.6%)	18 (22%)	<0.001
Intraoperative hypotension	3 (1.8%)	20 (6.4%)	11 (13.4%)	=0.002
Postoperative complications	24 (14.7%)	27 (8.6%)	13 (15.9%)	=0.053
Grade 3a complications	12 (7.4%)	19 (6%)	8 (9.8%)	=0.485

*Level of statistical significance: p<0.05

travasation (7.2%) (Grade 3a), blood transfusion (11.2-17.5%) (Grade 2), and fever (21-32.1%) (Grade 1). However septicemia (0.3-4.7%) (Grade 4a), colon injury (0.2-4.8%) (Grade 4a), and pleural injury (0-3.1%) (Grade 4a) were rarely encountered major complications.[9] Clavien grading system may seem to be adequate as for classification of complications, however when compared with higher grade complications, a consensus is more strong on low grade complications. In the year 2012, De la Rosette et al.[8] realized CROES (Clinical Research Office of the Endourological Society) study so as to evaluate PNL complications, and evaluated post-PNL complications based on Clavien system The most important consensus among urologists has been realized for major complications (Clavien>3a) which demonstrates that Clavien system is more suitable for serious complications. In this study we sometimes encountered difficulties in utilization of Clavien Complication Scale. Therefore use of this scale was found to be suitable only for major complications. Grade 3a major complications were observed in only 39 (7%) patients, while 36 patients required implantation of double J catheter, and in 3 patients perirenal hematoma developed. Grade 3b, 4, and 5 complications were not seen in any patient. Based on ASA risk groups, a statistically significant difference was not detected between Grade 3a complications (p=0.485).

Even though patient's age is not a disease by itself, decrease in cardiopulmonary reserve in advanced ages renders the patients more susceptible to stress factors as bleeding, need for blood transfusion during perioperative period, and medical complications.[10] In elder people evaluation of surgical outcomes, and complications may predict surgical prognosis in patients with high risk.[11] In a study published by Unsal et al.[12] in the year 2012, increases in preoperative comorbidity, and postoperative complications in parallel with age were reported. This study tends to support the study by Resorlu et al.[13] In other words statistically significant increases in the incidence of postoperative bleeding in line with increases in Charlson Comorbidity Index (a scoring system for the determination of the number, and grade of underlying diseases) scores are seen.

From centers with an ample experience in high-risky operations, superior surgical outcomes have been reported.[14] A total of 3933 cases who had undergone PNL during the period between 2007-2009 years were analyzed from many perspectives. Data of 96 centers with scarce or ample number of cases were analyzed retrospectively in 2 groups, and preoperative characteristics, and surgical outcomes were compared. Both effectiveness, and safety of PNL were found to be higher in centers which performed increased number of surgical interventions. Besides it has been thought that in centers with greater number of admissions, surgeons attained various levels of experience, and encountered more complex cases.[15] In conclusion, it has been contemplated that in experienced clinics PNL can be performed safely with lower complication rates.

Classification of American Society of Anesthesiologists (ASA) is a widely accepted method for the evaluation of perioperative risk, and it is the determinant of postoperative outcomes. ASA score is determined by the clinician via physical examination, and laboratory findings. However it can be identified without the need for a blood test or objective criteria.[16] Still by itself ASA classification is not a determinant of surgical risk.[17]

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Percutaneous nephrolithotomy can be performed under general, spinal, and combined spinal-epidural anesthesia. Any difference was not found between complications of PNL operations performed under spinal or general anesthesia.[18] In our clinic all PNL operations were performed under general anesthesia. PNL operations can be performed with the patient in the prone or supine position. Some authors have indicated that in high-risk patients (ASA III/ IV), and morbid obese cases supine position is safer[19] however others have advocated safe application of PNL with the patient in the prone position.[20] In all of our patients who underwent percutaneous nephrolithotomy we preferred prone position. In our opinion this position can be safely used for all PNL patients.

In the year 2010, Patel et al.[20] published a study where they evaluated high-risk (ASA III/IV) patient groups, and demonstrated that in these patient groups PNL operation can be performed safely with an average overall complication rate of 21.2 percent. When compared with ASAI/II patient population groups, a statistically significant difference was not detected between complication rates. However in another study, in a multivariate regression analysis, statistically significant increases in average Clavien scores of ASA III, and ASA IV patients were observed.[21] Still in a separate study, a statistically significant difference was not detected between ASA risk groups,and any Clavien complication class.[22] In two separate studies performed by Toksöz et al.[23], and Nouralizadeh et al.[11] the patients were divided into low (ASA I-II), and high risk (ASA III-IV) groups. According to Clavien classification, a statistically significant intergroup difference was not found regarding postoperative complications, and safe application of PNL even in high-risk patients was reported. In cases we performed in our clinic, high risk was considered for ASA III patients. In 13 (15.9%) high-risk patients postoperative complications developed, and in 8 (9.8%) patients Grade 3 a complications were observed. In none of the patients, Grade 3b, 4, and 5 complications were seen. Although these data are in compliance with literature data, they also tend to support safety, and reliability of PNL in the high-risk group.

In our study, intraoperative complication rates were more intensively seen in ASAII, and ASA III risk groups. When we assessed intraoperative complications we observed increased risk of intraoperative hypotension in the ASA III risk group (p=0.001). We thought that comorbidities which augment preoperative ASA risk, and anesthetic agents used might lead to hypotension. A significant difference was not observed between postoperative complication rates, and we concluded that need for double-J catheterization for 36 patients with Grade 3a complications, and development of perirenal hematoma in 3 patients might be related to stone burden, and intrarenal access technique.

In conclusion, a significant clinical difference was not found between ASA risks of the patients, and rates of postoperative complications. Statistically significant difference was rather detected in intraoperative vital signs. In this study, we concluded that ASA risks of the patients constituted a major risk factor regarding intraoperative complications of PNL procedures.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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