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The Effect of Charlson's Comorbidity Index on Clavien-Dindo Classification of Surgical Complications in Percutaneous Nephrolitotomy

Perkütan Nefrolitotomide Charlson Komorbidite İndeksi'nin Postoperatif Clavien Komplikasyon Skalası Üzerine Etkisi

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What's known on the subject? and What does the study add?

In this series the remarkable feature is that about 50% of patients had various comorbidities. Advanced age and comorbidity makes patients more susceptible to surgical complications. In this study, achievement similar complication rate between the groups suggest that the presence of preoperative comorbidities do not create a major risk factor on com.

ABSTRACT

Objective

Percutaneous nephrolithotomy (PCNL) in comorbid patients is challenging due to the high susceptibility to complications. In our study, by taking the age of patents into account, we have tried to figure out the impact of comorbid conditions on complications identified after PCNL operations in our clinic.

Materials and Methods

Three hundred-sixty patients, who underwent PCNL in our clinic between June 2002 and June 2012, were retrospectively analyzed. The patients were assessed in terms of demographic characteristics, access locations, preoperative comorbidity using the age-adjusted Charlson's Comorbidity Index (ACCI) and postoperative complications using the Clavien-Dindo classification of surgical complications.

Results

The mean age of the patients was 46 (10-83) years. Two hundred-twenty (61.1%) patients were male and 140 (38.9%) were female. According to preoperative ACCI, 169 (46.9%) of the cases were classified as group 1 and 191 (53.1%) of the cases as group 2. In 212 (58.8%) patients, entry into the lower calyx, in 136 (37.7%) - into the middle calyx and in 12 (3.3%) patients, entry into the upper calyx was done. The rate of complications in ACCI group 1, grade 1, grade 2 and grade 3a was 12.4%, 18.9%, 8.28% and in group 2, it was 6.8%, 26.7%, 6.28%, respectively. There was no significant difference between the groups (p=0.098, p=0.16 and p=0.49, respectively). Grade 3b and grade 4a complications were seen only in

ÖZ

Amaç

Perkütan nefrolitotomi (PNL), komorbiditesi olan hastalarda komplikasyonlara daha duyarlı olmaları nedeniyle zorludur. Bu çalışmada, kliniğimizde PNL operasyonları sonrası belirlenen komplikasyonlar üzerinde eşlik eden durumların etkisini hastaların yaşlarını da dikkate alarak dikkate alarak incelemeye çalıştık.

Gereç ve Yöntem

Haziran 2002 ve Haziran 2012 tarihleri arasında kliniğimizde, PNL uygulanan 360 hasta retrospektif olarak incelendi. Bu çalışmada hastalar, demografik özellikleri, akses giriş yerleri, yaşa göre düzeltilmiş Charlson Komorbidite İndeksi'ne (ACCI) göre preoperatif komorbiditeleri ve Clavien-Dindo Sınıflandırma Sistemi kullanılarak gelişen postoperatif komplikasyonları açısından değerlendirildi.

Bulgular

Çalışmaya alınan 360 hastanın yaş ortalaması 46 idi (10-83 yıl). Hastaların 220'si (%61,1) erkek ve 140'ı (%38,9) kadındı. ACCI sınıflamasına göre hastaların 169'u (%46,9) grup 1 ve 191'i (%53,1) grup 2 olarak tanımlandı. Olguların 212'sine (%58,8) alt kaliks, 136'sına (37,7%) orta kaliks ve 12'sine (3,3%) de üst kaliks girişi uygulandı. Komplikasyonlara bakıldığında ACCI grup 1 hastalarda %12,4 sınıf 1, %18,9 sınıf 2, %8,28 sınıf 3a ve ACCI grup 2 hastalarda %6,8 sınıf 1, %26,7 sınıf 2, % 6,28 sınıf 3a komplikasyon görüldü (p=0,098; 0,16; 0,49). Sınıf 3b ve sınıf 4a komplikasyonlar sadece ACCI grup 2 hastalarda görüldü. Sınıf 4b ve 5 komplikasyon her iki grup hastalarda da görülmedi.

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group 2 (1.04%, 0.52%, resceptively). Grade 4b and 5 complications were not observed in both groups.

Conclusion

Considering the age of patients, we have not observed a significant difference in the rate of postoperative complications between the groups. Therefore, we assume that the recognized preoperative comorbidities are not risk factors for PCNL procedures and operations.

Keywords

Percutaneous nephrolithotomy, the age-adjusted Charlson's Comorbidity Index, the Clavien-Dindo Classification of surgical complications

Sonuç

Biz hastaların yaşlarını da dikkate aldığımızda, ameliyat sonrası komplikasyon oranları arasında anlamlı bir fark gözlemlemedik. Bu nedenle, tanımlanmış preoperatif komorbiditelerin PNL işlemleri ve operasyonları için risk faktörleri olmadığını düşünmekteyiz.

Anahtar Kelimeler

Perkütan nefrolitotomi, yaşa göre düzeltilmiş Charlson Komorbidite İndeksi, Clavien-Dindo sınıflandırma sistemi

Introduction

Urinary tract stone disease is widely seen in our country occupying an important place in the practice of urology. It has been reported that 10% of people live with this disease throughout their lives (1). Treatment options for kidney stones include extracorporeal shock wave lithotripsy (ESWL), ureterorenoscopy, percutaneous nephrolithotomy (PCNL), and open and laparoscopic surgery. PCNL is a minimally invasive surgical procedure for the treatment of kidney stones. Since Rupel and Brown extracted an calculus via an operatively established nephrostomy in 1941, owing to the development of novel techniques and equipment through years, PCNL today has become a preferred method in the treatment of large-volume stones in cases where stone extraction is difficult for reasons depending on the anatomical structure or stone localization. The method is not completely innocent although overall success rate of >90%; it has been reported in the Clinical Research Office of the Endourological Society (CROES) PCNL Global Study that 20.5% of 5724 subjects (n=1175) experienced one more complications (2,3). Although extravasation (7.2%), hemorrhage requiring blood transfusion (11.2-17.5%) and fever (21-32.1%) are common complications; septicemia (0.3-4.7%), colon injuries (0.2-4.8%) and pleural injury (%0-3.1) are among the rare major complications (4). Conversion to open surgery is rare and is usually required during the first experience with PCNL (5). In PCNL operation, the reported mortality rate is between 0.3% and 0.046% (6).

In the literature, although there are studies investigating the effects of patients' co-morbid conditions on PCNL complications (4), there have been no study examining the effects of multiple co-morbid factors including patient age on complications.

In our study, taking into account patients' age, we discussed the relationship between complications and pre-existing comorbid conditions in patients undergoing PCNL operations in light of the literature.

Materials and Methods

Three hundred-sixty patients who underwent PCNL in our clinic between June 2002 and June 2012 were retrospectively analyzed. Written informed consent was obtained from all subjects. Demographic characteristics, preoperative comorbidity, preoperative and postoperative hemoglobin values, access locations, and intraoperative and postoperative complications were evaluated. Patients with a history of previous operations on the same side of the kidney, solitary kidney, PCNL made simultaneously on both kidney and those with operations with more than one access were excluded from the study. Preoperative comorbidities were obtained from hospital records and age-adjusted Charlson's comorbidity index (ACCI) scores were calculated by using the existing 19 comorbid parameters including the patients' age (Table 1) (7). The patients were divided into two groups according to their preoperative comorbidities as ACCI group 1 (0 points) and ACCI group 2 (points 1 and above). The protocol for this study was reviewed and approved by the Ethics Committee (Institutional Review Board) of the Faculty of Medicine, Bülent Ecevit University (date: 16/04/2013, meeting number: 2013/09, protocol number: 2013-49-16/04).

Two grams of ceftriaxone was given as prophylactic antibiotic in patients with negative urine cultures. Patients with positive urine culture were treated with antibiotics based on the antibiogram at least 48 hours before surgery. The percutaneous access was performed with the patient in the prone position following the contrast media injection via the open-ended ureteral catheter which was placed transurethrally in the supine position prior to the renal access. Both working and safety guide wires were inserted after successful access. Tract dilatations were performed by Amplatz fascial dilators until 30 Fr and Amplatz sheath was used in all cases. A standard nephroscope was used with pneumatic lithotripsy for stone disintegration. At the end of the procedure, 20 F nephrostomy tubes were inserted for 48 to 72 hours. All patients had postoperative direct urinary system graphy and laboratory investigation.

Postoperative complications were defined as adverse events occurred in 30 days and were graded by the Clavien-Dindo classification of surgical complications (CDCSC) that provides an objective and practical way to grouping complications (8). The complications were divided into 7 groups according to the classification (1, 2, 3a, 3b, 4a, 4b, 5). Underarm measurement of 37.5 degrees and above was evaluated as fever.

Statistical analysis was performed using SPSS version 19.0. Descriptive statistics for continuous variables were shown as mean and standard deviation and descriptive statistics of categorical variables were shown as frequency and percentage. Pearson's Chi-Square, Yates-corrected Chi-Square and Fisher's exact tests were used for comparison of categorical variables.

Results

The average age of the 360 patients (220 (61.1%) male and 140 (38.9%) female) was 46 (10-83) years. According to preoperative ACCI, 169 (46.9%) patients were classified as group 1 and 191 (53.1%) as group 2. In 212 (58.8%) patients, entry into the lower calyx, in 136 (37.7%) - into the middle calyx, and in 12 (3.3%) patients, entry into the upper calyx was done. The demographic characteristics of the patients and intra-postoperative findings are summarized in Table 2. All patients underwent standard PCNL under general anesthesia. In 40 (11.1%) subjects intraoperative complications and in 50 (13.8%), postoperative complications were observed.

In Table 3 ACCI groups and scores CDCSC are compared. The most common complications were fever and mild bleeding (Table 4). Fourteen (3.8%) of complications were due to surgery, 47 (13.0%) were due to medical reasons. There was no significant difference in the complication rate though patients co-morbidity index (ACCI scores) increases. Minor complications as CDCSC grade 1 and 2 were seen in the foreground. Fever seen after operation, blood transfusion because of a fall in hemoglobin level as a result of surgical procedure, DJ catheter application secondary to extravasation because of surgeon, surgical procedure and stone burden were independent factors of comorbidities.

The relationship between complications and calyceal entry sides are described in Table 5 and 6.

In ACCI group 2 after the middle caliceal entry, in 1 case grade 3b (0.5%) and in 1 case grade 4a (0.5%) complication has been seen that were not significant (Table 5). In 1 patient of ACCI group 1, after the upper caliceal entry, pneumothorax followed by deep vein thrombosis due to pulmonerthromboembolism was seen (p=0.032) (Table 6).

Discussion

Table 1. The age-adjusted Charlson's Comorbidity Index (7)

Point	Comorbid conditions
1	Myocardial infarction Congestive heart failure Peripheral vascular disease Cerebrovascular disease Dementia Chronic pulmonary disease Connective tissue disease Ulcers Mild liver disease Diabetes
2	Hemiplegia Moderate/severe renal disease Diabetes with end-organ damage Any tumor Leukemia Lymphoma
3	Moderate/severe liver disease
6	Metastatic solid tumors AIDS
1	Over 40 years for every decades

AIDS: Acquired immune deficiency syndrome

This study emphasizes that patients with kidney stones treated with PCNL also have preoperative comorbidities. In about half of patients, there are a variety of comorbidities. However, an increased comorbidity score does not show an increase in the rate of complications.

According to the American Urological Association and the European Association of Urology (EAU) guidelines on nephrolithiasis, ESWL is considered as the first-line treatment modality The main indications for PCNL include stones not responding to ESWL and stones especially over 2 cm in size and hard (cystine, COM) (9).

ACCI was created to estimate the long-term mortality and is a method to classify existing comorbid conditions (10). Charlson and colleagues have created a variety of disease categories and have identified certain points in each category. They gave 1 point to comorbid conditions, such as myocardial infarction, congestive heart

Table 2. The demographic characteristics of the patients and intra-postoperative findings

		n	%
Gender Fale	Female	140	38.9
	220	61.1	
Mean age	46±14	(10-83 years)	
Calyceal entrance Middle calyx entry Upper calyx entry	Lower calyx entry	212	58.8
	Middle calyx entry	136	37.7
	Upper calyx entry	12	3.3
Mean nephrostomy withdrawal period	2.92±1.09	(1-8 day)	
Mean length of stay in hospital	4.5±1.62	(2-17 day)	
ACCI group 1	169 (46.9%)		
ACCI group 2	191 (53.1%)		

	Lower calyx	Middle calyx	Upper calyx	Total
ACCI group 1	103 (60.7%)	62 (36.9%)	4 (2.4%)	169 (100%)
ACCI group 2	109 (56.8%)	74 (38.9%)	8 (4.2%)	191 (100%)

(p<0.01, comparison of values between lower calyx, middle calyx, upper calyx), ACCI: Age-adjusted Charlson Comorbidity Index

Table 3. Comparison of age-adjusted Charlson Comorbidity Index groups and Clavien-Dindo Classification of surgical complications

CDCSC	ACCI group 1 (n=169)	ACCI group 2 (n=191)	p*
Grade 1	21 (12.4%)	13 (6.8%)	0.098
Grade 2	32 (18.9%)	51 (26.7%)	0.16
Grade 3a	14 (8.28%)	12 (6.28%)	0.49
Grade 3b	-	2 (1.04%)	NS**
Grade 4a	-	1 (0.52%)	NS**

*p<0.05, Chi-square tests, **NS: Non specific, ACCI: Age-adjusted Charlson Comorbidity Index, CDCSC: Clavien-Dindo Classification of Surgical Complications

failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcers, mild liver disease, and diabetes. The sum of all points of comorbid conditions constitute the final score (Table 1).

Geriatric population constitutes the fastest growing segment in many parts of the world. Although age itself is not a disease, but in elderly patients with reduced functional reserve of organs makes them more sensitive to stress factors, such as bleeding, sepsis and medical complications (11,12). The effects of age on complications have been addressed in several studies (13,14,15,16). Koppie et al. (7), for the first time, formed the ACCI scores by including the patients' age to estimate the outcomes of patients who underwent radical cystectomy when calculating the Charlson's comorbidity index scores (Table 1).

In a retrospective series published by Sahin et al. (14), the complication rate of percutaneous nefrolitototmy operation in patients aged over 60 years has been reported to be similar to that in younger patients. Similarly, in a series published in 2012, Okeke and colleagues (15) have reported similar complication rates in younger patients compared to those in patients aged 70 years and older. Stoller et al. (13) have reported higher transfusion rates in elderly after PCNL. In their study published in 2012, Unsal et al (16) have reported that there was an increase in preoperative comorbidities and postoperative complications in parallel with age.

In this study, when patients were divided into two groups according to ACCI based on the preoperative comorbid conditions and taking into consideration the age, similar postoperative complication rates were observed between ACCI group 1 and ACCI group 2.

Oner et al. (17) have reported in their study of 1750 cases that large stones, stone complexity, multi tract entry, lack of experience and a prolonged period of PCNL operations increased the rate of complications. Similarly, in a study of 2.318 subjects made by Olvera-Posada et al. (18), it has been reported that older age and upper pole access were associated with an increased risk of major complications.

The pleura and the lungs are reported to be the most injured organs during PCNL operations especially in those via intercostal entry above the 12th rib. Hopper and Yakes (19) in their series reported that intercostal entry made after full expiration was responsible for 86% of the pleura and 29% of the lung injuries. In their series published in 2007, Sukumar et al. (20) assessed the success of supracostal

Table 4. Age-adjusted Charlson Comorbidity Index groups and Clavien-Dindo Classification of Surgical Complications were compared

		ACCI group 1 (n=169)	ACCI group 2 (n=191)		
CDCSC	Type of complication	Number of patients		p*	Treatment
Grade 1	Fever	21 (12.4%)	13 (6.8%)	0.098	Antipyretic therapy
Grade 2	Mild bleeding	29 (17.1%)	40 (209%)	0.45	Blood transfusion
	Mild respiratory distress	1 (0.6%)	2 (1.0%)	0.63	Follow-up
	Urinary infection	1 (0.6%)	2 (1.0%)	0.63	Antibiotics
	Hypertension	1 (0.6%)	7 (3.7%)	0.053	Antihypertensive therapy
Grade 3a	Pelvis perforation	5 (2.95%)	6 (3.1%)	0.92	Double J ureteral stent insertion for 4 weeks
	Persistent urine leakage	7 (4.1%)	6 (3.1%)	0.62	Double J ureteral stent insertion for 4 weeks
	Pneumothorax	1 (0.6%)	-	NS**	Insertion chest tube
	Perirenal hematoma (requiring medical follow-up)	1 (0.6%)	-	NS**	Follow-up
Grade 3b	Perirenal hematoma	-	2 (1.0%)	NS**	Selective angioembolization
Grade 4a	Shortnes of breath	-	1 (0.5%)	NS**	Intensive care follow-up

*p<0.05, Chi-square tests, **NS: Non specific, ACCI: Age-adjusted Charlson Comorbidity Index, CDCSC: Clavien-Dindo Classification of surgical complications

Table 5. Comparison of age-adjusted Charlson Comorbidity Index groups and Clavien-Dindo Classification of Surgical Complications According to the calyx of entry

	ACCI group 1 (n=169)			ACCI group 2 (n=191)			
CDCSC	Lower calyx	Middle calyx	Upper calyx	Lower calyx	Middle calyx	Upper calyx	p
Grade 1	16 (9.5%)	5 (2.9%)	-	8 (4.2%)	4 (2.1%)	1 (0.5%)	0.326
Grade 2	21 (12.4%)	11 (6.5%)	-	30 (15.7%)	19 (9.9%)	2 (1.0%)	0.347
Grade 3a	7 (4.1%)	6 (3.5%)	1 (0.6%)	9 (4.7%)	3 (1.6%)	-	0.435
Grade 3b	-	-	-	1 (0.5%)	1 (0.5%)	-	-
Grade 4a	-	-	-	-	1 (0.5%)	-	-

ACCI: Age-adjusted Charlson Comorbidity Index, CDCSC: Clavien-Dindo Classification of surgical complications

Table 6. Complications and statistical p values according to the calyx of entry in all cases

	Lower calyx	Middle calyx	Upper calyx	p*
Mild respiratory distress	-	3 (2.2%)	-	0.054
Hypertension	4 (1.9%)	4 (2.9%)	-	0.626
Severe hematuria	1 (0.5%)	1 (0.7%)	-	0.891
Fever	24 (11.4%)	9 (6.6%)	1 (8.3%)	0.326
Perirenal hematoma	1 (0.3%)	2 (0.5%)	-	0.725
Deep vein thrombosis	-	-	1 (0.5%)	0.586
Pulmonerthromboembolism	-	-	1 (8.3%)	0.032
Urinary infection	1 (0.5%)	2 (1.5%)	-	0.569
Pneumothorax	-	-	1 (8.3%)	0.032
Arteriovenous fistula	-	1 (0.7%)	-	0.379
Convertion to open surgery	2 (0.9%)	-	-	0.343
Intensive care follow-up	-	1 (0.7%)	-	0.379

*p<0.005

entry in 110 patients and reported that the overall complication rate was 11.8%. In 10 patients, hydrothorax/hemothorax, in one patient - perinephric collection, in two patients - infection/sepsis and in 2, massive bleeding were observed. As a result, they have reported high success rates in selected patients with acceptable morbidity. In a study of 597 cases published in 2011 by Mousavi et al. (21) investigating the complication rate of supracostal and infracostal entry in 123 patients, total complication rate and the rate of perioperative bleeding as the most common complication were reported to be 13% and 5.7%, respectively. In supracostal access applications, the incidence of complications requiring intervention, such as pleural effusion and pneumothorax ranges from 12% to 4% (22,23). Intrathoracic complication rate has been reported to increase when entry was done over the 11th rib compared to that over the 12th rib (1.4% versus 34.6%) (24). Mousavi-Bahar et al. (21) has reported the pneumothorax rate as 2.4%. These results show that supracostal entry should not be done unless required. In a study of 318 cases published in 2011 by Honey et al. (25) that examined the complication of supracostal and infrakostal access, the total complication rate, independent from tract enty, was reported to be 11.6%. Pleural complication rate was reported to be 3.2% in supracostal entry application although even higher than literature. (p=0.038). However, in the same study, it was reported that in patients undergoing infracostal puncture febrile infection as complication was observed more frequently with the rate of 5.6% (p=0.043).

In this study, similar to the literature, pulmonary complications occurred most often in supracostal entry cases with a rate of 8.3% (p=0.032). Likewise, febrile complication rates were more frequently observed in infracostal entry with a rate of 11.4% (p=0.326), though not significant (Table 6). In subjects who underwent supracostal entry, no perirenal bleeding and severe hematuria were seen (p=0.891). Our study also appears to support the reliability and minimal morbidity of supracostal entry, as (because of) pleural injury risk for supracostal entry seems to be low. Despite less number of subjects, we believe that our complication rate was in parallel with the literature data.

While trying to treat urinary tract stone disease, causing death is the most feared complication. The rate of mortality after PCNL was reported to be 0% to 0.3% in the 2013 EAU guideline (26). A few cases of death occurring after bleeding have been reported in the published first series (6). Although Segura et al. (27) reported no cases of deaths in their study of 1.000 PCNL cases published in 1985, in the series issued in 1987 by Lee et al. (6), 1 (0.2%) death due to respiratory failure in a patient with previous lung disease and other 1 (0.2%) death due to acute myocardial infarction were reported.

Although CDCSC was used in several studies in the field of general surgery, in those related to urology was used only in retroperitonoscopy, laparoscopic radical prostatectomy and laparoscopic live donor nephrectomy (28,29,30). Attempting to classify the PCNL complications according to the CDCSC is based on the very near future.

Although CDCSC brings standardization to the rating of postoperative complications, when placed in the urology practice, it seems to have some limitations. In the world of urology, creating a novel classification system that can cover urological operations might be more beneficial or CDCSC can be revised slightly to strictly include complications after urological operations.

Study Limitations

The factors that limit our study were the electively good evaluation of patients, not to use multiple tract entrance, and though the main goal was to achieve stone-free status, the limited number of complications we have seen compared to the number of cases. The second limitation of this study was that although there was not an exact age cutoff point in the literature to make the differentiation between young and old, we tried to overcome this issue by using the classification system used in the study of Koppie et al. (7).

Conclusion

In this series, the remarkable feature is that about 50% of patients had various comorbidities. Advanced age and comorbidity makes patients more susceptible to surgical complications. In this study, achieving similar complication rate between the groups suggests that the presence of preoperative comorbidities do not create a major risk for complications after PCNL. Further studies with larger samples and multiple tract entry are warranted.

Ethics

Ethics Committee Approval: The study were approved by the Bülent Ecevit University of Local Ethics Committee (Date: 16/04/2013, meeting no: 2013/09), Informed Consent: Consent form was filled out by all participants.

Peer-review: Internal peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Reha Girgin, Bülent Akduman, Concept: Bülent Akduman, Reha Girgin, Design: Bülent Akduman, Reha Girgin, Data Collection or Processing: Reha Girgin, Analysis or Interpretation: Reha Girgin, Ramazan Topaktaş, Literature Search: Selçuk Altın, Ali Akkoç, Writing: Reha Girgin, Cemil Aydın.

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