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Araştırma/*Research Article*

Evaluation of Survival Using American Society of Anesthesiology and Modified Charlson Comorbidty Index Scores in Geriatric Patients Undergoing Thoracic Surgery

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Torasik Cerrahi Geçiren Geriyatrik Hastalarda Amerikan Anestezistler Derneği ve Modifiye Charlson Komorbidite Skorlarının Sağkalım Değerlendirmesi

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ABSTRACT

Objective: *We aimed to evaluate the relationship between preoperative American Society of Anesthesiology and Modified Charlson Comorbidty Index scores and postoperative survival in geriatric patients who had undergone thoracic surgery.*
Methods: *A total of 109 patients aged 65 years and above who had undergone thoracic surgery under elective conditions were included in this retrospective study.*
Results: *Patients who died within the first postoperative two years had higher American Society of Anesthesiology III–IV scores (p=0.03), higher Modified Charlson Comorbidty Index scores (p=0.04), and lower hemoglobin and hematocrit values (p=0.02 and p=0.005, respectively). We found that Modified Charlson Comorbidty Index was significantly effective in predicting two-year mortality among geriatric patients (AUC = 0.648, 95% CI: 0.516–0.780, p=0.02). In the ROC analysis, the best predictive cut-off value for Modified Charlson Comorbidty Index was found to be 7 (sensitivity: 79.7%, and specificity: 44.4%).*
Conclusion: *The cautious choice of patients for the medical procedure has contributed to the improvement in mortality rates after some time, and with refinements in preoperative testing meticulous patient selection should be maintained.*

Keywords: *elderly, thoracic surgery, mortality*

ÖZ

Amaç: *Torasik cerrahi geçirmiş geriyatrik hastaların preoperatif American Society of Anesthesiology ve Modified Charlson Comorbidty Index skorları ile postoperatif sağkalım arasındaki ilişkiyi değerlendirmeyi amaçladık.*
Yöntem: *Bu retrospektif çalışmaya elektif koşullarda göğüs cerrahisi geçirmiş 65 yaş ve üzeri 109 hasta dahil edildi.*
Bulgular: *İlk iki yıl içinde ölen hastaların daha yüksek American Society of Anesthesiology III-IV skorları (p=0.03), daha yüksek Modified Charlson Comorbidty Index skorları (p=0.04) ve daha düşük hemoglobin ve hematokrit değerleri (sırasıyla p=0.02 ve p=0.005) vardı. Geriyatrik hastalar arasında Modified Charlson Comorbidty Index skorlarının iki yıllık mortaliteyi öngörmede anlamlı derecede etkili olduğunu bulduk (AUC=0.648,% 95 CI: 0.516-0.780, p=0.02). ROC analizinde, Modified Charlson Comorbidty Index için en iyi kestirim değeri 7 olarak bulundu (duyarlılık:%79.7, özgüllük:%44.4).*
Tartışma: *Cerrahi prosedür için hastaların dikkatli seçimi, ileride mortalitede iyileşmeye katkıda bulunabilir. Preoperatif testlerdeki iyileştirmeler ile ayrıntılı hasta seçimi yapılmaya devam edilmelidir.*

Anahtar kelimeler: *yaşlı hasta, göğüs cerrahisi, ölüm hızı*

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INTRODUCTION

Surgery of the lungs and other intrathoracic structures and anesthesia applications are complicated procedures in both developed and developing countries [1]. Perioperative follow up of geriatric patients who underwent thoracic surgery is common among surgeons, anesthesiologists, and chest and intensive care physicians. Anesthesia for intrathoracic surgery in geriatric patients should maintain physiological stability, reduce surgical trauma to the lungs, and provide postoperative analgesia [2].

The American Society of Anesthesiologists (ASA) classification is an evaluation system that classifies operation risk preoperatively and is considered useful for determining the appropriate anesthetic approach, especially the monitoring methods. Indices such as the Charlson comorbidity index (CCI) and the Charlson age corrected comorbidity index (CACI) are used to determine comorbidity in surgical or internal problems [3].

In intrathoracic procedures, there are problems related to the position, thoracotomy, and existing pathology in addition to the risks of a major operation. The factors that characterize thoracic anesthesia are the general condition of the patient, associated anomalies, protection of the healthy lung from secretion and blood, and lung collapse. One-lung ventilation (OLV) is the oxygenation of the blood and the elimination of CO_2 from the blood by venting only one lung. OLV is the most important anesthetic application during thoracic surgery [4]. While perfusion continues in the collapsed lung during OLV, lack of ventilation causes right-to-left intrapulmonary shunt. With the mixing of nonoxygenated blood from the collapsed lung with oxygenated blood from the ventilated dependent lung, the alveolar-arterial oxygen gradient increases, and hypoxemia may develop [5].

In recent years, there has been an increase in the geriatric patient population in parallel with the preventive and therapeutic developments in the field of health. With this change in population and the advancements in the use of anesthesia, surgery has become applicable to a more diverse disease type and an increasing number of patient populations [6]. It is predicted that approximately half of the population over 65 years of age in Western countries will require surgical intervention during their lifetime [7].

The Goldman criteria are used to determine the elevated risk for elective surgery. Today, some studies have reflected that the 90-day mortality is much higher than the 30-day mortality [8]. Functional status, physiologic age (not chronologic), and frailty have also been found to have a close relationship with the operative risk [9]. The ASA classification is widely used in anesthesia practice to evaluate the preoperative physical condition of patients with a wide range of diseases. Multimorbidity is common in patients aged 65 years and above [10]. There is also an increase in surgery among ASA III–IV group of patients, which isassociated with the increasing geriatric patient population with multiple morbidities. Indices such as CCI and CACI are used to determine comorbidity in surgical or internal problems [11].

This retrospective study aimed to evaluate the relationship between postoperative survival and preoperative ASA and mCCI scores of geriatric patients who had undergone thoracic surgery.

MATERIALS and METHODS

We examined the hospital records of patients over 65 years who have undergone thoracic surgery under elective conditions in our hospital between January 2015 and May 2019 retrospectively. Patients in the geriatric age group who were operated under elective conditions in the thoracic surgery operating room were included in the study. The study was approved by the ethics committee of the hospital (decision number: 2018/514/144/1; Date: 26.12.2018). Patients who died within 24 hours postoperation, patients considered “in-operable” during the surgery or the surgery was terminated for any reason, and patients who developed surgical complications such as vascular injury, serious organ damage, or life threatening reactions due to anesthesia were excluded from the study. Patients with concomitant complications, emergency surgery patients, and pediatric patients were also excluded from the study.

One hundred and nine patients over 65 years who had undergone thoracic surgery were included in this study, which was designed as a retrospective study. Age, gender, weight, height, BMI, postoperative survival, surgical method, comorbidity, ASA score, mCCI score, mCCI survival prediction percentage, operation time, double-lumen tube length and side, and the patients' position were recorded. Furthermore, the need for a central venous catheter, the amount of bleeding, the amount and type of fluid used, the need for blood transfusion, the length of stay in the intensive care unit, the length of hospital stay, complications, preoperative hemogram and biochemistry values, and postoperative hemogram and biochemistry values were recorded. After the study was approved by the ethics committee, the surgical records were checked by the assistant investigators. All patients who were 65 years or older and had undergone elective thoracic surgery were included in the study, while patients who were under 64 years andthose who had emergency surgery were excluded.

The collected data were analyzed with the Statistical Package for the Social Sciences (IBM®) version 23. The variables were characterized using mean, maximum and minimum values, and percentages. Normal distributions were reported as mean ± SD, while Student's t-test was used for comparisons between groups. Pearson's chi-square test was used to analyze the quantitative variables; however, if the group was small, Fisher's exact test was used. Nonparametric continuous variables were recorded as median and spatial distribution and compared using Mann–Whitney U tests. A value of $p < 0.05$ was considered statistically significant.

The reliability of the calculated preoperative mCCI in predicting Exin2y was examined with the ROC curves, and the areas under the curve (AUCs) were evaluated. The patients were divided into two groups according to the threshold score value determined by ROC for mCCI, and a comparison was made. For themultivariate analysis, only statistically significant variables (Ex in 2 year-Ex in 2 year) in the first two years in the univariate analysis were evaluated to determine the independent risk factors.

RESULTS

Preoperative, perioperative, and postoperative data of the patients included in the study are shown in Table 1,2. In the first two years postoperation, 18 of the patients died. Patients who died in the first two years had higher ASA III–IV scores (p=0.03), higher mCCI scores (p=0.04), lower hemoglobin and hematocrit values (p=0.02 and p=0.005, respectively), and higher postoperative urea level than those who did not die (p=0.03). Regarding the remaining variables, there was no statistically significant difference between the patients that died within the first two

Table 1. Preoperative demographic and clinical findings of the patients and their distrubition in terms of patients withhout mortality in the first 2 posterative years.

Variables Preoperative		Total (n=107)	Exin2y (+) (n=18)	Exin2y (-) (n=89)	p value
Age, year±SD	Male	70.4±4.7	70.1±5.0	70.4±4.7	0.747
Gender, n (%)	Female	83 (77.6%)	12 (66.7%)	71 (79.8%)	0.224
	ASA I-II	24 (22.4%)	6 (33.3%)	18 (20.2%)	
ASA score, n (%)	ASA III-IV	28 (26.2%)	1 (5.6%)	27 (30.3%)	0.037
		79 (73.8%)	17 (94.4%)	62 (69.7%)	
mCCI score, n±SD		5.57±2.26	6.55±2.14	5.37±2.24	0.045
mCCI percentage, n (%)	0-21%	69 (64.5%)	15 (83.3%)	54 (60.7%)	0.104
	≥50	38 35.5%)	3 (16.7%)	35 (39.3%)	
BMI, n±SD		25.8±1.5			0.138
Comorbidity, n (%)	Yes	85 (79.4%)	15 (83.3%)	70 (78.7%)	0.654
	No	22 (20.6%)	3 (16.7%)	19 (21.3%)	
Preop Hg, n±SD		12.5±1.4	11.9±1.6	12.7±1.3	0.020
Preop Hct, n±SD		37.6±4.2	35.4±4.7	38.0±3.9	0.005
Preop PLT, n±SD		262.1±104.9	271.3±91.0	260.2±107.8	0.393
Preop WBC, n±SD		8.4±3.6	8.1±1.9	8.5±3.8	0.594
Preop Urea, n±SD		38.6±13.2	42.3±17.8	37.8±12.0	0.421
Preop Cre, n±SD		0.88±0.29	0.99±0.48	0.86±0.23	0.997
Preop ALT, n±SD		20.3±11.9	20.6±8.9	20.3±12.5	0.568
Preop AST, n±SD		22.0±11.1	19.7±9.2	22.5±11.5	0.211

Table 2. Peroperative and postoperative demographic and clinical findings of the patients and their distrubition in terms of patients withhout mortality in the first 2 posterative years.

Variables Intraoperative/postoperative		Total (n=107)	Exin2y (+) (n=18)	Exin2y (-) (n=89)	p value
Operation type, n (%)	Open	66 (61.7%)	8 (44.4%)	58 (65.2%)	0.099
	Closed	41 (38.3%)	10 (55.6%)	31 (34.8%)	
Operation mode, n (%)	Anatomic resec.	65 (60.7%)	9 (50.0%)	56 (62.9%)	0.259
	Nonanatomic resec	26 (24.3%)	5 (27.8%)	21 (23.6%)	
	Other	16 (15.0%)	4 (22.2%)	12 (13.5%)	
Operation time, min±SD		167.6±42.8	158.0±40.4	169.6±43.3	0.249
Amount of bleeding, ml±SD		449.0±401.3	569.4±692.8		0.906
Crystalloid, ml±SD		2273.8±565.2	2194.4±667.2	2289.8±545.2	0.674
Colloid, ml±SD		488.8±125.0	500.0±0.0	478.5±132.9	0.689
Blood transfusion, n (%)	Yes	29 (26.2%)	6 (33.3%)	23 (25.8%)	0.514
	No	79 (73.8%)	12 (66.7%)	66 (74.2%)	
Complication, n (%)	Yes	24 (22.4%)	4 (22.2%)	20 (22.5%)	0.982
	No	83 (77.6%)	14 (77.8%)	69 (77.5%)	
Postop Hg, n±SD		11.5±1.4	11.2±1.3	11.5±1.4	0.233
Postop Hct, n±SD		34.5±4.2	33.8±3.8	34.6±4.3	0.332
Postop PLT, n±SD		280.2±130.3	263.6±111.0	283.5±134.2	0.635
Postop WBC, n±SD		11.2±4.2	12.2±5.5	11.0±4.0	0.745
Postop Urea, n±SD		41.2±18.4	47.6±18.2	39.9±18.3	0.034
Postop Creatinine, n±SD		0.89±0.34	1.01±0.52	0.86±0.29	0.787
Postop ALT, n±SD		27.5±25.2	29.5±34.2	27.1±23.2	0.346
Postop AST, n±SD		34.8±27.1	34.8±28.5	34.8±27.0	0.602
ICU admission, n (%)		79 (73.8%)	15 (83.3%)	64 (71.9%)	0.315
ICU stay, day±SD		2.7±2.2	3.6±3.2	2.5±1.9	0.325
LOS, day±SD		8.3±4.4	8.0±3.4	8.4±4.6	0.997

years postoperation and those who did not.

When we compared the relationship between mCCI and death in the first two years postoperation, together with ROC analysis, we found that mCCI was significantly effective in predicting two-year mortality among the geriatric patients (AUC = 0.648, 95% CI: 0.516–0.780, p = 0.02; Figure 1). In the ROC analysis, the best predictive cutoff value for mCCI was found to be 7(sensitivity: 79.7%, specificity: 44.4%). Using this cutoff value for mCCI, the patients were divided into two groups: the high mCCI group (>7, n=26) and low mCCI group (≤7, n=81). Patients with high mCCI had higher mortality in the first two years than those with low mCCI (69.2% vs. 12.3%, p=0.02). The analysis revealed that those with high ASA scores (p<0.0001) and those with comorbidities (p=0.01) were more in the high mCCI group, and this was found to be statistically significant (Table 3, 4). There was no significant difference between the high mCCI and low mCCI groups in terms of other variables.

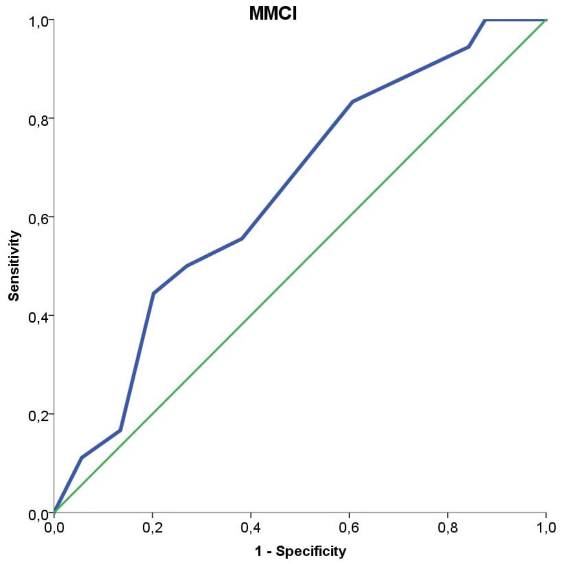

Figure 1. ROC analysis of mCCI in mortality.

The multivariate analysis was performed using patients with high mCCI scores (>7) that were found to significantly affect mortality to determine the independent variables that affected mortality in the first two years (Table 1, 2). An mCCI score above 7 (p=0.02) was the only independent variable that

Table 3. Categorization of patients according to mCCI cutoff value determined by ROC and comparison between these groups in Preoperative period.

Variables Preoperative		mCCI≤7 (n=81)	mCCI>7 (n=26)	p value
Age, year±SD		70.1±4.3	71.0±6.0	1.000
Gender, n (%)	Male	66 (81.5%)	17 (65.4%)	0.087
	Female	15 (18.5%)	9 (34.6%)	
ASA score, n (%)	ASA I-II	28 (34.6%)	0 (0%)	<0.0001
	ASA III-IV	53 (65.4%)	26 (100.0%)	
BMI, n±SD		25.9±1.5	25.4±1.3	0.155
Comorbidity, n (%)	Yes	60 (74.1%)	25 (96.2%)	0.013
	No	21 (25.9%)	1 (3.8%)	
Preop Hg, n±SD		12.5±1.3	12.7±1.6	0.601
Preop Hct, n±SD		37.5±4.0	37.8±4.7	0.813
Preop PLT, n±SD		270.5±112.1	235.8±74.2	0.151
Preop WBC, n±SD		8.6±3.6	7.7±3.3	0.092
Preop Urea, n±SD		38.6±13.6	38.5±12.0	0.591
Preop Creatinine, n±SD		0.89±0.27	0.85±0.34	0.225
Preop ALT, n±SD		19.6±8.7	22.6±18.8	0.655
Preop AST, n±SD		20.9±7.8	25.6±17.7	0.332

Table 4. Categorization of patients according to mCCI cutoff value determined by ROC and comparison between these groups in Intraoperative/postoperative period.

Variables Intraoperative/postoperative		mCCI≤7 (n=81)	mCCI>7 (n=26)	p value
Operation type, n (%)	Open	49 (60.5%)	17 (65.4%)	0.655
	Closed	32 (39.5%)	9 (34.6%)	
Operation mode, n (%)	Anatomic resec.	50 (61.7%)	15 (57.7%)	0.926
	Nonanatomic resec	19 (23.5%)	7 (26.9%)	
	Other	12 (14.8%)	4 (15.4%)	
Operation time, min±SD		165.6±43.4	173.8±41.3	0.404
Amount of bleeding, ml±SD		433.3±339.2	498.0±558.1	0.881
Crystalloid, ml±SD		2225.9±594.3	2423.0±440.8	0.089
Colloid, ml±SD		463.6±78.9	600.0±223.6	0.208
Blood transfusion, n (%)	Yes	22 (27.2%)	7 (26.9%)	0.981
	No	59 (72.8%)	19 (73.1%)	
Complication, n (%)	Yes	21 (25.9%)	3 (11.5%)	0.126
	No	60 (74.1%)	23 (88.5%)	
Postop Hg, n±SD		11.4±1.4	11.7±1.6	0.450
Postop Hct, n±SD		34.3±4.3	35.2±4.2	0.463
Postop PLT, n±SD		289.4±122.7	251.4±150.7	0.033
Postop WBC, n±SD		11.1±4.1	11.3±4.8	0.856
Postop Urea, n±SD		41.9±0.0	39.1±12.3	1.000
Postop Creatinine, n±SD		0.90±0.35	0.86±0.33	0.492
Postop ALT, n±SD		25.7±21.7	33.1±34.0	0.588
Postop AST, n±SD		33.5±25.7	38.9±31.4	0.705
ICU admission, n (%)		58 (71.6%)	21 (80.8%)	0.355
ICU stay, day±SD		2.7±2.3	2.6±2.0	0.797
LOS, day±SD		8.3±4.0	8.3±5.5	0.622
Deaths witihin Postoperative 2 years, n (%)		10 (12.3%)	18 (69.2%)	0.029

affected mortality and was thus found to be a risk factor (Table 5). The fact that ASA was III–IV showed a near-significant trend toward affecting mortality (p=0.07).

DISCUSSION

This study attempted to identify two different scoring systems and other factors affecting survival in

Tablo 5. Multivariate Logistic Regression Analysis for Postoperative Mortality in two years*.

	Multivariate analysis-1			Multivariate analysis-1		
Variables	**Odds ratio**	**95% CI**	**p value**	**Odds ratio**	**95% CI**	**p value**
PreopHg	1.662	0.518-5.392	0.392	1.662	0.518-5.392	0.392
PreopHtc	0.745	0.496-1.119	0.157	0.745	0.496-1.119	0.157
PostopUrea	1.014	0.988-1.041	0.290	1.014	0.988-1.041	0.290
ASA III-IV	6.547	0.808-53.037	0.07	6.547	0.808-53.037	0.07
mCCI>7	--	--	--	--	--	--

** For multivariate analysis, mCCI> 7 was used with the independent variables determined to affect the development of mortality in Table 1. In Multivariate analysis-1, independent variables affecting mortality and ASA were analyzed together, while in Multivariate analysis-2, mCCI was used with independent variables affecting mortality.*

geriatric patients who had undergone thoracic surgery. High ASA and mCCI scores, low hemogram values, and high postoperative renal function markers were determined as poor prognostic factors. There was no significant difference in prognosis with other variables. ASA scoring system is a risk classification based on the presence and severity of comorbidities and is used to determine the perioperative risk of a procedure [12]. Various studies have stated that the ASA score may affect mortality in geriatric patients. Mortality has been found to be higher in geriatric patients with high ASA scores such as ASA III–IV [13]. This is consistent with our study, as ASA score was found to be higher in patients who died. According to Cook and Rooke, limited physiological reserve in geriatric patients may cause an increased risk of complications and mortality after surgical operation [14]. Geriatric patients represent a significant portion of the population undergoing surgery, and this patient population is increasing. Since geriatric patients have a high prevalence of comorbidity and perioperative complication rate, careful preoperative evaluation should be performed [15]. In European countries, mortality from lung cancer is more common in women than mortality from breast cancer [16]. The average age of patients who applied to clinics for lung cancer was found to be 71 years, and lung cancer is the leading cause of cancer-related death in elderly patients [17].

CCI is the most widely used method for predicting comorbidity and mortality in patients [18]. It was developed to determine the risk of mortality and has been used by different clinics [19]. Infante et al. [20], in their retrospective study among 163 patients who underwent thoracic surgery, stated that age-added CCI score was the only independent prognostic factor in determining mortality. Nakada et al. [21] found a significant relationship between the postoperative complication rate and high CCI score in patients who underwent thoracoscopic lobectomy. In our study, a high mCCI score was also significant as a poor prognostic criterion for demonstrating mortality. Also, when the relationship between mCCI and death in the first two years postoperation was analyzed together with ROC analysis, we found that mCCI was significantly effective in predicting two-year mortality (AUC=0.648, 95% CI: 0.516-0.780, p=0.02). In the ROC analysis, the best predictive cutoff value for mCCI was found to be 7 (sensitivity: 79.7%, specificity: 44.4%).

When patients were divided into two groups using the mCCI cutoff value—the high mCCI group and the low mCCI group—patients with high mCCI had more mortality in the first two years than those with low mCCI (69.2% vs 12.3%, p=0.02). Those with high ASA scores (p<0.0001) and those with comorbidity (p=0.01) were found to be more in the high mCCI group, and this was statistically significant.

Multivariate analysis was performed using patients with high mCCI (>7) foundto significantly affect mortality todetermine the independent variables that affect the mortality rate in the first two years, mCCI score above seven (p=0.02) was found to be the only independent risk factor affecting mortality (Table 5). The fact that ASA is III–IV showed a near-significant trend toward affecting mortality (p=0.07). These findings also support our above conclusion.

Several other factors may have effects on mortality among elder patients who had undergone thoracic surgery [22]. Eguchi et al. [23] conducted a retrospective study of early-stage NSCLC (non-small cell lung cancer) patients who underwent lung resection to equate cancer-related mortality to non-cancer-related mortality in the context of increasing age. Tanner et al. [24] used the SEER and NLST datasets to look at the results of elderly patients with minor morbidities who took part in a screening experiment. According to this report, patients with severe comorbidities can see a lower gain from screening. Haruki et al. [25] used a Simplified Comorbidity Score to estimate postoperative morbidity and prognosis in a retrospective analysis. Patients with higher Simplified Comorbidity Scores have more postoperative problems, according to the researchers. Jung et al. [26] observed that acute respiratory distress syndrome and delirium were independent risk factors for in-hospital mortality in a systematic study of patients admitted to the ICU following initial discharge from major lung surgery.

CONCLUSION

High ASA and mCCI scores, low hemogram values, and high postoperative renal function markers were determined as poor prognostic factors. In our study, preoperative hemoglobin and hematocrit values were found to be lower in patients who died and were statistically significant. This result can be evaluated as a new factor affecting mortality. Thoracic anesthesiologists must consider the high perioperative danger, which is dependent on age-related physiological changes and the presence of comorbidities.

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