

# Evaluation of Long-term Intensive Care Patients in A Cardiac Surgery Center

## Kalp Cerrahisi Merkezinde Uzayan Yoğun Bakım Hastalarının Değerlendirilmesi

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### Abstract

**Objective:** This study was aimed to evaluate the clinical and demographic characteristics of patients in a chronic intensive care unit in a cardiac surgery center and to research the effect of these characteristics on scoring systems used.

**Method:** From 1 September 2014 to 1 September 2019, the study was performed retrospectively with cases admitted to the chronic intensive care unit due to lengthened intensive care requirements after monitoring in the cardiovascular surgery intensive care or coronary intensive care units. Each case had study forms including information like age, gender, comorbid diseases, acute physiology and chronic health evaluation-II (APACHE II) scores, Glasgow coma scale (GCS). The results were statistically assessed.

**Results:** 263 patients were enrolled for this study. The mean age of patients was 64.6±6 years, with 61% male and 39% female. Of cases, 46% had coronary bypass surgery (n=122), 25% had valve + aorta dissection (n=67), 19% had acute coronary artery (n=51) and 7% had peripheral artery disease (n=17). The mean follow-up duration for patients was identified as 44.2± 96.38 days. Cases developing mortality had significantly higher APACHE II scores compared to cases without mortality (p<0.05, 24.9±8.0 vs 20.5±7.2). The most common comorbidities in cases were kidney failure in 41% (n=48). 69 cases had a percutaneous tracheostomy and 21 cases had a surgical tracheostomy, for a total of 90 cases with a tracheostomy.

The mortality rate of entire monitored patients during this study period was 42.6%

**Conclusion:** Very different problems may be encountered in cases observed in the chronic intensive care unit. For these cases, kidney failure is the most important risk fact increasing mortality and morbidity. Additionally, APACHE II scoring of patients may be helpful for the assessment and prediction of operative mortality and morbidity.

**Keywords:** Chronic intensive care, cardiac center, APACHE-II, prolonged mechanic ventilation

### Öz

**Amaç:** Bu çalışmada kalp cerrahisi merkezinde, kronik yoğun bakım ünitesinde yatan hastaların klinik ve demografik özelliklerinin değerlendirilmesi ve bu özelliklerin kullanılan skorlama sistemlerine olan etkisinin araştırılması amaçlandı

**Yöntem:** 1 Eylül 2014- 1 Eylül 2019 tarihleri arasında retrospektif olarak kardiyovasküler cerrahi yoğun bakım veya koroner yoğun bakım ünitesinde izlenip yoğun bakım sürecinin uzaması nedeniyle kronik yoğun bakım ünitesine alınan olgularda gerçekleştirildi. Her bir olgunun yaş, cinsiyet, eşlik eden hastalık, Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi-2 (APACHE-2) skorları, Glasgow Koma Skalası (GKS), bilgileri içeren çalışma formu oluşturuldu. Sonuçlar istatistiksel olarak değerlendirildi.

**Bulgular:** İki yüz altmış üç hasta çalışmaya alınmıştır. Hastaların ortalama yaşları 64.6±6 yıl olup, %61'i erkek %39'u kadındı. Olguların %46'una koroner bypass(n=122) cerrahisi, %25'ine kapak+aort diseksiyonu (n=67) %19 akut koroner arter sonrası (n=51) %7'si periferik arter hastalığı (n=17) sonrası izlenmişti. Hastaların takip süresi ortalama 44,2± 96,38 gün olarak saptanmıştı. Mortalite gelişen olgularda, mortalite gelişmeyen olgulara göre APACHE II skoru anlamlı olarak daha yüksekti (p<0,05 24,9±8,0 vs 20,5±7,2). Olgularda en sık gözlenen komorbidite %41 (n=48) Böbrek yetmezliği idi. 69 olguya Perkutan trakeostomi ve 21 olguya cerrahi trakeostomi olmak üzere 90 olguya trakeostomi açıldı. Toplam izlenen hastaların %42,6'sı (n=112) kaybedildi.

**Sonuç:** Kronik yoğun bakımda izlenen olgular çok farklı sorunlarla karşılaşılabilir. Bu olgularda böbrek yetmezliği mortaliteyi ve morbiditeyi artıran en önemli risk faktörüdür. Ayrıca hastalarda APACHE 2 skorlaması operatif mortalite ve morbiditeyi değerlendirmede ve öngörmeye yardımcı olabilir.

**Anahtar kelimeler:** Uzayan yoğun bakım hastaları, kalp merkezi, APACHE 2, uzamış mekanik ventilasyon

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## Introduction

Currently, with the development of technology in cardiac centers, both invasive cardiac procedures and open heart surgery operations are successfully performed for geriatric cases with higher risks. This situation has led to longer intensive care and hospital stays. Studies have stated that nearly 19-45% of cases have lengthened intensive care duration after open-heart surgery (1-2). For lengthened intensive care duration, a variety of risk factors may be listed such as advanced age, chronic obstructive pulmonary disease (COPD), renal failure or dysfunction, atrial fibrillation, low ejection fraction, emergency surgery, previous history of cardiac surgery and inotrope support (3).

As the intensive care duration lengthens for cases, additional problems that may increase mortality and morbidity may develop and support treatments are required to resolve these problems. The most important of these are tracheostomy performed in cases requiring a longer duration of mechanical ventilation support to reduce complications of endotracheal intubation and mechanical ventilation to a minimum and ensure patient comfort, and renal replacement treatments to control kidney failure.

There are many factors affecting mortality in intensive care units. By noting these factors, a variety of scoring systems were developed to determine the patient's prognosis. The Acute Physiology and Chronic Health Evaluation (APACHE) is one of the most commonly used systems with this aim. The most important advantages of these scoring systems are the creation of common use, reliable database, lowering costs in intensive care, effective use of resources, assisting in clinical decisions and applications and the opportunity for objective assessment. However, some studies have proposed that these scoring systems are insufficient to estimate the prognosis for patients admitted to intensive care for long durations (4).

Prolonged mechanical ventilation (PMV) is a common problem, with a reported incidence between 2.9% and 8.6%, (5) after coronary artery bypass grafting (CABG). The PMV patients were older, sicker, had more complex operations and had higher rates of postoperative morbidity.

The primary aim of our study is to investigate the clinical and demographic characteristics of patients admitted to a chronic intensive care center and report our five-year experience. Our secondary aim to investigate the correlation of patient APACHE II and GCS scores with mortality and our final aim is to evaluate the additional support treatments.

## Material and Methods

This study was retrospectively performed on cases admitted to the chronic intensive care unit due to lengthened intensive care durations in the cardiovascular surgery intensive care or coronary intensive care units from 1 September 2014 to 1 September 2019. After receiving ethics committee permission from the ethics committee of our hospital (Decision No: 59, Date: 10/9/2019), the patient information for patients admitted to chronic intensive care were investigated from admission files and the hospital electronic records system.

Study forms containing information about the age, sex, main diagnosis, intensive care stay duration, problems developing in intensive care, discharge status, etc. of patients were created. Patients with missing information or who stayed in chronic intensive care for less than twenty-four hours were not included in the study.

Additionally, the acute physiology and chronic health evaluation II (APACHE II) and Glasgow Coma Scale (GCS) used during the monitoring and treatment of every patient in intensive care were evaluated.

Chronic obstructive pulmonary disease (COPD) was defined as those patients with a COPD diagnosis or patients who required bronchodilator treatment before surgery. All patients, except for the emergency cases, were examined by the pulmonologist before the operation as a routine workup.

Chronic renal dysfunction (CRD) denoted the patients who had serum creatinine levels above the normal (0.5-1.3 mg/dL).

The primary clinical endpoint of this study Was to evaluate the weaning failure by 7 days...

Was to evaluate the weaning failure by 7 days after surgery. The pulmonary complication was defined as any pulmonary abnormality occurring in the postoperative period that produces identifiable disease or dysfunction that is clinically significant and that adversely affects clinical course such as postoperative respiratory distress syndrome, re-intubation, presence of pneumothorax or pulmonary effusion but not, prolonged mechanic ventilation (PMV) (6).

The neurologic status of the patients was examined daily: the daily neurologic status of the patients were performed Neurologic complication was defined as the presence of any cerebrovascular event or transient neurologic dysfunction.

Infectious complications were defined as positive blood, urine, sputum or wound cultures postoperatively,

requiring dressings and intravenous antibiotics, requiring revision surgery (like mediastinal infection) or presence of radiographic infiltrates.

The gastrointestinal complication was defined as the presence of 1 or more of the following (7). Hematemesis or melena (with a 42 g decrease in hemoglobin level).

### Statistical Analysis

SPSS 22 was used for analyzing data. The distribution of variables was measured with the Kolmogorov-Smirnov test. Descriptive statistics used mean, standard deviation, median, minimum, maximum, frequency and percentage values. Quantitative independent data analysis used the Mann-Whitney U test. Qualitative data analysis used the chi-square test. The effect level was researched with univariate and multivariate logistic regression.  $P < 0.05$  was accepted as significant.

## Results

263 patients (61% male, 39% female) were enrolled in the study. The mean age of patients was  $64.6 \pm 6$  years. Of patients, 61% were male and 39% were female. In terms of age, 134 (51%) were under 65 years and 129 (49%) were over 65 years of age. The mean duration of stay in intensive care was  $34.6 \pm 68$  days. Of cases, 46% had coronary bypass surgery (n=122), 25% had valve + aorta dissection (n=67), 19% had acute coronary artery (n=51) and 7% had peripheral artery disease (n=17).

The demographic characteristics of the cases are summarized in Table 1.

The mortality rate of entire monitored patients during this study period was 42.6%. When the reasons for mortality of cases are investigated, the most frequently observed comorbidity was kidney failure at 41% (n= 48). Patients

**Table 1. Demographic data**

		Min-max		Median		Av. $\pm$ SD/n-%	
		23.0	-	86.0	65.0	64.4	$\pm$ 12.6
<b>Age</b>	$\leq 65$					134	51.0%
	$> 65$					129	49.0%
<b>Gender</b>	Female					105	39.9%
	Male					158	60.1%
<b>Follow-up duration (day)</b>		1.0	-	685.0	16.0	34.6	$\pm$ 68.4
<b>APACHE2</b>		7.0	-	50.0	22.0	22.4	$\pm$ 7.9
<b>APACHE mortality (%)</b>		8.0	-	97.0	42.4	44.1	$\pm$ 22.8
<b>GCS</b>		0.0	-	15.0	11.0	10.5	$\pm$ 3.9
<b>Valve + A. dissection</b>	(-)					196	74.5%
	(+)					67	25.5%
<b>Bypass</b>	(-)					141	53.6%
	(+)					122	46.4%
<b>Periphery + carotid + abdominal aneurysm</b>	(-)					246	93.5%
	(+)					17	6.5%
<b>Coronary + emergency + COPD</b>	(-)					212	80.6%
	(+)					51	19.4%
<b>Kidney failure</b>	(-)					126	47.9%
	(+)					107	40.7%
<b>P. tracheostomy</b>	(-)					194	73.8%
	(+)					69	26.2%
<b>Surgical tracheostomy</b>	(-)					240	91.3%
	(+)					23	8.7%
<b>Mortality</b>	(-)					151	57.4%
	(+)					112	42.6%

with high APACHE scores and low GCS scores were found to have significantly higher mortality rates.

The mortality status of cases and Influencing factors are summarized in Table 2.

The univariate model observed significant effects of APACHE II score, APACHE-II mortality % rates, GCS score and renal failure for prediction of mortality ( $p < 0.05$ ). When the efficacy of these variables was tested in the multivariate model, APACHE II expected mortality rate % and kidney failure were independently significant for prediction of mortality (Table 3). The reasons for which patients were followed up in the intensive care unit (Table 4).

## Discussion

There is limited data related to a long duration of admission to intensive care for patients in Turkey. Agence et al.

(8) reported 9.3% of patients admitted to a tertiary ICU stayed for 21 days or longer. Martini et al. (9) stated that surgical critical care patients stayed for a mean of 116 days. However, the ICU duration of stay for patients with respiratory diseases was identified as  $24.17 \pm 8.38$  days (10). In our study, the surviving group of patients was admitted for  $27.5 \pm 33.4$  days, while the patients in the mortality group were monitored in intensive care for mean  $44.2 \pm 96.38$  days (Table 1).

As in the whole world, the elderly population is increasing in Turkey. Recent census counts in our country identified the elderly population rate as 8.3% (11). The elderly population has 4 times higher surgical requirements compared to the remaining population. In the elderly patient group, standard mortality rates for those undergoing operations were identified to be 87% high compared to unoperated peers compared to data in the national mortality information

**Table 2. Analysis**

		Mortality (-)			Mortality (+)			p			
		Av.± SD/n-%	Median		Av. ± SD/n-%	Median					
		64.6	±	12.1	67.0	64.2	±	13.2	64.0	0.963	m
<b>Age</b>	≤65	74		49.0%		60		53.6%		0.464	X <sup>2</sup>
	>65	77		51.0%		52		46.4%			
<b>Gender</b>	Female	65		43.0%		40		35.7%		0.230	X <sup>2</sup>
	Man	86		57.0%		72		64.3%			
<b>Follow-up duration (days)</b>		27.5	±	33.4	15.0	44.2	±	96.8	17.5	0.132	m
<b>APACHE2</b>		20.5	±	7.2	21.0	24.9	±	8.0	25.0	<b>0.000</b>	m
<b>APACHE mortality (%)</b>		35.6	±	19.0	34.0	55.3	±	22.6	57.0	<b>0.000</b>	m
<b>GCS</b>		11.4	±	3.7	13.0	9.4	±	3.8	10.0	<b>0.000</b>	m
<b>Valve + A. dissection</b>	(-)	110		72.8%		86		76.8%		0.469	X <sup>2</sup>
	(+)	41		27.2%		26		23.2%			
<b>Bypass</b>	(-)	82		54.3%		59		52.7%		0.794	X <sup>2</sup>
	(+)	69		45.7%		53		47.3%			
<b>Peripheral + carotid + abdominal aneurysm</b>	(-)	144		95.4%		102		91.1%		0.162	X <sup>2</sup>
	(+)	7		4.6%		10		8.9%			
<b>Coronary + emergency + COPD</b>	(-)	118		78.1%		94		83.9%		0.241	X <sup>2</sup>
	(+)	33		21.9%		18		16.1%			
<b>Kidney failure</b>	(-)	91		60.3%		35		31.3%		<b>0.000</b>	X <sup>2</sup>
	(+)	41		27.2%		66		58.9%			
<b>P. tracheostomy</b>	(-)	103		68.2%		91		81.3%		<b>0.017</b>	X <sup>2</sup>
	(+)	48		31.8%		21		18.8%			
<b>Surgical tracheostomy</b>	(-)	144		95.4%		96		85.7%		<b>0.006</b>	X <sup>2</sup>
	(+)	7		4.6%		16		14.3%			

GCS: Glasgow coma scale, COPD: Chronic obstructive pulmonary disease, Av: Average, SD: Standard deviation, APACHE: Acute physiology and chronic health evaluation, n: Number

<sup>m</sup>Mann-Whitney U test/<sup>X<sup>2</sup></sup>Chi-kare test test

**Table 3. Regression data**

	Univariate model				Multivariate model			
	OR	95% CI		p	OR	95% CI		p
APACHE2	1.08	1.04	- 1.12	<b>0.000</b>				
APACHE mortalite (%)	1.04	1.03	- 1.06	<b>0.000</b>	1.04	1.02	- 1.05	0.000
GCS	0.88	0.82	- 0.94	<b>0.000</b>				
Kidney failure	4.19	2.41	- 7.26	<b>0.000</b>	3.25	1.70	- 6.21	0.000
P. tracheostomy	0.50	0.28	- 0.89	<b>0.019</b>	0.35	0.17	- 0.73	0.005
Surgical tracheostomy	3.43	1.36	- 8.65	<b>0.009</b>	2.97	1.02	- 8.68	0.046

Logistic Regression

OR: Odds ratio, CI: Confidence Interval, GCS: Glasgow coma scale, APACHE: Acute physiology and chronic health evaluation

**Table 4. Indicators of intensive care**

	Patient number	Percentage
<b>Chronic renal failure</b>	62	16.30%
<b>Chronic obstructive pulmonary disease</b>	36	9.40%
<b>Hypoxic brain injury</b>	18	4.70%
<b>Sepsis</b>	42	11.04%
<b>Mediastinitis</b>	18	4.70%
<b>Advanced right heart failure</b>	25	6.50%
<b>Stroke + subarachnoid hemorrhage</b>	17	4.40%
<b>Left heart failure + hemodynamic instability</b>	15	3.90%
<b>Gastrointestinal complication</b>	4	1.05%
<b>Acute respiratory distress syndrome</b>	22	5.70%
<b>Peripheral arterial disease</b>	8	2.10%

bank (12). Ursavas.et al. (10) in a study of a respiratory intensive care unit did not identify a significant difference between the mean ages of surviving and mortal patients. Similarly, in our study, the mortality rates for patients aged over 65 years, comprising 49% of the group admitted to intensive care, were not different compared to those under 65 years of age (Table 2).

According to sex, 60.1% of our patients were male and 39.9% were female. Differences linked to sex have been discussed in previous studies; however, it is uncertain whether sex is a predictive factor for clinical outcomes or not. Research in Sweden revealed 60% of patients in ICU were male; however, disease severity was similar to females (13). Our study shows similarities to this study. In our study, sex was not a factor providing clues about the long duration of stay. It is not considered that sex is associated with high mortality rates (Table 2).

Mortality after cardiac surgery is still a controversial topic in spite of surgical techniques developed and anesthesia

management. A variety of studies found mortality after cardiac surgery was from 2.94 to 30.7% (14,15). In our study, mortality was 42.6%. The reason for this may be linked to the inclusion of those admitted to chronic intensive care after cardiovascular surgery and patients with stay lengthened due to hypoxia or who could not be weaned from mechanical ventilation. Diagnoses for patients admitted to intensive care are various, with some patients having more than one diagnosis. The most common cause in the mortality group was cardiopulmonary arrest occurring due to any factor. In our retrospective study, the patient data not being recorded in detail on admission or cardiopulmonary arrests without explained cause may have led to this general diagnosis being most frequent in the mortality group.

Doerr et al. (16) in a 2801-patient study of APACHE II reported it showed good performance in terms of calibration and differentiation statistics. Argyriou et al. (17) reported the APACHE II score had a good prediction of outcomes in the cardiac ICU and had comparable differentiative capabilities. Kamis et al. (18) identified the APACHE II score for the surviving group in the ICU was  $20.5 \pm 7.28$ , while it was  $24.9 \pm 6.22$  in the mortality group. They reported the APACHE II score was significantly higher for patients in the mortality group. In our study, the mean APACHE II scores for patients who died were  $24.9 \pm 8.0$ , while it was  $20.5 \pm 7.2$  for surviving patients. Our results are similar to the studies above.

There are a variety of situations limiting the use of another prognostic parameter (19) of the Glasgow Coma Scale. Long mechanical ventilation duration and postoperative sedation may be given as examples (20). The values of postoperative scoring systems may be affected by electrolyte and blood glucose imbalance, long mechanical ventilation duration, sedation after open-heart surgery and especially the use of cardiopulmonary bypass (21). As

a result, the GCS scoring may not be very effective. In our study, the GCS in the surviving group was  $11.4 \pm 3.7$ , while it was  $9.43 \pm 8$  for the mortality group and this was statistically significant ( $p < 0.05$ ).

In the postoperative period (22), the use of Intra-aortic balloon pumps and ventricular support devices, and low cardiac output syndrome (LCOS) are significant parameters affecting patient outcomes. Unfortunately, most scoring systems ignore these parameters (23). As a result, mortality rates measured with cardiac postoperative scoring systems may be roughly compatible but insufficient. It may be more appropriate to add a cardiac scoring system to the APACHE II and GCS scores.

Mortality due to cardiac reasons in CRF patients is reported from 40-50%. This rate is nearly 20 times the risk for people without renal failure (24). Open heart surgery mortality for CRF patients is higher compared to patients with normal kidney functions (25-26). In our study, the renal failure rate was significantly higher in the mortality group compared to the surviving group ( $p < 0.05$ ) (Table 2).

Tracheostomy is a surgical method frequently applied to patients with long term mechanical ventilation, for treatment of upper respiratory tract obstruction, and those with endotracheal intubation in intensive care units and predicted to remain linked to a mechanical ventilator for a long period (27-28). Percutaneous tracheostomy (PT) is easily performed, has low complication rates and can be performed in a short period at the patient's bedside so it is mostly chosen in recent years and is frequently used in the ICU for cases with elective tracheostomy especially (29-30). During the PT procedure, complications like hemorrhage, hypoxia, hypercapnia, pneumothorax, pneumomediastinum, subdermal emphysema, paratracheal insertion, tracheal wall injury, aspiration, sudden death, and esophagus injury may be observed (29). In our study, 21 (23%) surgical tracheostomy and 69 (77%) percutaneous tracheostomy was performed in 263 patients hospitalized in the ICU in the last 5 years.

In studies, rates for minor hemorrhage linked to the PT procedure are 1.51-5.2% (28,31,32), while rates for major hemorrhage are 0.75-2.6% (28). In our study, after the percutaneous tracheostomy procedure, 10 (14.4%) had minor hemorrhage and 2 (1.9%) had a moderate hemorrhage. For the surgical procedure, 10 (76.8%) had minor hemorrhage and 5 (23.8%) had a moderate hemorrhage. Major hemorrhage was not observed. The

reason for the high incidence of minor hemorrhage is considered to be the use of anticoagulant medication by our patients. Only one case developed pneumothorax linked to percutaneous tracheostomy.

Coronary artery bypass surgery comprises a significant portion of everyday cardiac surgery practice; about 90% for many cardiac surgery centers. Prolonged mechanical ventilation is still a significant reason for postoperative morbidity and mortality. Apart from the patient-related suffering, these patients cause a significant increase in the workload of postoperative intensive care units. Postoperative prolonged ventilation was associated with advanced, chronic renal dysfunction, and longer perfusion times in CABG patients(33).

### Study Limitations

There are some limitations to this study. The first is that our study took place in a single-center, so it may not reflect all chronic intensive care patients in Turkey. The second is that it was a retrospective study. There is a need for multicenter studies to further confirm our findings.

## Conclusion

Very different problems may be encountered in cases observed in the chronic intensive care unit. For these cases, kidney failure is the most important risk fact increasing mortality and morbidity. Additionally, APACHE II scoring of patients may be helpful for the assessment and prediction of operative mortality and morbidity.

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