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COMPARISON OF FREQUENTLY USED RISK SCORING SYSTEMS IN PATIENTS WHICH WAS PERFORMED OPEN HEART SURGERY BY THE COUNCIL DECISION AND DETERMINING THE MOST SUITABLE RISK SCORING SYSTEM FOR OUR PATIENT POPULATION

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Retrospective Observational Study

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Abstract

In this study, we compared the Türkskor risk scoring system, which we have used for many years in our clinic, with other risk scoring systems.

A retrospective review of 267 patients we presented to the council before open heart surgery was performed in the Cardiovascular Surgery Clinic of Dr Siyami Ersek Training and Research Hospital in 2013-2014. The efficiency of Türkskor, standard EuroSCORE, logistics EuroSCORE and EuroSCORE II, calculated with the preoperative parameters of the patients, in predicting the actual mortality was compared with the ROC analysis.

When the whole patient population was evaluated, the mean Türkscore value was 6.05±3.46, the mean standard EuroSCORE value was 6.09±2.85, the mean logistic EuroSCORE value was 7.72±7.81, and the mean EuroSCORE II value was 3.75±5.49. The total mortality was 44 (44/267 %16,5). The efficiencies of Türkskor, Standard, logistic EuroSCORE and EuroSCORE II in determining mortality in all patient groups were compared with the ROC curve. With these results, the area under the curve was AUC: 0.729 %95 CI: 0.640-0.817 for Türkskor, AUC: 0.710 %95 CI: 0.618-0.803 for Standard EuroSCORE , AUC: 0.715 %95 CI: 0.623-0.807 for Logistic

EuroSCORE and AUC:0.730 95% CI: 0.639-0.822 for EuroSCORE 2 were calculated . When compared in all risk groups, Türkskor, Standard EuroSCORE, logistic Euroscore Euroscore II were found to be similar in predicting mortality (p>0.05).

Türkskor, Standard EuroSCORE, logistics EuroSCORE and EuroSCORE II are similarly successful in predicting mortality for all patient groups.

Key Words: Active Endocarditis, Emergency Surgery, Mortality, Non-fatal Morbidity, Preoperative Critical State, Renal Insufficiency.

Özet

Bu çalışmada kliniğimizde uzun yıllar kullandığımız Türkskor risk skorlama sitemini diğer risk skorlama sistemleri ile karşılaştırdık.

Dr Siyami Ersek Eğitim ve Araştırma Hastanesi, Kalp ve Damar Cerrahisi kliniğinde 2013-2014 yıllarında açık kalp ameliyatı yapılmadan önce konseye sunduğumuz 267 hasta retrospektif olarak incelendi. Hastaların operasyon öncesi parametreleri ile hesaplanan Türkskor, standart EuroSCORE, lojistik EuroSCORE ve EuroSCORE II'nin gerçekleşen mortaliteyi öngörmekteki etkinliği ROC analiziyle kıyaslandı.

Tüm hasta popülasyonu değerlendirildiğinde ortalama Türkskor değeri 6.05±3.46 ortalama standart EuroSCORE değeri 6.09±2.85, ortalama lojistik EuroSCORE değeri 7.72±7.81, ortalama EuroSCORE II değeri ise 3.75±5.49 olarak bulundu. Toplam mortalite 44 olarak gerçekleşti (44/267%16,5). Türkskor,Standart, lojistik EuroSCORE ve EuroSCORE II'nin mortaliteyi belirlemekteki etkinlikleri ROC eğrisi ile kıyaslandı.Bu sonuçlarla eğri altında kalan alan Türkskor için AUC:0.729 %95 CI: 0.640-0.817, Standart EuroSCORE için AUC:0.710 %95 CI:0.618-0.803, Lojistik EuroSCORE için AUC:0.715; %95 CI:0.623-0.807 ve EuroSCORE II için AUC: 0.730 %95 CI:0.639-0.822 olarak hesaplandı. Tüm risk gruplarında kıyaslandığında Türkskor, Standart Euroskor, Euroskor 2 ve lojistik Euroskor mortaliteyi öngörmede benzer bulundu (p>0.05).

Türkskor, Standart EuroSCORE, lojistik EuroSCORE ve EuroSCORE II tüm hasta grupları için mortaliteyi öngörmede benzer şekilde başarılıdır.

Anahtar Kelimeler: Acil Cerrahi, Aktif Endokardit, Ameliyat Öncesi Kritik Durum, Böbrek Yetmezliği, Mortalite, Ölümcül Olmayan Morbidite.

1. Introduction

Risk assessment is the statistical estimation of the outcome of an intervention to be performed on patients evaluated according to a certain risk classification system (Alhan, 2004). Determining the risks of death and disability in cardiovascular surgery is very important in terms of determining cost-effective treatment methods (Cai et al., 2011). Analysis of clinical outcomes should not be limited to mortality and morbidity; It should also include endpoints such as long-term survival rates, hospital readmission and retreatment. With the results obtained, it is possible to inform the patient and their relatives about the risks of the planned operation. In cardiovascular surgery operations, at least four risks that concern the patient and the surgeon are evaluated. These; mortality (death), non-fatal morbidity (disability or severe organ damage), utilization of national resources, and patient satisfaction (Paç, 2016).

The first version of EuroSCORE, known as the standard or additive system, is based on the direct aggregation of the risk coefficients obtained by the logistic regression method of the identified factors. Later, the system was changed as a mathematical formula in 2003 according to the same criteria and has been used as logistics EuroSCORE until today. Akar et al. in 2011, it was concluded that EuroSCORE predicted high mortality in all risk groups in our country. In 2011, the current system was again developed by Nashef et al. a new model was announced as EuroSCORE II (Akgül et al., 2013). It has been shown that the EuroSCORE risk scoring system is easy to implement in our country, the expected mortality value is slightly higher, but it can be better evaluated with multicenter studies with the increasing number of patients (Mavioğlu, 2001).

In this study, we compared the Türkskor scoring system, which we have been using in our clinic for many years, with internationally used scoring systems such as standard EuroSCORE, logistics EuroSCORE and EuroSCORE II. Thus, determining the most appropriate risk score system for our patient population; It will help us to set an example in the evaluation of hospital performances, to reveal the risk weights of patients who have undergone surgery, to predict

hospital costs, to improve care services, to inform and educate patients, to contribute to the literature and national database.

2. Material and Methods

In the Cardiovascular Surgery Clinic of Dr Siyami Ersek Training and Research Hospital, 267 patients were analyzed retrospectively between 2013 and 2014.

Patient files, perfusion follow-up cards analyzed and patient data were obtained. Estimated mortality values were calculated for all patients according to the risk factors obtained from the files of the patients, according to the Türkskor, standard EuroSCORE, logistic EuroSCORE and EuroSCORE II scoring system. Mortality data were obtained from patient control cards. Age, gender, diabetes, hyperlipidaemia, hypertension, smoking history, left ventricular ejection fraction (LVEF), surgical procedure, aortic cross clamp time, and cardiopulmonary bypass time were evaluated for all patents.

The preoperative demographic characteristics and operative data of the patients included in the study are summarized in Table 1. The distribution of the patients according to the evaluated Türkskor criteria is shown in Table 2. The risk factors analyzed according to the Türkskor risk scoring system are shown in Table 3. EuroSCORE parameters and changes made are shown in Table 4.

Table 1. Preoperative demographic characteristics and operative data of the patients included in the study

Patient, n	**267**
Male, n (%)	177 (66.3)
Female, n (%)	90 (33.7)
Age, year	61.51 ± 12.63
Mean EF* (%)	59
Diabetes, n (%)	84 (31.5)
XCT**, min	70
Emergency Surgery (%)	17 (6.4)
Life-threatening operation (%)	1 (0.4)
Creatinine (avg)	1 mg dL^{-1}

* EF = Ejection Fraction, ** XCT = Cross-Clamping time

Table 2. Percentage Distribution of Evaluated Parameters

Parameter	Number	%
Chronic Pulmonary Disease	12	4.5
Extracardiac Arteriopathy	39	14.6
Neurological Disfunction	6	2.2
Preoperative Critical State	4	1.5
Undergone Cardiac Surgery	24	9
Renal Insufficiency	18	6.7
Active Endocarditis	7	2.6
NYHA* Class IV	7	2.6
Myocardial Infarction	51	19.1
Emergency	17	6.4
Multiple Simultaneous Procedures	68	25.4
Simultaneous Thoracic Aortic Surgery	14	5.2
Post-MI VSD**	0	0

*NYHA = New York Heart Association, **Post-MI VSD= Post-Myocardial Infraction Ventricular Septal Defect

Table 3. Türkskor

A. PATIENT-RELATED FACTORS		Point
1. Age	For every 5 years over 60 years old: 1 point; 60-65 years old: 1.66-70 years old 2…	
2. Gender	Female	1
3. Obesity	Body Mass Index: 30-35:1 point, 36-40:2 points, 41 and above 3 points	1-3
4. Chronic Lung Disease	1. Presence of airway stenosis in the Respiratory Function Test F1(forced expiratory volume in one second) / FVC (forced vital capacity) below %70 and/or 2. Decreased Lung volume: FVC: less than 80 % +F1/FVC: above 70 %	1
5. Extracardiac Arteriopathy	More than %50 carotid lesion, previous or planned abdominal aorta, carotid or peripheral vessel operation after cardiac surgery, radiological diagnosis	2
6. Past Cardiac Surgery	Operation history in which the pericardium was opened before	3
7. Kidney Dysfunction	Serum creatinine > 2.26 mg dL-1 and/or GFR (Glomerular filtration rate) < 60 ml min -1	2
8. Renal Failure+Dialysis Patients (7th item score is not added)	Dialysis through an A-V (Arterio-venous) haemodialysis fistula and/or dialysis catheter	5

9. Active Endocarditis	Diagnosis of endocarditis by echocardiography and/or positive blood cultures	3
10. Diabetes Mellitus	Presence of insulin dependent diabetes mellitus	2
B. CARDIAC FACTORS		
1.LV Dysfunction	Ejection Fraction between 30-50 % Ejection Fraction < 30	1 3
2.Previous Myocardial Infarction	Troponin value above 1.5 ng ml-1 for the last 7 days before the operation	2
3.Pulmonary Hypertension	> 40 mmHg > 60 mmHg	2 3
C. OPERATION-RELATED FACTORS		
1.Critical Preoperative Situation	The patient who was operated on with cardiopulmonary resuscitation and/or the operation of the patient with IABP (Intraaortic Balloon Pump) inserted	3
2.Concomitant Cardiovascular Surgery	Concomitant vascular operation Concomitant valve operation	1 2
3.Thoracic Aorta Surgery	Intervention in Ascending Arch or Descending Aorta pathologies	4
4.Postenfarct Ventricular Septal Rupture	Diagnosed during echocardiography and/or Catheterization	5

Table 4. The risk factors and changes examined in additive, logistics, and EuroSCORE II are shown

Parameter	Additive and logistics EuroSCORE	EuroSCORE II
Age	> 60 years risk score for every 5 years	Risk score given without age limit
Gender	Female	Female
Chronic Lung Disease	Long-term use of bronchodilators or steroids due to *COPD	Long-term use of bronchodilators or steroids due to *COPD
Extracardiac artery disease	One or more of claudication, > 50 % or total occluded carotid artery disease, previous or planned abdominal aorta, peripheral artery, carotid artery intervention	One or more of claudication, > 50 % or total occluded carotid artery disease, previous or planned abdominal aorta, peripheral artery, carotid artery intervention
Neurological dysfunction	Difficulty moving	Defined as serious movement disorder of neurological or musculoskeletal origin
Past heart surgery	Cardiac surgery that will require opening the pericardium	Cardiac surgery that will require opening the pericardium
Serum creatinine value	Preoperative serum creatinine > 200 micromole L^{-1} was considered a risk.	Except for dialysis patients, creatinine clearance > 85 mL min^{-1} was normal, 85-50 mL min^{-1} moderate, and < 50 mL min^{-1} advanced renal dysfunction.
Active endocarditis	Continuing antibiotic therapy until surgery for infective endocarditis	Continuing antibiotic therapy until surgery for infective endocarditis

Critical preoperative situation	Preoperatively, one or more of the symptoms of ventricular tachycardia, fibrillation, cardiac arrest, heart massage, mechanical ventilation, inotropic administration, use of intra-aortic balloon pump, acute renal failure (anuria or oliguria < 10 mL hour^{-1})	Preoperatively, one or more of the symptoms of ventricular tachycardia, fibrillation, cardiac arrest, heart massage, mechanical ventilation, inotropic administration, use of intra-aortic balloon pump, acute renal failure (anuria or oliguria < 10 mL hour^{-1})
Unstable Angina	Resting angina requiring intravenous nitrate administration	*CCS 4, resting angina
Left ventricular dysfunction	A left ventricular ejection fraction between 30 % and 50 % is moderate, and < 30% is advanced ventricular dysfunction.	Left ventricular *EF was evaluated as > 51 % good, %31-50 moderate, %21-30 poor, < 20 % very poor
Recent myocardial infarction	Myocardial infarction <90 days	Myocardial infarction <90 days
Pulmonary Hypertension	Systolic pulmonary artery pressure > 60 mmHg	Pulmonary arterial pressure > 55 mmHg was considered advanced, and 31-55 mmHg was considered moderate pulmonary hypertension.
Urgency	Operation of the patient after diagnosis	It is divided into four groups as elective, priority, emergency, and rescue.
Major cardiac surgeries other than coronary artery bypass grafting	Major cardiac surgeries other than coronary artery bypass grafting	Isolated *CABG, non-CABG surgery, 2 procedures and 3 procedures
Thoracic Aortic Surgery	Operations for the ascending, arch or descending thoracic aorta	Operations for the ascending, arch or descending thoracic aorta
Post-infarction ventricular septal rupture	Septal rupture after infarction	Not in the criteria
Insulin dependent diabetes mellitus	Not in the criteria	Insulin dependent diabetes mellitus disease has been added to the criteria
Functional capacity	Not in the criteria	NYHA classification added to criteria

*CCS = Canadian Heart Society, *CABG = Coronary Artery Bypass Grafting, *COPD = Chronic Obstructive Pulmonary Disease ,*NYHA = New York Heart Association, EF = Ejection Fraction

Risk grouping was done according to Türkskor risk scoring. Accordingly, 0-4 points low risk, 5-7 points medium risk, ≥ 8 points high risk group were accepted. The efficiency of Türkskor, standard EuroSCORE, logistics EuroSCORE and EuroSCORE II, calculated with the preoperative

parameters of the patients, in predicting the actual mortality was compared with the ROC analysis.

This study was approved by the Scientific Advisory Board of İstanbul Dr Siyami Ersek Cardiovascular Surgery Training and Research Hospital (28001928-773.99).

3. Results and Discussion

177 (66.3%) were male and 90 (33.7%) were female of 267 patients. The mean age of the patients was 61.51±12.63. 44 of the patients (16.5%) died. Early mortality was observed in 36 (%13) patients.

Serum creatinine levels of patients with early mortality were found to be statistically significantly higher than the patients who were alive (p:0.001; p<0.01) The blood glucose levels of the patients with early mortality were found to be statistically significantly higher than the patients who were alive (p:0.020; p<0.05).The pulmonary hypertension levels of the patients with early mortality were found to be statistically significantly higher than the patients who were alive (p:0.013; p<0.05).The crossing times of the patients with early mortality were found to be statistically significantly higher than the patients who were alive (p:0.003; p<0.01). By-pass times of patients with early mortality were found to be statistically significantly higher than the patients who were alive (p:0.001; p<0.01).

The mean Türkskor value of the patients was 6.05±3.46, the mean Standard EuroSCORE value was 6.09±2.85, the mean Logistic EuroSCORE value was 7.72±7.81, and the mean EuroSCORE II value was 3.75±5.49.The mean Türkskor value of the patients with early mortality was 8.69±3.96, the mean Standard EuroSCORE value was 7.72±2.53, the mean Logistic EuroSCORE value was 11.38±7.63, the mean EuroSCORE II value was 7.71±9.33.There was no statistically significant difference between EuroSCORE II and logistic EuroSCORE averages in terms of early mortality in patients with a low-risk Türkskor (p1:0.924; p2:0.943; p>0.05). EuroSCORE II and logistic EuroSCORE averages of patients with early mortality were found to be statistically significantly higher in patients with a moderate risk Türkskor than in patients without early mortality (p1:0.016; p2:0.022; p<0.05). In patients with a high-risk Türkskor the EuroSCORE II averages of patients with early mortality were found to be statistically significantly higher than those without early mortality (p:0.049; p<0.05). There is no statistically significant difference between the

logistic EuroSCORE averages of patients with early mortality in patients with a high-risk Türkskor, and those without early mortality (p:0.216; p>0.05).

The effectiveness of Türkskor, standard EuroSCORE, EuroSCORE II and logistics EuroSCORE in determining mortality was compared with the ROC curve (Figure 1). With these results, the area under the curve was AUC: 0.729 %95 CI: 0.640-0.817 for Türkskor, AUC: 0.710 %95 CI: 0.618-0.803 for Standard EuroSCORE, AUC: 0.715 %95 CI: 0.623-0.807 for Logistic EuroSCORE and AUC:0.730 95% CI: 0.639-0.822 for EuroSCORE 2 were calculated. When compared in all risk groups, Türkskor, Standard EuroSCORE, logistic Euroscore II were found to be similar in predicting mortality (p>0.05).

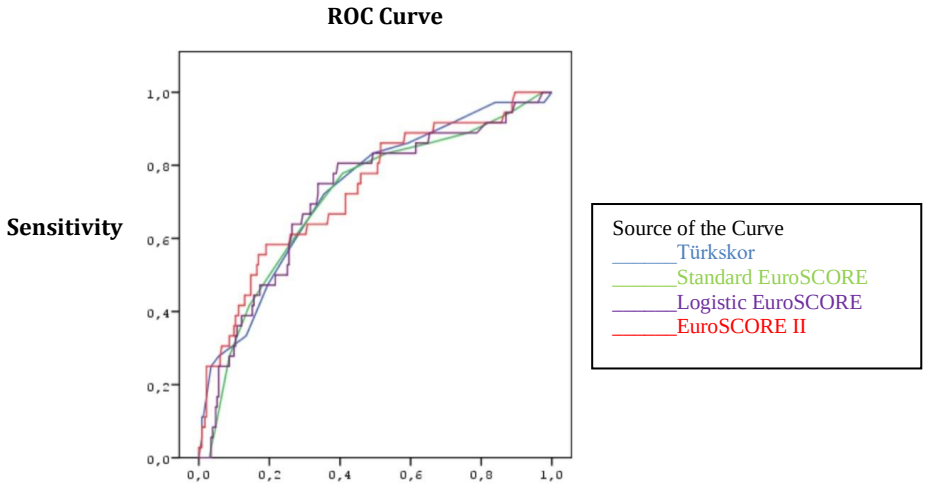

Figure 1. ROC curve for Türkskor, Standard EuroSCORE, EuroSCORE 2 and logistics EuroSCORE in all risk groups (AUC: 0.729 %95 CI: 0.640-0.817 for Türkskor, AUC: 0.710 %95 CI: 0.618-0.803 for Standard EuroSCORE, AUC: 0.715 %95 CI: 0.623-0.807 for Logistic EuroSCORE and AUC:0.730 95% CI: 0.639-0.822 for EuroSCORE II)

The effectiveness of Türkskor, standard EuroSCORE, EuroSCORE II and logistic EuroSCORE in determining mortality in high-risk patients was compared with the ROC curve (Figure 2) With these results, the area under the curve was AUC:0.617 95% CI: 0.504-0.723 for Türkskor, AUC:0.579 95% CI:0.465-0.687 for Standard EuroCORE, AUC:0.591; 95% CI: 0.477-0.698 for logistics EuroSCORE and AUC: 0.645 95% CI: 0.531-0.747 for EuroSCORE II. Türkskor, Standard EuroSCORE, logistic EuroSCORE and EuroSCORE II were found to be similar in predicting mortality in high-risk groups (p>0.05).

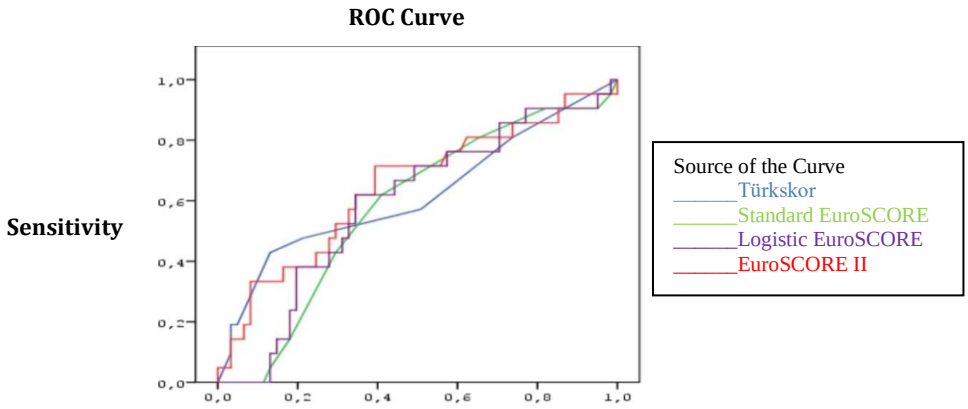

Figure 2. ROC curve for Türkskor, standard EuroSCORE, EuroSCORE 2 and logistics EuroSCORE in the high-risk group (AUC:0.617 95% CI: 0.504-0.723 for Türkskor, AUC:0.579 95% CI:0.465-0.687 for Standard EuroSCORE, AUC:0.591; 95% CI: 0.477-0.698 for logistics EuroSCORE and AUC: 0.645 95% CI: 0.531-0.747 for EuroSCORE II)

4. Conclusion

Treatment of heart diseases is done with medical or medical treatment in addition to invasive approaches or surgical treatment. Evidence-based protocols have been an important guide in choosing which treatment method (Dişcigil, 2005). The outcomes to be considered in surgical practice are mortality, morbidity, resource use and patient satisfaction. Mortality is the most important performance indicator in cardiac surgery. The ability to compare different institutions at different times is one of the advantages of risk scoring systems (Kapan et al., 2003). Yucel Ozen et al. in their study, 520 open heart patients were evaluated for standard EuroSCORE and they came to the conclusion that "standard EuroSCORE is an objective and reliable system used for the evaluation of cardiac surgery (Özen et al.,2012).

Mehmet Kaplan et al. used the EuroSCORE system prospectively for risk scoring in consecutive cardiac surgery patients who were operated on. 225 of a total of 320 patients, 104 of whom were women, underwent coronary artery bypass grafting and 95 had valve surgery. As a result, they concluded that "When we look at the expected and actual mortality rates, the EuroSCORE risk scoring system is a suitable and easy to apply system in the patient profile of our country, especially for patients who have undergone coronary artery bypass and valve surgery." Fausto Biancari et al. Data were collected from 1027 patients undergoing isolated CABG to arrive at the

accuracy of EuroSCORE II and to compare its discriminatory ability with the original euroSCORE. As a result, "EuroSCORE II performs better than its original version in determining operative mortality and morbidity in patients with isolated CABG. The ability to predict 30-day mortality in high-risk patients is of particular importance. EuroSCORE II also appears to be a good predictor of late survival (Biancari at al., 2012).

Ahmet Akgul et al. in his study, 406 patients who underwent coronary artery bypass grafting between 2011 and 2012 were analyzed retrospectively. The efficiency of standard EuroSCORE, logistic EuroSCORE and EuroSCORE II, calculated with the preoperative parameters of the patients, in predicting the actual mortality was compared with the ROC analysis. And as a result, they concluded that Standard EuroSCORE, logistic EuroSCORE and EuroSCORE II are similarly successful in predicting mortality for all patient groups. EuroSCORE II is more successful in the high-risk group and the difference will become evident with large-scale studies. We also reached a similar conclusion in our study. When we divided the patients into low, medium, and high-risk patients according to Türkskor, when the risk level increased, it was seen that the mean scores of Logistic EuroSCORE and EuroSCORE II patients with early mortality increased significantly. It was determined that there was no significant difference in high-risk patient groups only in Logistic EuroSCORE. Although this is a small number of patients, we use the Türkskor system in the decision of the council; It may indicate that EuroSCORE II is a more appropriate scoring system.
In this study, we worked on all four risk scoring systems (Türkskor, Standard EuroSCORE, Logistics EuroSCORE, EuroSCORE II). According to Türkskor, three risk groups (low, intermediate, and high-risk patients) were formed and these risk groups were applied to all operations and the scores of Logistic EuroSCORE and EuroSCORE II in patients with and without early mortality were calculated. It was found that there was no statistically significant difference between EuroSCORE II and logistic EuroSCORE averages in terms of early mortality in patients with low-risk Türkskor (p1:0.924; p2:0.943; $p>0.05$). The mean of EuroSCORE II and logistic EuroSCORE of the patients with early mortality were found to be statistically significantly higher in patients with moderate risk for Türkskor, than those with no early mortality (p1:0.016; p2:0.022; $p<0.05$). In patients with a high-risk Türkskor, the EuroSCORE II averages of patients with early mortality were found to be statistically significantly higher than those without early mortality (p:0.049; $p<0.05$). There is no statistically significant difference between the logistic

EuroSCORE averages of the patients with early mortality in patients with high-risk Türkskor, and the patients without early mortality (p:0.216; p>0.05). As we mentioned before; When we separate the patients according to Türkskor, when the risk level increased, it was seen that the mean scores of Logistic EuroSCORE and EuroSCORE II patients with early mortality increased significantly. It was determined that there was no significant difference in high-risk patient groups only in Logistic EuroSCORE. Although this is a small number of patients, we use the Türkskor system in the decision of the council; It may indicate that EuroSCORE II is a more appropriate scoring system. In order to adapt a widely used risk scoring system to our own risk scoring system, data should be collected from different centers with a larger number of patients. Today, the competition between health institutions is also valid for institutions that perform cardiac surgery. In order to be objective in the comparison of mortality rates, which is one of the most important criteria in this competition, it is necessary to objectively reveal the risk status of the patients before the operation. Thus, some possible mistakes will be prevented from comparing the results of a center with a higher mortality rate because it operates on high-risk patients with the low-mortality results of another center with low-risk patients. For any risk scoring system to be useful and acceptable, it must be simple, accurate, verifiable, and inexpensive. Risk factors should also be objective, credible and achievable.

Conflicts of interest

The authors declare that there are no potential conflicts of interest relevant to this article.

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