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Research Article

Evaluation of Effectiveness of Euroscore 2 in Patients Undergoing Isolated Coronary Artery Bypass and Isolated Mitral Valve Replacement Surgery

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Abstract

Objectives: In our study, we aimed to evaluate the results of our patients who underwent isolated coronary artery bypass graft (CABG) and isolated mitral valve replacement (MVR) surgeries under cardiopulmonary bypass (CPB) with one of the most common of these scoring systems, Euroscore 2.

Methods: All patients who underwent consecutive isolated CABG and isolated MVR operations under CPB between May 2012-March 2014 in Private Akay Hospital Cardiovascular Surgery Clinic were included in this study. In this study, intraoperative deaths and deaths within 30 days postoperatively were considered as mortality. The patients' demographic data, preoperative risk factors, preoperative medication, postoperative data, postoperative complications, laboratory findings and observed mortality and morbidity records were obtained retrospectively from patient files and hospital database.

Results: As a result of ROC analysis; In patients in the CABG group, the agreement of Euroscore expected mortality rates with the actual mortality rates was found to be 81.3%, and this was statistically significant. Sensitivity was found to be 80%, and specificity was around 70%.

In patients in the MVR group, the agreement of Euroscore expected mortality rates with the actual mortality rates was found to be 77.1%, and this was statistically significant. Sensitivity was found to be 75%, and specificity was around 62%.

Conclusion: The result of our study showed that Euroscore 2, a preoperative risk assessment test, has an effective use in the determination of the mortality rate that may occur surgically in isolated coronary bypass and isolated mitral valve surgery, although it showed slight differences from the procedures applied.

Keywords: Euroscore 2, isolated coronary artery bypass graft, isolated mitral valve replacement

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In the early 1990s, interest in risk assessment and quality of care analysis among healthcare services gradually increased.[1]

When the need for precise calculation of risk probability in cardiac surgery became an indispensable factor, risk scoring systems have emerged. These scoring systems allow risk assessment in patients using traditional statistical methods and objective risk factors related to operative mortality. In addition to its practical use for clinicians and for predicting expected mortality, scoring allows us to estimate not only

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Table1. Patient characteristics

Sex	n	%
Female	514	28.0
Male	1324	72.0
Mortality		
Survived	1792	97.5
Exitus	46	2.5
Operation		
CABG	1611	87.6
MVR	227	12.4
Diabetes Mellitus	414	22.5
Hypertension	740	40.3
Family History	727	39.6
Hyperlipidemia	832	45.3
Obesity	366	19.9
Smoking	695	37.8
Chronic obstructive pulmonary disease	122	6.6
Pulmonary Hypertension	0	0
Extracardiac Arteriopathy	89	4.8
Neurological Dysfunction	57	3.1
Reoperation	50	2.7
Emergency Operation	62	3.4
Chronic Kidney Failure	31	1.7
Active Endocarditis	0	0
Critical Preoperative Status	30	1.6
Left Ventricular Aneurysm	21	1.1
Post MI Ventricular septal defect	1	0.1
Aortic Surgery	0	0
Preoperative intra-aortic balloon pump	6	0.3
Postoperative intra-aortic balloon pump	35	1.9
Postoperative Inotropic Support	180	9.8

CABG: Coronary artery bypass graft; MVR: Mitral valve replacement.

operative mortality, but also morbidity, length of hospital stay and especially the hospital cost of patients in various risk categories.[2]

The developed systems are also important in assessing outcomes in cardiac surgery centers and in making operation or medical treatment and follow-up decisions in high-risk patients.[3]

The most commonly used scoring system is Euroscore. Began to be developed in 1995, Euroscore has been started to be used in Europe and then in many countries around the world since 1999.[4]

However, the experience gained in cardiac surgery suggested that Euroscore may predict probable mortality higher than the actually observed mortality.[5,6]

It has been reported that this is due to the nature of the system being based on the simple sum of the risk coefficients and therefore there being the possibility of ignoring the interaction of different risk factors among themselves, especially in patients with a large number of risk factors. Therefore, the system was changed to a mathematical formula based on the same criteria in 2003 and used as logistic Euroscore.[7]

In 2011, the system was revised again, and Euroscore 2 was announced as a new model.[8]

In our study, we aimed to evaluate the results of our patients who underwent isolated coronary artery bypass graft (CABG) and isolated mitral valve replacement (MVR) surgeries under cardiopulmonary bypass (CPB) with one of the most common of these scoring systems, Euroscore 2.

Methods

All patients who underwent consecutive isolated CABG and isolated MVR operations under CPB between May 2012-March 2014 in Private Akay Hospital Cardiovascular Surgery Clinic were included in this study. In this study, intraoperative deaths and deaths within 30 days postoperatively were considered as mortality. The patients' demographic data, preoperative risk factors, preoperative medication, postoperative data, postoperative complications, laboratory findings and observed mortality and morbidity records were obtained retrospectively from patient files and hospital database (Table 1).

CABG Surgical Technique

In all CABG cases, the operation was performed by median sternotomy. All CABG cases were performed with aortic right atrial cannulation. After cardiac arrest was achieved with antegrade and retrograde cold crystalloid cardioplegia and topical hypothermia following cross-clamp, the continuation of the arrest was done with intermittent retrograde cold blood cardioplegia. The operations were completed under moderate hypothermia (28°C). In all CABG patients, the left internal mamarian artery (LIMA) was used in the left anterior descending artery position. Saphenous vein graft was used in bypasses to other coronary arteries. Hot blood cardioplegia was given before the cross-clamp was removed.

MVR Surgical Technique

In all MVR cases, the operation was performed by median sternotomy. All MVR cases were performed with aorto-bicaval cannulation. After cardiac arrest was achieved with antegrade and retrograde cold crystalloid cardioplegia and topical hypothermia following cross-clamp, the continuation of the arrest was done with intermittent retrograde cold blood cardioplegia. The operations were completed under moderate hypothermia (28°C). Mitral valve diameters to be replaced were determined by intraoperatively

Table 2. Euroscore 2 expected mortality and actual mortality comparison

Euroscore2	Mortality	n	X	SD	p
Whole group	Exitus	46	7.92	9.67	0.01*
	Survived	1792	2.01	2.02	
CABG	Exitus	40	6.75	8.17	0.01*
	Survived	1571	1.90	2.01	
MVR	Exitus	6	15.74	5.34	0.04*
	Survived	221	2.84	1.90	

CABG: Coronary artery bypass graft; MVR: Mitral valve replacement.

Table 3. Euroscore 2 expected mortality and actual mortality evaluation of diagnostic accuracy

ROC	Total group (%)	CABG (%)	MVR (%)
Sensitivity	78	80	75
Specificity	67	70	62
Diagnostic accuracy	80.4 (p=0.03)	81.3 (p=0.03)	77.1 (p=0.04)

ROC: Receiver-operating characteristic; CABG: Coronary artery bypass graft; MVR: Mitral valve replacement.

evaluating the valve area after the native valve was excised. Hot blood cardioplegia was given before the cross-clamp was removed.

Statistical Analysis

In the study, the patients' general characteristics, disease states and scores are given as mean deviation, percentage and frequency. Independent sample t test and chi-squared analysis were used to examine the Euroscore 2 measurements of the patients according to their mortality levels. ROC (Receiver-Operating Characteristic) analysis was performed to examine the consistency between Euroscore 2 assessments and actual mortality, and ROC curves were drawn. AUROC (Area Under the Receiver-Operating Characteristic) values were calculated to compare the ROC areas. In the study, independent sample t test was used to examine whether Euroscore 2 measurements differed according to the disease conditions and clinical characteristics of the patients. Correlation analysis was performed to examine the patients' age, LVEF, length of hospital stay, intubation time and Euroscore 2 relationship. For statistical evaluation, SPSS (Statistical Package for Social Science, Chicago, Il, USA) 19.0 Windows package software was used, and α=0.05 was taken as the critical decision value.

Results

In the study, 28% of the patients were female, and 72% were male. It was found that 97.5% of the patients survived and 2.5% were exitus. 87.6% of the patients underwent CABG, and 12.4% underwent MVR. 22.5% of the patients had Diabetes mellitus, 40.3% had Hypertension, and 39.6% had Family History. 19.9% of the patients were obese, 37.8% actively smoking, 6.6% had COPD, and none had PHT. 4.8% of the patients had Extracardiac Arteriopathy, and 3.1% had Neurological Dysfunction. 2.7% of the patients underwent reoperation, and 3.4% had an emergency operation. 1.7% of the patients had Chronic Kidney Failure, 1.6% remained in Critical Preoperative Status, 1.1% had a Left Ventricular Aneurysm, 99.7% had no Preoperative intra-aortic balloon pump, 98.1% had no Postoperative intra-aortic balloon pump and 9.8% received Postoperative inotropic support (Table 2).

In the study, the mean Euroscore2 scores were found to be 7.92±9.67 in patients who were Exitus (n=46) and 2.01±2.02 in patients who survived (n=1792). It was observed that Euroscore 2 scores were statistically higher in patients who were exitus compared to those that survived. This result is an indication that Euroscore 2 expected mortality rates were consistent with the actual mortality (p=0.01, p<0.05).

In the CABG patient group, the mean Euroscore 2 scores were 6.75±8.17 in patients who were exitus (n=40) and 1.90±2.01 in those who survived (n=1571). It was observed that Euroscore 2 scores were statistically higher in patients who were exitus compared to those that survived. This result is an indication that Euroscore 2 expected mortality rates were consistent with the actual mortality in the CABG patient group (p=0.01, p<0.05).

In the MVR patient group, the mean Euroscore 2 scores were 15.74±5.34 in patients who were exitus (n=6) and 2.84±1.90 in those who survived (n=221). It was observed that Euroscore 2 scores were statistically higher in patients who were exitus compared to those that survived. This result is an indication that Euroscore 2 expected mortality rates were consistent with the actual mortality in the MVR patient group (p=0.04, p<0.05) (Table 3).

ROC analysis was done to evaluate Euroscore 2 expected mortality rates and to evaluate the diagnostic accuracy of the expected mortality results of Euroscore 2 according to the actual mortality rates. The agreement of Euroscore expected mortality rates with the actual mortality rates was found to be 80.4%, and this was statistically significant. Sensitivity was found to be 78%, and specificity was around 67%. A cut-off point was determined for Euroscore2 expected mortality rates, and this was found to be 3.5. In addition, patients with Euroscore scores of 3.5 and above can be considered to have high expected mortality risk.

In patients in the CABG group, the agreement of Euroscore expected mortality rates with the actual mortality rates

Table 4. Evaluation of euroscore 2 expected mortality and actual mortality rates

Actual mortality	Group score		p
	Low Score (0–3.49)	High Score (3.5 and above)	
Survived			
n	1529	263	0.01*
Survived (%)	85.30	14.70	
According to score (%)	98.58	92.61	
Exitus			
n	22	24	
Exitus (%)	47.80	52.20	
According to score (%)	1.42	7.39	

was found to be 81.3%, and this was statistically significant. Sensitivity was found to be 80%, and specificity was around 70%.

In patients in the MVR group, the agreement of Euroscore expected mortality rates with the actual mortality rates was found to be 77.1%, and this was statistically significant. Sensitivity was found to be 75%, and specificity was around 62% (Table 4).

As a result of the Roc analysis, it was found that patients with Euroscore 2 scores of 3.5 and above would have high expected mortality risk. Mortality levels were examined according to these groups. It was found that 14.7% (n=263) of the surviving patients and 52.2% (n=24) of the patients who were exitus had high scores. Exitus rates were found to be higher in the high score group (3.5 and above). While 1.42% of patients with low scores were exitus, this rate was found to be 7.39% in high score patients (p=0.01) (Table 5, Fig. 1).

In the CABG group, 13.8% (n=217) of the surviving patients and 50% of the patients who were exitus (n=20) were found to have high scores. Exitus rates were found to be higher in the high score group (3.5 and above). While 1.5% of patients with low scores were exitus, this rate was found to be 8.4% in high score patients (p=0.01).

In the MVR group, 20.8% (n=46) of the surviving patients and 66.7% of the patients who were exitus (n=4) were found to have high scores. Exitus rates were found to be higher in the high score group (3.5 and above). While 1.1% of patients with low scores were exitus, this rate was found to be 8.0% in patients with high scores (p=0.03) (Table 6).

It was found that the Euroscore 2 measurements of the patients were positively and weakly correlated with their length of hospital stay (p=0.01). It was observed that an increase in the length of stay caused an increase in Euroscore 2 evaluation scores.

Discussion

Today, invasive methods and surgical treatment methods are used in cases where medical treatment is insufficient in the treatment of heart diseases. Evidence-based treatment protocols have been important guidelines on which treatment method among these is more effective and appropriate. In these treatment protocols, the most important factor that determines the decision of the physician is the benefit-harm relationship that the selected method will bring to the patient, in other words, mortality and morbidity risks. Treatment methods with low risks of mortality and morbidity have been more applicable to patients for physicians.

In open heart surgery, the most important factor in selecting treatment methods is mortality risk rates. The higher the mortality rate of the surgical procedure to be done to cure the disease, the same level of avoidance is shown to the surgical decision.

Euroscore 2 was designed to overcome the performance limitations in the previous versions, and its consistently high overestimates that have been widely shown in the literature were reduced.[8,4,7]

Because a predictive model that overestimates the level of risk misleads confidence.[9]

In our study, a high level of agreement was seen between Euroscore2 expected mortality rates and actual mortality rates. Overall, we found that the level of effectiveness of the test was good. However, despite the fact that patients with high Euroscore2 scores showed the expected mortality, the higher survival rate of the patients caused the specificity of the test to be low. We think that the clinical experience of the center that performs the surgical applications was effective here.

External verification from a risk-predicting model aims to confirm whether it can be generalized outside the boundaries of the population on which it is built as a preliminary basis for its use as a reference for quality assessment.[10]

The differences in the clinical profile of the reference population and the test sample are generally considered to be serious obstacles to and such a verification process. In addition, the currently used risk scoring systems have been developed for quite a long time and therefore require periodic recalibration and validation to reflect the recent advances in surgical techniques and postoperative patient management.[11,12]

Many countries have performed validation studies to determine whether the scoring systems used are affected by the demographic factors in their population.[13] Our study was carried out in Ankara, Turkey, in a clinic accepting pa-

Table 5. Evaluation of euroscore 2 expected mortality and actual mortality rates according to operation status

Operation	Mortality		Group score		p
			Low Score (0-3.49)	High Score (3.5 and above)	
CABG	Survived	n	1354	217	0.01*
		Survived (%)	86.2	13.8	
		According to score (%)	98.5	91.6	
	Exitus	n	20	20	
		Exitus (%)	50.0	50.0	
		According to score (%)	1.5	8.4	
MVR	Survived	n	175	46	0.03*
		Survived (%)	79.2	20.8	
		According to score (%)	98.9	92.0	
	Exitus	n	2	4	
		Exitus (%)	33.3	66.7	
		According to score (%)	1.1	8.0	

CABG: Coronary artery bypass graft; MVR: Mitral valve replacement.

Table 6. Days of hospital stay and Euroscore 2 relationship

Measurements		Hospital Stay
Euroscore 2	r	0.06*
	p	0.01

tients from many cities of the country. Thus, we can say that the results of our study generally reflect the results in Turkish society.

Euroscore 2 has been released to improve the old Euroscore. In Euroscore 2, although the core of the risk factors is almost the same, more weight has been given to surgical procedures to improve risk estimation, even in non-CABG procedures.[8]

A study in Liverpool focused on the evaluation the clinical performance of Euroscore 2 in different surgical subgroups of patients.

The authors found that Euroscore 2 was a reasonable risk model for hospital mortality in isolated coronary surgery (AUC 0.79; HL p ¼ 0.052) and aortic procedures (AUC 0.81; HL p ¼ 0.43) and was perfect for mitral valve surgery (AUC 0.87; HL p<0.6).[14]

As a result of our study, it was observed that there was a high level of agreement between Euroscore2 expected mortality rates and actual mortality rates in CABG and MVR patients. However, we found that the level of agreement was higher for the CABG group of patients compared to the MVR group.

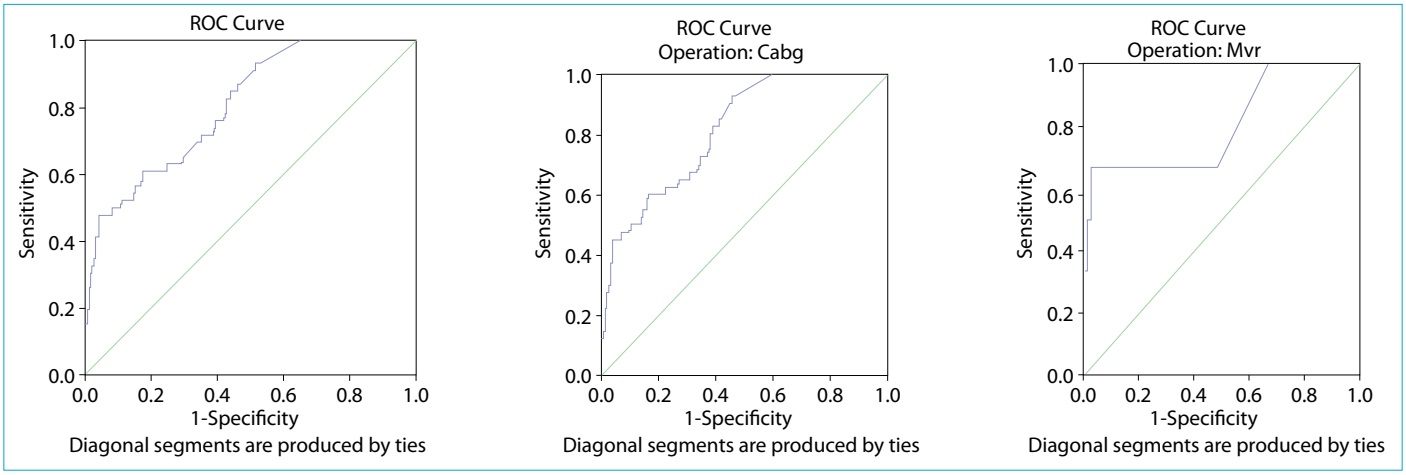

Figure 1. Euroscore2 expected mortality and actual mortality evaluation of diagnostic accuracy. ROC: Receiver-operating characteristic; CABG: Coronary artery bypass graft; MVR: Mitral valve replacement.

We also observed that Euroscore2 results were correlated with the length of hospital stay. We found that hospital stays were longer in patients with higher Euroscore 2 scores. This result suggests us that preoperative Euroscore 2 scores can give us an insight into hospital costs, complications that may occur due to prolonged hospital stay and strategies that can be established in intensive care follow-up.

Conclusion

The result of our study showed that Euroscore 2, a preoperative risk assessment test, has an effective use in the determination of the mortality rate that may occur surgically in isolated coronary bypass and isolated mitral valve surgery, although it showed slight differences from the procedures applied.

Limitations

Our study was carried out with 23-month data obtained from a single center. Since Euroscore2 risk scoring was not performed on patients who were previously operated, we do not know the situation in these patients. However, we think that the number of patients in the study group reduces this limitation.

Disclosures

Ethics Committee Approval: The ethics committee of Lokman Hekim University provided the ethics committee approval for this study (07.03.2020-2020010).

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