

ÜÇ FARKLI RİSK SKORLAMA SİSTEMİNİN KORONER ARTER BAYPAS GREFTLEME YAPILAN HASTALARDA MORTALİTE ÖNGÖRMEDEKİ ETKİNLİKLERİNİN KARŞILAŞTIRILMASI

The Comparison of the Efficacy of Three Different Risk-Scoring Systems on Predicting the Mortality Rates of Patients Undergoing Coronary Artery Bypass Grafting

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ÖZET

Giriş: Çalışmamızda dünya genelinde kabul görmüş üç skorlama sistemini koroner arter bypass cerrahisi geçiren hastalarda karşılaştırarak bu sistemlerin globalleşmesine katkı sağlamak ve hasta popülasyonumuza en uygun risk değerlendirme sistemini tespit etmek için bu çalışmayı planladık.

Materyal-Metod: Ocak 2003 - Aralık 2004 tarihleri arasında Türkiye Yüksek İhtisas Hastanesi Kalp ve Damar Cerrahisi Kliniği'nde ardışık olarak koroner arter bypass greftleme (KABG) operasyonu yapılan 2120 hasta çalışmaya dahil edildi. Bu incelemede ameliyat dönemi ve ameliyattan sonra 30 gün içinde olan ölümler mortalite olarak kabul edildi. Hastalar çalışmada kullanılan preoperatif risk değerlendirme sistemlerinin öngördüğü şekilde düşük, orta ve yüksek risk gruplarına ayrıldı. Kullanılan risk değerlendirme sistemlerinde beklenen ve gözlenen mortaliteler karşılaştırıldı.

Bulgular: Her üç risk grubunda da gözlenen mortalite oranları ile beklenen mortalite oranları yönünden EuroSCORE sisteminde istatistiksel olarak anlamlı fark saptanmadı ($p>0.05$). Parsonnet ile yapılan değerlendirmede düşük ve orta risk grubunda gözlenen mortalite ve beklenen mortalite oranları yönünden istatistiksel olarak gözlenen mortalitenin az olması yönünde anlamlı bir fark görüldü ($p<0.001$), yüksek risk grubunda ise istatistiksel olarak anlamlı bir fark saptanmadı ($p>0.05$). Ontario Province Risk (OPR) sistemiyle yapılan değerlendirmede her üç risk grubu içinde gözlenen ve beklenen mortalite oranları arasında düşük risk grubunda anlamlı fark saptanırken ($p<0.001$), orta ve yüksek risk grubunda anlamlı fark saptanmadı ($p>0.05$).

Sonuç: EuroSCORE risk sınıflamasının belirli hasta grubunda literatür ile uyumlu sonuçlar verdiğini ve bu skorlama sisteminin bölgemizdeki KABG hasta popülasyonunda preoperatif risk değerlendirmesi için güvenilir olarak kullanılabileceğini söyleyebiliriz.

Anahtar Sözcükler: EuroSCORE; Ontario province risk; Parsonnet; Mortalite; Koroner arter baypas cerrahisi

ABSTRACT

Introduction: We aimed to compare the efficacy of three different well-known and commonly used mortality risk-scoring systems and to provide a more suitable scoring system for our patient population.

Material-Method: A total of 2120 patients who had undergone a CABG operation in Türkiye Yüksek İhtisas Hospital Cardiovascular Surgery Clinic between January 2003 – December 2004 included in this study. The in-hospital deaths and the deaths in postoperative 30 days were accepted as mortality. The patients were divided into low, moderate and high-risk groups as the risk scoring systems prerequisites. The predicted mortality rates by the risk scoring systems and the observed mortality rates were compared.

Results: The observed mortality rates and the predicted mortality rates by EuroSCORE were similar between the groups ($p>0.05$). The observed mortality rates of low and moderate risk groups were significantly lower than the predicted mortality rates with Parsonnet risk scoring system ($p<0.001$). In the high-risk group, the observed mortality rates were not significantly different from the predicted mortality rates with the same risk scoring system ($p>0.05$). The predicted mortality rates with Ontario Province Risk (OPR) scoring system and observed mortality rates in the low risk group were significantly different ($p<0.001$). In the moderate and high risk groups, the observed mortality rates and predicted mortality rates with the OPR were not significantly different ($p>0.05$).

Conclusion: The EuroSCORE risk scoring system results were similar to the results in the literature. It is a reliable way of risk prediction for the patients undergoing CABG surgery in our region.

Keywords: EuroSCORE; Ontario province risk; Parsonnet; Mortality; Coronary artery bypass grafting

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INTRODUCTION

Risk prediction is grouping the patients in regard to the severity of their diseases according to a risk scoring system and predicting the outcome of an intervention in these patients using statistical methods. There have been many systems that were designed for this purpose in all over the world and many studies have been conducted about this subject. The most widely

used risk scoring systems and the risk factors they take into account are listed in Table 1. These scoring systems were approved to predict the operative mortality of CABG surgery after being tested in large scale studies (1-5).

Table 1. Risk factors often used in most frequent risk scoring systems

| Risk factors | Parsonnet | EuroSCORE | Cleveland Clinic | OPR |
|---------------------------|-----------|-----------|------------------|-----|
| Demographic data | | | | |
| Age | + | + | + | + |
| Female sex | + | + | | + |
| Cardiac risk factors | | | | |
| Cardiogenic shock | + | | | |
| Peroperative MI | + | + | | |
| IABP/PIDT | + | + | | |
| Stable angina | | + | | |
| Operational timing | + | + | + | + |
| Reoperation | + | + | + | + |
| Low LVEF | + | + | + | + |
| Ventricular arrhythmias | | + | | |
| Left ventricular aneurysm | + | | | |
| Recent PTCA | + | | | |
| Valvular heart disease | + | + | + | + |
| Post-MI VSD | | + | | |
| Pulmonary hypertension | + | + | | |
| Comorbidities | | | | |
| Obesity | + | | + | |
| Extracardiac arteriopathy | | + | + | |
| Diabetes mellitus | + | | + | |
| Renal dysfunction | + | + | + | |
| Dialyses | + | | | |
| COPD | | + | + | |
| Hypertension | + | | | |
| CVA history | + | + | + | |
| Smoking | + | | | |
| Hyperlipidemia | + | | | |
| Aortic surgery | | + | | |
| Infective endocarditis | | + | | |
| Anemia | | | + | |

OPR: Ontario Province Risk, MI: Myocardial infarction; IABP: Intraaortic balloon pump, PIDT: Positive inotropic drug treatment, LVEF: left ventricular ejection fraction, PTCA: Percutaneous transluminal coronary angioplasty, VSD: Ventricular septal defect, COPD: Chronic obstructive pulmonary disease, CVA: Cerebrovascular accident.

Nowadays; the Parsonnet, The European System for Cardiac Operative Risk Evaluation (EuroSCORE), Cleveland Clinic, Society of Thoracic Surgeons (STS) and Ontario Province Risk (OPR) scoring systems are the most widely known and used risk scoring systems. These systems can also predict the in-hospital time and treatment costs besides mortality rates by evaluating the patient characteristics and surgical risks (1, 6-10). The statistical evaluation and prediction of the outcomes of a medical intervention has become more important in the last two decades. This increased interest on this subject is due to patients' and health care institutions' demand for the knowledge about the outcomes of the interventions and therapies. Because of the legal rights of the patients to know about the interventions that were planned to be done on them and the results of these interventions, it is crucial for the health care providers to match the patient and the intervention correctly. It is one of the priorities of health care providers to know about operative mortality and morbidity of CABG operations in adult heart surgery.

Open heart surgery become possible in the high risk patient group due to recent technological improvements (11). But inaccurate mortality predictions of these high risk patients cause a drawback in decision making of the health care providers for CABG operations. This is a disadvantage for the high risk patient group as they are the group that benefits the most from the open heart surgery (12). More accurate risk predictions systems were developed to cover this disadvantage.

Although there were many studies conducted about the risk scoring systems in the open heart surgery, they were mostly done on local populations so this made these risk scoring systems locally reliable (1). We aimed to globalize the risk scoring systems in the open heart surgery in this study which was done on the Turkish population located in the middle of the Asia and Europe.

MATERIAL AND METHOD

This research was designed as a retrospective observational study. A total of 2120 patients who had undergone a CABG operation in Türkiye Yüksek İhtisas Hospital Cardiovascular Surgery Clinic between

January 2003 – December 2004 included in this study. The patients who had concomitant surgery with CABG operation were excluded. The in-hospital deaths and the deaths in postoperative 30 days were accepted as mortality. The patients were divided into low, moderate and high-risk groups in regard to the points calculated in each risk scoring system similar to other studies (1, 7, 10, 13 - 20). The criteria for grouping the patients were as follows in each scoring system: 0 – 2 points were low, 3 -5 points were moderate, $6 \leq$ points were high risk group in EuroSCORE system; 0 – 4 points were low, 5 – 9 points were moderate, $10 \leq$ points were high risk group in Parsonnet system; 0 – 3 points were low, 4- 7 points were moderate and $8 \leq$ points were high risk group in OPR scoring system. The predicted mortality rates by these risk scoring systems and the observed mortality rates were compared.

Statistical Analysis

The SPSS 11.05 (Statistical Package for the Social Sciences SPSS Inc., Chicago, IL) for Windows programme was used for the statistical analysis. Descriptive statistics were expressed as mean \pm standard deviation for continuous variables and percent values (%) for categorical variables. The significance analysis of mean values of independent groups was done with one way variance analysis (ANOVA) or Kruskal Wallis test. The score group which caused the difference was determined with Tukey test if the ANOVA test was used and with post-hoc multiple comparisons the Kruskal Wallis test was used to compare means.

The receiver operating characteristic curve (ROC) analysis was done to determine the prediction accuracy of EuroSCORE, Parsonnet and OPR risk scoring systems. The Area Under the Curve (AUC), 95% confidence interval, cut-off point, sensitivity and specificity levels were calculated for each risk scoring system. The significance level of mortality classification of each risk scoring system was determined with McNemar test. Chi-square test and Fisher's exact test were used to evaluate the categorical data. P values <0.001 and 0.05 were accepted as statistically significant. The results of ROC analysis were proofread with non-parametric Wilcoxon rank-sum test.

ROC is used to determine the power of the risk scoring system. It is the probability of the risk score of a randomly selected case among the deceased cases to be higher than the risk score of a randomly selected case among the survived cases. According to Hosmer and Lemeshow test reference if the AUC was 0.5, it means no discrimination; if it is between 0.5 and 0.7, it means that the discriminative power of the test is statistically not significant; if it is between 0.7 and 0.7, it means that the discriminative power of the test is acceptable; if it is between 0.8 and 0.9, it means that the discriminative power of the test is very good and if it is higher than 0.9, it means that the discriminative power of the test is perfect.

RESULTS

The demographical data and the risk factors of the patient population of this study are presented in Table 2.

Table 2. Preoperative risk factors of patients undergoing CABG

| Risk factors | N (%) |
|---|-------|
| Male | 1408 |
| Female | 712 |
| Diabetes mellitus | 578 |
| Hypertension | 945 |
| Family history | 1011 |
| Hyperlipidemia | 1123 |
| Obesity | 482 |
| Smoking | 946 |
| Chronic obstructive pulmonary disease | 174 |
| Pulmonary hypertension (sPAP 60≤) | 64 |
| Extracardiac arteriopathy | 112 |
| Sol ventricle aneurism | 11 |
| Preoperative intraaortic balloon pump | 11 |
| Neurologic dysfunction | 9 |
| Re-operation | 25 |
| Emergent operation | 189 |
| Chronic renal insufficiency | 51 |
| Critical preoperative statement | 65 |
| Left ventricular ejection fraction < %30 | 45 |
| Left ventricular ejection fraction %30-50 | 898 |

sPAP: Systolic pulmonary arterial pressure

There was no significant difference between the predicted and observed mortality rates of the three groups when the EuroSCORE risk scoring system was used ($p>0.05$) (Table 3). The observed mortality rates of the low and moderate risk groups were significantly lower than the predicted mortality rates when the Parsonnet risk scoring system was used ($p<0.001$) (Table 3). There was no significant difference between the observed and the predicted mortality rates of the high risk group ($p>0.05$) (Table 3). The observed and predicted mortality rates of the low risk group were significantly different ($p<0.001$) where the same rates of the moderate and high risk groups were not significantly different ($p>0.05$) when the OPR risk scoring system was used (Table 3). In ROC analysis the AUC value of the EuroSCORE system was 0.801 which meant that the discrimination power of the test was statistically significant ($p<0.001$) and the area under the ROC was between 0.8 and 0.9 which meant that the discrimination power was very high (Table 4) (Figure 1). The ROC values of the Parsonnet system was as follows: the AUC value was 0.737 and the area under ROC was between 0.7 and 0.8 which meant that the discriminative power of the test was statistically significant ($p<0.001$) and was acceptable (Table 4) (Figure 1). The ROC values of the OPR system was as follows: the AUC value was 0.677 and the area under the ROC curve was between 0.5 and 0.7 which meant that the discrimination power of the test was statistically significant ($p<0.001$) but the discrimination power of the test for CABG operations was not significant (Table 4) (Figure 1).

DISCUSSION

The health care authorities, the health care providers and the patients demand the highest quality service in health care. The in-hospital mortality rate is an important indicator of this quality. The rough mortality calculations could not be an appropriate indicator of the health care quality and an objective evaluation criterion in complex patient groups.

The treatment modalities for heart diseases are medical therapy and/or concomitant invasive techniques and surgery.

Table 3. Comparison of predicted and observed mortality rates of three risk scoring systems

| | Risk group | Patient (n) | Observed mortality (n) | Predicted mortality (%) | 95% CI | Observed mortality (%) | 95% CI | P value |
|------------------|------------|-------------|------------------------|-------------------------|-------------|------------------------|-------------|---------|
| EuroSCORE | Low | 1401 | 14 | 1.1 | 1.08-1.19 | 1 | 0.6-1.67 | 0.112 |
| | Moderate | 536 | 12 | 3.02 | 2.94-3.1 | 2.24 | 1.29-3.87 | 0.613 |
| | High | 183 | 15 | 9.58 | 8.66-10.51 | 8.2 | 5.03-13.08 | 0.321 |
| Parsonnet | Low | 1065 | 9 | 1.64 | 1-57-1.71 | 0.85 | 0.45-1.6 | <0,001 |
| | Moderate | 669 | 10 | 2.8 | 2.68-2.92 | 1.49 | 0.81-2.73 | <0,001 |
| | High | 385 | 22 | 6.29 | 5.66-6.91 | 5.71 | 3.8-8.5 | 0.143 |
| OPR | Low | 1962 | 34 | 0.91 | 0.88-0.95 | 1.73 | 1.24-2.41 | <0,001 |
| | Moderate | 154 | 5 | 5.6 | 5.27-5.92 | 3.25 | 1.39-7.37 | 0.474 |
| | High | 3 | 2 | 13.22 | 13.22-13.22 | 66.67 | 20.76-93.85 | 0.104 |

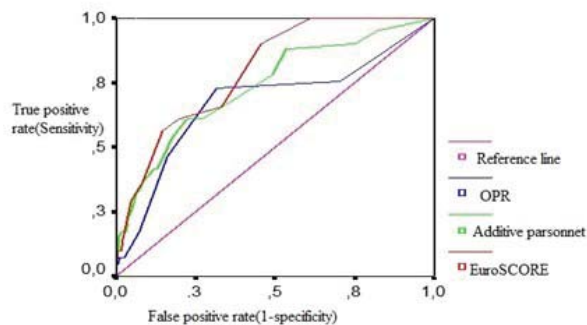
OPR: Ontario Province Risk

Table 4. Comparison of proportion power of three risk scoring systems according to area under ROC curve

| | AUC | Standard deviation | 95% CI | P value |
|-----------|-------|--------------------|-------------|---------|
| EuroSCORE | 0.801 | 0.029 | 0.743-0.859 | <0,001 |
| Parsonnet | 0.737 | 0.042 | 0.655-0.819 | <0,001 |
| OPR | 0.677 | 0.050 | 0.579-0.775 | <0,001 |

AUC: Area under the curve, OPR: Ontario Province Risk

Figure 1. ROC curve of three risk scoring systems



There are many evidence based treatment protocols that combine the medical, invasive and surgical treatment modalities. The mortality and the morbidity rates of these protocols are important when choosing the right protocol for the right patient. The lower the morbidity and the mortality rate, the more the chance of the protocol and the patient to be chosen.

There are four important factors that need to be considered in the surgical practice. These are

mortality, serious non-fatal morbidity, increased resource consumption and patient satisfaction. The most important factor that indicates success in adult open heart surgery is the mortality rate. Grouping the patients who would undergo open heart surgery as low, moderate and high risk groups make the comparison of different surgeons and health centres more objective. There is not any scoring system which would guess the outcomes of the open heart surgery precisely though. But there are some risk scoring systems that allow the surgeon to give accurate information about the risk of the surgery that the patient would undergo. We have to compare the mortality and the morbidity rates of our centre with the same rates of other centres to evaluate the effectiveness of the protocols that are being performed in our centre. We have to use an appropriate risk scoring system to accomplish this comparison. Also a risk scoring system helps to determine the correct surgery schedule, to plan the post-operative intensive care unit services, to evaluate

the hospital resources and treatment costs.

The parameters that are used in risk scoring systems for mortality prediction are divided into four main groups as follows: non-cardiac, patient related, cardiac and surgery related. The lower the surgical parameters in the risk scoring system, the better the patient risk evaluation. Also it helps to minimize the discrepancies of surgical teams.

In a study conducted by Geissler et al, the EuroSCORE system was found to be the most powerful in determining relation between predicted and observed mortality rates. In addition, they emphasized that the EuroSCORE system was affected less by the surgery related and the surgical team related variables when compared to other risk scoring systems because most of the parameters used in the EuroSCORE system were patient related (20). In our study, we found no significant difference of predicted mortality rates by EuroSCORE system and observed mortality rates in all of the risk groups ($p < 0.05$). In ROC analysis, the discrimination power of the EuroSCORE system in CABG patients group was found to be very good. We found a significant difference of predicted mortality rates by Parsonnet system and observed mortality rates of low and moderate risk groups ($p < 0.001$) but there was no significant difference in high risk group regarding the predicted and observed mortality rates ($p > 0.05$). In ROC analysis, the discrimination power of the Parsonnet system was found to be lower than the power of EuroSCORE system but was acceptable. There was a significant difference of predicted mortality rates by OPR system and observed mortality rates of low risk group patients ($p < 0.001$) but no significant difference in moderate and high-risk group patients regarding the mortality rates ($p > 0.05$). In ROC analysis, the discrimination power of the OPR system in CABG patients was non-significant. This might be due to the failure in distributing patients homogenously among the risk groups because of the less number of parameters used in OPR. In conclusion, we can say that the EuroSCORE system results were similar to the results in the literature in certain patient group and this risk scoring system could be used for pre-operative risk prediction in the CABG patients group in our region (4, 7, 12, 14, 16, 18, 20, 21).

CONCLUSION

According to the patient population in Turkey, EuroSCORE is a reliable risk scoring system for the patients undergoing CABG operations.

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