EURO-SCORING FOR RISK STRATIFICATION IN CABG SURGERY - 10 YEARS EXPERIENCE

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SUMMARY

Aim of the study was to evaluate patients pre operatively with Euroscoring System to judge the end point, hospital mortality in CABG done in last ten years by a single surgeon. From June 1989 to June 1999 the data of 262 cases of CABG done was collected on the data sheet each case was scored pre operatively with Euroscoring System. The different groups were made from this system, Group 1 Score 0-1, Group 2 Score 3-4, Group 3 Score 5-6, Group 4 Score 7-8, Group 5 > 9, Another Grouping was Group 1 score 0-5, and Group 2 score 6-10 and Group 3 score 11-15. Pre op data was collected and analyzed by SPSS Version 7.5, The End point was hospital mortality. In this group of 262 patients, the age range was 25-77 with the mean 52.41 years, 248 (94.7%) were male and 14 (5.3%) were female. In this whole cohort of pas patients 227 (86.6%) were having stable angina pectoris and 35 (13.4%) were having unstable angina. Pre op angina status was Class I in 5 (1.9%), Class II 88 (33,6%), Class III 132 (50.4%) and Class IV were 37 (14.1%). There were 116 (44.3%) hypertensive, 56 (21.4%) were diabetics and 9 (3.4%) were obese. Recent myocardial Infarction was there in 9 (14%) of cases, the old non Q- wave infarction was present in 18 (6.9%) of cases and Q- wave infarction was present in 42 (16%) of cases. Pre op Ejection fraction was good in (EF>50%) in 204 (77.9%) cases, Fair EF 30-49%) in 50 (19.1%) cases, poor EF<30%) in 8 (3.1%) cases. Pre op support of intra-aortic balloon counterpulsation (IABP) was used in 3 (1.1%), pre operative ventilation was done in 1 (0.4%), Inotropic support was present in 4 (1.5%), and vasodilators were given in 14 (5.3%) cases. Elective surgery was done in 92%, urgent in 4%, emergency in 3% and salvage surgery was done in 1% of cases. Mortality in Euroscore Group I (Score 0-1) was 3.1%, in Group II (Score 2-3) 9.4%, in Group III (Score 4-5) 19%, in Group IV (Score 6-7) 25% and in Group VI (Score >9) the mortality was 60%. The Euroscore from 0-5 was having 6.1% mortality, the score from 6-10 was having 20% and the score from 11-15 was having 80% mortality. On Logistic regression overall predictive accuracy of Euroscoring is very good (90%), Predictive accuracy, 37% of deaths could be explained on the existing variables positive predictive value is 19.05% and negative predictive value is 99.17%. The predictive accuracy of Euroscoring changes with various risk groups. In low risk Groups (Score 0-5) and (Score 6-10) Euroscore predicts survival more accurately. In high risk Group (11-15) Euroscoring better predicts mortality rather than survival. The factors included in permutations of Euroscore explain only 37% of the observed mortality. It is noted that the observed mortality is consistently higher than that predicted by logistic regression. Euroscoring is a good tool of risk stratification to predict the out come but not ideally suited to our clinical circumstances. Though we have documented an overall predictive accuracy of 92%, it is limited in its usefulness because it does not take into consideration certain risk factors found to be important in our patient population. In addition, the relative weight assigned to various risk factors in scoring needs to be readjusted for our patient population in the light of observations made on our patient population. There is a need to develop a scoring system of our own which could be used for better prediction of outcomes in our clinical circumstances.

INTRODUCTION

Risk stratification is ability to predict outcome for a given intervention by arranging patients according to severity of illness. By risk stratification one can predict about the causes of mortality and morbidity, plan and economize resource utilization thus provide better patient care. The purpose of risk stratification is to improve the standard of care and to screen the cause of complications. The goals of risk stratification are cost containment, better patient valuation pre operative, effectiveness of the care strategy and improving procedural practices. The

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tools of risk stratification are database, database analysis, interpretation, inferencing and interpolation. Not all patients are the same, the risk that any one patient will not survive, is dependent on a number of different factors, some of which can be quantified, such as age, gender and the existence of co-morbid conditions. Risk scoring systems attempt to take account of these risk factors and convert them into numeric risk score. The higher the score the greater the predicted risk. However it is Important to remember that low risk is not the same as any risk. Over the years a variety of risk stratification systems have evolved using logistic regression and Bayes Modeling techniques (1,2,3). These range from simple additive, systems (4,5,6,7) to highly complex statistical algorithms(8). While none of these systems accurately predict the outcome for an individual patient, some models are better than others in estimating risks for cohorts of patients. This provides the basis for rational and meaningful comparisons of outcome between group's of patients, institutions and individual surgeon by taking patient related variables and co morbidity in account. The Parsonnet system was devised in North America in the late 1980,s. Since then the specialty has moved forwards and although most of the risks variables in the Parsonnet System remain pertinent their relative impact on mortality has changed. More recently another system the Euroscore, based on a Pan European patient population has been described in order to make the system more applicable to European patients(14,15). The principle is much the same but some of the risk factors and their weightings are different making allowance for advances in surgical practice and different patient population. We were interested how this system works for Pakistani population, whether we can adopt it fully or changes are needed in giving different weightage as the disease patterns of the Europeans and Pakistanis are different.

PATIENTS AND METHODS

In this study 262 cases of Ischaemic Heart disease who had coronary artery bypass grafting (CABG) from June 1989 to June 1990 by the author were included. The Database having 190 variables pre operative, operative and post operative was already in the computer for last ten yeas of surgery. Euroscoring was done as shown in the Table 1 (6,13). The six groups were made after doing Euroscoring of those 262 cases Group 1 was from Score 0-1, Group 2 was from score 2-3, Group 3 was from score 4-5, Group 4 was from score 6-7, Group 5 was from score 8-9, and Group 6 was >9. Additional groups were also made lower risk Score 0-5, moderate risk score 6-10 and high risk 11-15. All the pre operative variables and their score groups were analyzed in SPSS Version 7.5. Forward conditional method of logistic regression was used for analysis. Hospital mortality (30 day mortality) was taken as the marker event. All the preoperative perioperative and post operative factors included in our database were analyzed but only preoperative variables have been used for risk prediction in this study. Score weights add up to an approximate percentage predicted mortality.

Table-1
EURO SCORE

Patient related factors	Definitions	Score
Age	per 5 years or part thereof over 60 years	1
Sex	Female	1
Chronic pulmonary disease	Long term use of Bronchodilators or steroids	1
Extracardiac Arteriopathy	Carotids, limbs, Abdominal Aorta Occlusion>50%	2
Neurological Dysfunction	disease affecting ambulation and day - to - day function	2
Previous cardiac Surgery	Requiring pericardial reopening	3
Serum Creatinine	>200 micromol preoperatively	2
Active endocarditis	Still under antibiotic cover	3
Clinical preoperative state	IABP, Ventilated pt, inotropic support, ac renal failure	3
Cardiac related factors		
Unstable angina	iv nitrates in OT	2
LV dysfunction	Moderate LV EF(30-50%)	1
	Poor or LVEF <30%	3
Recent Myocardial Infarction	< 90 days	2
Pulmonary hypertension	Systolic PA pressure >60	2
Operation Related factors		
Emergency	Carried out on referral before the beginning of next day	2
Other than Isolated CABG	In addition to CABG	2
Surgery on thoracic, ascending or descending aorta		3
Post infarct septal rupture		4

RESULTS

In this group of 262 patients, the age range was 25-77 with the mean 52.41 years, 248 (94.7%) were male and 14 (5.3%) were female. In this whole cohort of

patients 227 (86.6%) were having stable angina pectoris and 35 (13.4%) were having unstable angina. Pre op angina status was Class I in 5 (1.9%), Class II 88 (33.6%), Class III 132 (50.4%) and Class IV were 37 (14.1%). There were 116 (44.3%) hypertensive, 56 (21.4%) were diabetics and 9 (14%) were obese. Recent myocardial Infarction was there in 9 (3.4%) of cases, the old non Q- wave infarction was present in 18 (6.9%) of cases and Q- wave infarction was present in 42 (16%) of cases. Pre op Ejection Fraction was good (EF >50%) in 204 (77.9%) cases, Fair (EF 30-49%) in 50 (19.1%) cases and poor (EF<30%) in 8 (3.1%) cases. Pre op LVEDP was <18 in 230 (87.8%), 19-25 in 27 (10.3%) and >26 In 4 (1 .5%) cases. Regarding vessel involvement, single vessel disease was found in 15 (5.7%), Double vessel disease in 59 (2.5%), Triple vessel disease was present in 168 (64.1%) and Left Main Disease was present in 18 (6.8%). Pre op support of Intra Aortic Balloon Counter Pulsation (IABP) was used in 3 (1.1%), pre operative ventilation was done in 1 (0.4%), Inotropic support was present in 4 (1.5%), and vasodilators were given in 14 (5.3%) cases. Elective surgery was done in 92%, urgent in 4%, emergency in 3% and salvage surgery was done in 1% of cases. Distribution of groups according to Euroscore: Group I (0-1) were 75%, Group II (2-3) were 12%, Group III (4-5) were 8%, Group IV (6-7) were 3%, and Group VI (>9)were 2%. While analyzing mortality, the mortality in male was 7.1% and in female mortality was 21.9% (p= 0.09). In non-hypertensive mortality was 4.1% and hypertensive were having 12.9% (p=0.01). Mortality in different anginal groups were CCS-I - 0%, CCS-II - 6.8%, CCS-III - 5.3% and CCS Class IV 21.6% (p=0.01). Mortality in patients without previous infarction was 4.5%, while with non Q MI 16.7% and with Q-wave infarction, it was 21.4% (p=0.000). Mortality with good Ejection Fraction (EF) was 5.1%, with moderate EF was 14.3%, and with poor EF it was 42.9%(p=0.001). Mortality with LVEDP<18 mmHg was 6.1%. with LVEDP 19-25 the mortality was and with LVEDP of 25-40 it was 66.7%.

Mortality related to severity of coronary artery disease. With single vessel disease there was no mortality, with double vessel disease the mortality was 3.4% with triple vessel disease the mortality was 10.1% and with left main stem disease the mortality was 20% (p <0.001). The mortality for elective surgery was 6.6%, for urgent operation (during the same admission) 30%, emergency (same day) surgery 28.6%, while the few salvage procedures had no mortality (p=0.009). When patients required no pre-op support the mortality was 6.6%, with pre-op IABP 33.3%, with pre-op inotropic support 26% and with pre-op vasodilators 28.5%. (p=0.01%), Mortality in Euroscore Group I (Score 0-1) was 3.1%, in Group II (Score 2-3) 9.4%, in Group III (Score 4-5) 19%, in Group IV (Score 6-7) 25% and in Group VI (Score >9) the mortality was 60%. The Euro score from 0-5 was having 6.1% mortality, the score from 6-10 was having 20% and the score from 11-15 was having 80% mortality. On Logistic regression overall predictive accuracy of Euroscoring was very good (90%). Predictive accuracy (Table 2)shows R - value 0.37 means only 37% of deaths could be explained on the existing. variables, positive predictive value is 19.05% and negative predictive value is 99.17% (Table 2). The predictive accuracy of Euroscoring changes with various risk groups (Table 3). In low risk Groups (Score 0-5) and (Score 6-10) Euroscore predicts survival more accurately. In high risk Group (11-15) Euroscoring better predicts mortality rather than survival. The Euro Score predicts only part of (20%) observed mortality in our patient population.

Table-2
PREDICTIVE ACCURACY OF EUROSCORE

• Positive Predictive Value	19.05%
• Negative Predictive Value	99.17%
• Overall Predictive Value	92.72%
• R Value (Regression Coefficient)	-0.3704
• P Value	0000 (HS)

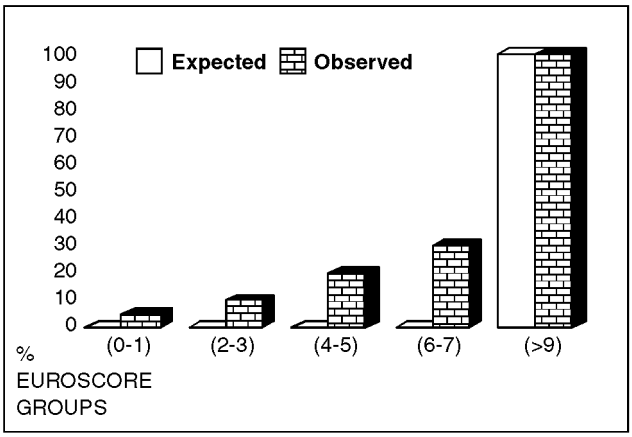
Table-3
DYNAMICS OF EUROSCORE:

Euro Score	PPV	NPV	Overall	
1-5	0%	100%	93%	.0002
6-10	0%	100%	80%	NS
11-15	100%	00%	80%	NS
Overall	19%	99%	92%	.0000

PPV POSITIVE PREDICTIVE VALUE
NPV NEGATIVE PREDICTIVE VALUE
P P VALUE

The factors included in permutations of Euroscore explain only 37% of the observed mortality. It is noted that the observed mortality is consistently higher than that predicted by logistic regression. (Figure 1).

Figure - 1
OBSERVED VERSUS EXPECTED MORTALITY



DISCUSSION

The different scoring systems have been found very useful for pre op evaluation and forecasting in our practice which has been confirmed by different reports of the world literature. Outcome analysis of many surgical procedures has become increasingly important to surgeons, institutions and the public, Because there may be wide difference in case mix, outcome must be evaluated in light of the patient's preoperative status. All relevant preoperative conditions must be identified and weighted, so that when risk factor scores are combined in some fashion, they will provide a single preoperative risk estimate for the individual patient, representing the likelihood of dying as a consequence of the operation. Comparing the mean risk adjusted score of a group of patients undergoing the same procedure with the observed mortality rate for the same group yields an index of the quality of care, provide all preoperative risk scores are calculated with reference to the same benchmark. Paraonnet V, (9) has questioned the logic and wisdom of surgical outcome analysis because of infinitely complex nature of biological and pathological processes, as well as the particular problems of the reliable data collection. The assumption of true scientific accuracy may be illusory. Even though risk adjusted outcome analysis has merit in studying trends in therapy, it should be regarded with caution when used as a tool for evaluating quality of care. If publicized at all, the result should not be represented as "hard" scientific facts. Gabrielle F et al, (10) have shown in their study that Parsonnet scores are predictive, but that these scores remain imperfect: many risk factors are non significant, the initial Parsonnet score has a moderate predictive value, and the modified Parsonnet scores is too complex. Martinez-Alario et at (1 1). have concluded that the Parsonnet score performs very well, with calibration and discrimination very high, better than general severity systems, and it is an appropriate tool to access mortality in cardiac surgery patients. Weightman WM et al, (1 2) concluded that any of the scores may be used to estimate perioperative risk and to compare outcome between coronary surgery units, but none has sufficient specificity and sensitivity to identify development of risk. Assesment is needed before adverse outcome can be accurately predicted in cardiac surgical patients. For the more sick patients where the stay has to be more Edinburgh Cardiac Surgery Score may be more useful which is under going evaluation in Scotland. Thompson M J et al (13) in their study for finding the predictors of out come in long stay patients following cardiac surgery have defined certain parameters. The aim was to test the Parsonnet pre operative scoring system and to define a scoring for in hospital mortality applicable post operatively to strengthen the clinical decision making process. In their 262 consecutive patients who stayed seven days or more in Intensive care, a total number of 110 pre, intra and post operative factors were documented. In that long stay group the Parsonnet score was confirmed to be predictive of 30 days mortality. Univariate analysis identified significant association between mortality in the Intensive Care Unit (ICU) and the following . inotrope days, (defined as number of inotrope times number of days) ventilation, units of platelets, chest reopening, fresh frozen plasma units, total parentral nutrition, noradrenaline, Parsonnet score, dopamine, bypass time, vasodilators, Intra-aortic balloon counterpulsation, enteral nurtrition and other major surgery. In there study step wise logistic regression on these significant factors was used to produce the Edinburgh Cardiac Surgery Score (ECS) applicable from day 10 onwards in the intensive care unit: ECS Score = (Inotrope days) + 2 (Ventilation) + (Platelets) +

(Parsonnet) - 3. The ECS score may be a useful predictor of ICU mortality probability for cardiac surgical patients requiring 10 days or more on intensive care.

Nashef SA et al, (14), and Roques F et al, (15) devised the Euroscore database which was divided into developmental and validation subsets. In the former, risk factors deemed to be objective, credible, obtainable and difficult to falsify were weighted on the basis of the regression analysis. An additive score of predictive mortality was constructed. Its calibration and discrimination characteristics were assessed in the validation dataset. Thresholds were defined to distinguish low, moderate and high-risk groups. The developmental dataset had 13,302 patients, and the validation dataset had 1479 patients., The scoring system identified three groups of risk factors with their weights (additive% predicted mortality) in brackets. Patients related factors were age over 60 (one per five years or part thereof), female (1) chronic pulmonary disease (1), extra cardiac Arteriopathy (2), neurological dysfunction (2), previous cardiac surgery (3), serum creatinine>200 micro mol/1 (2), active endocarditis (3) and critical preoperative state (3). Cardiac factors were unstable angina on intravenous nitrates (2), reduced left ventricular ejection fraction (30-50%: 1, <30%: 3), recent (<90. days) myocardial infarction (2) and pulmonary systolic pressure >60 mmHg (2). Operation related factors were emergency (2) other than isolated coronary surgery (2) thoracic aorta surgery (3) and surgery for postinfarct septal rupture (4). The scoring system was then applied to three risk groups. The low risk group (Euroscore 1-2) had 4529 patients with 36 deaths (0.8%), 95% confidence limits for observed mortality (0.56-1.10) and for. expected mortality (1.27-1.29). The medium risk group (Euroscore 3-5) had 5977 patients with 182 deaths (3%), observed mortality (2.62-3.51%), predicted (2.90-2.94%). the high risk group (Euroscore 6 plus) had 4293 patients with 480 deaths (11.2%) observed mortality (10.25-12.16), predicted (10.93-11.54%). Overall there were 698 deaths in 14,799 patients (4.7%), observed mortality (4.37-5.06), predicted (4.72-4.95). They concluded that Euroscore is simple, objective and up to date system for assessing heart surgery, soundly based on one of the largest most complete and accurate databases in European cardiac surgical history and this information can be used to develop risk stratification system for the prediction of hospital mortality and the assessment of quality of care.

In our study we used the Euroscore, On Logistic regression overall predictive accuracy of Euroscoring is very good(90%). The predictive accuracy of Euroscoring changes with various risk groups, In low risk groups Euroscore predicts survival more accurately. In high risk group Euroscore better predicts mortality rather than survival. The Euroscore predicts only part of (20%) observed mortality in our patient population, The factors included in permutations of Euroscore explain only 37% of the observed mortality. It is noted that the observed mortality is consistently higher than that predicted by logistic regression. It may be due the fact that in our clinical setting, factors other than mentioned in Euroscoring may be contributing to mortality. Another factor could be that relative weight of various risk factors may be different for our patients. For example being a female adds only 1 point to Euroscore, but observed mortality in females is almost 6-7 times that of males in our patients. Additional risk factors need to be included in risk stratification of our patients. For example the severity of coronary artery disease is not a consideration in Euro score but is of major significance in our patients. As Bridgewater B et al, (16) have concluded differences between the British and American population for CA13G and the North Ame rican algorithms are not useful for predicting mortality in the United Kingdom. They have concluded in their study that of Europe and American population are different and extreme caution has to be done in making conclusions or using the same markers. We conclude from our study that Euroscoring is a good tool of risk stratification to predict the out come but not ideally suited to our clinical circumstances. Though we have documented an overall predictive accuracy of 92%, it is limited in its usefulness because it does not take into consideration certain risk factors found to be important in our patient population. In addition, the relative weight assigned to various risk factors in scoring needs to be readjusted for our patient population in the light of observations made on our patient population. There is a need to develop a scoring system of our own which could be used for better prediction of outcomes in our clinical circumstances.

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