ELSEVIER

European Journal of Cardio-thoracic Surgery 17 (2000) 396–399

EUROPEAN JOURNAL OF CARDIO-THORACIC SURGERY

www.elsevier.com/locate/ejcts

Coronary surgery in Europe: comparison of the national subsets of the European System for Cardiac Operative Risk Evaluation database ☆

S.A.M. Nashef*, F. Roques, P. Michel, J. Cortina, A. Faichney, E. Gams, A. Harjula, M.T. Jones

Papworth Hospital, Cambridge CB3 8RE, UK

Received 7 September 1999; received in revised form 4 February 2000; accepted 8 February 2000

Abstract

Objective: To compare the national samples of patients who underwent isolated coronary artery bypass grafting (CABG) during the European System for Cardiac Operative Risk Evaluation (EuroSCORE) trial in order to evaluate national differences in epidemiology, patient risk profile and surgical methods. **Methods**: From September to November 1995, 11 731 patients had CABG in the six largest contributing nations to the EuroSCORE project: Germany, UK, Spain, Finland, France and Italy. The Chi-square and Kruskal–Wallis tests were applied to obtain an international comparison of patient general status, including pre-operative risk factors, cardiac status, critical pre-operative states, rare conditions, urgency of surgery, angina status, coronary lesions, procedures and EuroSCORE risk assessment. **Results**: Large national samples (from 984 patients in Finland to 3138 in Germany) identified significant differences in epidemiology, risk profile and surgical practice. Regarding epidemiology, CABG accounted for 62.8% of adult cardiac surgery, with a range of 46.2 in Spain to 77.7% in Finland ($P < 0.001$). The mean age was 62.9 years (61.4 in Britain to 64.4 in France, $P < 0.001$). The mean body mass index was 26.8 (26 in France to 27.5 in Finland, $P < 0.001$). With regard to risk profile, diabetes was present in 20.3% of patients (11.8% in Britain to 27.7% in Spain, $P < 0.001$). Chronic renal failure was present in 8.3% (6.8% in Germany to 10.6% in Spain, $P < 0.001$). Chronic airway disease affected 3.8% (1.9% in Italy to 5.1% in Germany, $P < 0.001$). The mean ejection fraction was 0.56 (0.48 in Britain to 0.58 in Finland, $P < 0.001$). The mean predicted mortality (according to EuroSCORE) was 3.3% (2.8% in Finland to 3.6% in France, $P < 0.001$). The prevalence of chronic congestive heart failure, unstable angina and recent myocardial infarction also showed statistically significant differences. No differences were found for some critical preoperative states (such as immediate preoperative cardiac massage and pre-operative intubation), or for surgery for catheter laboratory complication. Regarding surgical practice, major differences were noted in preoperative intra-aortic balloon use (mean 1%, Finland 0%, Spain 2.3%, $P < 0.001$), the number of mammary artery conduits used (mean 0.9, Spain 0.7, France 1.1, $P = 0.0001$) and the number of distal anastomoses (mean 3, France 2.7, Finland 3.8, $P = 0.001$). **Conclusion**: There are important epidemiological differences in the national cohorts of CABG patients in the EuroSCORE database. Any international comparison of European surgical results must therefore take into account the risk profile of patients by using a compatible risk stratification system.

Keywords: Coronary surgery; Europe; European System for Cardiac Operative Risk Evaluation; Epidemiology

1. Introduction

There may be differences in the characteristics and risk profiles of patients undergoing coronary surgery in different European countries, as well as differences in surgical strategy and decision-making. We analyzed the European System for Cardiac Operative Risk Evaluation (EuroSCORE) database to determine whether these differences exist and to quantify their extent.

2. Methods

The construction of the EuroSCORE database has been described [1]. Briefly, information on 68 preoperative risk factors, 29 operative variables and outcomes (survival) were collected in 128 voluntary participating centres from eight European countries during the period of September–November 1995. After double entry and submission to quality and completion checks, the database was used to identify risk factors for operative mortality in Europe. This study will focus on coronary surgery in Europe. The coronary surgery subset was defined as patients who underwent isolated coronary surgery excluding major concomitant procedures (aneurysmectomy, surgery for ventricular septal rupture, valve surgery, thoracic aortic surgery and congeni-

☆ Presented at the 13th Annual Meeting of the European Association for Cardio-thoracic Surgery, Glasgow, Scotland, UK, September 5–8, 1999.

* Corresponding author. Tel.: +44-1480-364299.

E-mail address: sam.nashef@papworth-tr.anglox.nhs.uk (S.A.M. Nashef)

1010-7940/00/$ - see front matter
PII: S1010-7940(00)00380-8

Table 1
Coronary patients in relation to the overall cardiac surgical population[a]

Centres	Number of coronary patients	Coronary patients as a percentage of the cardiac surgical population
Germany	3138	73.4
UK	2557	71.7
Spain	1119	46.2
Finland	984	77.7
France	2415	53.6
Italy	1518	57.6
Total	11731	62.8

[a] $P < 0.001$.

tal cardiac surgery). Only operations performed using cardiopulmonary bypass were included in the database. Countries which contributed more than 500 isolated coronary artery bypass graft (CABG) patients to the EuroSCORE database were included in the study. National demographic, epidemiological and operative characteristics were compared using usual bivariate methods (the Chi-square test for categorical variables and the Kruskall–Wallis test for continuous variables). The risk profiles of national coronary subsets, as determined by the mean EuroSCORE [2], were compared using the Kruskall–Wallis test.

3. Results

Six European countries contributed more than 500 patients each to the EuroSCORE database. Coronary artery disease accounted for significantly different proportions of the cardiac surgical population (Table 1). There were significant differences in the prevalence of general risk factors, such as age, body mass index, hypertension, diabetes, chronic renal failure and chronic airway disease (Table 2). There were also significant differences in cardiac status at the time of operation (Table 3).

The mean overall risk scoring (according to EuroSCORE) differed significantly between contributing countries, as a result of the different risk profiles of the patients. These differences in casemix are detailed in Table 3. There were, however, no significant differences in the prevalence of critical preoperative states (such as immediate preoperative cardiac massage and pre-operative intubation), or for surgery for catheter laboratory complication. The analysis also highlighted major variations in surgical strategy for coronary disease, as evidenced by the rates of emergency surgery and preoperative intra-aortic balloon use, the number of mammary artery conduits used and the number of distal anastomoses (Table 4). The overall risk profile as assessed by EuroSCORE also differed significantly between countries, as did the actual operative mortality (Table 5).

4. Discussion

This analysis shows that there are major differences in the risk profiles of coronary patients in European countries and in the extent that coronary surgery contributes to the individual national cardiac surgical workload. There are also major differences in surgical strategy and decision making.

Many reasons can be put forward to account for the above differences. The epidemiology of ischaemic heart disease may differ significantly between countries. This may be related to hereditary factors, or to a variation in lifestyle and living standards with different diets, smoking history, alcohol consumption, and so on. Another reason may be found in the severity of cardiac disease and comorbidity in patients presenting for operation. This may be derived from differences in the risk profile of the population as a whole, or it may arise as a result of the impact of resource availability for coronary revascularization; the more limited the resources, the longer the waiting times and the more advanced the state of disease at the time of presentation to the surgeon. The UK, for example, has relatively fewer resources for coronary surgery in comparison with other northern European countries. It is interesting to note that surgery within 90 days of a myocardial infarct is relatively rare in the UK, presumably because of the more limited access to angiographic facilities. Finally, we highlighted differences which are likely to be more related to surgical decision making than to the risk profile of the patient, although the latter undoubtedly plays a part. Major differences in the use of the internal mammary artery as a conduit, in preoperative intra-aortic balloon use, and in the number of distal anastomoses are likely to be influenced by the prevalent surgical culture.

One interesting feature is the consistently higher risk

Table 2
General risk factor variation in European coronary surgery[a]

Centres	Mean age	BMI	Diabetes (%)	Hypertension (%)	Chronic renal failure (%)	Chronic airway disease (%)
Germany	63.6	26.8	25.2	67.1	6.8	5.1
UK	61.4	27.1	11.8	35.4	12.2	4.4
Spain	62.6	27.1	27.7	51.6	10.6	3.3
Finland	62.3	27.5	16.7	41.8	3.4	2.3
France	64.4	26.4	20.6	47.5	7.0	3.7
Italy	62.2	26.6	20.9	47.4	8.0	1.9
P-value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

[a] BMI, body mass index. Percentages indicate the proportion of patients with the condition.

Table 3
Cardiac risk factor variation in European coronary surgery[a]

Centres	AF (%)	CCF (%)	Unstable angina (%)	Recent MI (%)	LVEF
Germany	3.6	8.0	6.0	14.7	0.59
UK	2.0	1.6	9.9	5.8	0.49
Spain	2.9	3.0	17.7	19.0	0.57
Finland	1.4	1.3	10.6	11.8	0.59
France	2.0	2.9	10.4	15.5	0.57
Italy	2.4	2.2	13.9	17.1	0.54
P-value	0.001	0.0001	0.0001	0.0001	0.0001

[a] AF, atrial fibrillation; CCF, chronic congestive cardiac failure; unstable angina, on intravenous nitrates; recent MI, myocardial infarction within 90 days; LVEF, left ventricular ejection fraction.

profile on patients in some parts of southern Europe (France and Spain), and this is mirrored by a higher procedural mortality in coronary surgery. On the other hand, the exceptionally low surgical mortality rate in Finland is associated with a relatively low-risk cardiac surgical population as assessed by EuroSCORE.

Table 4
Surgical practice and decision making in different European countries

Centres	Emergency operation as a percentage of total	Preoperative IABP (%)	Mean number of IMA conduits	Mean number of distal anastomoses
Germany	4.5	0.1	0.88	3.2
UK	3.9	0.7	0.85	3.1
Spain	2.0	2.3	0.76	2.7
Finland	4.0	0.0	0.93	3.9
France	4.3	2.0	1.12	2.7
Italy	4.6	1.5	0.96	2.7
P-value	0.007	0.0001	0.0001	0.0003

Whatever the causes of the differences that we identified, it is clear that there is significant variation in patients, risk profile and surgical strategy in Europe. It is therefore not sufficient to assess the quality of care in European cardiac surgery by measuring crude procedural mortality alone.

Table 5
Risk profile and outcome of coronary surgery[a]

Centres	Actual mortality (%)	Predicted mortality (mean % EuroSCORE)	EuroSCORE SD
Germany	2.4	3.0	2.4
UK	3.7	3.3	2.5
Spain	6.8	3.5	2.6
Finland	1.5	2.8	2.3
France	3.2	3.6	2.6
Italy	2.4	3.3	2.5
Overall	3.2	3.3	2.5
P-value	0.0001	0.0001	–

[a] EuroSCORE predicted mortality is calculated by adding the weights of individual risk factors when present. Actual mortality is within 30 days of operation or within the same hospital admission as operation.

One limitation of this study is the voluntary nature of centre recruitment in the EuroSCORE project. Such self-selection may introduce a bias towards centres that support open audit and assessment and, by implication, those whose results may better withstand close scrutiny. This limitation is partly addressed by the guaranteed patient, surgeon and centre confidentiality provided by the project organizers.

This study shows that international comparisons of operative mortality rates in Europe are meaningless without risk adjustments derived from casemix. The use of an appropriate risk stratification system which is compatible with European cardiac surgery would allow better comparison and more meaningful assessment of the quality of surgical care, provided that the system is applicable and has good discriminatory powers in individual European countries. Further analysis is needed to determine whether EuroSCORE satisfies these requirements.

References

[1] Roques F, Nashef SAM, Michel P, Gauducheau E, de Vincentiis C, Baudet E, Cortina J, David M, Faichney A, Gabrielle F, Gams E, Harjula A, Jones MT, Pinna Pintor P, Salamon R, Thulin L. Risk factors and outcome in European cardiac surgery: analysis of the EuroSCORE multinational database of 19 030 patients. Eur J Cardio-thorac Surg 1999;15:816–823.

[2] Nashef SAM, Roques F, Michel P, Gauducheau E, Lemeshow S, Salamon R, and the EuroSCORE study group. European System for Cardiac Operative Risk Evaluation (EuroSCORE). Eur J Cardio-thorac Surg 1999;16:9–13.

Appendix A. Conference discussion

Dr J. Pepper (*London, UK*): This represents a great deal of work. Were you able to compare your data with the data that exists from WHO sources of the incidence of coronary disease in the countries from which you obtained data on coronary artery surgery?

Dr Nashef: No, we haven't done that. It would be possible to do so, but we would also have to look at the resources and the availability of resources for coronary surgery, which are also different between countries.

Dr Pepper: Do you plan to do that?

Dr Nashef: Well, it is a little bit difficult, because although our samples

represented a very large proportion of what happened in these countries during the three months, it was on a voluntary enrolment basis; for example, we have 100% of the operations in Scotland but only about 50 or 60% of the operations in Germany. So it would be a little bit difficult to carry out that sort of assessment.

Dr P. Sergeant (*Leuven, Belgium*): Could some of the differences be due to variable interpretation or to treatment variability?

Dr Nashef: I think it would be very difficult. If you saw the definitions that were given for the risk factors in the EuroSCORE data collection project, these definitions were very tight indeed, and the definitions were there at the point of data collection, so that it really allowed no ambiguity as to whether something would or would not feature as a factor.

Dr Sergeant: Has there been some active auditing or process control, validation after?

Dr Nashef: No. One of the limitations of this study is that there was no on-site validation, as you know.

Dr W. Brenner (*Hackensack, NJ, USA*): In the US, in the interest of consumer education, the publication of mortality data in newspapers and other media sources under the guise of allowing the consumers to make a better choice has resulted in denial of open heart surgery to high risk categories. As publication of data like this becomes more prevalent around the world, I am concerned that it becomes a game of 'gaming the system', comparing heterogeneous populations with homogenous populations. I wonder if we are really heading anywhere meaningful.

Dr Nashef: This is clearly one of the largest debates that we as cardiac surgeons will have to face in the next few years, and it has already happened in the US, it is beginning to happen in the UK, and I am sure that the rest of Europe will follow. I cannot really address that particular issue in this presentation, but it is important that, if we are going to risk-stratify, our system should be compatible with the population that we are looking at, and this issue will be dealt with by my collaborator on Wednesday.

Dr Sergeant: I think that the larger institutions in Europe, University Teaching Centers, or similar, should publish their risk profiles as well as their results. In our own institution, the average EuroSCORE predicted risk is 6%. Patient profiles can similarly vary from institution to institution as they vary between countries.

Dr R. Stanbridge (*London, UK*): I wondered if there was a sort of gross error check here, because I noticed that the figures for the UK for diabetes and hypertension seemed much lower than I would expect from our usual clinical practice, and I wondered if you had compared those figures with the practice that you have in Cambridge to see whether there is perhaps a big sampling error here or not?

Dr Nashef: The figures were compatible with what we have seen in Cambridge, and I think that perhaps if you look at your own figures you might find that they are not far off.

Dr F. Grover (*Denver, CO, USA*): This is really interesting data and it is interesting to see the different risk profiling from country to country. The US is more homogenous, I think, but then STS is also performing data analysis at some state and regional levels. We have found, in several, that our national risk coefficient is very close to regional risk coefficients, and can therefore be utilized for the state and regional analyses. There may be subtle differences in the prevalence of certain risk factors in different regions, but the weight of those risk factors on mortality may still be the same.

It would be interesting for you to calculate risk coefficients for each country eventually and do a risk algorithm for that country, utilize it for estimating the operative mortality using that risk algorithm, and then compare the results to those obtained from the risk coefficient that is derived from the data from all countries.

It may be that the single country and multi country risk models are very similar but the incidence of the various risk factors varies from country to country. The single risk coefficient may still produce an accurate estimate of your operative mortality. This is fascinating work and I appreciate your bringing it to our attention.