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Case Mix and outcome in Northern Sweden and Eastern Hungary

Mikael Péterffy[1], Per Eriksson[1], István Szentkirályi[2], Árpád Péterffy[2], Torkel Åberg[1]

[1]Department of Cardio-thoracic Surgery, Heart Centre, University Hospital of Northern Sweden, Umeå, Sweden
[2]Department of Cardiac Surgery, University of Debrecen, Hungary

Levelezési cím:
Szentkirályi István
H-4001 Debrecen,
Móricz Zs. krt. 22.
Tel./Fax.: (36-52) 413-369
E-mail:
iszentkirályi@hotmail.com

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Case Mix and Outcome in Northern Sweden and Eastern Hungary. The aim of the study is to visualize and compare the case mix, patient risk profile and outcome in cardiac surgery in two geographically separated centres: Umeå, Sweden and Debrecen, Hungary. The EuroSCORE forms of 3367 consecutive adult patients were collected from the two different centres. Predicted mortality for each patient was calculated according to the logistic regression model of EuroSCORE. The case mix varies between the two centres. There were significant differences in prevalence of several relevant risk factors in the two groups. Overall 30-day mortality was 3.7% in Debrecen and 1.8% in Umeå as a comparison with predicted mortality at 6.8% and 6.2%. In spite of the fact that the patients from Debrecen generally were younger than the patients from Umeå, the prevalence of risk factors in cardiac surgery where in many cases higher in Debrecen than in Umeå.

***Case-mix, kockázati profil és kimenetel Svédország északi részén és Kelet-Magyarországon. Célkitűzés:** Két, földrajzilag elkülönülő szívsebészeti központ (Umea, Svédország és Debrecen, Magyarország) beteganyagának vizsgálata és összehasonlítása a case-mix, kockázati profil és kimenetel szempontjából. **Módszer:** A EuroSCORE műtéti kockázatbecslő skála értékelésre került 3367, folytatólagosan műtétre kerülő betegnél, a 2 különböző központban. A műtét típusa és a 30 napos halálozás került feljegyzésre. A várható halálozási kockázat meghatározása minden egyes betegnél a EuroSCORE skála alapján történt. **Eredmények:** A case-mix index különbözik a két központban. Az izolált CABG-műtétek az összműtéti szám 75%-át adták Umeaban, szemben a 60,6%-os debreceni értékkel. Az aortabillentyű-műtétek az összes billentyűműtét 75%-át jelenti Umeaban, ugyanakkor Debrecenben a mitralis billentyű műtéteit végzik magasabb számban (27,7% vs. 21,1%). Több jelentős rizikófaktor előfordulásában szignifikáns különbség volt a két csoport között. A 30 napos halálozás 3,7% volt Debrecenben és 1,8% Umeaban összevetve a becsült 6,8%-os és 6,2%-os értékkel. **Következtetés:** Annak ellenére, hogy a debreceni betegek átlagosan fiatalabbak az umeaihoz képest, a műtéti rizikófaktorok prevelanciája sok esetben magasabb Debrecenben, mint Umeaban.*

Introduction

The outcome in cardiac surgery is partly due to case mix and prevalence of preoperative risk factors. In order to improve the quality of cardiac surgery, case mix and prevalence of risk factors must be known. Furthermore, it is interesting to compare these features in two very different parts of Europe. Sweden and Hungary has had a diverse recent history regarding to politics, socio- economic factors and health care systems. These differences probably affect the case mix and prevalence of risk factors and thereby the outcome in cardiac surgery.

The aim of this study is to visualize and compare the case mix, patient risk profile and outcome in cardiothoracic surgery in two geographically separated centres (Northern Sweden and Eastern Hungary).

Materials and Methods

A retrospective material consisting of 3367 consecutive adult patients were collected from two diffe-

rent centres, Umeå (Sweden) and Debrecen (Hungary) using the normal data acquisition systems of the departments with a prospective intent. Type of surgical procedure was divided into four different groups: Isolated CABG (including beating heart procedures), Isolated Valve Surgery, CABG + Valve Surgery, and Other types of surgery (e.g. closure of atrial septum defect). Valve procedures were further divided into four subgroups: Isolated Aortic, Isolated Mitral, Double Valve, and Other types of valve surgery.

In order to compare relevant risk factors and outcome between the separated groups, the EuroSCORE risk stratification model was used (5,7). Both centres included in the study implemented the EuroSCORE model in 2001, Umeå in the beginning of January and Debrecen three months later. In Umeå the material consists of 1762 patients ranging from January 2001, until August 2002. The material from Debrecen consists of 1605 patients ranging from April 2001 until July 2002.

The primary catchment's area in Debrecen consists of about two million people. However, approximately 20% of the procedures are carried out on patients not included in the catchment's area. In Umeå the vast majority of the procedures are carried out on patients included in the primary catchment's area, consisting of about nine hundred thousand people.

Mortality was defined as death from any cause within 30 days of operation. Predicted mortality for each patient was calculated according to the logistic regression model of EuroSCORE (6).

Due to local procedures, the approach to register EuroSCORE differs between the two centres. In Debrecen a printed EuroSCORE-form was filled in immediately after performing the operation by the surgeon. These forms were later transferred to a computerized database in Microsoft Access software. The figures were later double checked for errors in the transfer process. As a comparison to Debrecen, the EuroSCORE in Umeå was filled in preoperatively by the anaesthesiologist. The figures included in EuroSCORE were, together with other patient data, inserted to the clinic's database. These data were controlled before they were transferred to the computerized database shared with the material from Debrecen. All statistical analysis was conducted using SPSS 11.0. Comparison of the data from the two centres was performed with the Pearson's chi-square test for categorical variables.

Results

The case mix varies between the two centres. Isolated CABG accounted for 75.0% of the total number of surgical procedures in Umeå *(Fig. 1)* and 60.6% in

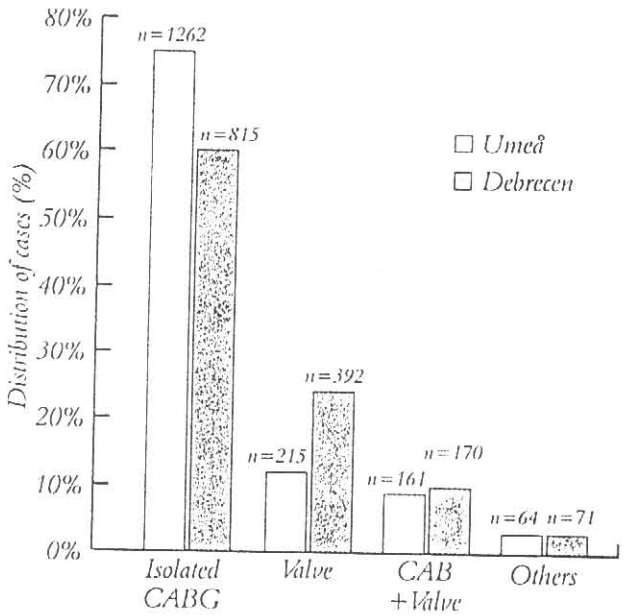

Fig. 1. Distribution of cases and the absolute number of cases sorted by type of operation and centre.

Debrecen ($p<0.0001$). Among the isolated CABG procedures 4.8% were carried out on beating heart in Umeå and 19.3% in Debrecen ($p<0.0001$). Isolated Valve surgery was performed in 12.2% of the cases in Umeå compared to 24.4% in Debrecen ($p<0.0001$). Mixed coronary and valve surgery accounted for 9.1% in Umeå and 10.6% in Debrecen ($p=0.06$). Other types of surgery accounted for less than 5% of the total number of cases in both centres ($p=0.11$).

As shown previously, Debrecen has a higher proportion of isolated valve surgery than Umeå. The proportion of valve surgery differs between the two centres *(Fig. 2)*. Aortic valve surgery accounts for 75% of all valve surgery in Umeå and 54% in Debrecen ($p<0.0001$). Debrecen performs mitral valve procedures at a higher extent than Umeå ($p<0.05$). Double valve and other types of surgery are also more often performed in Debrecen ($p<0.001$).

Comparing the two groups, there were significant differences in prevalence of several relevant risk factors in cardiac surgery according to the EuroSCORE model *(table 1.)*. The patients in the Umeå material were generally older which is reflected in a considerable difference in mean age. The mean age was 66.7 ± 10.1 years in Umeå and 60.9 ± 10.6 years in Debrecen. Female gender accounted for only 25.0% of the patients in Umeå but 36.1% in Debrecen. Patients with recent myocardial infarction were significantly more common in Umeå than in Debrecen. The risk factor prevalence, besides high age and recent myocardial infarction, was in many categories significantly higher in the material from Debrecen

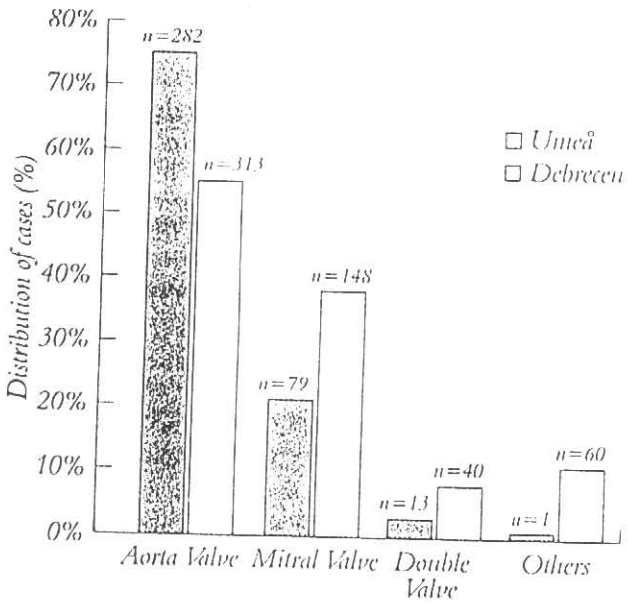

Fig. 2. Valve surgery procedures sorted by subgroups and centre

than in the Umeå material. Debrecen had more diagnosed extracardiac arteriopathies, high serum creatinine levels and low ventricular ejection fractions among their patients. The prevalence of critical preoperative state was more common and acute surgical procedures were performed at a higher rate than in Umeå.

Overall, the risk factor prevalence results in a mean EuroSCORE of 4.6±3.1 in Umeå and 4.9±3.1 in Debrecen ($p<0.0001$). The higher mean EuroSCORE in Debrecen is reflected in a higher mortality rate. Overall 30-day mortality was 3.7% in Debrecen and 1.8% in Umeå as a comparison with predicted mortality at 6.8% and 6.2% according to the logistic EuroSCORE model *(table 2.)*. The 30-day mortality following cardiac operation is mostly due to cardiac reasons (83% in Debrecen and 90% in Umeå). This number includes several cases when multi organ failure occurred after low cardiac output syndrome.

Discussion

This study visualizes and compares case mix, risk factors and outcome in cardio-thoracic surgery in two geographically separated centres. Our results show that there are significant differences in case mix and the spectrum of relevant risk factors as well as in 30-day mortality.

The EuroSCORE model was shown to be an adequate tool in the processing of the patient material and their risk factors. EuroSCORE is a simple and objective up to date risk stratification system, which has previously been described elsewhere as a good model, to compare risk factors in relation to outcome between different geographical locations (3, 4, 8). This model is derived from a multi centre study of over 19 000 patients undergoing cardiac surgery in Europe from September to November 1995. The purpose with EuroSCORE is to help in the assessment of the quality of cardio-thoracic surgery [5]. Although mortality is used as an indicator of quality, EuroSCORE also takes the preoperative condition and cardiac function of the patient as well as surgical procedure under consideration. The nature of

Table 1. Prevalence of risk factors in Debrecen and Umeå

Risk factor	Debrecen	Umeå	P-value
N of patients	1605	1762	
Mean age	60.9	66.7	<0.0001
<60 years	42.4%	26.7%	
60–64 years	17.0%	13.6%	
65–69 years	18.9%	17.6%	
70–74 years	15.6%	19.5%	
75–79 years	5.5%	16.1%	
80–84 years	0.5%	6.1%	
85–90 years	0.5%		
Female	36.1%	25.0%	<0.0001
Chronic pulmonary disease	9.1%	8.5%	n
Extracardiac arteriopathy	19.6%	9.0%	<0.0001
Neurological dysfunction	3.1%	4.0%	n
Previous cardiac surgery	5.2%	4.9%	n
Serum creatinine	2.1%	1.0%	<0.05
Active endocarditis	1.5%	1.0%	n
Critical preoperative state	5.9%	2.5%	<0.0001
Unstable angina	10.1%	10.1%	0.952
LVEF 30–50%	43.9%	26.3%	<0.0001
LVEF <30%	4.8%	1.9%	<0.0001
Recent myocardial infarct	13.2%	21.2%	<0.0001
Pulmonary hypertension	4.4%	3.2%	n
Emergency	9.1%	4.0%	<0.0001
Other than isolated CABG	40.6%	22.5%	<0.0001
Surgery on thoracic aorta	5.1%	5.2%	n
Postinfarct septal rupture	0.4%	0.3%	n

LVEF: left ventricular ejection fraction

Table 2. Predicted and actual mortality in the two centres sorted by type of surgery

Case mix	Predicted mortality		Actual mortality	
	Umeå	Debrecen	Umeå	Debrecen
Overall	6.2%	6.8%	1.8%	3.7%
Isolated CABG	4.4%	5.1%	0.8%	2.6%
Valve Surgery	10.2%	8.6%	2.8%	3.8%
CABG + Valve	11.2%	9.3%	5.0%	8.2%
Others	16.4%	13.7%	10.9%	8.5%

EuroSCORE and its widely spread use in Europe makes the use of it ideal in this study.

It is interesting to see that the patients in the Swedish material have a considerable higher mean age than the Hungarian group. In spite of this they have a mean EuroSCORE that is slightly lower than the Hungarians. This shows that the Swedish patients probably are in a better preoperative state even though they are older, which probably reflects a better overall health status in Sweden, coupled with a very long history of cardiology in Northern Sweden with referral to cardiac surgery. The Healthy Life Expectancy differs considerably in these 2 countries (9). According to the WHO data from 2001 the difference is 10 years (71.8 in Sweden versus 61.8 in Hungary) measuring the total population at birth. The same data for men at the age of 60 represents better the health status of our heart-operated patients. The difference in this aspect – 16,5 years in Sweden and 10,4 years in Hungary – reflects almost exactly the mean age difference in the two materials. The Healthy Life Expectancy at the age of 60 is a detached measure of the biological age of our patients. This data explains the discrepancy between the higher EuroSCORE value by a lower age in the patients in Debrecen. It is reasonable to assume that differences in national background with Hungary's turbulent history in contrast to Sweden contribute to the current health situation and that the differences found in this material will diminish.

The male predominance in CABG is well known. The male predominance is not that prominent in valve surgery and indeed usually reversed in mitral valve operations. The case mix in Debrecen with a lower rate of CABG and more valve procedures results in more patients of female gender. But the higher rate of female gender in Debrecen is not only due to the difference in the mix of CABG and valve surgery. The group of patients undergoing CABG in the present study, as well as the group undergoing valve surgery, were more often females in Debrecen than in Umeå. This fact is unexplained.

One of the parameters in the EuroSCORE system is a myocardial infarction within 90 days from the procedure. There is a difference in number of operations performed within this period after an infarction regarding the two centres. This difference could have several possible explanations, for example there could be another queue situation regarding the CABG procedures or just varieties in local guidelines and treatment traditions. Another explanation could be unsatisfying communication between diagnosing cardiologist and the surgeon, which might lead this category to be uncorrectly scored in Debrecen. This in turn may reflect underlying resource availability. In the more than twice as large population in Debrecen, about equal amounts of operations were performed as in Northern Sweden.

These data point to the interpretation that Debrecen serves an area with a relative underutilization of cardiac surgery. As the department is relatively young, it has not had enough time to resolve the prevalence of patients with valve problems that have not yet come to surgery for lesions that in other areas would have been operated upon much earlier. The differences in recent myocardial infarction may also be interpreted this way: In an area with sufficient resources, a myocardial infarction is seen as a cry for help from a suffering heart. Measures are therefore taken in order to investigate the heart and if suitable, revascularization is performed as a matter of some urgency.

This adds up to the interpretation that if the population is well served by adequate resources, the surgical task at hand will be easier and yield better end results – with the proviso that indications do not broaden unjustifiably.

In recent years, indications have been broadened in Northern Sweden as regards elderly people. The oc-

Table 3. Predicted and actual mortality in the two centres sorted by EuroSCORE risk group

Case mix	Predicted mortality	Actual mortality	
		Umeå	Debrecen
0–2; low risk	0.56–1.1	0/471	1/325 (0.3%)
3–5; medium risk	2.62–3.51	6/667 (0.9%)	9/635 (1.4%)
over 6; high risk	10.25–12.16	25/624 (4%)	50/645 (7.8%)

Table 4. Predicted and actual mortality in the two centres sorted by type of valve surgery

Case mix	Predicted mortality		Actual mortality	
	Umeå	Debrecen	Umeå	Debrecen
Aortic valve	6.7%	6.3%	3.9%	5.1%
Mitral valve	6.8%	5.8%	3.8%	4.1%
Double valve	6.8%	6.5%	0	5%
Other valve	5%	7%	0	8.3%

togenarians have increased from 2.9% in the time period of 1994–96 to 6.6% in the present material. The consequences of that expansion of the indications were recently analyzed. Survival and postoperative quality of life seem to justify the continued use of cardiac surgery also in this age group (1, 2).

Notwithstanding the differences in case mix and risk factors, there is a difference in risk adjusted early mortality between the two centres. Of course, the ability of the Euroscore to allow true risk stratification has first to be questioned.

A risk stratification model is primarily a mirror of the time when it was created. The essential purpose of defining a risk factor must ultimately be to develop ways to eliminate it, to create routines, quality measures or adjuvant treatment that solves the problem. Even a risk factor such as age that would seem to be very difficult to influence is amenable to amelioration by learning the reactions of the aging body to trauma and act accordingly. Thus any risk stratification model is bound to fail and predict much higher risk when measured some time after the new knowledge became available – because medicine progresses. How this process occurs is not known in its details. Collecting information and reaction on the information is a traditional way of improvement. Differences in the time frame by which this process occurs may be one reason for the differences found.

However, risk scores most certainly do not take into account all risk factors as many of them may not yet have been detected. Thus risk factors, still unknown, may be more prevalent in one area compared with the other. We have not included analyses of departmental resources, routines or the way surgery is performed in this simple comparison.

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