Mortality related to cardiac surgery in Brazil, 2000-2003

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See related editorial on page 773.

Cardiovascular disease (CVD) is now a leading cause of death in the developing world, where, because of demographic shifts of the population age profile, a staggering additional increase in CVD morbidity and mortality can be predicted.¹ Cardiac surgery (CS) remains a standard treatment for select patients with advanced CVD, although data about surgical results in developing countries are scanty. The aim of this study was to determine mortality related to CS in adults according to sex and type of surgery by studying its relation to age and hospital volume in a large nationwide dataset.

Data of open CS performed from January 2000 to December 2003 in adults (>17 years) were extracted from the Hospital Information System of Brazilian Ministry of Health (SIH/DATASUS) dataset, an established and audited nationwide database with administrative and epidemiologic data on every hospital admission performed by the Brazilian Universal Health System (SUS; Sistema Único de Saúde).² In Brazil, 75.4% of the population is covered exclusively by SUS, and highly complex procedures, such as CS, are performed mainly under the public system. SIH/DATASUS dataset files contain summarized hospital-discharge records for the hospitalization of all SUS patients, including procedure code, hospital identification, and patient information, such as the city of residence, age, sex, and vital status at discharge. Hospital volume was expressed as the average number of procedures per year, and, to analyze hospital volume, only hospitals with 5 or more procedures per year were included. Surgical procedures were grouped into coronary artery surgery, heart valve surgery, surgery for congenital disease in the adult, and complex CS, including combined procedures and aortic surgery. Pacemaker implantation and other minor CS procedures were excluded. Mortality was defined as death before hospital discharge. Univariate analysis included correlation analysis, logistic regression, and χ^2 test. Hospital volume and age were ranked in order and divided into 4 groups (quartiles) for further analysis. Multivariate logistic regression was used to examine relationships between CS-related mortality and sex, type of surgery, age, and hospital volume.

From 115,021 CS performed between 2000 and 2003, death occurred in 9211 cases (8.0%). Both univariate and multivariate analyses showed that CS mortality increases with age (Table 1 and Figure 1), is higher in women (8.8% vs 7.4%; $P < .001$), and increases significantly for valvular and complex CS and, after adjustment, decreases for coronary artery surgery. There is a significant relationship between hospital volume and CS mortality ($r_s = -0.326$; $P < .001$; Figure 1) that remains significant after adjustment for age, sex, and type of operation (Table 1).

Classic determinants of an increased risk of death related to CS, such as age, sex, and hospital volume,³⁻⁴ are also related to an increased risk of death after CS in a developing country's nationwide database. Moreover, valve, combined, and aortic surgery were more risky than coronary artery revascularization. The overall mortality rate for each group of conditions observed in this dataset is grossly higher than in the most recent surgical registries, such as The Society for Thoracic Surgeons database in the United States³ and the UK Cardiac Surgical Register.⁴ Nonetheless, these results should be cautiously analyzed. Considering that both The Society for Thoracic Surgeons and UK Cardiac Surgical Register are voluntary registries, whereas the DATASUS is an administrative

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TABLE 1. Mortality in cardiac surgery related by age, sex, type of operation, and hospital volume in Brazil, 2000 to 2003

Variable	No. cases (%)	Mortality (%)	Unadjusted OR	Adjusted OR
Age (y)				
18-45	27,857 (24.2)	5.8		
46-57	30,721 (26.7)	6.4	1.12 (1.04-1.19)	1.50 (1.39-1.61)
58-66	28,871 (25.1)	8.0	1.41 (1.31-1.50)	2.01 (1.87-2.16)
67-99	27,572 (24.0)	12.0	2.22 (2.09-2.36)	3.24 (3.03-3.48)
Sex				
Male	66,710 (58.0)	7.4		
Female	48,311 (42.0)	8.8	1.21 (1.16-1.26)	1.20 (1.15-1.26)
Type of operation				
Congenital	5806 (5.0)	6.1		
Coronary	65,716 (57.1)	7.0	1.17 (1.05-1.31)	0.72 (0.64-0.81)
Valvular	38,789 (33.7)	8.9	1.51 (1.35-1.69)	1.22 (1.09-1.37)
Complex	4710 (4.1)	16.5	3.04 (2.66-3.47)	2.30 (2.01-2.63)
Hospital volume (CS/y)				
1-130	28,562 (24.8)	9.7	1.73 (1.63-1.84)	1.81 (1.70-1.93)
131-270	29,244 (25.4)	8.4	1.47 (1.38-1.57)	1.52 (1.42-1.62)
271-340	27,867 (24.7)	8.1	1.43 (1.34-1.53)	1.49 (1.39-1.56)
>341	29,348 (25.5)	5.8		

Values are expressed as absolute numbers (%) and odds ratios (OR) with 95% confidence intervals. The adjusted OR refers to the OR obtained in a model that included all 4 variables. CS, Cardiac surgery.

Figure 1. A, Correlation between cardiac surgical (CS) mortality (%) and hospital volume (number of CS per year). B, CS hospital mortality according to age groups, Brazil, 2000 to 2003.

dataset, it is inappropriate to formally compare these surgical results obtained in Brazil with those observed elsewhere. Hospital volume calculated in our study considered surgical procedures financed only by the public health system, but this is probably a minor cause of error, because other sources provide less than one fifth of the CS performed in Brazil. Surgical results may be influenced by several factors, including differences in the socioeconomic status of the local population, the severity of cardiac illness and of comorbidities, standards of medical care, and adequacy of facilities and staffing.⁵

Important practical considerations emerged from this study. Because the choice of surgical treatment for a specific heart disease relies

on the balance between surgical risk and benefit in comparison with more conservative strategies, prudence is desirable in the appliance of guidelines developed in Europe and North America in other countries' settings, in which CS-related mortality might be relatively increased. On the administrative and regulatory fronts, the Brazilian Health Ministry defined, in conjunction with the scientific societies, a national policy of high-complexity cardiovascular care, which comprises a series of minimal prerequisites, both in facilities and staffing levels, as well as a minimum surgical volume to allow a cardiovascular service to operate in the public health system. A national registry, the Brazilian Cardiac Surgery Registry, which is being implemented as part of the national policy, will permit, in the future, the

comparison of Brazilian CS mortality with data from other international databases.

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Simultaneous removal of an Amplatzer device from an atrial septal defect and the descending aorta

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The Amplatzer Septal Occluder (ASO; AGA Medical) has been in clinical use since 1996¹ and is associated with few complications and excellent short-term and midterm results.² We report a case of late embolization of an ASO into the descending thoracic aorta, which was managed surgically by means of simultaneous device retrieval from the descending aorta and atrial septal defect (ASD) closure through a median sternotomy.

Clinical Summary

A 37-year-old woman was investigated for recurrent symptoms after previous successful transcatheter closure of a complex secundum ASD. She had presented 4 years previously with palpitations, dizzy spells, and blackouts. On that occasion, she was given a diagnosis of 2 secundum ASDs. These were closed percutaneously in December 2002 with 2 ASOs with diameters of 16 and 13 mm, respectively. These 2 ASOs were deployed in an interdigitating fashion. The devices were stable to provocative maneuvers, and postprocedure echocardiography revealed only a trivial residual shunt. Up to 18 months' follow-up, the patient remained asymptomatic with a small residual shunt. Two years after device placement, however, she presented with recurrent palpitations and symptoms of nocturnal dyspnea. Repeat echocardiography revealed a recurrent ASD below the previous closure. After coun-

Figure 1. Radiograph demonstrating Amplatzer devices in the atrial septum and descending aorta, with a transesophageal echocardiographic probe in the esophagus.

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seling regarding the alternatives of repeat transcatheter closure or surgical intervention, the patient elected to proceed with device closure. Her ensuing transesophageal echocardiogram and on-table radiographic screening revealed an embolized ASO (the 13-mm device) in the descending aorta (Figure 1). Transcatheter closure was therefore abandoned, and the patient was referred for surgical closure of her residual ASD and retrieval of the embolized ASO. Preoperative computed tomographic scanning confirmed the location of the ASO in the descending aorta just above the diaphragm (Figure 2). The operation was performed through a median sternotomy to avoid a staged procedure.

Cardiopulmonary bypass was established by using ascending aortic and femoral arterial cannulation and bicaval cannulation.