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Indicators of Healthcare Quality in Isolated Coronary Artery Bypass Graft Surgery Performed at a Tertiary Cardiology Center

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Summary

Background: Quality indicators (QI) for cardiac surgery are important instruments for measuring healthcare quality in hospital centers and allow comparison with high-quality healthcare centers.

Objective: To evaluate QIs in isolated myocardial revascularization procedures (CABG) performed at a tertiary cardiology center.

Methods: One hundred and forty-four consecutive patients who had undergone isolated CABG were evaluated between October 2005 and March 2007. One hundred and eight patients were men (75%), the mean age was 65 ± 11, and the EuroSCORE was 4 ± 3. The following QIs were measured: time elapsed between the surgery date-setting appointment and the actual day of the CABG (TDC); surgery cancellation rate (SCR) due to problems in hospital infrastructure; length of hospital stay (LOS); operative mortality (OM) and rate of readmission (RHR) for infection in the surgical wound.

Results: The TDC (n=98) was 4 ± 3 days (median: 4 days) and the SCR was zero. The OM recorded of 4.9% (95% confidence interval [CI] = 2.2 – 9.87%) was lower than the expected OM of 5.1% (95% CI = 1.4% to 14.37%), but with no statistical significance (p=0.65). The area under the ROC curve of the EuroSCORE for the OM was 0.702 (95% CI = 0.485 – 0.919). LOS was 11 ± 9 days. The area under the ROC curve of the EuroSCORE for the LOS was 0.764 (95% CI = 0.675 – 0.852). The RHR recorded was 2.1%.

Conclusion: The measurement of the QIs showed that, in a medical center with a low annual volume of CABG, the results were compatible with the risk profile of the population involved. (Arq Bras Cardiol 2008; 90(5): 320-323)

Key words: Perioperative care; quality of health care; quality indicators, health care; myocardial revascularization.

Introduction

Within a context of increasing cost control for high-complexity procedures, it is important to systematically measure quality indicators for cardiac surgery. There are two types of healthcare quality measurements: those that measure performance, also known as indicators of results or outcomes, and those that measure the processes related to healthcare[1-6]. Mortality rates after myocardial revascularization surgery (CABG), which measure surgeon performance, hospitals or both are examples of outcome indicators. Process indicators, on the other hand, frequently known as quality indicators (QIs), report rates of utilization of screening tests for diseases, use of medications on hospital admission and discharge, length of hospital stay, etc[3,4].

As populations of patients undergoing cardiac surgery may differ significantly among institutions and geographical areas, the comparison of absolute numbers, such as mortality rates

for instance, is inappropriate for a cost-benefit analysis and comparison of outcomes among institutions[7-9]. However, the risk-adjusted mortality rate is an important indicator of performance of surgical services (hospitals and surgeons)[1,3,4,10-12].

In the United States, the Society of Thoracic Surgeons (STS) database is one of the most comprehensive and consistent systems for measuring and reporting results of cardiac surgery[13,14]. This system collects data from all myocardial revascularization surgeries (CABG), valvar surgeries and cardiac transplants performed in that country.

In Brazil, medical literature is still lacking as to publications about quality indicators. Most reports address operative mortality in public hospitals involving patients of *SUS - Sistema Único de Saúde* (the Unified National Health System)[15,16].

Starting in October 2005, in order to comply with the requirements of the hospital accreditation process set by the *Organização Nacional de Acreditação - ONA* (National Accreditation Organization) and with the project of best clinical practices of the *Associação Nacional de Hospitais Privados - ANAHP* (National Association of Private Hospitals), *Hospital Pró-Cardíaco* began to systematically monitor the QIs of the care provided to its clients.

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The aim of this study was to measure the quality indicators during the performance of isolated myocardial revascularization surgery at the *Hospital Pró-Cardíaco*.

Methods

From October 2005 and March 2007, 144 consecutive patients submitted to CABG were selected to be included in the study. One hundred and eight were men (75%), aged 65±11 years (median: 65 years). Fifty-one per cent of the patients were ≥ 65 years of age (Table).

CABG was performed by conventional techniques, and extracorporeal circulation (EC) was used in 90% of the cases. In those cases where EC was employed, mean aortic clamping time was 96±47 minutes (median: 88.5 minutes). Urgency or emergency surgeries were performed on 36 patients (25%).

The quality indicators analyzed were the following: time interval elapsed between the surgery date-setting appointment and the actual date of the procedure (TDC); surgery cancellation rate (SCR) due to problems in hospital infrastructure; length of hospital stay (LOS); operative mortality (OM) and rate of readmission (RHR) for infection in the surgical wound (saphenectomy, sternotomy, etc.).

Specifically for time calculation reasons between the date-setting appointment and the surgery itself, emergency or urgency surgeries were left out.

The operative mortality considered was the death rate recorded during the same hospital admission or within 30 days after surgery.

For outcome comparison purposes, the operative mortality was adjusted as per the standard EuroSCORE, so that the recorded operative mortality was compared to the expected operative mortality for each patient. The expected operative mortality was obtained using the logistic regression analysis applied to the standard EuroSCORE relative to operative mortality. Still according to the standard EuroSCORE, patients were grouped during the pre-operative phase as: low, medium and high operative risk. Length of hospital stay was also analyzed using the adjustment relative to standard EuroSCORE.

Continuous data are presented by their means, medians and standard deviations, whereas categorical data are presented by their respective proportions. To compare the continuous variables, we used either Student's t test or the single factor analysis of variance, and to compare categorical variables, Fisher's exact test or the chi-square test was used. For the variance analysis, the Dunnet test was used to allow comparison among the groups. To establish the correlation among continuous data, Pearson's Linear correlation was used. The area under the ROC (receiver operating characteristic) curve was calculated as a rate of how well the EuroSCORE could discriminate patients who survived from those who died or patients who remained in the hospital longer than 12 days from those who stayed less than 12 days. *P* values (two-tailed) equal to or lower than 0.05 were considered statistically significant.

Results

The time elapsed between the date-setting appointment and the surgery itself (n=98) was 4±3 days (median: four days). The rate of cancellation was zero. The EuroSCORE for the population studied was 4±3 (median: three). Low-risk EuroSCORE was observed in 38.7%, medium-risk in 38% and high-risk in 23.4% of the patients. The OM recorded of 4.9% (95% confidence interval [CI] = 2.2 – 9.87%) was lower than the expected OM of 5.1% (95% CI = 1.4% to 14.37%), but with no statistical significance (p=0.65). No difference in operative mortality was observed among patients considered as high (9.4%), medium (5.8%) or low (1.9%) risk as per the EuroSCORE (p=0.10). The operative mortality observed in low-risk patients as per the EuroSCORE was similar to the expected value (1.9% - 95% CI = 0.01 to 11.69% and 2.0% - 95% CI =1.9 to 2.58%, respectively). Among high-risk patients, the operative mortality observed was lower than expected (9.4% - 95% CI = 2.46 to 25.0% and 12.0% - 95% CI = 8.7 to 14.66%, respectively). The expected operative mortality for medium-risk patients was lower than the observed value (4.1%; 95% CI = 3.90 to 4.4% and 5.8%, 95% CI = 1.41 to 16.54%, respectively; p<0.0001). The area under the ROC curve of the EuroSCORE for operative mortality was 0.702 (95% CI = 0.485 – 0.919) (Figure 1).

The length of hospital stay was 11±9 days (median: eight days). A statistically significant correlation was observed between the length of hospital stay and the EuroSCORE (r=0.39, p<0.0001). Patients with a low EuroSCORE spent a significantly shorter time in hospital (8±4 days) than those with a medium (12±10 days; p=0.036) and high (15±10 days; p<0.0001) EuroSCORE. No significant difference was observed in the length of hospital stay of patients with medium-risk in comparison with those with high-risk EuroSCORE (p=0.147). The area under the ROC curve of the EuroSCORE for the length of hospital stay was 0.764 (95% CI = 0.675 – 0.852) (Figure 2). The rate of hospital readmission due to surgical wound infection was 2.1%.

Discussion

The findings of this study showed that the operative mortality rate recorded for isolated CABG, contrary to the link between outcomes and the number of surgeries performed by services and surgeons[1,10,17], is similar to the

Table 1 - Patient characteristics

Women (%)	25
Age (mean ± standard deviation)	65±11 years
Age ≥ 65 years (%)	51
Elective surgery (%)	74
EuroSCORE (mean ± standard deviation)	4±3
EuroSCORE – low risk (%)	38.7
EuroSCORE – medium risk (%)	38
EuroSCORE – high risk (%)	23.3

EuroScore - operatory risk score adopted by the European Society of Cardiology.
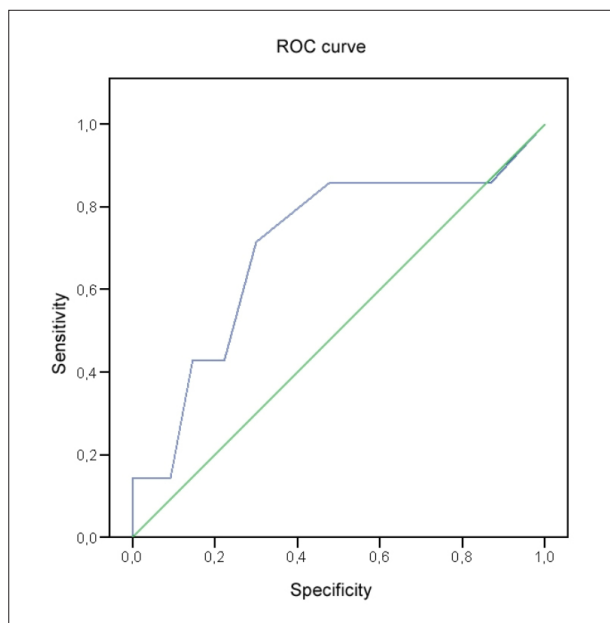
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Figure 1 - Area under the ROC (receiver operating characteristic) curve of the EuroSCORE for operative mortality (area = 0.702±0.11; 95% CI = 0.485 – 0.919).
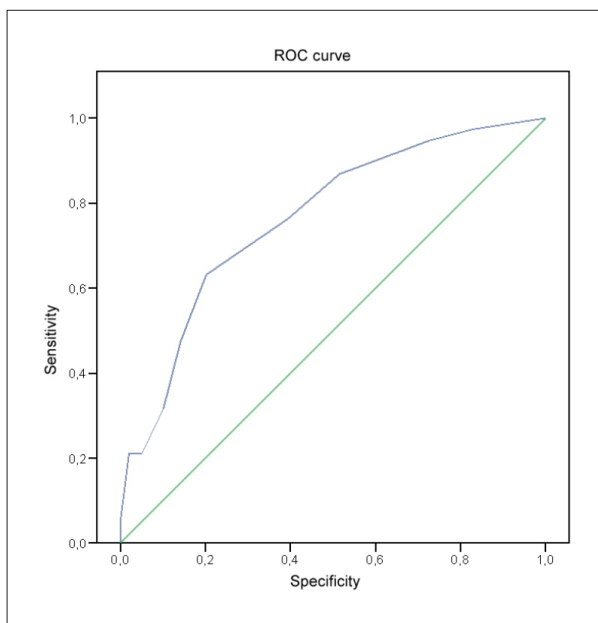

Figure 2 - Area under the ROC (Receiver Operating characteristic) curve of the EuroSCORE for length of hospital stay (area = 0.764±0.45; 95% CI = 0.675 – 0.852).

expected value (4.9%; 95% CI =2.2 to 9.87% *vs* 5.1%; 95% CI = 1.4% to 14.37%), with an area under the ROC curve of 0.702 (Figure 1). These data are in accordance with those recorded by Moraes et al[16], who, by analyzing the use of the EuroSCORE in a population of 759 patients submitted to CABG, found 69.9% of agreement between the observed operative mortality rate and the expected operative mortality rate.

In Brazil, according to DATASUS data, an inverse relationship was shown between the volume of cardiac surgeries performed and operative mortality[15]. The results of our study do not confirm the existence of this inverse relationship, but they are consistent with North-American publications that report that the correlation between the number of surgeries and mortality is weak[10,17-19].

According to SUS data, operative mortality from CABG in Brazil is 7.0%, a rate which is higher than that reported in the database from the Society of Thoracic Surgeons in the USA and the records of cardiac surgeries performed in the United Kingdom[19] and the rate observed in this study. However, as the authors emphasize, North-American and British databases refer to voluntary records of institutions that perform cardiac surgeries, whereas those from DATASUS are administrative data of institutions that perform surgeries in Brazil. Unfortunately, since the DATASUS data available are administrative, it is not possible to adjust operative mortality according to the severity of the patients' conditions.

According to some authors, the length of hospital stay for a CABG surgery should not exceed 12 days[20,21]. In this study, the median total hospital stay was eight days. In accordance with findings by Toumpoulis et al[21], a direct relationship was found between the EuroSCORE and the total length of

hospital stay. Thus, patients with a low EuroSCORE remained a significantly shorter time in hospital than medium- and high-risk patients. Among medium- and high-risk patients, no significant difference was found. The area under the ROC curve of the EuroSCORE for total hospital stay was 0.744 (Figure 2). Therefore, EuroSCORE, similarly to what happened with operative mortality, helped to identify patients who were more likely to have longer hospital stays for myocardial revascularization surgery.

The rate of hospital readmission due to surgical wound infection in this study was 2.1%. This rate is lower than that reported in the database from the National Society of Thoracic Surgeons (STS) in the USA[22].

One of our difficulties in evaluating the outcomes was in obtaining references for all indicators measured. There are no available data in medical literature about time elapsed between the date-setting appointment and the actual elective myocardial revascularization surgery. For this reason, the goal in our institution is to keep this time interval shorter than five days. The time between the date-setting appointment and the surgery in our study was four days (median). Likewise, at our institution the target for the cancellation rate due to problems in hospital infrastructure or processes linked to the procedure is zero (0%), and this was the rate observed throughout the 14 months of evaluation.

The quality of healthcare must, on principle, be safe, efficacious, patient-centered, timely, effective, and follow strict scientific methodology. Within this spirit, by evaluating healthcare quality indicators in CABG, the *Hospital Pró-Cardíaco* showed that, despite being a center with a low annual volume of CABG procedures performed, it reached results compatible with the risk profile of the population involved.

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The control of quality indicators allows a broad evaluation of the institution by identifying strengths and weaknesses and, therefore, contributing to the improvement of quality of the care provided to patients.

Conclusion

QI assessment showed that, in a medical center with a low annual volume of myocardial revascularization surgeries performed, the results were compatible with the risk profile of the population involved.

Potential Conflict of Interest

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