BRIEF ARTICLE

Long-Term Survival of Multivessel Coronary Surgery Bypass Grafting up to 20 Years of Follow-Up

Supervivencia de la cirugía coronaria de múltiples vasos en el seguimiento hasta 20 años

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ABSTRACT

Background: The outcomes of long-term follow-up constitute one of the best parameters to assess the quality of a medical intervention.
Objectives: The aim of this study was to analyze the overall and free-of-cardiovascular events 20-year survival after coronary artery bypass grafting (CABG) in a community hospital with long-standing electronic medical records.
Methods: The results of CABG in patients with multivessel or left main coronary artery disease between 1999 and 2003 were retrospectively studied in a community hospital. Follow-up to 20 years was carried out through the electronic medical records.
Results: A mean follow-up of 125 months (range: 6-268) was achieved in 254 (93.4%) out of 272 operated patients in that period. The average number of bypasses was 3.3 (standard deviation: 0.97); in 97.6% of cases at least one internal mammary artery was used and in 59.4% a radial artery graft. Follow-up of 2,646 patient-years was obtained with an annual risk of all-cause death of 2.5%. Overall survival at mean follow-up was 0.806 [standard error (SE) 0.03], and cardiovascular event-free survival was 0.826 (SE: 0.03).
Conclusions: Complete electronic registry of affiliates to a community hospital operated more than 15 years ago allowed us to analyze overall and event-free long-term survival. These results will serve as a standard when choosing between surgery and multivessel angioplasty.

Key Words: Coronary artery bypass graft surgery - Long-term follow-up – Multiple vessel coronary artery disease

RESUMEN

Introducción: Los resultados del seguimiento a largo plazo constituyen uno de los mejores parámetros para evaluar la calidad de una intervención médica.
Objetivos: Analizar la supervivencia global y la supervivencia libre de eventos cardiovasculares a 20 años de la cirugía coronaria en un hospital de comunidad con historia clínica electrónica de larga data.
Métodos: Se estudiaron en forma retrospectiva los resultados alejados de las cirugías coronarias aisladas efectuadas en pacientes con enfermedad de múltiples vasos o tronco de coronaria izquierda entre 1999 y 2003 en un hospital de comunidad. El seguimiento hasta 20 años se realizó a través de la historia clínica electrónica.
Resultados: Se logró un tiempo de seguimiento medio de 125 meses (rango: 6-268) en 254 pacientes de los 272 operados en ese período (93,4%). El número promedio de puentes fue 3,3 (desvío estándar: 0,97); en 97,6% se usó al menos una arteria mamaria y 59,4% recibieron un puente con arteria radial. Se obtuvo un seguimiento de 2646 pacientes-años, con un riesgo anual de muerte por toda causa de 2,5%. La supervivencia global al seguimiento medio fue de 0,806 (error estándar, EE: 0,03), y la supervivencia libre de eventos cardiovasculares fue de 0,826 (EE: 0,03).
Conclusiones: El registro electrónico completo de los afiliados a un hospital de comunidad operados hace más de 15 años permitió analizar la supervivencia global y libre de eventos a largo plazo. Estos resultados servirán como estándar al momento de elegir entre la cirugía y la angioplastia de múltiples vasos.

Palabras clave: Cirugía coronaria – Seguimiento a largo plazo – Enfermedad coronaria de múltiples vasos

INTRODUCTION

The outcomes of long-term follow-up constitute one of the best parameters to assess the quality of a medical intervention. Patients with multi-vessel coronary artery disease are often selected for angioplasty or coronary artery bypass grafting (CABG) to improve their quality of life and survival. While the choice of either procedure depends on the risks of each intervention, choosing the bypass grafting strategy should also include long-term outcomes. (1)

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Reported survivals for CABG, have been between 54% and 87% at 15 years, and between 16% and 29% at 25 years. (2, 3) In our context, the reported 10-year survival rate was 77.9% for CABG without cardiopulmonary bypass (4) and 82.6% with bilateral internal mammary artery grafting during the same follow-up period. (5)

In turn, coronary angioplasty in patients with multivessel disease is associated with a higher incidence of myocardial infarction, need for new revascularization, stroke and/or death at approximately 5 to 7 years of follow-up. (6, 7) Given the importance of local long-term follow-up assessments, the purpose of this study was to analyze the overall and the free-of-cardiovascular events 20-year survival rate after CABG in a community hospital with long-standing electronic medical records.

METHODS

The late outcomes of CABG in patients with multivessel or left main coronary artery disease between 1999 and 2003 in a community hospital were retrospectively analyzed. Only patients with left main coronary artery and/or three vessel lesion and no other associated surgical procedure were included in the study. Follow-up to 20 years was done through the institutional electronic medical record and telephone contact. Since it was mostly a population of patients affiliated with the hospital, a high follow-up rate could be obtained. Baseline data at the time of surgery were included, and cardiovascular events were: surgical cause, angina, myocardial infarction, need for repeat revascularization, and stroke. Long-term all-cause and cardiovascular mortality were evaluated and stratified by age, also considering the operative mortality. All surgeries were performed with cardiopulmonary bypass and antegrade/retrograde blood cardioplegia solution. Although this series of operations ended in 2003 when the logistic EuroSCORE was just published, we calculated it retrospectively in order to have a risk stratification parameter for this cohort.

Statistical analysis

Follow-up was analyzed with Kaplan-Meier curves, and comparisons were made with the log-rank test. Continuous variables were expressed as mean ± standard deviation (SD) or standard error (SE). Welch's t-test was used to compare means with unequal variances, while the chi-square test was used to compare the observed versus expected (O:E) risk ratio according to the logistic EuroSCORE. SPSS Statistics for Windows, version 17.0 (SPSS Inc., Chicago, IL, USA) software package was used for statistical analysis.

Ethical considerations

The study was evaluated and approved by the Institutional Review Board. As this was a study based on retrospective non-sensitive data in medical records, patient consent was not requested.

RESULTS

A mean follow-up of 125 months (SE: 5.2) (range: 6-268) was achieved in 254 (93.4%) out of 272 operated patients in that period. Follow-up of 2,646 patient-years yielded an annual risk of all-cause death of 2.5%. Mean age at the time of surgery was 64 years (SD: 9.3), and 86.2% were male patients. Table 1 shows the rest of baseline population characteristics. A low rate of prior angioplasty was observed, and the types of angina were presented according to the classification at the time the patients underwent surgery. A total of 15.4% (n=39) of patients had a lesion in the left main coronary artery. The average number of bypasses in all the series was 3.3 (SD: 0.97); in 97.6% (n=248) of cases at least one internal mammary artery was used, 59.4% (n = 151) received a radial artery graft, and 84.6% (n = 215) at least a venous graft.

Operative mortality rate was 3.9% (n=10), with an expected risk of 2.6% (SD: 2.5, range: 0.88-21.8) according to the EuroSCORE (O:E: 1.5; p = 0.459).

Figure 1 shows cumulative survival up to 20 years of isolated CABG according to cardiovascular and all-cause mortality (log-rank p = 0.003). Overall survival at mean follow-up was 0.806 (SE: 0.03). Figure 2 shows cardiovascular event-free survival up to 20 years; this survival at mean follow-up time was 0.826 (SE: 0.03). In addition, survival free of further revascularization at mean follow-up time was 0.945 (SE: 0.02), myocardial infarction/angina-free survival was 0.889 (SE: 0.02), 0.02), and stroke-free survival was 0.981 (SE: 0.01) (Figure 3).

Figure 4 shows overall cumulative survival, stratified by age. Mean age at the time of surgery was 56.7 years (SD: 6.06) in patients <65 years versus 72.1 years (SD: 4.38) in those >65 years (Welch's t-test p < 0.001). Twenty-year survival rate for all-cause mortality was higher in patients <65 years (0.615 vs. 0.515, log-rank p=0.004) due to a higher incidence of cancer in the older group.

Figure 5 compares survival in patients with or without radial artery graft (log-rank p=0.054). This difference at the limit of statistical significance could

Table 1. Baseline population characteristics (n=254)

Variables	N (%)
Hypertension	211 (83.1)
Smoking history	167 (65.7)
Dyslipidemia	143 (56.3)
Diabetes	68 (26.8)
Chronic obstructive pulmonary disease	31 (12.2)
Peripheral artery disease	7 (2.8)
Chronic kidney disease	7 (2.8)
Heart failure	50 (19.7)
Prior angioplasty	44 (17.3)
Recent myocardial infarction	38 (15.0)
Cardiac reoperation	7 (2.8)
Chronic stable angina	29 (11.4)
Recent onset angina	79 (31.1)
Progressive angina	115 (45.3)
Post-infarction angina	31 (12.2)

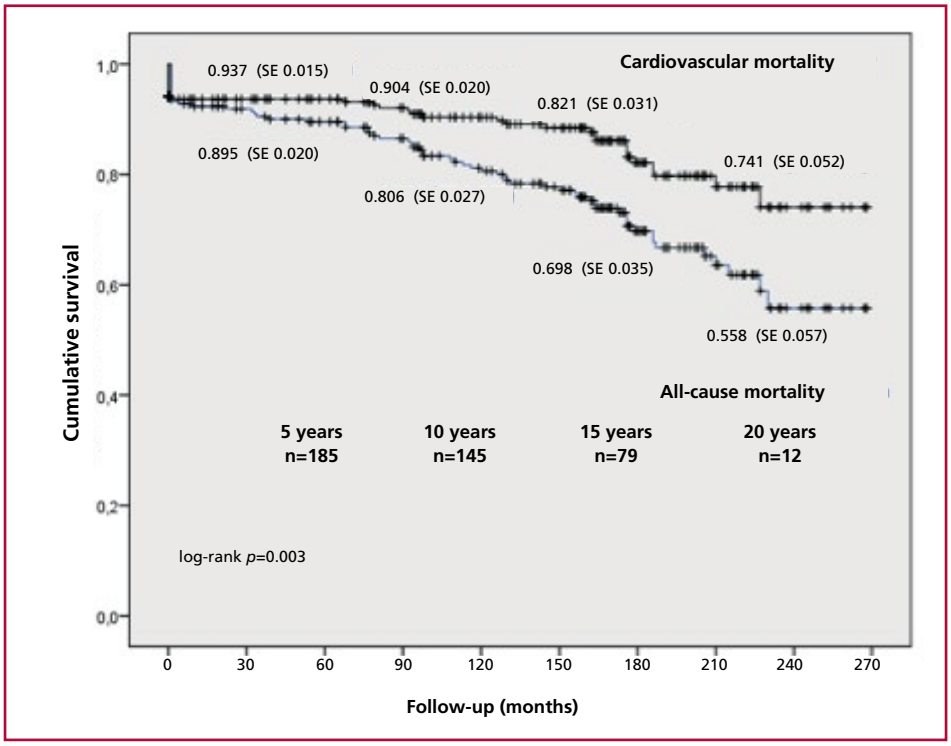


Fig. 1. Cumulative survival up to 20 years of isolated coronary artery bypass grafting according to cardiovascular and all-cause mortality.

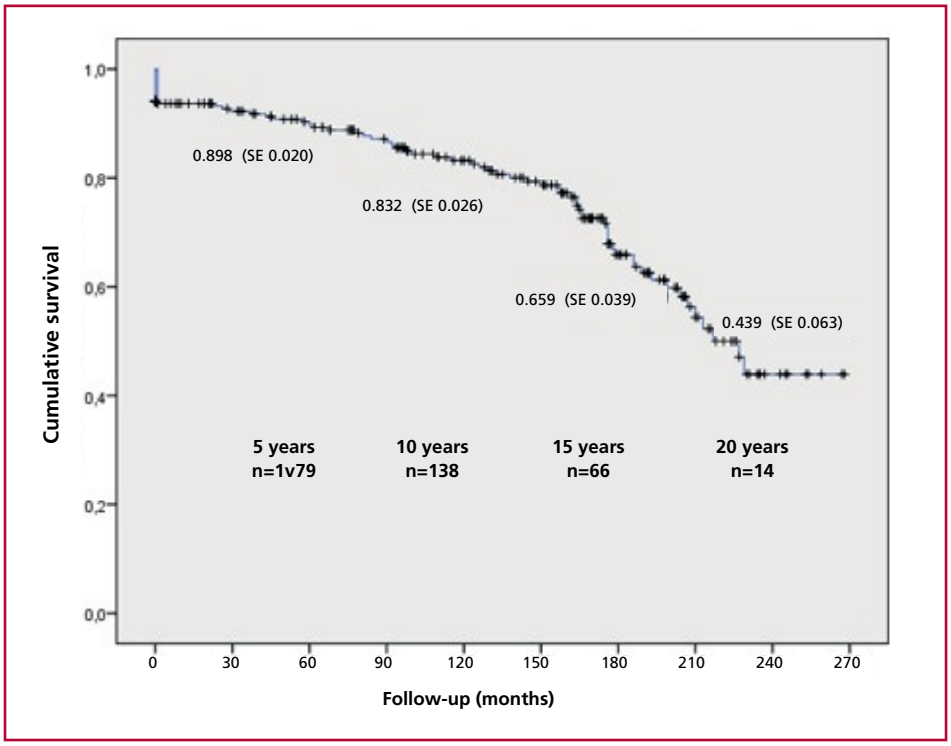


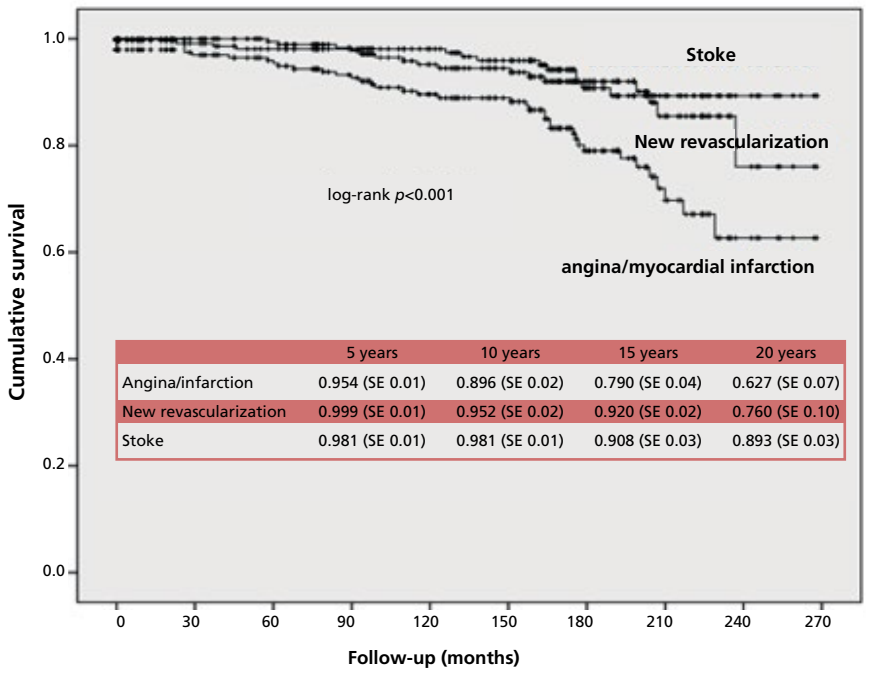
Fig. 2. Cumulative cardiovascular event-free survival up to 20 years (angina, myocardial infarction, need for repeat revascularization, or stroke) for isolated coronary artery bypass grafting.

be due to the fact that patients with radial artery graft were on average younger than those without it [61.3 years (SD: 8.32) vs. 67.8 years (SD: 9.69), Welch´s t-test p <0.001].

DISCUSSION

In the present series of patients undergoing multivessel CABG, an average 10-year follow-up and a 15-year follow-up for almost one third of the patients was achieved. Ten-year survival was 81%, and 90% when considering all-cause or cardiovascular death, respectively.

A retrospective review conducted on 4,584 consecutive CABG surgeries performed between 1972 and 1994 showed a 15-year survival rate of 37.5% for single internal mammary artery graft, and 53.5% for



	5 years	10 years	15 years	20 years
Angina/infarction	0.954 (SE 0.01)	0.896 (SE 0.02)	0.790 (SE 0.04)	0.627 (SE 0.07)
New revascularization	0.999 (SE 0.01)	0.952 (SE 0.02)	0.920 (SE 0.02)	0.760 (SE 0.10)
Stoke	0.981 (SE 0.01)	0.981 (SE 0.01)	0.908 (SE 0.03)	0.893 (SE 0.03)

Fig. 3. Cumulative cardiovascular event-free survival up to 20 years (angina, myocardial infarction, need for repeat revascularization, or stroke) for isolated coronary artery bypass grafting, discriminated by type of event.

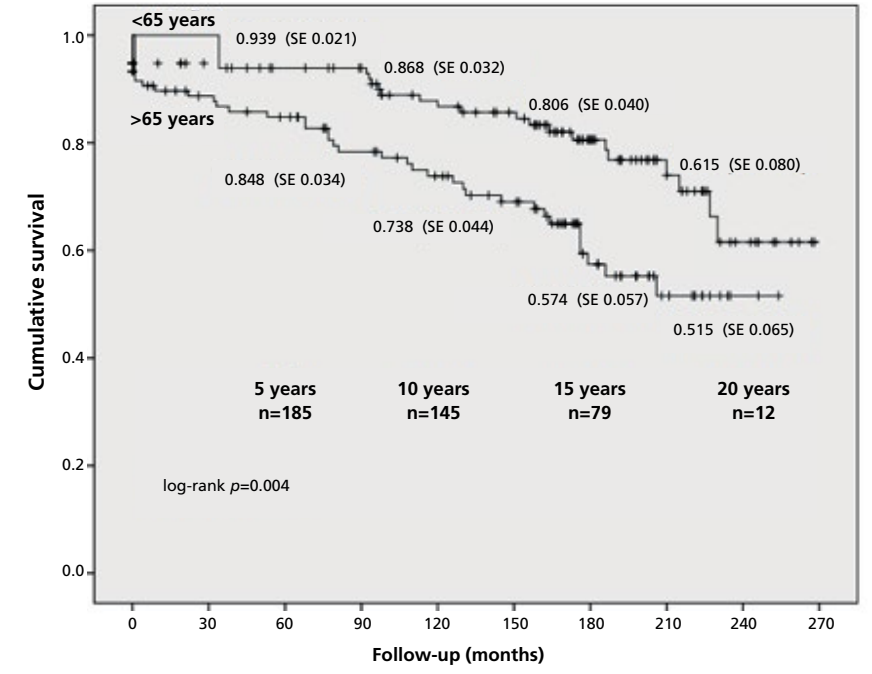


Fig. 4. Cumulative survival up to 20 years for isolated coronary artery bypass grafting, according to all-cause mortality, stratified by age.

bilateral internal mammary artery graft. (3) For the same follow-up time and mean patient age, the results in our series revealed a survival rate of about 70% with the use of a single internal mammary artery plus radial artery in 60% of the cases. This difference may be due to the fact that our cohort is more recent than that reported in the review, and therefore their quality of postoperative care may have been lower compared with a more modern one.

In our study, the difference in survival among patients with or without radial artery graft could be biased by the age difference between cohorts. Other studies have failed to demonstrate that the use of a radial artery graft is associated with increased survival at 15 years. (2) However, it has recently been argued that there is a difference in long-term survival among

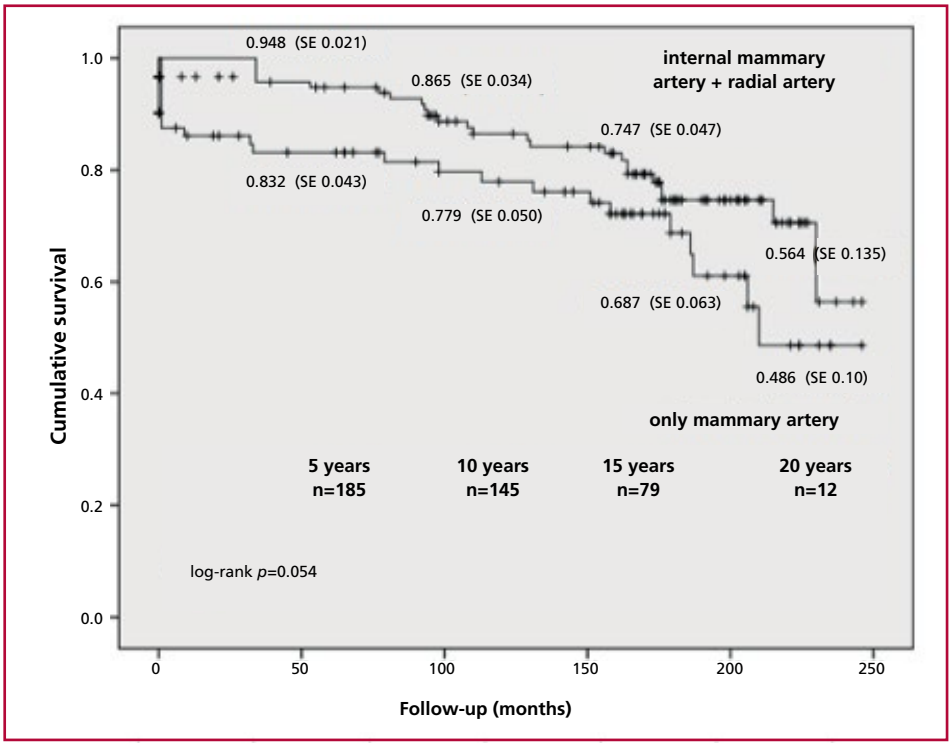


Fig. 5. Cumulative survival up to 20 years for isolated coronary artery bypass grafting stratified by type of graft used, according to all-cause mortality.

patients with one or more arterial bypass grafts. In 60% of cases our patients had at least two bypasses with arterial conduits. In a study by Habib et al. (8) on 8,402 patients with multiple arterial bypass grafts, 9-year survival rate was between 86.9% and 89% when long-term all-cause mortality was analyzed, and it significantly improved compared to survival rate with coronary angioplasty. Other studies showed that higher long-term mortality rate for coronary angioplasty in multivessel disease could be associated with incomplete revascularization. Recently, a combined analysis of the SYNTAX, PRECOMBAT, and BEST trials, (9) demonstrated that 5-year survival for coronary angioplasty with complete multivessel revascularization was similar to surgical results (90% vs. 89.6%). In the case of multivessel surgery with at least one mammary artery graft, leaving one territory incompletely revascularized (right coronary artery and/or circumflex artery) might not impact on long-term survival. (10)

Certainly, very-long-term survival is affected by life expectancy of the population at the time of surgery. Thus, in our study, cumulative survival up to 20 years in isolated CABG surgery was significantly different between those under and over 65, cancer being the leading cause of death in the older group.

Some recent publications show higher rates of cardiovascular events than those found in our study. For example, in a nationwide cohort of 1,507 patients operated in Iceland, overall 5-year survival was 89.9% with 4.5%, 2.2%, and 6.2% rate for stroke, myocardial infarction and need for repeat revascularization, respectively. (11) In the Polish national registry (KROK registry) with 8,196 patients >45 years old, operated on between 2006 and 2011 and with a mean follow-up of almost 5 years, survival rate was 85%, with a stroke, myocardial infarction and need for repeat revascularization rate of 4.3%, 5.6%, and 15.2%, respectively. (12)

Limitations include the retrospective analysis of a population from a single surgical center and with a moderate sample size. Also, since it is a closed population with financial resources, most patients received optimal medical treatment during follow-up. Finally, the retrospective evaluation of the logistic EuroSCORE may have underestimated the expected risk due to the absence of some variables in our registry needed to calculate this score.

CONCLUSIONS

The complete electronic registry of affiliates to a community hospital operated more than 15 years ago allowed to analyze the overall and event-free long-term survival of multivessel coronary artery bypass grafting. These results will serve as evidence for decision making in the surgical management of coronary artery disease, and as standard when choosing between surgery and multivessel coronary angioplasty.

Conflicts of interest

None declared.

(See authors' conflicts of interest forms on the website/ Supplementary material)

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