UPDATE

Myocardial Revascularization (VIII)

Coronary Surgery. Developments in the Last Decade. Indications and Results

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Coronary artery bypass surgery is endorsed by the excellent, well-documented, long-term results that follow complete revascularization and the use of 1 or 2 mammary artery grafts. This article contains a review of the current indications for and the results of such surgery and an evaluation of new challenges and opportunities, including the implementation of safer and less aggressive surgery, and surgery associated with other operative procedures. The aim was to develop a strategy linked to a cycle of innovation that could be used to adapt surgery to the needs of the population, to new technologies, and to pioneering developments.

Key words: *Coronary artery bypass surgery. Off-pump coronary artery bypass surgery. Internal mammary artery. Ischemic mitral regurgitation. Mitral restrictive annuloplasty. Surgical ventricular reconstruction.*

Cirugía coronaria. Evolución en la última década. Indicaciones y resultados actuales

La cirugía coronaria está avalada por unos excelentes resultados, bien documentados a largo plazo como consecuencia de la revascularización completa y la utilización de una o 2 arterias mamarias. En este artículo se revisan los resultados y las indicaciones de la cirugía y se valoran los nuevos retos y las oportunidades que incluyen la cirugía más segura, menos agresiva y asociada a otros procedimientos quirúrgicos. El objetivo es desarrollar estrategias ligadas a un ciclo innovador que adapte la cirugía a las necesidades de la población, las nuevas tecnologías y a las actividades pioneras.

Palabras clave: *Cirugía coronaria. Cirugía coronaria sin bomba. Mamaria interna. Insuficiencia mitral isquémica. Anuloplastia mitral restrictiva. Reconstrucción ventricular.*

INTRODUCTION

The origin of coronary artery bypass surgery is uncertain and depends on geographical location and the preferences of the author: Senning in Europe (1966), Garrett (1966) and Favaloro (1967) in the USA, or even much earlier if we include the experimental work of Alexis Carrel. Following the attempts made by Vineberg in Montreal from 1951 onwards to implant the internal mammary artery (IMA) into the myocardium, other proposals were made for direct revascularization by endarterectomy or interposition grafts using the saphenous vein or IMA. However, these techniques were neither accepted nor their potential use evaluated.[1] In 1964, Kolesov, from Leningrad, anastomosed the IMA to the left anterior descending (LAD) artery.[2] Without knowledge of this contribution, Garrett, from the group of deBakey in Houston, used the saphenous vein to revascularize the LAD artery in 1966, the graft remaining patent at 7 years,[3] and Favaloro introduced the aortocoronary bypass in the Cleveland Clinic in 1967,[4] with 741 cases treated in 1971.[5] In 1968 Green,[6] in New York, anastomosed the IMA to the LAD artery; in 1971, Flemma, Johnson, and Lepley in Milwaukee described the advantages of sequential bypass grafts[7]; bilateral IMA grafts are known to have been in use in 1972 but may have been employed as early as 1968.[8] Over a period of 6 years, coronary artery bypass surgery established its

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foundations and became universally accepted as a valid treatment.

Coronary artery bypass surgery is one of the best forms of treatment and its short-, medium-, and long-term results are well documented, situating it at the forefront of scientific knowledge.[9] The number of surgical interventions of this type performed in the USA increased significantly in the period up to 1996 but has decreased progressively since the year 2000, with a reduction of 100 000 cases per year.[10] This change is the result of the introduction of the stent in 1996, the use of which overtook the number of surgical interventions in 1998. An annual reduction of 7% to 10% in the number of surgical interventions has occurred in Europe, and in Spain the number fell by 16% between 2000 and 2002.[11] This reduction contrasts with the increase in the number of percutaneous coronary interventions (PCI), currently around 15% annually.[12,13] Advances in PCI, including the use of drug-eluting stents, have had an impact on the global reduction in the number of surgical interventions.[14,15] However, although drug-eluting stents have been shown to be more effective in certain patient groups, long-term scientific evidence is lacking, as is data from other types of patients or lesions.[16] These changes mean that surgical treatment of ischemic heart disease must adapt to future demands. Thus, this article will review the results of and indications for surgical intervention, and assess new opportunities, including safer, less invasive surgery and intervention associated with other surgical procedures.

RESULTS. INDICATIONS

Results

Mortality

Coronary artery bypass surgery represents the surgical technique with probably the best-documented short-, medium-, and long-term results. In-hospital mortality in the USA and Europe is less than 2.5%.[17-19] Patient survival following surgery is approximately 98% at 1 month and 97%, 92%, 81%, and 66% at 1, 5, 10, and 15 years, respectively.[20] The shape of this survival curve, with an initial reduction in patient survival during the first few months followed by a plateau up to 5 years and a progressive reduction in survival from that point on, more apparent from the eighth year onwards, is associated with occlusion of bypass grafts, disease progression, and development of comorbid conditions. The use of artery grafts for revascularization improves this survival curve.[21,22]

Large databases have been used to develop risk stratification models to predict mortality and outcome.[18-20,22-24] All of the scales include the following variables as predictors of in-hospital mortality: age, female sex, repeat revascularization, procedure urgency, left ventricular dysfunction, noncoronary surgery, kidney failure, and symptomatic peripheral artery disease. Other, anatomical factors must be added to this list, including incomplete revascularization, proportion of small caliber distal vessels, associated endarterectomy, severe left main artery disease, and experience of the surgeon.[20] Table 1 shows the EuroSCORE scale for prediction of surgical risk, developed using data from 19 030 patients who underwent surgery in Europe between September and December 1995.

Outcome

The probability of remaining free from angina at 1, 5, 10, 15, and 20 years following surgery is 95%, 82%, 61%, 38%, and 21%, respectively.[25] These results show that in the long term angina is almost inevitable, while the mean length of time to its appearance following surgery is slightly more than 12 years. The use of the IMA to revascularize the LAD artery reduces the recurrence of angina, this effect being most apparent beyond 4 years after surgery.[26] The probability of remaining free from infarction at 30 days and 5, 10, 15, and 20 years following surgery is 97%, 94%, 86%, 73%, and 56%, respectively.[26] The probability of sudden death is low, 97% of patients remaining unaffected

TABLE 1. **EuroSCORE Prediction of Surgical Risk**[19]

Risk Factors	Points
Age (each 5 years from 60 years)	1
Female gender	1
Chronic pulmonary disease	1
Peripheral artery disease	2
Repeat surgery	3
Renal failure	2
Active endocarditis	3
Critical preoperative state	3
Unstable angina	2
Ejection fraction less than 0.30	3
Recent myocardial infarction	2
Pulmonary hypertension	2
Emergency	2
Noncoronary surgery	2
Surgery of the thoracic aorta	3
Interventricular communication following myocardial infarction	4
EuroSCORE Index, Points	**Estimated Mortality, %**
0-2	1-0
3-5	2.62-3.51
6-8	6.51-8.37
9-10	14.0-19.0
11-13	31.0-42.0
≥13	>42.0