REVIEW

Coronary artery bypass grafting and ischemic cardiomyopathy

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Ischemic cardiomyopathy is defined as a coronary artery disease and left ventricular (LV) dysfunction with an ejection fraction (EF) equal to or less than 40%. The substrate of Ischemic cardiomyopathy is heterogeneous, a combined coexistence between normal, stunned, hibernating and scar myocardium in the same myocardial region.All together could represent the same process in different phases. It is a fact that just the assessment of myocardial viability and ischemia, failed to guide with precision the indication of CABG. The risk/benefit ratio of CABG in those patients is delicate and frágil. Critical and careful evaluation of all available information, to define the appropriate revascularization strategy, is of vital importance. The decision integrates a series of intricate aspects such as clinical presentation, myocardial viability, LV status and coronary angiogram. We believe CABG is a class I indication if the coronary anatomy is suitable.

***Key words*: Ischemic cardiomyopathy; CABG; Mypcardiocardial viability; Myocardial ischemia.**

Cardiomiopatia isquémica se define como una disfunción del ventrículo izquierdo , con una fracción de eyección menor o igual al 40% y enfermedad coronaria. El substrato de esta entidad es heterogéneo, una coexistencia combinada entre cicatriz y miocardio normal, hibernante y aturdido, todos hallazgos en la misma región ,representando el mismo proceso en diferentes fases. Es un hecho que la valoración de la isquemia y viabilidad, por si solas, no guían con precisión la indicación de bypass coronario. La relación riesgo/beneficio de la cirugía es delicada y frágil. A fin de definir la mejor estrategia de revascularización, una evaluación critica y cuidadosa, es de vital importancia. La decisión integra una serie de aspectos intrincados, como presentación clínica, viabilidad miocárdica, estado del ventrículo izquierdo y la coronariografía. Cuando los lechos coronarios son adecuados, creemos que el bypass coronario es indicación clase I en esta entidad.

***Palabras clave:* Miocardiopatía isquémica; Bypass coronario; Miocardio, viabilidad; Miocardio, isquemia.**

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Coronary heart disease represents the most common cause of heart failure in industrialized countries [1]. Regardless of this, there has been a substantial change in the spectrum of clinical presentation and coronary heart disease in the last two decades, on the one hand the rapid availability and technological advances associated with percutaneous coronary intervention, and on the other, the increasing effectiveness of the drugs. Increased survival translates into a proportional and progressive increase in heart failure in these patients [2].

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ISCHEMIC CARDIOMYOPATHY

Ischemic cardiomyopathy is defined as an left ventricular (LV) dysfunction with an ejection fraction (EF) equal to or less than 40%, obviously in the context of coronary heart disease [3]. These patients have a high risk of postoperative complications, but they also have the greatest potential to benefit from revascularization surgery. Properly assessing the risk / benefit of operating elderly patients with low ejection fraction is a real challenge. Critical and careful evaluation of all available information, to define the appropriate revascularization strategy, is of vital importance.

Ischemic damage spectrum of cardiac myocyte

Ischemic cardiomyopathy exists along a spectrum that includes myocardial stunning, hibernating myocardium and myocardial scar. Stunned myocardium refers to the muscle

with reversible contractile dysfunction. Such reversibility occurs when coronary flow is restored after a brief episode of occlusion, this phenomenon may take weeks to months after restarting a normal coronary blood supply. The hibernating myocardium has been defined as a state of down-regulated contractile function, in non-infarcted areas with critical coronary stenosis, contraction improves after revascularization Myocardial scar occurs after myocyte death, these scar areas evolve to adverse remodeling on the LV, dilation of the cavities, displacement of the papillary muscles and mitral regurgitation [3-6].

It is very important to understand that this mixed substrate of Ischemic cardiomyopathy, is extremely heterogeneous, and there is usually a combined coexistence between normal, stunned, hibernating and scar myocardium in the same myocardial region. Often there is an element of overlapping between 2 or more of these states, in fact, all together could represent the same process in different phases [7]. This concept guide to interpret feasibility studies with judgment and extreme care.

Rationale and reason for revascularization

The basis of revascularization in the spectrum of cardiac ischemic damage is focused on reversing myocardial dysfunction in these areas with hypocontractile myocardium, but viable. Important areas of hibernating myocardium have been found in up to 50% of patients with LV dysfunction [8]. Depending on the amount of viable myocardium, increases in LV EF after coronary bypass have been observed in up to 40% of patients with ischemic cardiomyopathy, which provides a solid basis for offering surgery in some of these patients [3,6].

A directly proportional relationship has been demonstrated between the number of pre-revascularization viable segments and the change in EF after surgery. Previous reports show that more than 10 viable segments (AHA model) adequately predict the increase in EF [6-12,13].

Viability and ischemia evaluation

Speaking of ischemic cardiomyopathy, there is a powerful tradition, in basing much of the surgical decision, on the presence or not of viability and / or myocardial ischemia. The detection of ischemia can help to specifically direct the revascularization strategy (where to place the coronary bypass). Therefore, this derives in the maximum benefit for the patient. However, there are some other factors and important questions that need to be evaluated carefully, before continuing to accept these concepts as an indisputable guide for the choice of treatment strategy. It is essential that, when questioning all available evidence regarding the importance of viability and myocardial ischemia, we briefly analyze the different techniques used in this regard.

Imaging techniques

Positron emission tomography (PET) has a sensitivity and specificity of 92% and 83% respectively for the detection of perfusion and viability, it is the gold standard for the evaluation of perfusion, it is less susceptible to artefacts, expensive and limited availability.

Single-photon emission-computed tomography (SPECT) is a widely accepted method for the evaluation of myocardial viability, has a sensitivity and specificity of 85% and 62% respectively. It is low cost, but nevertheless, its acquisition protocols are prolonged and with limited spatial resolution.

Dobutamine - stress (DSE) based techniques evaluate the contractile reserve within the areas of viability, does not emit radiation, the spatial resolution is excellent and can be combined with contrast to assess perfusion, contractile reserve, viability and functional recovery possibilities after revascularization. Its sensitivity and specificity are around 74% and 82% respectively.

Magnetic resonance imaging (MRI) accurately assesses myocardial scar, has a wide spatial resolution and is expensive, combined with late gadolinium enhancement is excellent for the simultaneous evaluation of perfusion and viability. Its combination with dobutamine stress accurately examines the contractile reserve, and improves the prediction of postoperative functional recovery. Its specificity is the highest in imaging studies in this clinical context, 87%. [6,7,9-11].

Coronary bypass and ischemic cardiomyopathy. Pre-STICH evidence

Three major trials and their meta-analyzes concluded the long-term benefit of surgical myocardial revascularization versus medical therapy [14-16]. However, only in the CASS registry was there evidence of the survival benefit associated with coronary bypass and ischemic cardiomyopathy, in fact, patients with angina had the greatest benefit [17]. Data from Duke University Center, 25-year experience confirmed better results, with CABG vs medical therapy, in patients with LVEF less than 40% [18].

The conclusion of the landmark trials in the 1970s based the recommendation of CABG in patients with angina, however, these studies mostly excluded subjects with left ventricular dysfunction (LVEF <35%). In fact, only 7.2% of patients had an LVEF ≤ 40%, and only 4% had symptoms of heart failure [17,19,20].

Speaking specifically of the relationship between myocardial viability and CABG, a meta-analysis by Allman et al. represented the key tool to follow over the past decade. The study demonstrated a better survival, between CABG and medical therapy, in patients with myocardial viability, particularly in those with more than 20% of hibernating myocardium. However, the analysis of these results had significant limitations [21].

Coronary bypass and ischemic cardiomyopathy. "STICH" Era.

The STICH trial was a randomized multicenter non-blinded controlled trial, that compared medical therapy versus CABG, in patients with coronary disease and left ventricular dysfunction [22]. Among the conclusions obtained in that study, the following stand out:

1. Patients assigned to CABG had fewer mortality rates and hospitalizations for cardiovascular disease (the difference was borderline P. 05), however, there was no difference between medical therapy and surgery with respect to mortality from any cause.

2. CABG was related to an early risk of mortality. About

age, the older, the greater the likelihood of postoperative mortality due to non-cardiovascular causes

3. There was no benefit of CABG in patients without left coronary artery disease and / or class III / IV angina.

4. The study is not blind, and the difference between the two groups, regarding the motility for any cause, may be due to a limited follow-up of the patients.

From this study, their results were subjected to various analyzes of specific topics, the most important are:

1. STICH extension study published a long-term follow-up in 97.9% of patients (mediated 9.8 years), a potential benefit in long-term mortality was shown in favor of CABG [23].

2. STICH viability sub-study reported the effects of myocardial viability (evaluated by DES and SPECT) in 5.1 years of follow-up. Patients with viability (with or without CABG) were more likely to survive in the univariate analysis, however, this benefit was not demonstrated in the multivariate analysis [24]. It is mandatory to highlight important facts of this study:

a) Only half of the STICH study underwent viability studies.

b) MRI or PET was not used

c) There is no interaction between the effect of CABG and the presence or absence of viability, the fact of having myocardial viability does not adequately identify which patients would benefit more from surgical revascularization.

3. STICH sub-study ischemia specifically studied STICH patients with myocardial ischemia during stress testing. No benefit of CABG was demonstrated versus medical therapy, based only on the presence or absence of ischemia [25].

4. The STICH angina sub-study exclusively analyzed STICH patients with angina class III / IV. CABG demonstrated improvement of symptoms compared to medical therapy.

Other studies, such as PPAR-2 and HEART, provided randomized evidence that there is no clear and conclusive correlation of the presence of viability and the benefit of revascularization [26,27].

New randomized multicenter studies, Revascularization for ischemic Ventricular Dysfunction-British Cardiovascular Intervention Society-2 (REVIDED-BCIS-2) and Alternative Imaging Modalities in Ischemic Heart Failure (AIMI-HF) are currently underway. It is expected that these studies provide sufficient evidence to define the exact therapeutic relationship between myocardial viability and revascularization [28,29].

Concluding, taking into account that the assessment of myocardial viability and ischemia, failed to guide with certainty and precision the indication of CABG in ischemic cardiomyopathy (results to be taken with caution), the analytical approach turned towards the evaluation of anatomical variables. Panza et al. studied the following factors in the STICH population: extent of coronary heart disease (3 vessels), EF ≤ 27% and LV end-systolic volume index ≥ 79 ml / m2. Their conclusions guided them to recommend surgical revascularization in patients who had 2 or more previously referred criteria [30].

According to the AHA / ACC guidelines, CABG is class IIb for coronary disease and LV dysfunction. Although, the ESC / EACTS established a level I if the operative risk is acceptable, and the coronary anatomy is suitable for bypass [31]. Regardless of all the information presented, in relation to the preoperative analysis of factors such as clinical presentation, functional status, comorbidities, myocardial viability and patient fragility, as surgeons, we must accept the fact that the determining factor at the time of the decision It is based on the angiographic assessment of the coronary target, so that when we are facing the patient with LV dysfunction, usually our first interest is to visualize coronary angiography, observing a bad coronary target immediately causes an exhaustive assessment of myocardial viability. , comorbidities, functional class etc. Our enthusiasm to perform the surgery is directly proportional to the dimension in millimeters of the diameter of the affected coronary vessel. However, in short, a more careful and balanced assessment of all the variables involved is essential, in order to consider the best revascularization strategy in these complex patients.

CONCLUSIONS

Coronary surgery in patients with severe LV dysfunction is a complex procedure that potentially carries a high risk of morbidity and mortality, the decision integrates a series of intricate aspects such as clinical presentation, myocardial viability, LV status and coronary angiogram. The precise relationship between all these factors is yet to be clarified. More randomized studies, with hard clinical outcome end points and prolonged follow-up, are necessary to find the answers to these questions.

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