



Multimodality Assessment of Myocardial Viability: The Role of Dobutamine Stress Echocardiography in Guiding Therapeutic Strategy. A Case Report

Evaluación multimodal de la viabilidad miocárdica: utilidad de la ecocardiografía de estrés con dobutamina para orientar la estrategia terapéutica. Reporte de un caso

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ABSTRACT

Assessing myocardial viability is a crucial component in the risk stratification of patients with ischemic heart disease and left ventricular systolic dysfunction, as it enables the identification of myocardial segments capable of recovery following revascularization. Dobutamine stress echocardiography is a widely available tool for assessing contractile reserve and guiding therapeutic decision-making in complex clinical scenarios. We present the case of a 72-year-old man with a history of arterial hypertension, type 2 diabetes mellitus, and chronic kidney disease who presented to the emergency department with progressive dyspnea and a recent history of chest pain. Transthoracic echocardiography revealed a left ventricular ejection fraction of 40% with septoapical akinesia. Coronary angiography demonstrated multivessel coronary artery disease with severe obstructive lesions in the left anterior descending artery and diagonal branches, associated with unfavorable distal vascular beds. Dobutamine stress echocardiography showed neither contractile reserve nor myocardial viability in the affected territories, alongside reduced coronary reserve. After evaluating the case, taking into account the anatomical and functional findings as well as the high surgical risk, revascularization was ruled out, and medical therapy was initiated. This case illustrates the value of dobutamine stress echocardiography as a tool for assessing myocardial viability in patients with advanced ischemic heart disease. Integrating clinical, anatomical, and functional data supported a conservative treatment strategy, consistent with contemporary evidence and current recommendations for tailoring revascularization decisions in patients with left ventricular dysfunction.

Keywords: Coronary revascularization; Dobutamine stress echocardiography; Heart failure; Ischemic heart disease; Myocardial viability.

RESUMEN

La evaluación de la viabilidad miocárdica constituye un componente esencial en la estratificación de pacientes con cardiopatía isquémica y disfunción sistólica del ventrículo izquierdo, ya que permite identificar segmentos miocárdicos recuperables tras la revascularización. La ecocardiografía de estrés con dobutamina es una herramienta ampliamente disponible para valorar la reserva contráctil y orientar la toma de decisiones terapéuticas en escenarios clínicos complejos. Se presenta el caso de un hombre de 72 años con antecedentes de hipertensión arterial, diabetes mellitus tipo 2 y enfermedad renal crónica, quien acudió al servicio de urgencias por disnea progresiva y antecedente reciente de dolor torácico. El ecocardiograma transtorácico evidenció una fracción de eyección del ventrículo izquierdo del 40% con acinesia septoapical. La coronariografía mostró enfermedad coronaria multivaso con lesiones obstructivas severas en la arteria descendente anterior y ramas diagonales, asociadas a lechos distales desfavorables. La ecocardiografía de estrés con dobutamina no demostró reserva contráctil ni viabilidad miocárdica en los territorios comprometidos, además de una reserva coronaria disminuida. Tras la valoración del caso, considerando los hallazgos anatómicos, funcionales y el elevado riesgo quirúrgico, se descartó la revascularización y se instauró tratamiento médico. Este caso ilustra el valor de la ecocardiografía de estrés con dobutamina como herramienta para la evaluación de la viabilidad miocárdica en pacientes con cardiopatía isquémica avanzada. La integración de la información clínica, anatómica y funcional permitió sustentar una estrategia de tratamiento conservador, en concordancia con la evidencia contemporánea y las recomendaciones actuales para la individualización de la revascularización en pacientes con disfunción ventricular izquierda.

Palabras clave: Cardiopatía isquémica; Ecocardiografía de estrés con dobutamina; Insuficiencia cardíaca; Revascularización coronaria; Viabilidad miocárdica.

Introduction

Ischemic heart disease remains the leading cause of death worldwide and represents one of the greatest burdens on healthcare systems due to its high incidence, disability, and associated costs. Despite advances in reperfusion strategies and evidence-based pharmacological treatment, a considerable number of patients progress to left ventricular dysfunction secondary to myocardial necrosis, ventricular remodeling, and the development of chronic heart failure (1,2). In this context, identifying potentially salvageable myocardium is crucial for optimizing therapeutic decisions and improving prognosis.

The concept of myocardial viability began to develop during the decade of 1970 with the description of 2 pathophysiological phenomena that modified the understanding of ischemic ventricular dysfunction: stunned myocardium, characterized by transient contractile dysfunction after 1 episode of ischemia with reperfusion, and hibernating myocardium, defined as a persistent reduction in contractility secondary to chronic hypoperfusion that can recover after restoring adequate coronary flow (3,4).

Currently, myocardial viability assessment can be performed using various imaging modalities, including dobutamine stress echocardiography, cardiac magnetic resonance with late gadolinium enhancement, single-photon emission computed tomography (SPECT), and 18F-fluorodeoxyglucose positron emission tomography (PET-FDG), considered the reference method for evaluating myocardial metabolism. Each technique provides complementary information on contractile reserve, perfusion, cellular integrity, and extent of fibrosis, enabling a more precise characterization of the myocardial substrate (5,6).

Among these modalities, dobutamine stress echocardiography remains a widely used tool due to its availability, low cost, absence of ionizing radiation, and high specificity for detecting contractile reserve in dysfunctional myocardial segments. The presence of a biphasic response during progressive dobutamine administration is one of the most specific findings of viable myocardium and is associated with functional recovery after revascularization, while the absence of a contractile response usually indicates transmural fibrosis and a low probability of clinical improvement (7,8).

However, the clinical interpretation of myocardial viability has evolved considerably in recent years. Results from randomized studies such as STICH, STICHES, and REVIVED-BCIS2 have questioned the isolated role of viability testing in selecting candidates for revascularization, emphasizing the need to integrate imaging information with coronary anatomy, ventricular function, comorbidity burden, surgical risk, and patient preferences. Consequently, contemporary guidelines recommend a multidisciplinary and individualized assessment before establishing a revascularization strategy or optimal medical therapy (9,10).

From a theoretical perspective, this case contributes to illustrating the utility and current limitations of dobutamine stress echocardiography within the diagnostic algorithm for myocardial viability. In the practical realm, it demonstrates how integrating functional findings with coronary anatomy and the clinical context can modify therapeutic management, avoiding potentially futile invasive procedures. From a methodological standpoint, the report was prepared following international recommendations for the presentation of clinical cases (CARE), promoting transparency and reproducibility of the information.

The objective of this case report is to describe the utility of dobutamine stress echocardiography in the evaluation of myocardial viability in 1 patient with advanced ischemic heart disease and left ventricular dysfunction, as well as to analyze its impact on therapeutic decision-making in light of contemporary scientific evidence.

Case Presentation

We present the case of 1 72-year-old man with a history of hypertension, type 2 diabetes mellitus, and chronic kidney disease, without documented history of coronary revascularization. He consulted the emergency department for progressive dyspnea of 24 hours of evolution, accompanied by deterioration of functional capacity. During the anamnesis, he reported an episode of oppressive chest pain with epigastric irradiation that occurred approximately 48 hours before admission, which he initially interpreted as a gastrointestinal disorder, so he did not seek immediate medical attention.

On physical examination, a hemodynamically stable patient was found, with a third heart sound (S3) and bibasilar inspiratory crackles, findings compatible with pulmonary congestion secondary to heart failure. Laboratory studies showed 1 serum troponin T of 0.02 ng/mL (reference value <0.04 ng/mL) and a creatine phosphokinase of 180 IU/L (reference value <192 IU/L), without biochemical evidence of acute myocardial necrosis.

The 12-lead electrocardiogram showed T-wave inversion in the precordial leads, QS complexes in the inferior wall, and repolarization abnormalities in DI and aVL, findings suggestive of ischemic heart disease with sequelae of prior infarction (Figure 1).

Figure 1. The electrocardiogram showed inverted T waves in the precordial leads and QS complexes in the inferior wall, and depolarization disorders in leads DI and AVL.



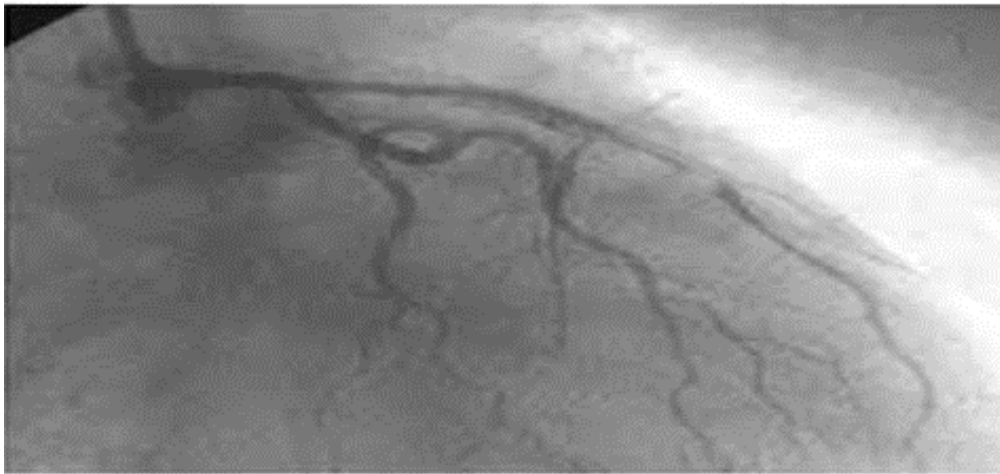
Subsequently, a transthoracic echocardiogram was performed, which demonstrated a left ventricular ejection fraction of 40%, associated with akinesia of the mid and apical septum, compatible with regional systolic dysfunction secondary to coronary artery disease (Figure 2).

Figure 2. Transthoracic echocardiogram 5-chamber view showing mid-apical septal akinesia with an ejection fraction of 40%.



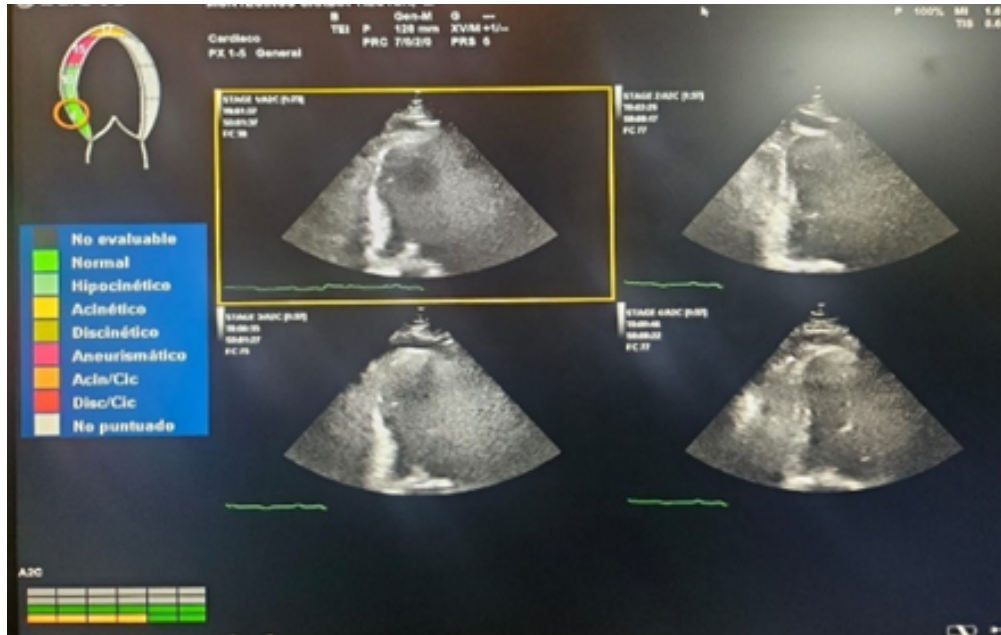
To define coronary anatomy, coronary angiography was performed, which identified multivessel coronary artery disease with severe obstructive lesions in the mid and distal segments of the left anterior descending artery, as well as significant involvement of the first and second diagonal branches, associated with unfavorable distal beds, limiting the potential for successful revascularization (Figure 3).

Figure 3. Coronary angiography revealed several obstructive lesions in the mid and distal portions of the left anterior descending artery (LAD) and in the first and second diagonal branches, with poor distal beds.



Given the presence of left ventricular dysfunction and anatomical complexity of coronary artery disease, dobutamine stress echocardiography was indicated to assess for viable myocardium amenable to functional recovery after eventual revascularization. The study showed no contractile reserve in the dysfunctional segments corresponding to the territories of the left anterior descending artery and the right coronary artery. Similarly, the coronary reserve of the left anterior descending artery was moderately decreased (<2), findings consistent with absence of myocardial viability and low probability of functional recovery after revascularization (Figure 4).

Figure 4. Negative viability test in the territory of the CD-DA: contractile reserve and coronary reserve in the DA are moderately decreased, less than 2.



The case was evaluated in a multidisciplinary manner, integrating clinical, echocardiographic, and angiographic information. Due to the combination of extensive coronary artery disease, absence of myocardial viability, unfavorable distal coronary beds, and high surgical risk estimated by EuroSCORE, it was considered that the expected benefit of revascularization, whether surgical or percutaneous, would be limited. Consequently, it was decided not to perform reperfusion procedures and to institute guideline-directed optimal medical therapy, with outpatient clinical follow-up and periodic reassessment of ventricular function and the patient's functional status.

DISCUSSION

The assessment of myocardial viability continues to be among the most debated aspects in the management of patients with chronic ischemic heart disease and left ventricular dysfunction. Although historically the demonstration of viable myocardium was considered a fundamental criterion for indicating revascularization, contemporary evidence has shown that the therapeutic decision must be based on a comprehensive evaluation that includes coronary anatomy, the degree of ventricular dysfunction, the burden of comorbidities, operative risk, and expectations of functional recovery, in addition to the findings obtained through imaging techniques (11,12).

Dobutamine stress echocardiography remains one of the most widely used diagnostic modalities for assessing myocardial contractile reserve due to its widespread availability, low cost, absence of ionizing radiation, and high specificity for identifying segments with potential for functional recovery. Its pathophysiological basis lies in the ability of viable myocardium to increase contractility in response to low doses of dobutamine, while the biphasic response is the pattern with the highest predictive value for recovery after revascularization. In contrast, the lack of improvement in contractility, as occurred in this case, is usually associated with extensive fibrosis and a low probability of subsequent functional recovery (13).

Several studies have shown that the sensitivity of dobutamine stress echocardiography for detecting myocardial viability ranges from 75% to 85%, with specificity exceeding 80%, and it is superior to other modalities when the goal is to identify contractile reserve. However, its performance may be limited in patients with poor echocardiographic window, significant ventricular geometry abnormalities, diffuse coronary artery disease, or extensive myocardial fibrosis. Moreover, the absence of a contractile response does not completely exclude the existence of viable tissue when areas with residual perfusion or preserved metabolism are present; therefore, current guidelines recommend interpreting its results within the overall clinical context and, when diagnostic uncertainty exists, complementing them with cardiac magnetic resonance imaging with late gadolinium enhancement or positron emission tomography (14,15).

For more than two decades, the prevailing concept was that demonstration of viability identified patients who would most benefit from revascularization. However, the results of the viability substudy of the STICH trial significantly modified this interpretation by demonstrating that, although the presence of viable myocardium was associated with better survival, it did not constitute an independent predictor of the benefit obtained with coronary artery bypass surgery. Subsequently, the long-term follow-up of the STICHES study confirmed the superiority of surgery over optimal medical therapy in certain patients with extensive coronary artery disease and ventricular dysfunction, although this benefit did not depend exclusively on the presence of viability demonstrated by imaging (16,17).

More recently, the REVIVED-BCIS2 trial provided new evidence comparing percutaneous coronary intervention plus optimal medical therapy versus medical therapy alone in patients with extensive coronary artery disease, reduced ejection fraction, and viable myocardium. Its results did not demonstrate a significant reduction in mortality or heart failure hospitalizations with the invasive strategy, reinforcing that viability alone should not be used as the sole criterion to indicate revascularization. These findings have driven a paradigm shift toward a more individualized and multidisciplinary clinical assessment (18). The present case adequately reflects this contemporary clinical scenario. Although the patient had multivessel coronary artery disease with impaired left ventricular systolic function, the absence of contractile reserve on stress echocardiography, combined with complex coronary lesions, unfavorable distal beds, and high surgical risk, led to the conclusion that the likelihood of functional recovery after revascularization was limited. Consequently, the decision to initiate optimal medical therapy was based not solely on the result of the viability test but on the integration of clinical, anatomical, and functional findings, in agreement with the recommendations of the most recent international guidelines (19).

In this context, dobutamine stress echocardiography retains a relevant role as a tool for functional stratification, particularly in centers where cardiac magnetic resonance imaging or PET is not widely available. However, each diagnostic modality provides different information: echocardiography mainly evaluates contractile reserve, magnetic resonance imaging allows high-precision quantification of the transmural extent of fibrosis, and PET characterizes myocardial metabolism. Thus, the selection of the technique should be individualized according to availability, local expertise, and the specific clinical question.

Among the main limitations of this report, it should be noted that viability assessment was performed using a single imaging modality, without being complemented by cardiac magnetic resonance with late gadolinium enhancement or PET with ^{18}F -FDG, which are considered reference techniques for myocardial tissue and metabolic characterization. Likewise, because this is a single case report, the findings cannot be extrapolated to the entire population with ischemic heart disease and left ventricular dysfunction. However, the case represents a frequent situation in clinical practice and highlights the importance of interpreting imaging test results within the individual clinical context and not in isolation.

In conclusion, this case illustrates that dobutamine stress echocardiography remains a useful tool for assessing myocardial viability and stratifying patients with advanced ischemic heart disease. However, contemporary scientific evidence supports that the indication for revascularization should be based on a multidimensional assessment integrating functional findings, coronary anatomy, comorbidity burden, and procedural risk. Adopting this approach allows optimizing therapeutic selection, avoiding interventions with low probability of benefit, and favoring clinical decisions aligned with personalized medicine and current international recommendations.

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