Spasm of the Internal Thoracic Artery. Value of Echocardiography and Doppler in Long-term Follow-up

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Introduction

Spasm of the internal thoracic artery (ITA) is an infrequent phenomenon that occurs in any segment of the vessel, presenting different intensities and clinical repercussions. It can occur early postoperatively or be diagnosed after a few years, determining transient ischemia, myocardial infarction or death.[1-4]

Anastomosis of ITA in the anterior descending coronary artery (ADA) determines a hybrid system in which, usually, the diastolic component of the flow predominates, which means that the ITA is grafted and patent.[5] Doppler can be used noninvasively to analyze the ITA flow pattern, making it possible to verify the patency or functional impairment of the artery.[6] Since the spasm of the ITA anastomosed in ADA may compromise the myocardium, echocardiography is an essential tool in the diagnosis of complications and in the evaluation of prognosis through ventricular function.[7]

Case Report

Female patient, 48 years old, hypertensive, dyslipidemic, developing coronary insufficiency, good general condition, eupneic, afebrile, hemodynamically stable and without arrhythmia. Hemodynamic study revealed single stenosis in the proximal ADA (> 90%), but with good distal bed, and 70% stenosis of the right coronary artery. In May 1990, she underwent coronary artery bypass grafting surgery with left ITA graft in situ to the ADA and saphenous vein bridge from the aorta to the right coronary artery, with no complications during the surgical procedure. In the immediate postoperative period, the patient had a previous wall infarction that was not associated with hemodynamic instability, and was treated with clinical measures.

After hospital discharge, the patient presented good evolution, despite the presence of aneurysm in the apical region of the Left Ventricle (VE), evidenced by the echocardiogram. In April 1996, the left ITA was assessed at the supraclavicular level using Doppler, which revealed that the ITA unusually showed systolic and diastolic flow (Figure 1A). The patient was told that there was a possibility that the ITA was not occluded and, with her verbal consent, hemodynamic study was performed. Catheterization showed a graft to the right coronary artery without stenosis and, on ventriculography, apical aneurysm (Figure 1B). Contrast injection in the ITA showed complete patency of the graft and the underlying ADA (Figure 1C). However, during a new contrast infusion in another projection, total occlusion of the ITA occurred after the proximal segment (Figure 1D). However, the patient presented no symptoms, hemodynamic instability or electrocardiogram changes compared to the previous ones.

Expecting that the spasm would be reversed, immediately after the hemodynamic study, the patient was referred to the echocardiography service for a new scan. Doppler showed a marked change in the flow of the grafted ITA, with a minimum systolic component and total absence of a diastolic component (Figure 2A). Despite being asymptomatic and without hemodynamic instability, the patient was hospitalized for 72 hours and another Doppler echocardiography was performed before discharge. On that occasion, it was surprising to observe a pattern of myocardial reperfusion characterized by wide spectral Doppler curves of the ITA, besides a clear predominance of the diastolic component (Figure 2B).

On all the tests performed in subsequent years, Doppler records of the grafted ITA showed prominent flow with large predominance of the diastolic component. Diastolic fraction (DF) of the flow was calculated using the diastolic velocity-time integral (DVTI) and systolic diastolic velocity-time integral (SVTI) of the flow, using the following formula:

$$DF = [(DVTI) / (DVTI + SVTI)]$$

In this case (Figure 2C), mean DVTI 15.04 and SVTI, 6.87; DF was 68%.

Over the 28 postoperative years, the patient did not present angina pectoris or pulmonary or systemic congestion, evolving hemodynamically stable. Due to the LV aneurysm, regular Holter scans were performed, and frequent ventricular ectopy episodes were detected, requiring drug therapy.

In the evaluation performed in May 2018, the patient remains asymptomatic in her daily activities, daily using diltiazem (60 mg daily), acetylsalicylic acid (100 mg daily), amiodarone (200 mg daily) and atorvastatin (10 mg daily). The latest Doppler echocardiography showed aneurysm of the LV apical region, diastolic function characterized by the relaxation deficit pattern and flow of the grafted ITA with large predominance of diastolic flow (Figures 2C and 2D).

Keywords

Mammary Arteries; Spasm; Internal Mammary-Coronary Artery Anastomosis; Heart Aneurysm; Myocardial Reperfusion; Echocardiography, Doppler/methods

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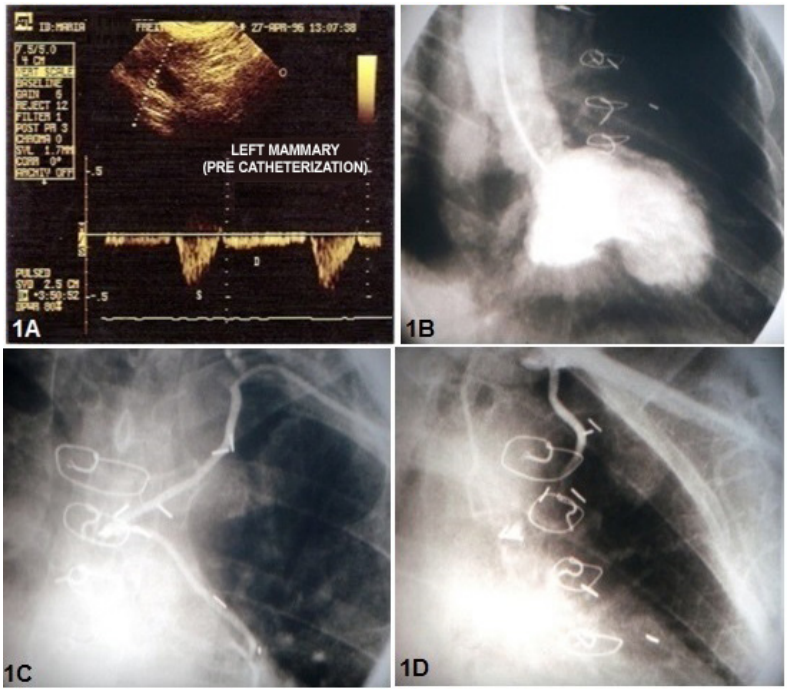

Figure 1 – *Doppler of the internal thoracic artery anastomosed in the anterior descending coronary artery presenting systolic and diastolic flow (A); aneurysm of the left ventricular (B) apical region seen before catheterization of the internal thoracic artery; angiography of the internal thoracic artery without stenosis or spasm perfusing the coronary artery (C); in a subsequent angiography, total occlusion of the internal thoracic artery occurs after its proximal segment (D).*

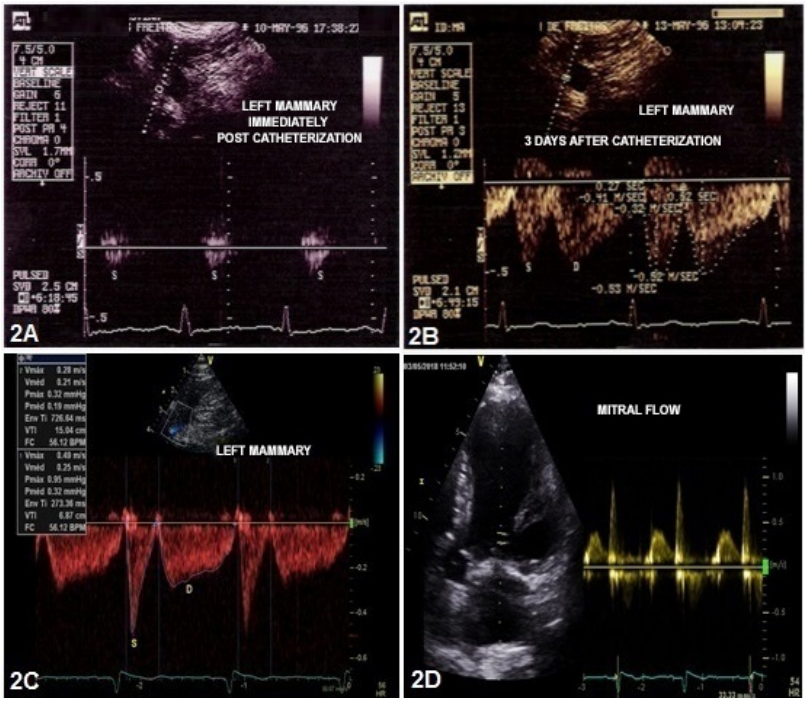

Figure 2 – *Doppler of the internal thoracic artery showing minimal systolic flow and absence of diastolic flow immediately after the spasm of this artery on angiography (A); 72 hours after the spasm, internal thoracic artery with prominent flow and diastolic predominance (B); 28 years after the surgery, the internal thoracic artery maintains the wide diastolic predominance of the flow (C), with the echocardiogram showing the left ventricular aneurysm and relaxation deficit (D).*

Discussion

Records of the ITA flow at the supraventricular level on Doppler can be performed with high feasibility, and, for more than two decades, our group has evaluated the ITA in situ.[8,9] In this report, the flow check in an ITA that perfused an aneurysmal region of the LV was suggestive of spontaneous reperfusion, which motivated the indication of the hemodynamic study. The absence of symptoms or complications during ITA spasm was attributed to the fact that this vessel irrigates an LV area with aneurysm.

The ITA Doppler performed immediately after catheterization was compatible with the occurrence of spasm, and the wide reperfusion of the ITA observed 72 hours after the spasm was surprising. However, other authors have already seen this phenomenon of late reperfusion on angiography.[3]

Management of the patient, before and during hospitalization, did not involve any author of this manuscript, and only a few weeks after discharge, one of the authors took over her clinical follow-up. In this period, the patient did not report any symptoms in her daily activities and, despite the apical aneurysm, the LV presented good contractility of the mid-basal region — a condition that could favor good evolution. Diagnosis of acute myocardial infarction due to probable occlusion of the ITA was considered plausible, which is why the conservative and noninvasive management was maintained during the first years of follow-up.

In 1995, our studies started, evaluating, at a supraclavicular level, the ITA flow of patients that had done coronary artery bypass grafting, so, in the following year, this procedure was routinely performed, a condition that favored the registration of an ITA with probable spontaneous reperfusion.

We could not measure the degree of fibrosis of the impaired LV area. However, we believed that the confirmation of this finding of patent ITA could be relevant in the context of a better outcome, considering the maintenance of myocardial perfusion. However, the hemodynamic study revealed an incidental occurrence of spasm and consequent ITA Doppler change. Madaric et al.[10] found that, in the case of proximal occlusion of the ITA, only one systolic and discrete flow component is seen – a characteristic recorded after the spasm in our case report.

The noninvasive observations on the ITA flow are of great importance, since regardless of the symptomatology, they can inform on the ITA patency even at the bedside, which may contribute to the management.

In situ ITA evaluation at the supraclavicular level is preferred because it presents the highest success rate and is the best access if the test needs to be repeated.[10-12] In the preoperative study, the flow is only systolic or predominantly systolic with a discrete diastolic component. After the ITA anastomosis in the left coronary system, its flow assumes a hybrid pattern, in which, the diastolic component usually predominates, a condition that suggests graft patency.[5,8,12]

Diastolic predominance can be seen by the relationship between systolic and diastolic velocities, but this relationship is more susceptible to limitations, depending on whether this record is taken in the proximal or distal ITA; the degree of stenosis of the native vessel; the underlying myocardial functional status; or of the competition of flow by the presence of branch in the graft.[5,9,12,13]

In resting assessment, the best predictor of significant stenosis of the anastomosed ITA is a flow DF $< 50\%$.[12,13] In this case (Figure 2C), DF was 68%, which is compatible with absence of significant ITA stenosis. A better noninvasive functional evaluation of the ITA can be obtained through the coronary reserve in the graft, but this analysis is not included in this report.[9,10]

Our case reports an unusual follow-up of 28 years. Although it is perfusing the coronary artery related to the aneurysmal LV area, the demonstration that the ITA remains patent and with predominance of diastolic flow is relevant. Likewise, the LV relaxation deficit pattern on Doppler is an important echocardiographic finding associated with a better prognosis in the presence of systolic dysfunction.[7]

Conclusion

Doppler echocardiography allows the noninvasive evaluation of patency or transient suppression of internal thoracic artery flow. Simultaneously with the analysis of ventricular geometry and function, it is an important diagnostic and prognostic tool.

Authors' contributions

Research creation and design: Abreu JS; Data acquisition: Abreu JS, Diogenes TCP, Barreto JEF; Data analysis and interpretation: Abreu JS, Barreto JEF; Manuscript writing: Abreu JS, Abreu MEB, Freire RA; Critical revision of the manuscript as for important intellectual content: Abreu JS, Farias AGLP.

Potential Conflicts of Interest

There are no relevant conflicts of interest.

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Academic Association

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