

# Non-invasive assessment of coronary flow velocity reserve before and after angioplasty in a patient with mammary graft stenosis

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**We report the diagnosis of mammary artery graft dysfunction by high-resolution transthoracic Doppler and venous adenosine infusion. The patient was treated by percutaneous balloon angioplasty, with optimal angiographic results. Coronary flow reserve in the distal left anterior descending artery was abnormal before angioplasty, and recovered soon after the procedure. The utility of this new non-invasive technique in the diagnosis of flow-limiting stenoses and follow-up of coronary angioplasty is described.**

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## Introduction

Coronary surgery with the left internal mammary artery (LIMA) grafted to the left anterior descending artery (LAD) is a widespread therapeutic strategy for the treatment of myocardial ischemia<sup>1</sup>. Percutaneous transluminal coronary angioplasty (PTCA) is an alternative technique to treat significant stenosis of coronary arteries<sup>2</sup> and grafts<sup>3,4</sup>. Graft patency can be assessed by invasive techniques, such as coronary angiography and intracoronary Doppler<sup>5,6</sup>, or by non-invasive techniques, such as transthoracic color-guided pulsed Doppler<sup>6-11</sup>.

Non-invasive ultrasound interrogation of the LIMA has initially been described from the supraclavicular approach<sup>6-10</sup>, at its take off from the subclavian artery. However, at this level the flow profile may be contaminated by muscular flow of proximal collaterals, which may have been left in place at surgery. More recently, we have proposed to image the distal tract of the graft at the level of the suture over the LAD<sup>11</sup>. At this level, the flow velocity profile more closely reflects myocardial flow<sup>12-14</sup>, and coronary flow velocity reserve with dipyridamole or adenosine<sup>15-17</sup> can be easily measured.

In this report, we describe the use of high-resolution transthoracic Doppler echocardiography and venous adenosine infusion, to predict the presence and site of LIMA-

LAD graft stenosis and to assess the immediate effect of PTCA on coronary flow reserve.

## Case report

A 53-year-old male patient who underwent coronary surgery in 1989 (non-skeletonized LIMA-LAD graft and saphenous vein grafts over the first obtuse marginal, first diagonal and right coronary artery) was readmitted to our institution for chest pain of recent onset. Basal electrocardiogram (ECG) was normal, effort ECG showed a 1.5 mm S-T segment depression in leads V<sub>4</sub>-V<sub>6</sub>, and echocardiography showed abnormal inferior-lateral wall motion and mild mitral incompetence.

High-resolution Doppler imaging of the LIMA graft was performed from the parasternal window (third and fourth left intercostal space) with an Acuson Sequoia C256 ultrasound unit (Acuson, Mountain View, CA, USA), connected to a dedicated multifrequency 3.5-7 MHz (3.5-6 MHz in color Doppler) transducer. Color-coded Doppler setting was adjusted for optimal scanning sensitivity, without significantly reducing the frame rate. The spatial orientation of flow in the distal LIMA, LIMA-LAD graft and distal LAD, was clearly detected. Coronary flow velocity in each segment was measured by pulsed Doppler,

which showed two different patterns: a continuous flow in the distal LIMA, with higher than normal peak systolic (50 cm/s) and diastolic (55 cm/s) velocities with a diastolic/systolic ratio of 1.1 (Fig. 1); a prevalent diastolic flow in the distal LAD, after the anastomosis, with a peak velocity of 40 cm/s (Fig. 1). The venous infusion of adenosine (140 mg/kg/min for 90 s) produced a hyperemic/baseline flow ratio of 1.1, consistent with a severely impaired coronary flow reserve in the distal LAD (Fig. 1). These flow patterns suggested a hemodynamically significant stenosis of the LIMA-LAD conduit<sup>8,9</sup>, probably at the anastomotic site.

Coronary angiography showed an 80% LAD stenosis, immediately below the LIMA graft (Fig. 2A). The lesion was treated by PTCA (two balloon inflations at 8 atm) with optimal lumen enlargement (Fig. 2B). Three days after PTCA, transthoracic Doppler showed normalization of the resting flow in the distal LIMA (peak diastolic velocity 34 cm/s, peak systolic veloc-

ity 20 cm/s, diastolic/systolic ratio 1.7) (Fig. 3). Adenosine infusion showed recovery of coronary flow reserve in the distal LAD with a 3-fold increase in velocity (Fig. 3).