Case Report

Additional Help to Diagnose Functionally Significant Left Main Coronary Artery Stenosis: Doppler Echocardiography

Zoltán Ruzsa[1], Edit Nagy[2], Imre Ungi[1], Tamás Forster[1], Attila Pálinkás[2], Attila Nemes[1]

[1]2nd Department of Medicine and Cardiology Centre, Faculty of Medicine, Albert Szent-Györgyi Clinical Centre, University of Szeged, Szeged, [2]Department of Medicine, Erzsébet Hospital, Hódmezővásárhely, Hungary

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Doppler echocardiography is a widely used non-invasive method for the evaluation of coronary flow velocities and reserve. We report a case that demonstrates the possible additive role of transthoracic echocardiography (TTE) in the diagnosis of significant left main coronary artery (LM) stenosis in a chest pain patient. Coronary angiography showed no significant LM stenosis. During TTE with pulsed-Doppler measurements, a significant increase in coronary flow velocities could be demonstrated in the distal LM. Intravascular ultrasound confirmed a significant soft plaque in the distal LM. The present case suggests that Doppler TTE may have an additional role in the diagnosis of significant LM stenosis in symptomatic patients. A colour Doppler flow acceleration with high velocities in the LM could raise the suspicion of significant LM stenosis, even if the stenosis cannot be detected by standard coronary angiography.

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Address: Attila Nemes

2nd Department of Medicine and Cardiology Centre, Medical Faculty, Albert Szent-Györgyi Clinical Centre, University of Szeged, Hungary, H-6720 Szeged, Korányi fasor 6. P.O. Box 427
e-mail: nemes@in2nd.szote.u-szeged.hu

Doppler echocardiography is a widely used non-invasive method for the evaluation of coronary flow velocities and reserve. The aim of this report was to demonstrate the possible additive role of transthoracic Doppler echocardiography (TTE) in the diagnosis of significant left main coronary artery (LM) stenosis in a patient with chest pain.

Case presentation

A 52-year-old hypertensive male with 6 months' history of progressive effort chest pain was referred to the Outpatient Cardiology Clinic of the University of Szeged. No abnormalities could be demonstrated during physical examination or on the 12-lead electrocardiogram. Coronary angiography showed no significant (40%) LM stenosis (Figure 1). During TTE with pulsed-Doppler measurements, a significant increase in coronary flow velocities in the distal LM could be demonstrated (Figure 2).[1] In view of the persistent symptoms and increased coronary flow velocities, a second coronary angiography was performed with the addition of an intravascular ultrasound (IVUS) examination. A significant soft plaque was found in the distal LM (Figure 3A). In our practice, a 6 mm^2 IVUS lumen area is used as the significant criterion for LM, because it has been shown to correlate with measurements of fractional flow reserve (FFR).[2] Therefore, additional FFR measurement was not performed because the LM measurements satisfied the significant IVUS "cut-off" parameters. Given the significant LM stenosis, an *ad hoc* percutaneous coronary intervention (PCI) was performed using the standard protocol, with a good result (Figure 3B). After PCI, the patient became asymptomatic and no ST-

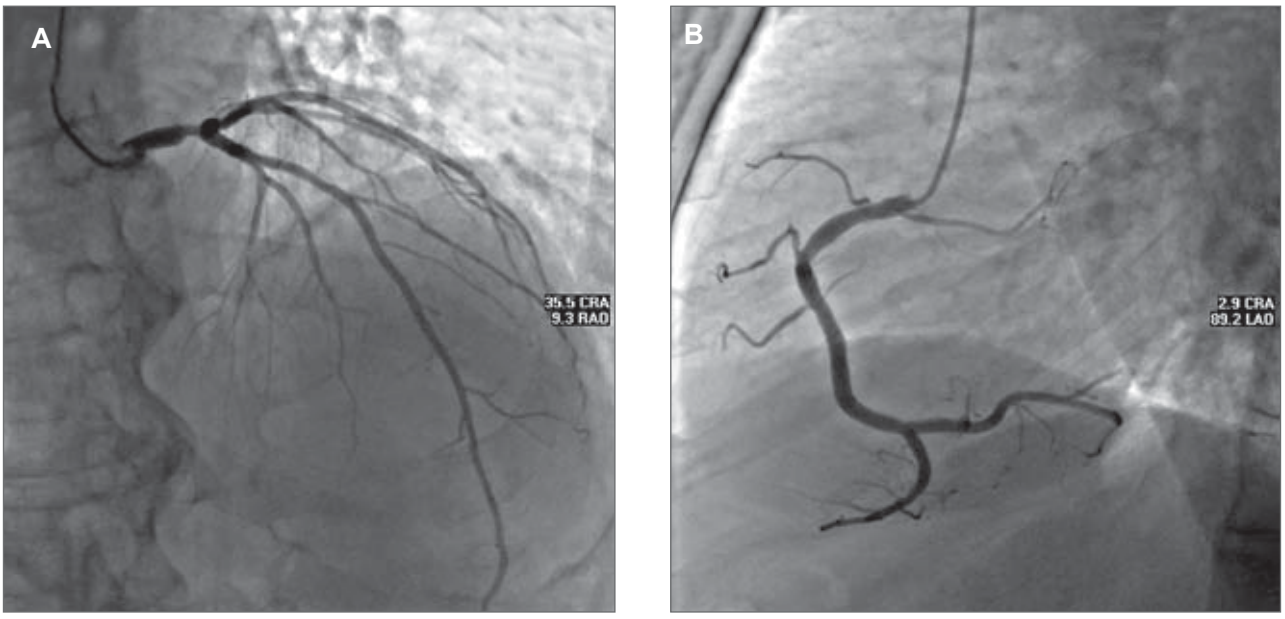


Figure 1. Both left (A) and right (B) coronary artery angiograms showed no significant coronary artery stenoses.

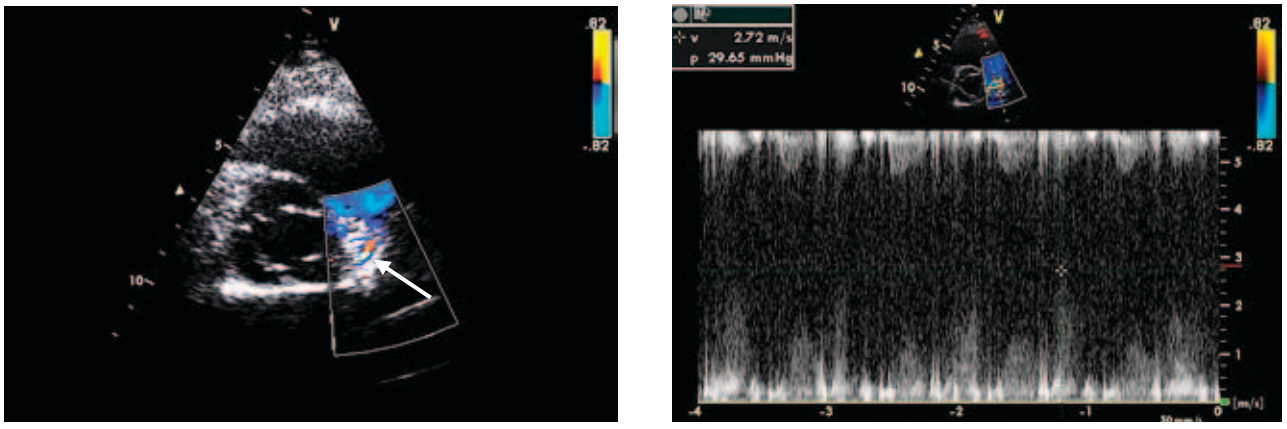


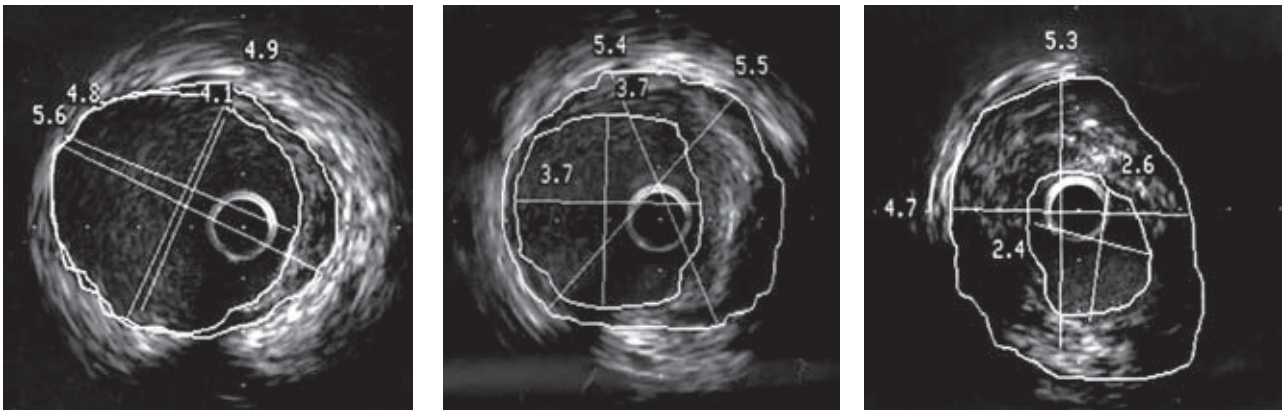
Figure 2. Increased coronary flow velocities could be detected by pulsed-wave transthoracic Doppler echocardiography in the distal part of the left main coronary artery (see arrow).

segment alteration was observed on subsequent serial ECGs. Biomarkers for myocardial damage remained within normal limits. The patient was discharged 2 days after the intervention and remained symptom free during the 4 months' follow up.

Discussion

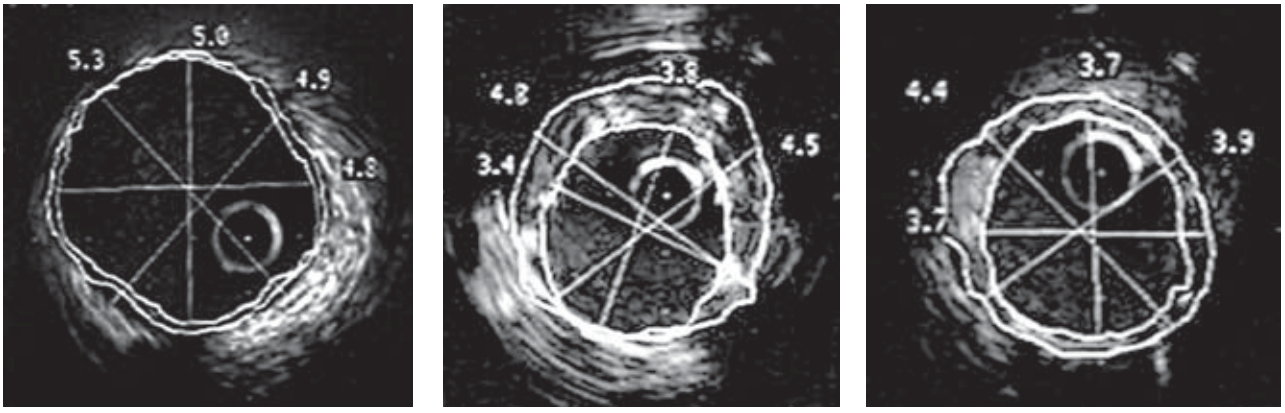
The LM has unique anatomical features which limit the visual and angiographic assessment of lesion severity, with relatively large intra- and inter-observer variability.[3] The LM is generally a short vessel and may be diffusely diseased, thus leaving little opportunity for a normal reference segment. The fact that certain parts of the coronary arteries, including the LM, can be visualised with Doppler-TTE has been recognised for several years.[4] In the present case the authors wish to emphasise the importance of Doppler TTE in the evaluation of the significance of LM stenosis in symptomatic patients. The method is simple, non-invasive, easy to learn, and can be used routinely. A colour Doppler flow acceleration with high velocities in the LM could raise the suspicion of significant LM stenosis, even if the stenosis cannot be detected by standard coronary angiography. In case of discrepancies, further examinations can be required (for instance IVUS).[5,6]

Pulsed-wave Doppler TTE is a reliable method for the evaluation of coronary flow velocity changes



A

Pre-PCI status	Ostium	Mid Shaft	Distal shaft
Min. lumen diameter	4.1 mm	3.5 mm	2.4 mm
Lumen area	17.4 mm^2	11.5 mm^2	5.5 mm^2



B

Post-PCI status	Ostium	Mid Shaft	Distal shaft
Min. lumen diameter	5 mm	3.4 mm	3.7 mm
Lumen and stent area	18.1 mm^2	9.9 mm^2	9.3 mm^2

Figure 3. During intravascular ultrasound examination, significant left main coronary artery stenosis could be demonstrated (A), which was treated with a successful percutaneous coronary intervention with stent implantation (B).

in the left anterior descending coronary artery (LAD) during vasodilator stress.[7] Assessment of coronary flow velocity reserve (CFR) in the LAD using TTE is an excellent option for evaluating the functional significance of an LAD stenosis, or coronary microcirculation conditions in the absence of significant LAD stenosis. CFR is usually calculated as the ratio of maximal (hyperaemic) to resting diastolic coronary blood flow velocities. Echocardiography-derived CFR is well correlated with the degree and location of a stenosis.[7,8] However, it should also be emphasised that CFR is dependent not only on micro- and macrovascular resistance, but also on myocardial resistance, hyperviscosity, metabolic factors, insulin resistance, etc.[7,9,10]

Apart from wall motion analysis, there are other new echocardiographic techniques that have been used to a limited extent in the diagnosis of coronary artery disease. Contrast echocardiography can be a method of choice in the evaluation of perfusion abnormalities and myocardial flow reserve in certain myocardial regions.[11] Speckle-tracking strain analysis can also be used for the detection of significant coronary artery disease.[12]

References

1. Krzanowski M, Bodzoń W, Brzostek T, Nizankowski R, Szczeklik A. Value of transthoracic echocardiography for the detection of high-grade coronary artery stenosis: prospective evaluation in 50 consecutive patients scheduled for coronary angiography. J Am Soc Echocardiogr. 2000; 13: 1091-1099.
2. Jasti V, Ivan E, Yalamanchili V, Wongpraparut N, Leesar MA. Correlations between fractional flow reserve and intravascular ultrasound in patients with an ambiguous left main coronary artery stenosis. Circulation. 2004; 110: 2831-2836.
3. Abizaid AS, Mintz GS, Abizaid A, et al. One-year follow-up after intravascular ultrasound assessment of moderate left main coronary artery disease in patients with ambiguous angiograms. J Am Coll Cardiol. 1999; 34: 707-715.
4. Rink LD, Feigenbaum H, Godley RW, et al. Echocardiographic detection of left main coronary artery obstruction. Circulation. 1982; 65: 719-724.
5. Sanidas EA, Vavuranakis M, Papaioannou TG, et al. Study of atheromatous plaque using intravascular ultrasound. Hellenic J Cardiol. 2008; 49: 415-421.
6. Van Velzen JE, Schuijf JD, De Graaf FR, et al. Imaging of atherosclerosis: invasive and noninvasive techniques. Hellenic J Cardiol. 2009; 50: 245-263.
7. Dimitrow PP, Galderisi M, Rigo F. The non-invasive documentation of coronary microcirculation impairment: role of transthoracic echocardiography. Cardiovasc Ultrasound. 2005; 3: 18.
8. Hutchison SJ, Soldo SJ, Gadallah S, Kawanishi DT, Chandraratna PA. Determination of coronary flow measurements by transesophageal echocardiography: dependence of flow velocity reserve on the location of stenosis. Am Heart J. 1997; 133: 44-52.
9. Nemes A, Forster T, Varga A, et al. How can coronary flow reserve be altered by severe aortic stenosis? Echocardiography. 2002; 19: 655-659.
10. Nemes A, Lengyel C, Forster T, et al. Coronary flow reserve, insulin resistance and blood pressure response to standing in patients with normoglycaemia: is there a relationship? Diabet Med. 2005; 22: 1614-1618.
11. Abdelmoneim SS, Dhoble A, Bernier M, et al. Absolute myocardial blood flow determination using real-time myocardial contrast echocardiography during adenosine stress: comparison with single-photon emission computed tomography. Heart. 2009; 95: 1662-1668.
12. Ng AC, Sitges M, Pham PN, et al. Incremental value of 2-dimensional speckle tracking strain imaging to wall motion analysis for detection of coronary artery disease in patients undergoing dobutamine stress echocardiography. Am Heart J. 2009; 158: 836-844.