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Coronary flow reserve assessment

We would like to add some comments to an interesting paper of Voci et al.1 Apart from the anterior and posterior descending coronary artery, it is possible to visualize transhorachically proximal and middle segments of the circumflex coronary artery and all three segments of the right coronary artery.2–5 The images other than from the apical windows are obtainable.4

Reduction of coronary flow reserve (CFR) depends not only on severity of stenoses in epicardial arteries but also on a number of ‘micromascular factors’ which either limit maximal vasodilatation or increase baseline coronary blood flow.2–6 In the absence of stenosis in the epicardial coronary artery, decreased CFR enables the detection of impaired microvascular vasodilatation in left ventricular hypertrophy (hypertension, aortic stenosis, and hypertrophic cardiomyopathy) diabetes mellitus, hypercholesterolaemia, smoking, and syndrome X.2,4–6 Importantly, epicardial coronary artery stenosis and microcirculation abnormalities may co-exist and cumulatively decrease the CFR. It is possible to distinguish the haemodynamic effect of stenosis of epicardial coronary artery from microcirculation abnormalities in order to identify cases with moderate stenosis in which coronary intervention can correct the abnormalities of blood flow. For this purpose, a stenosis-specific parameter, i.e. the accelerated coronary flow in the left ventricular hypertrophy (hypertension, aortic stenosis, and hypertrophic cardiomyopathy) diabetes mellitus, hypercholesterolaemia, smoking, and syndrome X.2,4–6 Importantly, epicardial coronary artery stenosis and microcirculation abnormalities may co-exist and cumulatively decrease the CFR. It is possible to distinguish the haemodynamic effect of stenosis of epicardial coronary artery from microcirculation abnormalities in order to identify cases with moderate stenosis in which coronary intervention can correct the abnormalities of blood flow. For this purpose, a stenosis-specific parameter, i.e. the accelerated coronary flow velocity within the stenosis and immediately proximal to it) is more reliable than any single velocity measurement. We successfully used the criteria valid for peripheral arteries where local velocity increase with at least doubling of velocity within the stenosis is regarded as a sign of haemodynamically significant stenosis.

Finally, we would like to mention that coronary endothelium-dependent vasodilatation is also measurable by transthoracic Doppler echocardiography.7

References


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Coronary flow reserve assessment: reply: the ghost of microcirculation

The possibility to directly image the coronary arteries and to measure the stenotic gradient was foreseen by Hozumi et al.1 in patients with left anterior descending (LAD) coronary artery stent, but unfortunately it could not be reproduced by others. We agree that scanning along the LAD to measure velocity gradients may be the future, but it is unfortunately not feasible today. Regarding coronary segmenta-
tion, by definition, the circumflex coronary artery (Cx) is divided into a proximal and a distal segment, but the middle segment does not exist.2 By transthoracic ultrasound it is theoretically possible to image only the proximal segment, but neither the marginal branches nor the distal Cx. Similarly, it is very hard to image the course of the right coronary artery. Both our findings and the literature data on transthoracic coronary

Doppler ultrasound consistently show that the impact of smoke, hormonal changes, remote coronary artery disease,3 hypertrophy (Figure 1), and even diabetes (unpublished personal data) on coronary flow reserve (CFR) is minimal when compared with that of an epicardial stenosis, and that microcirculation alone (if we exclude the very first days of acute myocardial infarction4) almost never reduces CFR to less than two. Noteworthy, if CFR is reduced because baseline flow is increased, this only means that part of the reserve is ‘burned at the rest’, which should never be interpreted as any microvascular dysfunction. Figure 1 works better than the 500 words allowed for this reply letter, to remove from our dreams the ghost of microcirculation.

References

2. Rogers WJ, Alderman EL, Chaitman BR et al. Bypass angioplasty revascularization


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![Image](https://example.com/image1)

**Figure 1** Hypertrophic cardiomyopathy with mid-ventricular obstruction.

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