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Myocardial viability: the search for a perfect method is not over yet

See page 1091 for the article to which this Editorial refers

Left ventricular systolic function is a major determinant of long-term prognosis in patients with coronary artery disease[1]. It is also clear that a subset of patients with impaired left ventricular function can improve substantially after revascularization[2]. This translates into prolonged survival and a decrease in heart failure symptoms. However, not all patients show an improvement in left ventricular function despite successful myocardial revascularization. The question is how to identify patients with dysfunctional myocardium that is still viable and has the potential for functional recovery. This is of paramount importance in the selection of patients for myocardial revascularization procedures. In fact, patients with lack of significant myocardial viability (less than four to six left ventricular segments) do have a worse prognosis if they undergo revascularization[3].

The methods that have been used to assess myocardial viability include positron emission tomography and F18-fluorodeoxyglucose, the latter being used in the current study as a gold standard. Dobutamine stress echo has also been used by some groups to study myocardial viability, particularly in low dose protocols used to evaluate myocardial contractile reserve. It is an inexpensive, readily available and accurate method of identifying contractile reserve in myocardial regions with resting wall abnormalities. It can be used to identify dysfunctional, but viable myocardium and it can provide some prognostic information in patients with left ventricular dysfunction[4]. However when compared with F18-fluorodeoxyglucose, in some studies, it was shown to be less sensitive and less specific. Another limitation is that it is only a semiquantitative method.

Pulsed wave Doppler tissue sampling is a new ultrasound methodology with the potential for quantitating myocardial contraction as the sum of contraction velocities of longitudinal and equatorally arranged myofilaments, each of which contributes approximately 50% to ejection fraction. It has been used to quantitatively assess regional left ventricular dynamics, including regional diastolic and systolic function.

In the study of Rambaldi *et al.*[5] the authors compare pulsed wave Doppler tissue sampling/dobutamine–stress echocardiography with standard F18-fluorodeoxyglucose for identification of myocardial viability in patients with known coronary disease and impaired left ventricular function. Forty patients were evaluated with a mean ejection fraction of 33%. The results showed that 96% of the 240 studied segments were able to be analysed by dobutamine echo, of which 77% showed reduced wall motion. There was a mean of 4·4 dysfunctional segments per patient. During dobutamine infusion 95% of all segments (227/240) could be scored for wall motion by using pulsed wave Doppler tissue sampling. It is important to highlight the fact that differences were

found among the different segments regarding the feasibility to obtain pulsed wave Doppler tissue sampling. For instance, the anterior wall showed a feasibility of only 85%. All segments were analysable by F18-fluorodeoxyglucose. F18-fluorodeoxyglucose demonstrated that 53% of the abnormal 177 segments were viable and 46% were non-viable and the distribution of these wall motion abnormalities was clearly demonstrated by this method. Fifty five percent of the 177 segments were considered non-viable by dobutamine–stress echocardiography. Viability by pulsed wave Doppler tissue sampling at low dose dobutamine correlated with improvement of velocity in 73% while non-viability corresponded with no improvement in ejection velocity, such that pulsed wave Doppler tissue sampling had a sensitivity of 87% and a specificity of 51% for the prediction of viable myocardium. These results are also important since they confirm some previous work done in an animal model[6].

Pulsed wave Doppler tissue sampling had a higher sensitivity than dobutamine–stress echocardiography alone for myocardial viability when F18-fluorodeoxyglucose was used as a reference standard. In this study the authors show that examination of longitudinal fibres rather than equatorial myocardial fibres in a quantitative fashion makes pulsed wave Doppler tissue sampling an attractive method for assessment of viability in patients with left ventricular dysfunction. This is important since the longitudinal and transverse fibres behave differently, resulting in non-linear contraction and relaxation throughout the myocardium. Long axis shortening starts 25 ms prior to sort axis shortening. Since longitudinal fibres are situated near the endocardial and epicardial surfaces, and circumferential fibres more within the myocardium, the contraction and relaxation may be non-linear throughout the wall. It is, however, important to understand some of the limitations of this method in order to better interpret the results. Pulsed wave Doppler tissue sampling may over- or under-estimate the presence of myocardial viability, for instance, due to tethering of adjacent viable segments to scar tissue or, in contrast, due to lack of contractile function in severely dyssynergic areas. In addition, the comparison of a method, such as pulsed wave Doppler tissue sampling, which assesses contractile function, and a method such as F18-fluorodeoxyglucose, which assesses metabolic activity, should be approached cautiously since each method is looking at different things, although with some common implications. Another limitation is the difference in obtaining pulsed wave Doppler tissue sampling of the different segments of the left ventricular walls, with the anterior wall being the more difficult to study. It is also important to note the low specificity of the method when compared with F18-fluorodeoxyglucose, which means that a large number of false-positive results can be obtained. This is relevant considering the fact that the number of viable segments is currently an important prognostic marker, which is used to select patients for revascularization.

Despite the limitations of the method, it can represent an easier and more accurate method to study patients with impaired left ventricular function who are being considered for myocardial revascularization, by providing quantitative information. It should, however, be considered as complementary to the semi-quantitative information provided by dobutamine stress echo and not as an alternative. Further studies are needed with larger patient populations and comparisons with other methods. The importance of this method in the selection of patients for myocardial revascularization and its impact on the definition of long-term prognosis is another issue to be further studied in the future.

F. J. PINTO
Lisbon University, Portugal

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