The role of SPECT and gated SPECT

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Independent of the involved physiopathologic mechanism of reversible dysfunction (true hibernation with reduced baseline myocardial blood flow, or preserved resting flow with minimal-threshold ischemia and repeated stunning) asynergic segments including viable myocardium are liable to recover their function after successful coronary revascularization (1). Therefore, the detection of myocardial viability in coronary artery disease patients with evidence of significant LV dysfunction is very important. Furthermore, due to population ageing the number of patients who come for the first time to medical attention because of heart failure symptoms is increasing. In these patients viability imaging is indicated, since the demonstration of a potentially reversible ischemic cardiomyopathy is a major chance of effective therapy.

PET is regarded as the most accurate technique for viability detection, but practical and economic constraints limit its widespread use. Similarly, magnetic resonance imaging is hampered by availability restrictions. Echocardiography and myocardial perfusion SPECT are the easily accessible techniques that play the key role in the current clinical setting (2). Echocardiography offers many advantages, but inadequate acoustic window, dependence on observer’s expertise, and limited reproducibility may be a problem. Therefore, the role of SPECT still appears to be a major one in viability imaging. It is well known that both thallium-201 ($^{201}$TI) and the currently used $^{99m}$Tc-labeled perfusion agents (sestamibi and tetrofosmin) are viability tracers, because reveal cell membrane integrity. To achieve reasonable accuracy in viability detection, however, dedicated acquisition protocols are needed. $^{201}$TI stress-redistribution-reinjection and rest-redistribution are both effective in terms of high sensitivity, but have a relatively poor specificity. Conversely, some early studies demonstrated a possible underestimation of viability in resting images with $^{99m}$Tc-labeled agents. To overcome this problem, the quantitative assessment of tracer uptake is mandatory. Another effective approach is to inject the tracer in combination with nitrate administration (3). This technique allows an increase in both sensitivity and in specificity, as compared with the demonstration of post-revascularization recovery (2). Also with $^{99m}$Tc-labeled agents the specificity in baseline hypokinetic areas is limited, because is difficult to differentiate between non-functioning viable myocardium and subendocardial infarct scarring.

In this particular setting, gated SPECT may be particularly useful. A first advantage of gated SPECT is that regional LV function and perfusion within the same areas can be compared without alignment problems. Thus, the tracer uptake threshold for viability can be adapted to the degree of regional dysfunction: higher values in hypokinetic segments increase specificity, whilst lower values in akinetic regions prevent an undue drop in sensitivity. Gated SPECT also gives the possibility to explore the contractile reserve of dysfunctional areas by performing an acquisition under inotropic stimulation, as it is currently done with echocardiography. Echocardiography remains the ideal tool to explore the contractile reserve of dysfunctional myocardium. Nevertheless, also dobutamine gated SPECT has its strong points. First, there are no acoustic window limitations. Second, off-line evaluation of reconstructed images reduces observer-related biases. Third, the global LV functional reserve can be explored as well, and gated SPECT ejection fraction (EF) under dobutamine has been found to be predictive of post-revascularization EF response (4). This last point must be attentively considered, since it has been demonstrated that LV EF recovery is more important than segmental recovery.

Gated SPECT could be of some interest in other conditions related to heart failure symptoms (5). Initial experiences suggest a role for gated SPECT in the follow up of patients submitted to cardiac resynchronization therapy (and possibly to select the ideal candidates to this treatment), in the prediction of the response to therapy and in the follow up of patients with dilated cardiomyopathy. Further studies will clarify whether these new uses of gated SPECT are going to become clinical routine.
References


