

## Myocardial perfusion scintigraphy before and after cardioversion for atrial fibrillation: Recovery of quantitative parameters

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**Case presentation.** A 54-year-old woman with a history of paroxysmal atrial fibrillation (AF) was referred to our department for myocardial perfusion scintigraphy (MPS) due to suspicion of coronary artery disease. The history revealed several cardioversions and two ablation-procedures for the treatment of AF. Adenosine stress test was used because the  $\beta$ -blockade medication was not stopped before of the exercise test. Prior to the adenosine-stress MPS, the electrocardiogram showed AF with a ventricular rate of 120 beats/minute (bpm) (Figure 1). 712 MBq <sup>99m</sup>Tc-tetrofosmin was administered at the third minute during adenosine infusion (140  $\mu$ g/kg body weight/minute for 6 min with simultaneous handgrip exercise). During adenosine infusion the patient complained of palpitations; however, no hemodynamic changes and no progression of the initial significant ST-T segment changes were observed. Immediately after acquisition of the images the patient underwent electric cardioversion and was discharged from the hospital the same day with sinus rhythm. Three days later the patient underwent rest MPS during sinus rhythm (60 bpm) (Figure 2). 768 MBq <sup>99m</sup>Tc-tetrofosmin was injected and 45 min later rest-images were acquired. Gated myocardial perfusion stress- and rest-images were acquired using a

three-headed Gamma Camera (GCA-9300, Toshiba, Japan) and analyzed using the 4DM-software (Corridor 4DM, INVIA, Ann Arbor, University of Michigan Medical Center).

Perfusion images (both stress and rest) showed slightly decreased tracer uptake anteroseptal due to breast attenuation, but no other abnormalities were observed. The left ventricular ejection fraction (LVEF) was 56% during adenosine-stress and 58% at rest. The left ventricular volumes during adenosine-stress were 86 ml (left ventricular end-diastolic, LVED) and 38 ml (left ventricular end-systolic, LVES), but significantly increased at rest to 137 and 58 ml, respectively (Figure 3). Nine months later, a second MPS at rest was performed during sinus rhythm (55 bpm) to evaluate the functional parameters and volumes. In the time between the two rest MPS studies, the patient did not have any cardioversion or other cardiac intervention. The second MPS study at rest (sinus rhythm) showed a LVEF of 67% with LVED volume of 133 ml and LVES volume of 44 ml. The perfusion images did not show any significant changes. The changes in left ventricular volumes between the 3 MPS acquisitions are displayed in Figure 4.

**Discussion.** AF is the most common arrhythmia and occurs in 0.4% of the general population. Furthermore, the incidence and prevalence increase with the age.<sup>1</sup> Cardioversion of AF is generally performed in an effort to improve cardiac function, to relieve symptoms and to decrease the incidence of thrombus formation. Although left ventricular dysfunction has been shown to improve after cardioversion, it can persist for a few weeks.<sup>2</sup> In this case, we present the effect of cardioversion on left ventricular volumes and ejection fraction shown by MPS.

The early and late effects of cardioversion on left ventricle volumes and function has been reported before, using cinematographic breath-hold magnetic resonance imaging and echocardiography.<sup>2-5</sup> This report showed the short- and long-term effects of cardioversion on left ventricular function by MPS.

In this case, myocardial dysfunction is probably due to tachycardia with a ventricular rate of 120 bpm at

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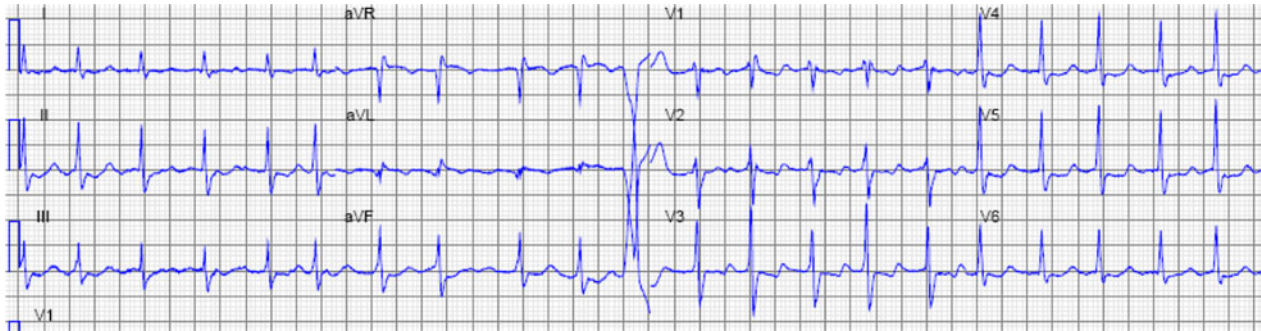
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J Nucl Cardiol 2011;18:192-5.

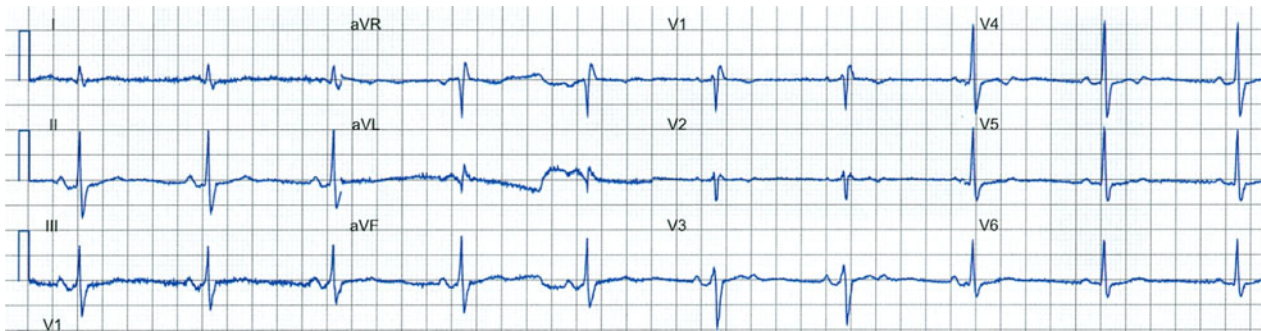
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doi:10.1007/s12350-010-9299-y



**Figure 1.** Baseline ECG showing atrial fibrillation with a ventricular rate of 120 beats/minutes, an incomplete right bundle branch block and slight diffuse ST-segment depression.

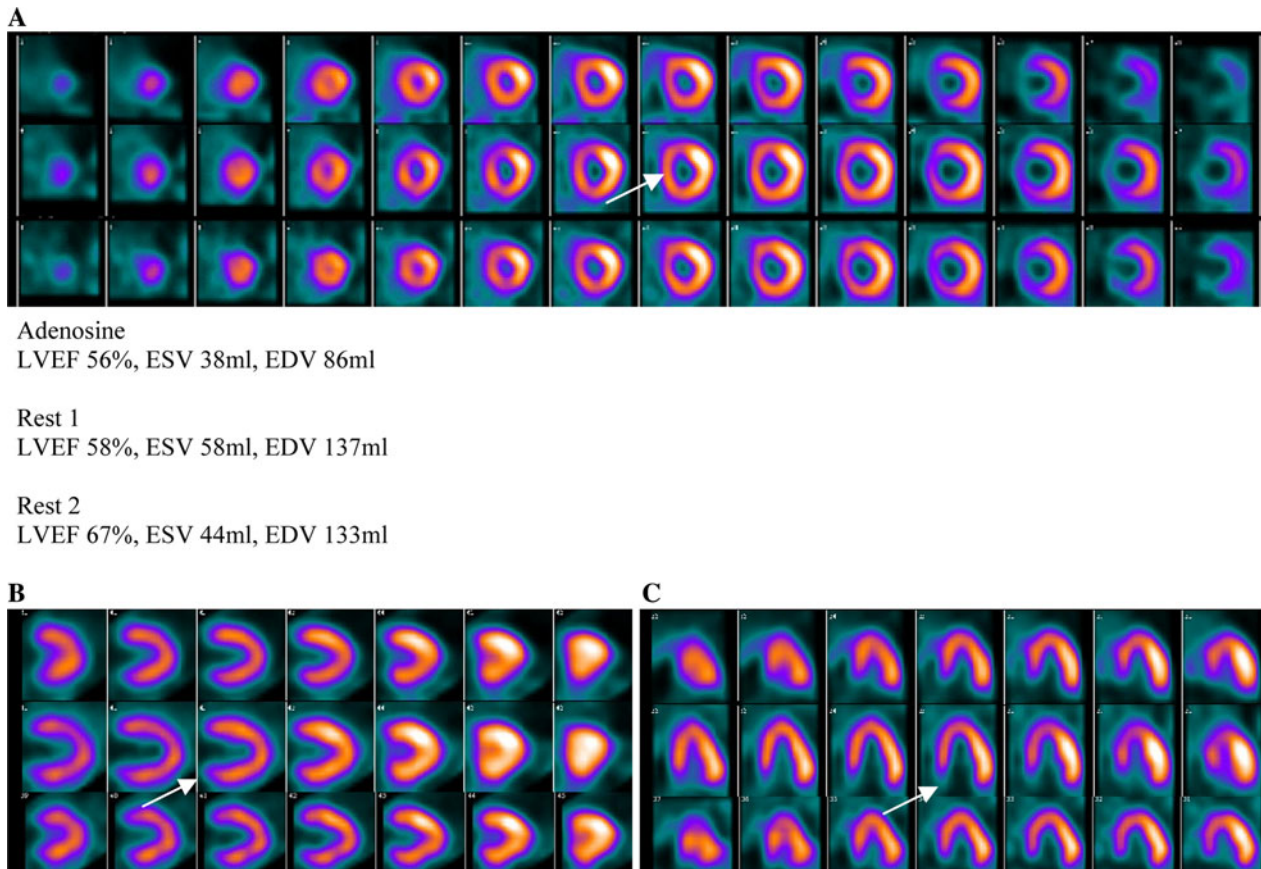


**Figure 2.** Rest ECG showing normal sinus rhythm with a heart rate of 60 beats/minutes and recovery of the ST-segment depression.

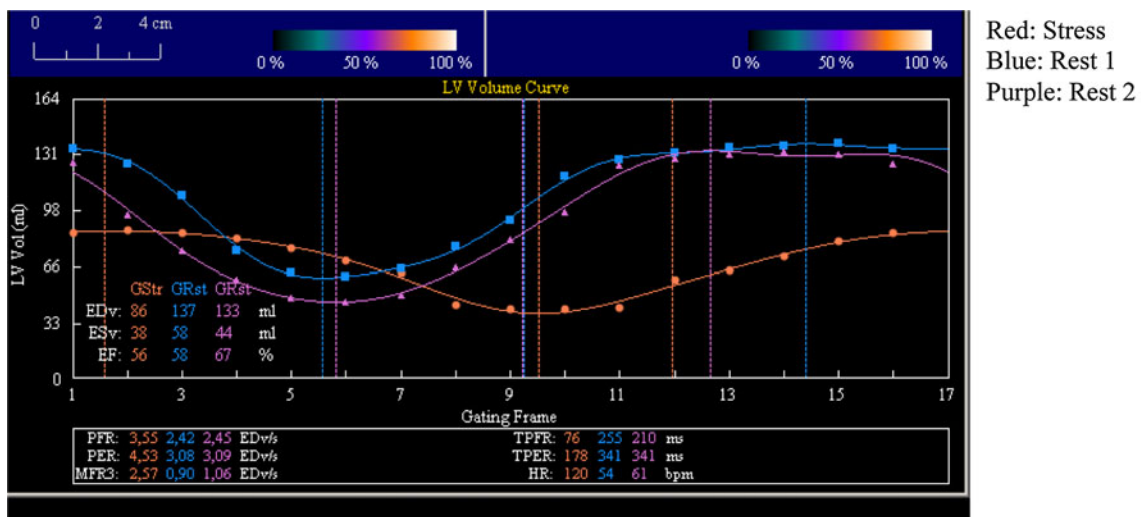
acquisition. During sinus rhythm improvement in LV volumes and a slightly (but not significant) increase in LVEF was observed 3 days after cardioversion. The significant increase in LVED volume can be explained by the regulation of the rhythm, increased cycle length and a reduction in heart rate after cardioversion. Nine months after cardioversion there was a significant increase in LVEF due to full recovery of the volumina with a further increase in stroke volume.

It has to be realized that there are some technical limitations related to the assessment of LV parameters by gated SPECT during AF. First, heart rate can influence EDV measurements. An increase in heart rate will ensure a smaller contribution of diastolic images to the entire summed volume, because the heart will remain a shorter period of time in diastole and may vary from beat to beat during AF. This may cause errors in

accurate identification of the end-diastolic and end-systolic phases. The images are referred to as “systolic pattern” and tend to display a LV cavity that is smaller with contracted walls. In addition, a reduced heart rate will produce the opposite. Secondly, optimal image reconstruction is based on stable R-R interval. If R-R intervals vary widely during acquisition, as is the case in AF, temporal misregistration occurs and image quality is severely degraded. This effect can be lessened by computer algorithms using acceptance windowing. A high acceptance window will reveal poor image due to temporal misregistration. However, on the other hand, a too low acceptance window will reveal a large number of rejected beats during acquisition and also causing poor image quality. In our case, we used a 50% acceptance window at all acquisitions and no rejected beats were registered.



**Figure 3.** Short axis (A), vertical long axis (B), and horizontal long axis (C) of regional myocardial perfusion, stress images above, rest images below (rest 1: 3 days after stress MPS, rest 2: 9 months after stress MPS). An obvious increase of intracavitary LV volume (*white arrow*) and recovery of intracavitary LV volume is shown.



**Figure 4.** Left ventricle volume curves. *Red line* stress acquisition. *Blue line* rest 1 (3 days after stress MPS) and *purple line* rest 2 (9 months after stress MPS) acquisition. A significant increase and recovery of LV volume is observed between the stress and rest 1 and 2 acquisition.

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