

Influence of the size of the Left Ventricle on the Result of Ejection Fraction Determined by Myocardial Perfusion Gated SPECT

Fettich J

Department of Nuclear Medicine, University Medical Centre Ljubljana, Zaloska 7, 1525 Ljubljana, Slovenia

Abstract

Accurate assessment of the global LVEF increases the confidence in the results of regional wall motion and consequently in the results of myocardial perfusion and diagnostic accuracy of myocardial perfusion gated SPECT to detect and evaluate coronary artery disease. The aim of the study was to examine the accuracy of the automated gated SPECT processing software to calculate LVEF in patients with left ventricular volumes of different sizes as compared with echocardiography. One hundred thirty two consecutive patients referred for myocardial perfusion study for detection or evaluation of known coronary artery disease, who fulfilled the criteria of having echocardiography performed in the same week were included in the study. Double headed gamma camera with detectors positioned at an angle of 101 degrees to optimize field of view with high-resolution collimators was used. The study was performed as 8 frame/ R-R cycle acquisition on 64 x 64 matrix in 32 projections per detector. No abnormal beat rejection was used. The inter-observer reproducibility of LVEF calculation using automated gated SPECT processing software was high ($r = 0.96$, $p < 0.001$). A linear relationship between LVEF determination by gated SPECT and echocardiography was found. However an underestimation of gated SPECT LVEF calculation at lower EF and overestimation of gated SPECT LVEF calculation for the higher EF was observed. This was found to be due to underestimation of the size of end-systolic

volumes in small ventricles and overestimation of the size of end-systolic volumes in dilated left ventricles. It was concluded that automated gated SPECT processing software provides highly reproducible estimate of LVEF with good overall agreement with LVEF as determined by echocardiography. However, gated SPECT LVEF calculation seems to be affected by the size of the left ventricle. In very small and very large ventricles automatic edge detection algorithm might not be ideal, thereby underestimating EF in large ventricles and overestimating EF in small ventricles.

Key words: Myocardial perfusion scintigraphy, gated SPECT, left ventricular function

World J Nucl Med 2006;5:79-81

Introduction

The introduction of Tc-99m labeled myocardial perfusion agents and improvement in hardware and software have provided new opportunities in nuclear cardiology, the most important is probably the ability to assess myocardial perfusion and function simultaneously with a single tracer injection in the evaluation of coronary artery disease. Gated SPECT using Tc-99m labeled isonitriles may be an ideal option to provide three-dimensional information on regional perfusion and function as well as LVEF (1). Detection of regional myocardial motion and wall thickening facilitates the distinction between true fixed perfusion defects and artifacts. Accurate assessment of the global LVEF increases the confidence in the results of regional wall motion and consequently in the results of myocardial perfusion and diagnostic accuracy of myocardial perfusion gated SPECT to detect and evaluate coronary artery disease (1,2).

The aim of the present study was to examine accuracy of the automated gated SPECT processing software to calculate LVEF in patients with left ventricular volumes of different sizes as compared with echocardiography.

Correspondence:

Department of Nuclear Medicine
University Medical Centre Ljubljana
Zaloska 7,
1525 Ljubljana
Slovenia
E-mail: jure.fettich@kclj.si

Patients and Methods

A total of 132 consecutive patients referred for myocardial perfusion study for detection or evaluation of known coronary artery disease, who fulfilled the criteria of having echocardiography performed in the same week were included into the study. There were 83 male and 49 female patients, aged 42–78 years (56 ± 16). Pharmacological stress using Dipyridamol 0.5 mg/kg body weight was performed in 36 and sub-maximal bicycle stress in 96 patients. Ischaemic heart disease was diagnosed in 91 while in 41 patients the results of myocardial perfusion SPECT were normal. Approximately 600 MBq of Tc-99m Sestamibi was injected during stress and gated SPECT acquisition was performed 30–60 min. after injection. Double headed gamma camera with detectors positioned at an angle of 101 degrees to optimize field of view with high-resolution collimators was used. The study was performed as 8 frame/ R-R cycle acquisition on 64 x 64 matrix in 32 projections per detector. No abnormal beat rejection was used.

The data were processed using automatic processing program with no or minimal operator interaction. LVEF, end diastolic (EDV) and end systolic (ESV) volumes were calculated. Processing was repeated three times by three different operators to determine reproducibility of data processing. Echocardiography was performed in all patients within 5 days of gated SPECT study. LVEF, end diastolic (EDV) and end systolic (ESV) volumes were also determined by echocardiography in all patients.

Results

The inter-observer reproducibility of LVEF calculation using automated gated SPECT processing software was high ($r = 0.96$, $p < 0.001$). A linear relationship between LVEF determination by gated SPECT and echocardiography was found (Table 1). Correlation

coefficients (r) between echocardiography and gated SPECT for LVEF, EDV and ESV were 0.69, 0.84 and 0.90 respectively (Table 1).

However an underestimation of automated gated SPECT LVEF calculation at lower EF was indicated by the negative intercept, while positive regression slope demonstrated an overestimation of gated SPECT LVEF calculation for the higher EF. This was found to be due to underestimation of the size of end-systolic volumes in small ventricles and overestimation of the size of end-systolic volumes in dilated left ventricles.

Discussion

Myocardial perfusion gated SPECT should ideally be performed routinely because it can enhance confidence in interpreting the perfusion images, and it can provide free information on regional function which is of particular value in patients with ischaemic LV dysfunction. It improves specificity for the detection of coronary artery disease to 92% (vs. 84% for non-gated study) (2-6). This approach has been proven especially helpful in women and individuals whose body configurations may lead to image artifacts (3).

Automated Emory Toolbox gated SPECT processing software provides highly reproducible estimate of LVEF with good overall agreement with LVEF as determined by echocardiography. However, gated SPECT LVEF calculation seems to be affected by the size of the left ventricle. In very small and very large ventricles automatic edge detection algorithm might not be ideal, thereby underestimating EF in large ventricles and overestimating EF in small ventricles.

References

1. Candel-Riera J, Ortega-Alcalde D. Nuclear cardiology in every day practice. London, Kluwer Academic

| | Echocardiography | Gated SPECT | Correlation (r) |
|-------------|------------------|-------------|-------------------|
| EDV | | | |
| Mean (ml) | 145 ± 67 | 146 ± 95 | 0.84 |
| Range (ml) | 70 – 393 | 44 – 490 | |
| ESV | | | |
| Mean (ml) | 69 ± 59 | 81 ± 90 | 0.90 |
| Range (ml) | 18 – 300 | 8 – 427 | |
| LVEF | | | |
| Mean (%) | 57 ± 17 | 54 ± 20 | 0.69 |
| Range (%) | 15 – 80 | 11 – 81 | |

Table 1: Volumes and LVEF determined with Echocardiography and Gated SPECT

- Publishers, 1994, 145-157.
2. Alan N, Ozman O, Halac M, et al. The clinical value of Tc-99m-MIBI gated SPECT for the evaluation of left ventricular function and volumes as compared with echocardiography. *Eur J Nucl Med* 2001; 28:1249
 3. Cwajg E, Cwajg J, He Z, et al. Gated myocardial perfusion tomography for the assessment of left ventricular function and volumes: comparison with echocardiography. *J Nucl Med* 1999; 40:1857-1865.
 4. Nihols K, Lefkowitz D, Faber T, et al. Echocardiographic validation of gated SPECT ventricular function measurements. *J Nucl Med* 2000; 41: 1308-1314
 5. Marin MD, Gonzales A, Coronado M, et al. Left ventricular ejection fraction (LVEF), end diastolic volume (EDV) and end systolic volume (ESV) by quantitative gated myocardial perfusion SPECT (QGS). Comparison with echocardiography (ECHO) in acute coronary syndrome. *Eur J Nucl Med* 2001; 28: 1169.
 6. Vourvouri Eleni C, Poldermans D, Bax J, et al. Evaluation of left ventricular function and volumes in patients with ischaemic cardiomyopathy: gated single-photon emission computed tomography versus two-dimensional echocardiography. *Eur J Nucl Med* 2001; 28: 1610-1615