# Automatic quantification of left ventricular ejection fraction from gated blood pool SPECT

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*Background.* **Cardiac gated blood pool single photon emission computed tomography (GBPS) better separates cardiac chambers compared with planar radionuclide ventriculography (PRNV). We have developed a completely automatic algorithm to measure quantitatively the left ventricular ejection fraction (LVEF) from gated technetium 99m–red blood cells (RBC) GBPS short-axis 3-dimensional image volumes.**

*Methods and Results.* **The algorithm determines an ellipsoidal coordinate system for the left ventricle and then computes a static estimate of the endocardial surface by use of counts and count gradients. A dynamic surface representing the endocardium is computed for each interval of the cardiac cycle by use of additional information from the temporal Fourier transform of the image data sets. The algorithm then calculates the left ventricular volume for each interval and computes LVEF from the end-diastolic and end-systolic volumes. The algorithm was developed in a pilot group (N = 45) and validated in a second group (N = 89) of patients who underwent PRNV and 8-interval GBPS. Technically inadequate studies (N = 38) were rejected before grouping and processing. Automatic identification and contouring of the left ventricle was successful in 121/172 patients (70%) globally and in 76/89 patients (85%) in the validation group. Correlation between LVEFs measured from GBPS and PRNV was high (y = 2.00 + 1.01x, r = 0.89), with GBPS LVEF significantly higher than PRNV LVEF (average difference = 2.8%, $P < .004$).**

*Conclusions.* **Our automatic algorithm agrees with conventional radionuclide measurements of LVEF and provides the basis for 3-dimensional analysis of wall motion.**

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**Key Words: LVEF • blood pool SPECT • surface extraction • automatic processing**

Gated blood pool scintigraphy has become a standard method for noninvasive assessment of cardiac function. The technique currently receives greatest clinical use in the measurement of left ventricular ejection fraction (LVEF), which is considered to be the strongest prognostic measure of cardiac function throughout the spectrum of types of heart disease.[1-4] To date, the most common method for assessment of LVEF in nuclear cardiology has been planar gated blood pool scintigraphy (or planar radionuclide ventriculography [PRNV]), first described by Strauss et al[5] and rapidly perceived as a clinically useful technique.[6] PRNV also allows the measurement of the right ventricular ejection fraction, as well as qualitative assessment of regional wall motion. Ventricular function and wall motion have been routinely analyzed in hospitals.[7-9] A problem inherent to PRNV is the overlap of cardiac chambers, so that variations in left ventricular count rates used for ejection fraction (EF) calculations do not arise exclusively from the left ventricle (LV). In recent years, single photon emission computed tomography (SPECT) has replaced planar imaging as the technique of choice for myocardial perfusion scintigraphy—one of the main reasons for this being that SPECT obviates the problem of structure overlap. In spite of widespread acceptance for perfusion, SPECT has not yet become routine for gated blood pool scintigraphy even though it is technically feasible.[10-12] It has been suggested that, because the SPECT approach is able to eliminate chamber overlap, it could provide a more accurate and reproducible method for assessment of regional and global LV function.[13] This hypothesis is the basis of our work.

Early approaches for the computation of ventricular volumes, ejection fractions, and cardiac output by PRNV

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