Early and delayed Tc-99m-tetrofosmin myocardial SPECT in patients with left bundle branch block

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To determine the utility of the myocardial tracer Tc-99m-tetrofosmin in the examination of patients with left bundle branch block (LBBB) and to investigate Tc-99m-tetrofosmin uptake and retention in the myocardium, early and delayed Tc-99m-tetrofosmin SPECT was performed in 10 patients having LBBB without coronary stenosis. Methods: After 740 MBq of Tc-99m-tetrofosmin injection in the resting state, the early and delayed SPECT imaging was done at 30 min and 180 min, respectively. Results: Decreased Tc-99m-tetrofosmin uptake in the septal segments was observed in 4 patients (40%) at 30 min and in 9 (90%) at 180 min. Reverse redistribution was seen in 9 of 10 patients. In patients with LBBB, the septal-to-lateral uptake ratio was lower in the delayed images than in the early images (0.80 ± 0.09 vs. 0.89 ± 0.09, p < 0.001). In patients with LBBB, the washout rate of Tc-99m-tetrofosmin was higher in the septal segments than in the lateral segments (28.3 ± 4.3% vs. 22.8 ± 3.3%, p < 0.001). Conclusion: The SPECT data indicate that in LBBB without coronary stenosis, the uptake of Tc-99m-tetrofosmin is decreased in the septal wall, and that reverse redistribution occurs frequently. Our results contribute to the elucidation of both the cellular biokinetics of Tc-99m-tetrofosmin in the myocardium and the hemodynamics of the septum in LBBB, and indicate the possible clinical utility of Tc-99m-tetrofosmin.

Key words: Tc-99m-tetrofosmin, left bundle branch block, septum, reverse redistribution

INTRODUCTION

Although thallium-201 single photon emission computed tomography (TI-201 SPECT) has been widely used for the diagnosis of coronary artery disease, its use in patients with left bundle branch block (LBBB) has been disappointing because we frequently encounter decreased uptake in the septum of patients with angiographically normal coronary arteries. Various theories have been proposed for the false positive results thus obtained, such as small vessel disease that cannot be visualized angiographically, functional ischemia caused by asynchronous contraction, and fibrodegenerative change in the septum. The precise mechanism, however, remains unknown. There may be a limit to the use of TI-201 SPECT in the diagnosis of coronary artery disease in patients with LBBB.

Tc-99m-labeled tetrofosmin is a newly developed myocardial tracer with many advantages. This tracer was reported to be rapidly cleared from the blood after intravenous administration and taken up by the myocardium and other tissues. It has been thought that once Tc-99m-tetrofosmin is taken up by the myocardium, its clearance is relatively slow, and that the redistribution does not occur for several hours. At our facilities, we do not use the ordinary protocol based on previous investigations regarding Tc-99m-tetrofosmin biokinetics; all Tc-99m-tetrofosmin SPECT data are acquired twice (30 min and 180 min after injection).

The present study was undertaken to investigate the septal uptake and retention of Tc-99m-tetrofosmin on the early and delayed images in patients with LBBB.
Subjects

**LBBB group:** Ten patients with LBBB (6 males and 4 females, aged 54 ± 10 years) were enrolled. Nine patients were asymptomatic, and one had atypical chest pain. No patient had heart disease such as coronary artery disease, cardiomyopathy, myocarditis, aortic valvular disease or hypertensive heart disease, with which LBBB is usually associated. All patients underwent coronary angiography, which disclosed normal coronary arteries.

**Control group:** Ten subjects were selected for the control group (7 males and 3 females, age 53 ± 11 years). Because of atypical chest pain or relatively trivial ECG findings, they had been transferred first to our radionuclide facility to rule out ischemic heart disease, but exercise myocardial scintigrams with Tc-99m-tetrofosmin demonstrated no abnormal lesion. Coronary angiography was done in 6 subjects and showed normal coronary arteries. The average age of control group was not significantly different from that of the LBBB group.

Data Acquisition

In each patient, 740 MBq of Tc-99m-tetrofosmin was intravenously injected at rest. Immediately after the injection, each patient drank a glass of milk to accelerate the tracer clearance from the hepatobiliary system. Data acquisition for SPECT imaging was performed twice; for early imaging at 30 min and for delayed imaging at 180 min after the Tc-99m-tetrofosmin injection, with a rotating digital gamma camera equipped with a low-energy, high-resolution, parallel-hole collimator. Projection images were obtained for 30 sec each at 6° increments over 180° circular orbits starting at the 45° left posterior oblique projection and ending at the 45° right anterior oblique projection.

An exercise Thallium-201 perfusion study was performed within 4 weeks of the Tc-99m-tetrofosmin study. All patients underwent bicycle exercise according to a standard multi-stage exercise protocol, with continuous monitoring of the heart rate, blood pressure, ECG and symptoms. At peak exercise, 111 MBq of Tl-201 was intravenously injected, and the patient continued to exercise for an additional 1 minute. Data acquisition was carried out 10 min and 180 min after the 201Tl administration. SPECT images were obtained, with the same data acquisition as for Tc-99m-tetrofosmin except for the data acquisition time (40 sec per frame).

Image Analysis

After data acquisition, the projection data were stored on a hard disk. After a preprocedure with a Butterworth filter, transverse axial tomograms of 5.3 mm thickness per slice were reconstructed with a Shepp-Logan filter without correction for attenuation or scatter. Data were reoriented...