# Two methods for increasing sensitivity of dobutamine stress echocardiography: strain imaging and heart-type fatty acid-binding protein levels

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Dobutamine stress echocardiography (DSE) is a valuable tool for evaluating patients with established or suspected coronary artery disease (CAD). However, conventional DSE assesses visually ; the visual assessment of regional wall motions is subjective and strongly dependent on experience (1, 2). Tissue Doppler-based longitudinal strain and strain rate (SR) permit the more quantitative and sensitive assessment of wall motions (3). Heart-type fatty acid-binding protein (hFABP) levels rapidly and sensitively increase in serum after myocardial damage (4). hFABP levels could increase after DSE in response to ischemia, and ischemia can be detected by measuring hFABP levels before and after DSE. Combination strain and SR imaging with hFABP levels on DSE could give additional information for predicting the severity of coronary lesions. In this study, we evaluated the diagnostic accuracy of strain, SR, and hFABP levels and compared it to frasionatal flow reserve (FFR) values in intermediate coronary lesions on DSE.

A total of 31 patients undergoing coronary angiography with a diagnosis of stable angina pectoris (SAP) were enrolled in this prospective observational study. Each patient had only one intermediate coronary lesion in a major epicardial coronary artery. The stenosis diameters of all coronary lesions, which were measured by quantitative coronary analysis, were between 40% and 70%. FFR was planned for all lesions. Coronary angiography and FFR were performed in two different sessions. DSE was performed after coronary angiography and before FFR. DSE images were recorded for the analyses of strain and SR imaging. Blood samples were collected to measure hFABP levels before and 4 h after DSE.

The analysis of tissue Doppler derived-strain and SR measurements was performed offline by two independent cardiologists without knowledge of the FFR results. Measurements were performed in each of the following culprit segments in line with the AHA recommendations: the anterior wall was analyzed from apical two-chamber images for the left anterior descending artery, the lateral wall was analyzed from apical four-chamber images for the left circumflex artery, and the inferior wall was analyzed from apical two-chamber images for the right coronary artery (5). Longitudinal strain, SR, and post-systolic strain indices (PSIs) of each wall were determined. PSIs were calculated as the ratio of post-systolic shortening to peak systolic strain.

The diagnostic accuracies of the mean SR values and PSIs of three segments (basal, mid-, and apical) of the wall parameters of the culprit vessel were determined as areas under the curve (AUC)-receiver operating characteristics (ROC). In all tests, a p-value of $<0.05$ was accepted to be statistically significant.

Sixteen patients whose FFR value was 0.80 and under 0.80 were added to the ischemic group. Fifteen patients whose FFR value was over 0.80 were added to the non-ischemic group. The mean FFR values were significantly lower in the ischemic group than in the non-ischemic group (0.74±0.03 and 0.87±0.04, respectively; p=0.001). Low-dose stage strain values were reduced in the ischemic group; however, an increase was seen in the non-ischemic group. Low-dose stage strain values were significantly lower in the basal and apical segments in the ischemic group than in the non-ischemic group (p=0.020 and p=0.004, respectively). High-dose stage strain values were higher in the basal and apical segments in the non-ischemic group than in the non-ischemic group (p=0.006 and p=0.047, respectively). There was no difference between the two groups in baseline SR values. SR values increased with dobutamine infusion in the two groups. Low-dose stage SR values were significantly low in the mid- and apical segments in the ischemic group. High-dose stage SR values were significantly low in all segments in the ischemic group. The mean SR values of all three segments were significantly lower in the ischemic group than in the non-ischemic group (–1.34±0.42 s–1 vs. –2.02±0.38 s–1, respectively; p=0.001).

The baseline PSIs were similar in all three segments. PSIs developed in 34 segments in the ischemic group in the high-dose dobutamine stage and in only 10 segments in the non-ischemic group. PSIs were significantly higher in the ischemic group in all segments in the low- and high-dose dobutamine stages.

hFABP levels increased in the ischemic group 4 h after DSE (from 4422±2328 pg/mL to 4783±3708 pg/mL, p=0.479), whereas they decreased in the non-ischemic group 4 h after DSE (from 3777±2540 pg/mL to 3183±1721 pg/mL, p=0.097). hFABP levels did not significantly change in the two groups after DSE.

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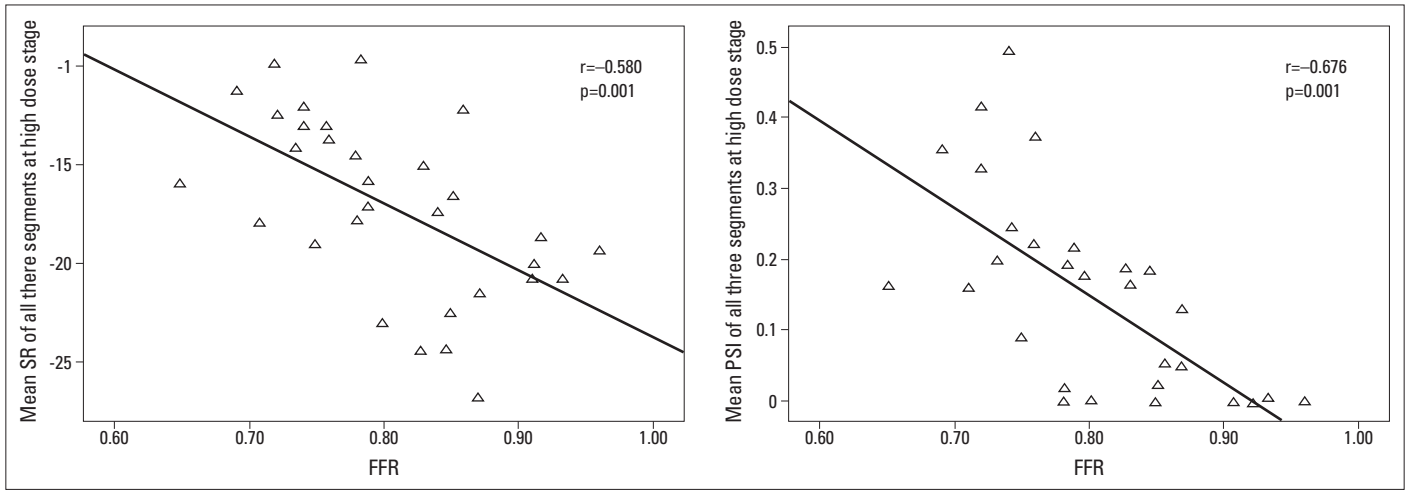



**Figure 1. The correlation between mean SR and PSIs of all three segments at the high-dose stage and FFR**

FFR - fractional flow reserve; PSI - post-systolic strain index; SR - strain rate, correlation analysis

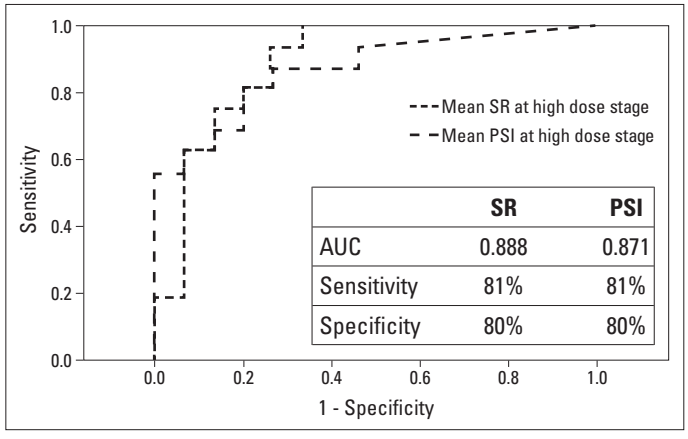



**Figure 2. ROC analyses of mean SR and PSI at the high-dose stage**

PSI - post-systolic strain index; ROC analyses; SR-strain rate

Mean SR values and PSIs of all three segments correlated well with FFR values (r=–0.580, p=0.001 and r=–0.676, p=0.001, respectively) (Fig. 1).

ROC analyses showed diagnostic accuracy for mean SR and PSI (Fig. 2). The mean SR value of –1.71 s–1 had a sensitivity of 81% and specificity of 80% for demonstrating ischemia. Likewise, PSI of 0.14 showed a sensitivity of 81% and specificity of 80%.

## Discussion

The sensitivity of DSE is generally 81% in whole patients and decreased in single vessel and intermediate coronary lesions (6). Further, the sensitivity of DSE decreased to 72% in single-vessel disease. Gaibazzi et al. (7) showed that the sensitivity of conventional stress echocardiography was low in intermediate lesions. In our study, PSIs and SR values on DSE predicted critical lesions with 81% sensitivity and 80% specificity. The use of strain and SR imaging on DSE provide a high diagnostic accuracy in detecting ischemia. hFABP levels did not significantly change after DSE. The investigation of hFABP in more extended CAD can be useful for assessing the diagnostic benefits of hFABP on DSE.

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