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False Positive Dobutamine Stress Echocardiograms: Characterization of Clinical, Echocardiographic and Angiographic Findings

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Objectives. **This study was designed to characterize the clinical, echocardiographic and angiographic findings in patients who have regional wall motion abnormalities predictive of coronary artery disease on dobutamine stress echocardiograms, although coronary angiography reveals no critical stenoses.**

Background. **The specificity of dobutamine stress echocardiography has been reported to be lower than its sensitivity; the sources of false positive findings on dobutamine stress echocardiograms have not been previously defined.**

Methods. **Clinical and echocardiographic characteristics were retrospectively reviewed for patients who had both a dobutamine stress echocardiogram indicative of coronary artery disease on the basis of wall motion abnormalities and <50% stenoses reported on coronary angiography performed within 6 weeks of the echocardiogram. A 16-segment model was used to perform wall motion scoring. Angiograms were independently reviewed, and stenosis severity was quantified with the use of digital calipers.**

Results. **Thirty-nine (11.4%) of 342 studies met criteria for false positive test results, which occurred predominantly in women (72%, $p < 0.001$). Regional wall motion abnormalities were evident more often in the posterior circulation (62%), and 65% of them were limited to the basal segments. Twelve (28%) of 43 wall motion abnormalities were associated with coronary stenoses of at least intermediate grade (lumen diameter 40.3% to 68.1%). Abnormalities confined to basal segments of the posterior circulation were unlikely to have associated coronary lesions ($p = 0.03$).**

Conclusions. **False positive findings on dobutamine stress echocardiograms tend to involve small wall motion abnormalities that are frequently located in basal segments of the posterior myocardial circulation. Approximately one third of false positive results occurred in patients with intermediate-grade coronary stenoses, and these studies may reflect true inducible ischemia. Additional sources of false positive study results may include poor endocardial visualization and abnormal motion due to tethering to the fibrous skeleton of the heart. Altered echocardiographic diagnostic criteria may be appropriate for small wall motion abnormalities confined to basal segments of the posterior circulation.**

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Dobutamine stress echocardiography has become established as a reliable method for the detection of coronary artery disease. Previous reports (1–6) on the accuracy of dobutamine stress echocardiography have demonstrated a high sensitivity for the detection of disease, ranging from 76% (3) to 96% (6), whereas the specificity in these series has been lower, ranging from 60% (3) to 95% (2). In the largest reported series (6), the sensitivity and specificity of dobutamine stress echocardiography were 96% and 66%, respectively.

Several factors may contribute to this comparatively lower specificity of dobutamine stress echocardiography. Most published trials on the accuracy of the technique studied patient groups with a high prevalence of coronary artery disease. Further, trials that were retrospectively analyzed created a posttest referral bias, in which abnormal dobutamine stress echocardiograms were more likely to lead to cardiac catheterization and inclusion in a study population than were negative studies. In these respects, each of the previous trials may have been influenced to some degree by pretest or posttest selection bias (7). After control for these factors, there remains a cohort of patients with regional wall motion abnormalities on dobutamine stress echocardiography who do not have significant coronary stenoses on coronary angiography. The source of these false positive studies has not been previously defined. Potential factors may include inadequate endocardial visualization, myocardial ischemia not associated with high-grade coronary stenoses, or abnormalities of wall motion not associated with ischemia.

This study was undertaken to investigate the underlying clinical syndromes, echocardiographic characteristics and angiographic findings of patients with dobutamine stress echocardiograms falsely positive for coronary artery disease.

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Methods

Study patients. Echocardiographic and angiographic data bases for the time period January 1, 1990 to September 30, 1992 were examined and cross-matched for patients who underwent both dobutamine stress echocardiography and coronary angiography within 6 weeks. Patients were identified who had a dobutamine stress echocardiogram indicative of coronary artery disease or ischemia and who had no lesion >50% lumen diameter stenosis in any major coronary artery on cardiac catheterization. Patient records were subsequently reviewed for clinical history. Patients were excluded from the study if there was a history of documented myocardial infarction, coronary artery bypass grafting or percutaneous revascularization procedures. In addition, patients were excluded if there was a documented cardiac event (acute myocardial infarction or coronary intervention) occurring between the time of the dobutamine stress echocardiogram and the cardiac catheterization.

Dobutamine stress testing. Dobutamine stress echocardiography was performed using a standard protocol that has been previously described (6). In brief, baseline echocardiographic imaging was performed for assessment of regional left ventricular wall motion using parasternal long- and short-axis and apical four- and two-chamber views. Dobutamine (Dobutrex, Eli Lilly) was infused in a 1-mg/ml solution in four 3-min stages of 5, 10, 20 and 30 μg/kg body weight per min. Atropine was not used in any patient. Echocardiographic imaging was repeated at the end of each stage, and all images were recorded on standard VHS videotape. In addition, images were digitized at rest, 5-μg/kg per min infusion, peak infusion and 5 min after termination of infusion and were analyzed off-line in a quad-screen format. Dobutamine stress echocardiography was conducted in accordance with standard guidelines for clinical research, with approval of the Institutional Review Board at the University of Michigan.

Analysis of dobutamine stress echocardiograms. Dobutamine stress echocardiograms were interpreted prospectively at the time of their performance by highly trained observers skilled in stress echocardiographic analysis. Each interpreter had undergone extensive training in such analysis and had interpreted at least 200 stress echocardiograms under supervision before the time period involved in this study. At the time of analysis, interpreters had no access to clinical information or coronary anatomy if cardiac catheterization had been previously performed. Results of dobutamine stress echocardiography were considered to be positive for ischemia if there was a new wall motion abnormality with stress or if an existing wall motion abnormality increased in extent or severity. Results were considered to be positive for coronary artery disease if there was regional left ventricular dysfunction at rest or evidence of ischemia inducible with stress. In the setting of underlying cardiomyopathy, coronary artery disease was judged to be present if there was left ventricular scar or aneurysm or if there was regional deterioration in functional myocardium with stress.

Regional wall motion scoring was performed using a 16-segment model (1,6). Circumferentially, the basal and midthirds of the left ventricle were divided into septal, anteroseptal, anterior, lateral, inferoposterior and inferior segments. The apical third of the ventricle was divided into anterior, lateral, inferior and septal segments. Wall motion was graded as normal, hypokinetic, akinetic or dyskinetic and assigned numeric values of 1, 2, 3 or 4, respectively. A wall motion score index was derived by dividing the sum of the individually scored segments by the number of segments visualized. Percent normal muscle was calculated as 100 times the ratio of the number of segments with normal function divided by the total number of segments visualized. If quantitative wall motion scoring was not performed at the time of stress echocardiographic analysis, then it was performed by a study investigator after review of the stress echocardiogram on videotape.

As previously described (6,8), the left ventricle was divided into anterior and posterior circulations. The anterior circulation, subtended by the left anterior descending coronary artery, comprises the anterior wall, anterior septum, mid- and apical inferoseptum and apical segments of the inferior and lateral walls. The posterior circulation, subtended by the left circumflex and right coronary arteries, comprises the remaining myocardial segments.

Coronary angiography. All patients underwent clinically indicated cardiac catheterization with coronary angiography within 6 weeks of dobutamine stress echocardiography. Multiple views were obtained to show lesions in orthogonal projections and to avoid vessel overlap. All angiographic studies were interpreted by highly trained observers at the time of the procedure, and visual estimates of maximal percent lumen stenosis for each major artery were recorded and entered into an angiographic data base. A threshold of ≥50% lumen stenosis was used to define significant disease. Subsequently, all angiographic films were retrospectively reviewed by a highly trained observer who had no knowledge of either the original angiographic report or the results of dobutamine stress echocardiography. All lesions visually assessed as ≥30% diameter stenosis were measured with digital calipers at end-diastole in the single tightest angiographic projection, as previously described (9).

Statistical analysis. All data are reported as mean value ± 1 SD. Gender distribution was compared between groups using a chi-square test; age and number of coronary risk factors were compared between groups using an unpaired *t* test. A chi-square test or a Fisher exact test was used to compare the incidence of hypertension and left ventricular hypertrophy between groups. Comparisons of wall motion score and percent normal muscle between rest and stress were made with a paired *t* test. The severity of coronary artery disease in percent diameter stenosis between groups was compared using an unpaired *t* test, and the incidence of coronary artery disease greater than a threshold value of 40% maximal lumen diameter stenosis between groups was made using a Fisher exact test. Differences were considered significant at $p < 0.05$ (two-sided).

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Results

Patients and demographics. A total of 1,595 dobutamine stress echocardiograms were performed between January 1, 1990 and September 30, 1992. Of these, 342 were performed in 332 patients within 6 weeks of coronary angiography. Patients undergoing paired dobutamine stress echocardiography and coronary angiography included 208 men (61%) and 134 women (39%), with an age range of 22 to 85 years (mean ± SD 58.3 ± 13.1). Data base comparison identified 49 patients with dobutamine stress echocardiograms positive for coronary artery disease and <50% lumen diameter stenosis in all arteries by coronary angiography. Review of patient records identified 10 of these patients as having a history of documented myocardial infarction (n = 6) or having had coronary intervention between the time of the stress echocardiogram and the coronary angiogram (n = 4). There were, therefore, 39 patients identified with no previous history of myocardial infarction or coronary revascularization who had dobutamine stress echocardiograms indicative of coronary artery disease and <50% maximal lumen stenoses in all arteries on coronary angiography.

These 39 patients comprised 11 men (28%) and 28 women (72%). This predominance of female patients represented a statistically significant difference in comparison with the cohort of all patients undergoing coronary angiography within 6 weeks of dobutamine stress echocardiography ($p < 0.001$). The mean age of these patients (62.8 ± 11.4 years [range 36 to 82]) was 4.5 years greater than that of the entire group of patients undergoing catheterization ($p = 0.02$). Risk factors for coronary artery disease were present in 34 of 36 patients for whom this information was available. Fifteen patients had one risk factor for coronary artery disease, whereas 12 had two, 5 had three, 1 had four, and 1 had five risk factors. Risk factors included hypertension in 25 patients, tobacco use in 18, family history of premature coronary artery disease in 8, hypercholesterolemia in 7 and diabetes in 5. Indications for performing dobutamine stress echocardiography included evaluation of atypical chest pain in 14 (36%), preoperative risk assessment in 8 (20%) and evaluation of typical anginal chest pain in 6 (15%), of exertional dyspnea in 5 (13%), of congestive heart failure in 2 (5%) and of new left bundle branch block in 1 (3%). Test indications were unknown in three patients (8%).

Women and men with false positive study results were similar in age (64.0 ± 11.7 vs. 59.7 ± 10.5 years, $p = 0.28$) and had a similar number of risk factors for coronary artery disease (1.8 ± 1.0 vs. 1.5 ± 1.1, $p = 0.40$). The incidence of hypertension was higher among women (21 [75%] of 28) than men (4 [36%] of 11, $p = 0.03$), although the incidence of echocardiographically detected left ventricular hypertrophy was comparable (5 [18%] of 28 vs. 3 [27%] of 11, $p = 0.66$). No patient had echocardiographically detected mitral valve prolapse.

Wall motion at rest. Seventeen (43.6%) of 39 patients had abnormal wall motion on rest echocardiography. The incidence of hypertension (11 [65%] of 17) and left ventricular hypertrophy (2 [12%] of 17) among patients with wall motion abnormalities at rest was not different from the incidence in those without these abnormalities (14 [64%] of 22, $p = 0.94$ and 6 [27%] of 22, $p = 0.43$, respectively).

Seven of 17 patients with abnormal wall motion at rest (41%, [18% of the total study group]) had diffuse abnormalities with global left ventricular dysfunction. Each of these seven patients had clinical evidence of cardiomyopathy and congestive heart failure. Two had regions of apical scar or aneurysm on echocardiography. The echocardiographic diagnosis of coronary artery disease in these seven patients with cardiomyopathy was based on regional worsening of function with dobutamine infusion compatible with ischemia in six patients, and on what was considered to be ischemic cardiomyopathy without inducible ischemia in one.

The remaining 10 patients (59% [26% of the total study group]) with abnormal wall motion at rest had a discrete abnormality involving one or two myocardial segments in the distribution of a single coronary artery, and preserved overall left ventricular systolic function. Nine of 10 regions exhibited only segmental hypokinesia, with a single akinetic segment located at the base of the inferior wall in one patient. Wall motion abnormalities at rest were confined to the proximal inferior wall, the proximal inferoposterior wall and the apical septum in three patients each. The only abnormality at rest located outside the apex or the proximal inferior or inferoposterior walls was a region of anteroseptal hypokinesia seen in a patient with left bundle branch block.

Dobutamine stress echocardiography. On dobutamine stress testing, 3 (8%) of 39 patients had symptoms of chest pressure, throat tightness or nausea that could have represented ischemia. The electrocardiographic (ECG) response was normal in 22 (56%), nondiagnostic in 13 (33%) and compatible with ischemia in four (10%).

Among the 32 patients without diffuse abnormalities on rest echocardiography, all had inducible wall motion abnormalities compatible with inducible ischemia. Nineteen patients (59%) had akinetic regions at peak stress, whereas 13 (41%) had only segmental hypokinesia. Nine of the 10 regional abnormalities on baseline echocardiography increased in severity or extent. One region of apical hypokinesia showed improvement with dobutamine. Five patients (16%) had two regional wall motion abnormalities at peak stress. There were therefore a total of 36 regional abnormalities compatible with ischemia among the 32 patients and a total of 37 regions predictive of coronary artery disease by wall motion abnormality either at rest or with stress. The location of regional abnormalities predictive of coronary artery disease is summarized in Table 1. Posterior circulation abnormalities included 15 regions confined to basal segments. The remaining posterior circulation abnormalities involved basal and midsegments of the inferior (n = 2), inferoposterior (n = 2) or lateral (n = 1) walls, or combinations of these areas (n = 3). Of 14 wall motion abnormalities in the anterior circulation, 9 (64%) were confined to apical segments, and 5 (36%) involved proximal or midventricular segments. All apical abnormalities involved two or fewer segments.

Among the seven patients with cardiomyopathy, one had

Table 1. Location of Stress or Rest Wall Motion Abnormalities Predictive of Coronary Artery Disease in 32 Patients Without Cardiomyopathy

	Segments				
	1 (n = 16)	2 (n = 13)	3 (n = 5)	>4 (n = 3)	Total (n = 37)
Anterior circulation	5 (14%)	6 (16%)	1 (3%)	2 (5%)	14 (38%)
Posterior circulation	11 (30%)	7 (19%)	4 (11%)	1 (3%)	23 (62%)

Eleven (48%) of the 23 posterior circulation abnormalities involved only a single abnormal segment, and 15 (65%) of the 23 were confined to the basal segments.

no regional worsening of function with stress, and six had discrete regions of worsened function compatible with ischemia. These regions involved the inferior wall in four patients and the anterior wall and septum in one patient each. In these patients, all regions compatible with ischemia involved at least two myocardial segments.

Wall motion scores and percent normal muscle at peak stress are summarized and compared with rest values in Table 2. For the whole group and for patients without underlying cardiomyopathy, there was a small but significant increase in wall motion score and decrease in percent normal muscle with stress. The same changes were not seen in patients with cardiomyopathy. In these patients, there was a trend toward increased percent normal muscle with stress (p = 0.38 [NS]).

Coronary angiographic correlation. There were 43 regions predictive of coronary artery disease among the 39 patients, including 6 regions among the 7 patients with and 37 regions among the 32 patients without cardiomyopathy. Independent review of coronary angiograms with the use of electronic digital calipers disclosed coronary stenoses >40% maximal lumen diameter in 14 (36%) of 39 patients, including 1 patient with an ~70% ostial left anterior descending coronary artery lesion that was not described on the original angiographic review. In 11 patients, 12 echocardiographic wall motion abnormalities correlated in distribution with these diseased arteries, potentially accounting for 28% of the 43 echocardiographic wall motion abnormalities predictive of coronary artery disease. Four of these patients had underlying cardiomyopathy, and seven had preserved left ventricular systolic function. Excluding the ostial lesion, the coronary stenoses identified ranged from 40.3% to 68.1% (mean 50.8 ± 8.6%) maximal lumen diameter. The coronary anatomy with accompanying clinical information and echocardiographic findings for these patients is summarized in Table 3. Patients with intermediate grade coronary stenoses accounted for two of three cases in which symptoms during dobutamine stress testing were suggestive of ischemia, although ECG analysis was normal or nondiagnostic in all.

Of 16 anterior circulation wall motion abnormalities on dobutamine stress echocardiography, 6 (33%) were associated with a left anterior descending coronary artery stenosis >40%, and 6 (22%) of 27 posterior circulation abnormalities were associated with left circumflex or right coronary artery stenosis. Although the incidence of intermediate grade coronary stenoses did not differ significantly between anterior and posterior circulation wall motion abnormalities (p = 0.31), the incidence was significantly less among wall motion abnormalities confined to the basal segments of the posterior circulation. These abnormalities, accounting for 15 (56%) of 27 posterior circulation wall motion abnormalities, had an associated coronary stenosis in only one case (7%). In comparison, 11 (39%) of 28 wall motion abnormalities in any other location had an associated coronary stenosis of at least intermediate grade (p = 0.03). The mean percent lumen diameter stenosis associated with wall motion abnormalities confined to the basal posterior circulation was 14.4 ± 17.4% using digital calipers, compared with 28.9 ± 26.7% in any other distribution (p = 0.04).

Discussion

Incidence of false positive echocardiographic findings. Of 342 dobutamine stress echocardiograms performed within 6 weeks of coronary angiography, 39 (11.4%) were identified that showed regional wall motion abnormalities suggestive of coronary artery disease, although no significant disease was identified by visual interpretation of the coronary angiograms. More than 70% of the patients with false positive dobutamine stress echocardiograms were women, with an incidence of false positive studies of 20.9% (28 of 134) for women and 5.3% (11 of 208) for men. Concomitant cardiac abnormalities, such as

Table 2. Wall Motion Scores and Percent Normal Muscle at Rest and at Peak Stress for All 39 Patients

Patients	No.	Wall Motion Score			Percent Normal Muscle		
		Rest	Stress	Δ	Rest	Stress	Δ
Total group	39	1.21 ± 0.42	1.36 ± 0.44	0.16 ± 0.21*	84 ± 32%	77 ± 27%	−7 ± 17%*
No cardiomyopathy	32	1.03 ± 0.05	1.21 ± 0.13	0.18 ± 0.11*	97 ± 5%	86 ± 9%	−11 ± 8%*
Cardiomyopathy	7	2.01 ± 0.43	2.05 ± 0.66	0.04 ± 0.46†	21 ± 30%	33 ± 39%	11 ± 32%†

*p ≤ 0.005. †p = NS. Data presented are mean value ± SD or number of patients. Patients with cardiomyopathy did not have deterioration in overall left ventricular function with stress and demonstrated a trend toward a greater percent of normally functioning myocardium with stress. Δ = change from baseline.

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Table 3. Clinical, Echocardiographic and Angiographic Features of 11 Patients With Regional Wall Motion Abnormalities and Coronary Stenoses of at Least Intermediate Grade

Age (yr)/Gender	Cardiac Risk Factors (no.)	Indication	Echocardiographic Wall Motion Abnormality		Coronary Anatomy on Angiography
			Location	Segments (no.)	
Anterior Circulation					
76/F	1	Angina	Anterior	2	>70 ostial LAD
65/M	1	Angina	Anterior, lateral, apex	5	68.1% LAD, 60.3% Diag, 40.1% LCx
77/F	1	Preop	Distal lateral	2	57.6% OM
79/F	2	Preop	Apex	2	45.8% LAD
71/F	2	DOE	Apex	1	40.5% LAD
66/F	3	DOE	Septum	3	40.3% LAD
Posterior Circulation					
42/M	NA	NA	Inferior	2	56.3% RCA
47/M	4	Angina	Inferior	3	54.4% RCA
69/F	3	Preop	Inferoposterior	1	51.5% RCA
64/M	NA	Atyp CP	Inferoposterior	2	51.3% RCA
73/F	1	Atyp CP	Inferior	3	49.3% RCA
65/M	1	Angina	Inferior	3	41.1% RCA

Other than one patient found to have an ostial left anterior descending coronary artery (LAD) lesion, patients had stenoses of intermediate grade on quantitation with digital calipers. Atyp CP = atypical chest pain; Diag = first diagonal branch of left anterior descending coronary artery; DOE = dyspnea on exertion; F = female; LCx = left circumflex coronary artery; M = male; NA = not available; OM = first obtuse marginal branch of the left circumflex coronary artery; Preop = preoperative risk assessment; RCA = right coronary artery.

left ventricular hypertrophy or mitral valve prolapse, did not account for the observed incidence of false positive studies in women. Although patient age and number of risk factors for coronary artery disease among women with false positive studies were comparable to those of men, a relatively lower incidence of coronary disease among women may account for this discrepancy.

Location of wall motion abnormalities. Regional abnormalities in left ventricular wall motion at rest were present among 10 of 32 patients without cardiomyopathy. One patient with left bundle branch block had anteroseptal hypokinesia, and the remaining nine abnormalities involved segments in the proximal inferior or inferoposterior walls or the apex. None of these patients had a clinical history of myocardial infarction, and wall motion was normal in all eight of those who underwent left ventriculography at cardiac catheterization. Thus, these regions of perceived abnormal wall motion on echocardiography appear to represent artifact. The anteroseptal wall motion abnormality is presumably related to the paradoxic septal motion associated with the accompanying conduction disturbance. The perceived abnormalities in the inferior wall, inferoposterior wall and apex are most likely related to poor endocardial visualization in these regions or could represent regions where relatively thinner myocardium is perceived as hypokinetic.

Stress-induced abnormalities in left ventricular wall motion were present in 38 of 39 patients with false positive dobutamine stress echocardiograms. Eight (20.5%) of 39 patients had a single wall motion abnormality comprising a single segment in the posterior circulation, and 12 (30.8%) had a single abnormality confined to basal segments of the posterior circulation. Although it is beyond the scope of this study to determine the effect on test sensitivity, limiting the diagnosis of coronary artery disease in the posterior circulation to abnormalities involving at least two myocardial segments or to those that involve more than only basal segments would have decreased the incidence of false positive tests in this study from 39 (11.4%) of 342 studies to 31 (9.1%) or 27 (7.9%) of 342 studies, respectively.

Quantitative coronary angiography. Independent review of coronary angiograms using digital calipers for quantitation of disease revealed stenoses ≥40% maximal lumen diameter in 14 patients (36%), with stenoses >50% diameter in seven arteries. Twelve regional wall motion abnormalities on dobutamine stress echocardiography corresponded anatomically with the location of the diseased arteries. It has been previously shown (10) that angiographic estimates of stenosis severity for some arteries with apparently mild disease may not adequately reflect true lumen narrowing and compromise in coronary flow. Therefore, it seems at least plausible that some stenoses of intermediate grade might be functionally significant on maximal stress testing with dobutamine. In this study, 28% of wall motion abnormalities predictive of coronary artery disease on echocardiography were associated with coronary stenoses ≥40% lumen diameter. Such stenoses were associated with wall motion abnormalities involving the anterior and the posterior myocardial circulations. However, wall motion abnormalities confined to basal segments of the posterior circulation, accounting for 41% of all wall motion abnormalities in patients without cardiomyopathy, were statistically less

likely to be associated with intermediate grade coronary stenoses.

Sources of false positive studies. Some wall motion abnormalities inducible with dobutamine stress testing may be mediated by myocardial ischemia, with apparently mild coronary stenoses on routine angiographic assessment. Other perceived abnormalities may be due to poor endocardial visualization or to "normal" heterogeneity in wall motion that is exaggerated during catecholamine stress testing. Many false positive studies were due to wall motion abnormalities confined to basal segments of the posterior circulation and were not associated with even mild coronary artery disease. The inferior, inferoposterior and lateral walls are anatomically the most distant from the anterior transducer positions utilized in transthoracic echocardiography. As such, they are subject to distance-related echo dropout and incomplete endocardial visualization. Techniques under development that may allow improved endocardial visualization, such as the use of transpulmonary intravenous echocardiographic contrast agents (11), may result in fewer false positive studies and warrant further investigation. Finally, the basal myocardial segments are juxtaposed to the fibrous skeleton of the heart and may be tethered by these structures and subjected to mechanical constraints in motion that become more apparent during stress testing. The basal segments may not thicken to the same extent or with the same degree of hyperdynamic motion as other segments, and these differences may result in an appearance of relative hypokinesia during maximal stress testing.

Conclusions. False positive dobutamine stress echocardiographic findings, defined as wall motion abnormalities predictive of coronary artery disease with <50% lumen stenosis on visual interpretation of coronary angiograms, occurred in 39 (11.4%) of 342 studies performed over a 33-month period. The incidence was statistically higher among women. Wall motion abnormalities tended to be small, with mean wall motion score and percent normal muscle at peak stress of 1.21% and 86%, respectively, among patients without coexistent cardiomyopathy. Twenty-three (62%) of 37 abnormal regions occurred in the posterior circulation, 65% of which were limited to basal myocardial segments.

There appear to be three potential sources of false positive study results. Some patients had intermediate grade coronary stenoses correlating anatomically with the location of echocardiographic wall motion abnormalities, raising the possibility that some apparently false positive test results were mediated by ischemia. Abnormalities limited to basal segments of the posterior circulation may have resulted from poor endocardial visualization or mechanical factors leading to abnormal wall motion, such as tethering by the fibrous skeleton of the heart, or both. In this study, limiting the diagnosis of coronary artery disease in the posterior circulation to wall motion abnormalities that involve at least two myocardial segments or to those that involve more than only basal segments would have decreased the incidence of false positive study results by 20.5% and 30.8%, respectively. The effect of these criteria on test sensitivity and accuracy warrants further investigation.

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