Objectives: Cardiovascular disease is the leading cause of morbidity and mortality in the elderly. The evaluation of coronary artery disease by exercise stress testing is frequently limited by the patient's inability to exercise. Although pharmacologic stress testing with dobutamine is an alternative, the safety of dobutamine myocardial perfusion scintigraphy in the elderly has not been previously studied.

Patients and methods: We studied the safety and feasibility of dobutamine (up to 40 μg/kg/min)-atropine (up to 1 mg) stress myocardial perfusion scintigraphy using technetium single-photon emission CT imaging in 227 patients ≥ 70 years old (mean ± SD age, 75 ± 4 years). A control group of 227 patients < 70 years old (mean age, 55 ± 11 years; matched for gender, prevalence of previous infarction, β-blocker therapy, and severity of resting perfusion abnormalities) was studied to assess age-related differences in the safety and the hemodynamic response. A feasible test was defined as the achievement of the target heart rate and/or an ischemic end point (angina, ST-segment depression, or reversible perfusion abnormalities).

Results: No myocardial infarction or death occurred during the test. The target heart rate was achieved more frequently in the elderly patients (87% vs 79%; p < 0.05). The elderly patients had a higher prevalence of supraventricular tachycardia (7% vs 1%; p < 0.005) and premature ventricular contraction (74% vs 32%; p < 0.005) during the test, as compared to the younger patients. There was a trend to a higher prevalence of ventricular tachycardia (5% vs 2%) and atrial fibrillation (3% vs 0.4%) in the elderly patients. Arrhythmias were terminated spontaneously by termination of dobutamine infusion or by administration of metoprolol. Independent predictors of supraventricular tachyarrhythmias and ventricular tachycardia were older age (p < 0.001; χ², 9.8) and myocardial perfusion defect score at rest (p < 0.01; χ², 6.8) respectively, by using a multivariate analysis of clinical and stress test variables. Elderly patients had a higher prevalence of systolic BP drop > 20 mm Hg during the test (37% vs 12%; p < 0.05). The test was terminated due to hypotension in 2% of the elderly patients and in 1% of the control group. Age was the most powerful predictor of hypotension (p < 0.005; χ², 10.3). The test was considered feasible in 216 elderly patients (95%) and in 209 patients of the control group (92%).

Conclusion: Dobutamine-atropine stress myocardial perfusion scintigraphy is a highly feasible method for the evaluation of coronary artery disease in the elderly. Elderly patients have a higher risk for developing hypotension and supraventricular tachyarrhythmias during a dobutamine stress test. However, dobutamine-induced hypotension is often asymptomatic and rarely necessitates the termination of the test.

Key words: arrhythmias; coronary artery disease; dobutamine; elderly; myocardial perfusion; safety
tional evaluation of coronary artery disease in this population to select patients who are candidates for further interventions. Exercise stress testing is the most widely used noninvasive method for evaluation of coronary artery disease. However, a larger proportion of the elderly population may be unable to perform exercise stress test due to the higher prevalence of pulmonary airway, degenerative joint, and peripheral vascular diseases, and the reduced physical fitness in the elderly as compared to the younger population. Pharmacologic stress testing in conjunction with myocardial perfusion imaging is an established method for the evaluation of coronary artery disease in patients with limited exercise capacity. Numerous studies have reported the way disease who are not candidates for a vasodilator method particularly in patients with obstructive airway. Dobutamine perfusion imaging is a feasible artery disease in patients with limited exercise capacity. Pharmacologic stress testing in conjunction with myocardial perfusion imaging is an established method for the evaluation of coronary artery disease in patients with limited exercise capacity. Numerous studies have reported the way disease who are not candidates for a vasodilator method particularly in patients with obstructive airway disease who are not candidates for a vasodilator stress test. Dobutamine perfusion imaging is a feasible method particularly in patients with obstructive airway disease who are not candidates for a vasodilator stress test. However, the safety of dobutamine perfusion imaging in the elderly has not been reported. Elderly patients are at a higher risk for developing spontaneous and exercise-induced arrhythmias, as well as impairment of compensatory mechanisms for hypotension. Therefore, these patients may be more vulnerable to hypotension and arrhythmias during a dobutamine stress test. The aims of this study are as follows: (1) to assess the safety, feasibility, and hemodynamic profile of dobutamine stress myocardial perfusion scintigraphy in the elderly population with limited exercise capacity who are referred for the diagnosis or functional evaluation of coronary artery disease; and (2) to assess the age-specific differences in the safety and hemodynamic profile by comparing these parameters in the elderly with a control group of younger patients matched for the major clinical characteristics that might influence the safety and feasibility of the test.

**Materials and Methods**

**Patient Population**

Study population comprised 227 elderly patients ≥ 70 years old with limited exercise capacity who were referred for evaluation of myocardial ischemia by dobutamine stress-technetium myocardial perfusion scintigraphy between January 1994 and January 1999 in our imaging laboratory. A group of 227 patients < 70 years old matched for gender, medication with β blockers, previous myocardial infarction, and fixed myocardial perfusion defect score served as control subjects. The test was not performed in patients with severe heart failure, significant valvular heart disease, severe hypertension (BP ≥ 180/110 mm Hg), hypotension (BP < 90/60 mm Hg), and unstable chest pain. All patients gave verbal informed consent to undergo the study. The Hospital Ethical Committee approved the use of the dobutamine stress test for evaluation of coronary artery disease.

**Clinical Features:** The clinical characteristics of patients ≥ 70 years and < 70 years old are summarized in Table 1. There was no significant difference between both groups regarding the prevalence of hypertension, diabetes mellitus, cigarette smoking, previous revascularization, medications at the day of the test, or indications of stress testing. Hypercholesterolemia was more prevalent in the younger group.

**Dobutamine Stress Test**

Dobutamine was infused through the antecubital vein starting at a dosage of 5 μg/kg/min followed by 10 μg/kg/min (3-min stages), increasing by 10 μg/kg/min every 3 min to a maximum of 40 μg/kg/min. Atropine (up to 1 mg) was given to patients who did not achieve 85% of maximal heart rate predicted for age and gender (220 – age [in years] beats/min in men and 200 – age beats/min in women) and dobutamine infusion was continued. The ECG was monitored throughout dobutamine infusion and was recorded every minute. Cuff BP was measured at rest, every 3 min during stress, and at maximal stress. The test was interrupted if severe chest pain, horizontal or downsloping ST-segment depression > 2 mm, ventricular or supraventricular tachycardia consisting of ≥ 10 complexes, hypotension (BP ≥ 240/120 mm Hg), systolic BP fall > 40 mm Hg, or any intolerable side effect regarded as being due to dobutamine occurred during the test. IV metoprolol (from 1 to 5 mg) was used to reverse the effects of dobutamine if these did not revert quickly.

**Single-Photon Emission CT Imaging**

Approximately 1 min before the termination of the stress test, IV 99mtechnetium sestamibi, 370 MBq, (in 230 patients) or 650 MBq (in 227 patients) were injected. SPECT imaging was performed 3 min after the injection of the radionuclide. The SPECT images were recorded every minute. Cuff BP was measured at rest, every 3 min during stress, and at maximal stress. The test was interrupted if severe chest pain, horizontal or downsloping ST-segment depression > 2 mm, ventricular or supraventricular tachycardia consisting of ≥ 10 complexes, hypotension (BP ≥ 240/120 mm Hg), systolic BP fall > 40 mm Hg, or any intolerable side effect regarded as being due to dobutamine occurred during the test. IV metoprolol (from 1 to 5 mg) was used to reverse the effects of dobutamine if these did not revert quickly.

**Table 1—Clinical Features of Patients ≥ 70 and < 70 Years Old Undergoing Dobutamine-Atropine Stress Myocardial Perfusion Scintigraphy**

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>≥ 70 yr (n = 227)</th>
<th>&lt; 70 yr (n = 227)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yr</td>
<td>75 ± 4</td>
<td>55 ± 11</td>
<td>0.00001</td>
</tr>
<tr>
<td>Men†</td>
<td>112 (49)</td>
<td>112 (49)</td>
<td>1</td>
</tr>
<tr>
<td>Previous MI‡</td>
<td>81 (36)</td>
<td>81 (36)</td>
<td>1</td>
</tr>
<tr>
<td>Previous CABG</td>
<td>36 (16)</td>
<td>38 (17)</td>
<td>0.9</td>
</tr>
<tr>
<td>Previous PTCA</td>
<td>33 (15)</td>
<td>36 (16)</td>
<td>0.8</td>
</tr>
<tr>
<td>History of hypertension</td>
<td>107 (47)</td>
<td>100 (44)</td>
<td>0.6</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>34 (15)</td>
<td>38 (17)</td>
<td>0.7</td>
</tr>
<tr>
<td>Cigarette smoking</td>
<td>44 (19)</td>
<td>59 (26)</td>
<td>0.1</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>56 (25)</td>
<td>79 (35)</td>
<td>0.02</td>
</tr>
<tr>
<td>Medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>β blockers‡</td>
<td>98 (43)</td>
<td>98 (43)</td>
<td>1</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>106 (47)</td>
<td>94 (41)</td>
<td>0.3</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>67 (30)</td>
<td>66 (29)</td>
<td>1</td>
</tr>
<tr>
<td>Indications for stress testing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical chest pain</td>
<td>76 (33)</td>
<td>70 (31)</td>
<td>0.6</td>
</tr>
<tr>
<td>Atypical chest pain</td>
<td>81 (36)</td>
<td>69 (30)</td>
<td>0.3</td>
</tr>
<tr>
<td>Exertional dyspnea or fatigue</td>
<td>22 (10)</td>
<td>25 (11)</td>
<td>0.8</td>
</tr>
<tr>
<td>Assessment after MI or after revascularization</td>
<td>45 (21)</td>
<td>63 (28)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

*Data are presented as mean ± SD or as No. (%); MI = myocardial infarction; CABG = coronary artery bypass graft surgery; PTCA = percutaneous transluminal coronary angioplasty; ACE = angiotensin-converting enyzmes.
†The two groups were matched for these parameters.
tetrofosmin (in 224 patients) was administered. The acquisition of stress single-photon emission CT imaging was started 1 h after the test. Resting studies were performed 24 h after the stress study and 1 h after injection of 370 MBq of sestamibi or tetrofosmin. The same isotope administered during stress was used for rest studies. An equal number of patients in each group received the same tracer. Image acquisition and interpretation were performed according to the previously described protocols. For each study, six oblique (short-axis) slices from the apex were performed according to the previously described protocol. The same isotope administered during stress was used for both studies and 1 h after injection of 370 MBq of sestamibi or tetrofosmin (in 224 patients) was administered. The acquisition of stress single-photon emission CT imaging was started 1 h after the test. Resting studies were performed 24 h after the stress study and 1 h after injection of 370 MBq of sestamibi or tetrofosmin. The same isotope administered during stress was used for rest studies. An equal number of patients in each group received the same tracer. Image acquisition and interpretation were performed according to the previously described protocols.

**Statistical Analysis**

Unless specified, data are presented as mean values ± SD. The $\chi^2$ test was used to compare differences between proportions. The Student’s $t$ test was used for analysis of continuous data. Stepwise logistic regression models were used to identify independent predictors of hypotension and arrhythmias. Differences were considered significant if the null hypothesis could be rejected at the 0.05 probability level.

### RESULTS

#### Hemodynamic Analysis

Table 2 summarizes the hemodynamic and dobutamine stress test variables in both groups. Heart rate increased significantly from rest to peak stress in both groups ($p < 0.0001$). Systolic BP increased significantly in the younger group ($p < 0.0001$), but not in the elderly group. Diastolic BP dropped more significantly from rest to peak stress in the elderly patients compared to the younger patients ($p < 0.05$). Elderly patients had a higher baseline systolic BP, a lower peak heart rate, a lower peak rate pressure product, and a higher prevalence of systolic BP drop > 20 mm Hg. There was no significant difference between both groups regarding the maximal dobutamine dose, frequency of atropine administration, incidence of ST-segment depression, angina, symptomatic hypotension, and minor side effects during the test (Table 3).

The prevalence of various types of arrhythmias during the test is shown in Figure 1. Ventricular and supraventricular tachycardia were terminated in all cases spontaneously by stopping dobutamine infusion or by administration of metoprolol. Ventricular tachycardia consisting of ≥ 10 beats occurred in two patients (one patient in each group). Elderly patients had a significantly higher prevalence of supraventricular tachycardia and premature ventricular contractions and a trend to a higher prevalence of atrial fibrillation ($p = 0.1$) and ventricular tachycardia ($p = 0.2$), compared to the younger patients.

### Table 2—Hemodynamic Data of Patients ≥ 70 and < 70 Years Old Undergoing Dobutamine-Atropine Stress Myocardial Perfusion Scintigraphy

<table>
<thead>
<tr>
<th>Hemodynamic and Stress Test Variables</th>
<th>≥ 70 yr (n = 227)</th>
<th>&lt; 70 yr (n = 227)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate at rest, beats/min</td>
<td>71 ± 14</td>
<td>74 ± 15</td>
<td>0.1</td>
</tr>
<tr>
<td>Heart rate at peak stress, beats/min</td>
<td>126 ± 15</td>
<td>136 ± 16</td>
<td>0.0001</td>
</tr>
<tr>
<td>Systolic BP at rest, mm Hg</td>
<td>147 ± 24</td>
<td>137 ± 23</td>
<td>0.0001</td>
</tr>
<tr>
<td>Systolic BP at peak stress, mm Hg</td>
<td>147 ± 31</td>
<td>147 ± 29</td>
<td>0.8</td>
</tr>
<tr>
<td>Diastolic BP at rest, mm Hg</td>
<td>78 ± 12</td>
<td>79 ± 13</td>
<td>0.4</td>
</tr>
<tr>
<td>Diastolic BP at peak stress, mm Hg</td>
<td>72 ± 15</td>
<td>76 ± 17</td>
<td>0.01</td>
</tr>
<tr>
<td>Rate pressure product at rest</td>
<td>10,522 ± 2,913</td>
<td>9,521 ± 2,412</td>
<td>0.2</td>
</tr>
<tr>
<td>Rate pressure product at peak stress</td>
<td>18,510 ± 4,284</td>
<td>19,953 ± 4,454</td>
<td>0.0007</td>
</tr>
<tr>
<td>Systolic BP drop &gt; 20 mm Hg, patients</td>
<td>48 (21)</td>
<td>27 (12)</td>
<td>0.01</td>
</tr>
<tr>
<td>Systolic BP drop &gt; 40 mm Hg, patients</td>
<td>10 (4)</td>
<td>5 (2)</td>
<td>0.2</td>
</tr>
<tr>
<td>Mean dobutamine dose, μg/kg/min</td>
<td>35.3 ± 7.6</td>
<td>36.4 ± 7.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Atrazine given, patients</td>
<td>82 (36)</td>
<td>94 (41)</td>
<td>0.3</td>
</tr>
<tr>
<td>Mean atropine, dose, mg</td>
<td>0.5 ± 0.3</td>
<td>0.6 ± 0.3</td>
<td>0.004</td>
</tr>
<tr>
<td>Horizontal or downsloping ST depression, patients</td>
<td>53 (23)</td>
<td>37 (16)</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*Data are presented as mean ± SD or No. (%).
5,810), respectively.

6.

was no significant difference regarding the stress rate
6. p

and a lower ischemic score (0.8 vs 1.1, p = 0.001) compared to men, respectively. There
was no significant difference regarding the stress rate pressure product between men and women in
the elderly group (18,707 ± 4,508 vs 18,304 ± 4,027) or in the younger group (19,967 ± 4,223 vs 19,940 ± 4,810), respectively.

Test End Points

The reasons for termination of the test in both groups are listed in Table 4. The test was terminated
because of reaching the target heart rate more frequently in the elderly group. The test was termi-
nated due to angina, ST-segment changes, arrhythmias, hypotension, hypertension, and other minor
side effects in a similar proportion of both groups, whereas the younger patients had a higher rate of
failure to reach the target heart rate, despite the maximal dose of dobutamine and atropine. Nineteen
elderly patients and 34 of the younger patients could not achieve the target heart rate and had no angina
or ST-segment depression. Reversible perfusion de-
fects were detected in 8 and 16 of these patients,
respectively, resulting in a feasible test (achievement
of the target heart rate or an ischemic end point) in
216 elderly patients (95%) and in 209 of the younger
patients (92%).

Myocardial Perfusion Scintigraphy

The prevalence of different perfusion scinti-
ographic patterns in both groups is shown in Figure 2.
There was no significant difference between both
groups regarding the prevalence of reversible or
fixed perfusion defects.

Gender Differences

Women had a higher prevalence of normal myo-
cardial perfusion (56% vs 23%; p < 0.001), a lower
infarction score (1.1 ± 2.2 vs 3 ± 3; p < 0.0001), and a lower ischemic score (0.8 ± 1.7 vs 1.6 ± 2.4; p < 0.0001) compared to men, respectively. There
was no significant difference regarding the stress rate pressure product between men and women in
the elderly group (18,707 ± 4,508 vs 18,304 ± 4,027) or in the younger group (19,967 ± 4,223 vs 19,940 ± 4,810), respectively.

Sestamibi vs Tetrofosmin Studies

Patients who underwent sestamibi imaging had a
higher ischemic score than patients who underwent
tetrofosmin imaging (1.4 ± 2.1 vs 0.8 ± 1.5; p < 0.005). The infarction score was not significantly
different between both groups (2.1 ± 2.7 vs
1.9 ± 2.8, respectively; p = 0.4)

Predictors of Hypotension and Arrhythmias

Clinical and stress test variables included in the multivariate analysis model were as follows: age,
gender, history of angina, previous myocardial in-
farction, hypertension, baseline systolic BP, medica-
tions, maximal dobutamine dose, peak heart rate,
abnormal perfusion, fixed and ischemic perfusion
defect scores, and angina during the test. Indepen-
dent predictors of systolic BP drop > 20 mm Hg
during stress were older age (p < 0.005; χ², 10.3), a
higher stress heart rate (p < 0.01; χ², 7.7), a higher
baseline systolic BP (p < 0.05; χ², 5.1), medication
with calcium antagonists (p < 0.05; χ², 4.1), and a
higher dobutamine dose (p < 0.05; χ², 4.7). The only
independent predictor of supraventricular tachyar-
hythmias (supraventricular tachycardia and atrial
fibrillation) was older age (p < 0.001; χ², 9.8). The
infarction (rest perfusion defect) score was the only
independent predictor of ventricular tachycardia
(p < 0.01; χ², 6.8).

Discussion

As far as we are concerned, this is the first study
that evaluates the safety and feasibility of dobut-
amine stress myocardial perfusion scintigraphy in the
elderly. The mean age of the elderly patients in our
study was 75 years. These patients represented the
usual candidates for pharmacologic stress testing at
this age group who are unable to perform an exercise
stress test. Referring patients at this age for the
noninvasive evaluation of coronary artery disease
reflects the confidence of physicians regarding the
beneficial effects of guided therapeutic interventions
in the elderly. A group of younger patients was used
as a control group in this study. The patients were
matched for the major clinical features that may have
an influence on the hemodynamic profile and the
safety of the test. The patients were matched for
gender because previous studies have shown gender-
related difference in the chronotropic response and
safety.18,19 The severity of resting perfusion abnor-
malities (and presumably left ventricular dysfunc-
tion) was also selected among matching parameters
because the extent of myocardial perfusion abnor-
malities was reported to predict complications dur-
ing the test. Finally, the patients were matched for the treatment with β blockers because these agents interfere with the chronotropic response to dobutamine and therefore may reduce the feasibility of the test, increase the need for atropine administration, or reduce the prevalence and severity of inducible ischemia. On the other hand, the intake of β blockers may be associated with more complications, presumably because these medications are prescribed to patients with a higher risk profile, as are patients with previous myocardial infarction, typical angina, and hypertension. Therefore, matching the two groups allowed an independent detection of any possible age-specific difference in the hemodynamic and safety profile of the dobutamine stress test. This matching explains the nearly similar clinical features of the two groups of patients, as shown in Table 1. Our study demonstrated that dobutamine myocardial perfusion scintigraphy is a highly feasible method for the noninvasive evaluation of coronary artery disease in the elderly. Ninety-five percent of these patients could achieve the end point of target heart rate and/or an ischemic end point.

**Heart Rate Response:** A higher proportion of the elderly patients could achieve the target heart rate. This may be related to a higher dose-related response due to age-related changes in the pharmacokinetics of the drugs. Another explanation is the lower calculated target heart rate in the elderly that renders the achievement of the target heart rate easier in older patients. This can also explain the lower peak heart rate in the elderly. Despite the fact that previous studies have demonstrated that elderly subjects have a reduced sensitivity to sympathetic stimulation, it has been recently shown that the cardiac chronotropic response to β-receptor adrenergic stimulation is not reduced in the elderly.

**BP Response:** Systolic BP increased significantly from rest to peak stress in the younger patients but not in the elderly patients. Diastolic BP dropped more significantly from rest to peak stress in the elderly patients compared to the younger patients. Additionally, the prevalence of hypotension during the test was significantly higher in the elderly pa-

### Table 4—Reasons for Termination of Dobutamine Stress Testing in Patients ≥ 70 and < 70 Years Old

<table>
<thead>
<tr>
<th>Reasons for Test Termination</th>
<th>≥ 70 yr (n = 227)</th>
<th>&lt; 70 yr (n = 227)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>85% of maximal heart rate</td>
<td>197 (87)</td>
<td>180 (79)</td>
<td>0.045</td>
</tr>
<tr>
<td>Maximal dose</td>
<td>8 (4)</td>
<td>29 (13)</td>
<td>0.001</td>
</tr>
<tr>
<td>Angina</td>
<td>7 (3)</td>
<td>9 (4)</td>
<td>0.8</td>
</tr>
<tr>
<td>ST changes</td>
<td>4 (2)</td>
<td>4 (2)</td>
<td>1</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>3 (1.3)</td>
<td>1 (0.4)</td>
<td>0.6</td>
</tr>
<tr>
<td>Hypertension</td>
<td>2 (0.9)</td>
<td>1 (0.4)</td>
<td>0.7</td>
</tr>
<tr>
<td>Hypotension</td>
<td>5 (2)</td>
<td>2 (1)</td>
<td>0.3</td>
</tr>
<tr>
<td>Chills, flushing, anxiety, dizziness</td>
<td>1 (0.4)</td>
<td>1 (0.4)</td>
<td>1</td>
</tr>
</tbody>
</table>

*Data are presented as No. (%).
tients. However, most of the episodes of hypotension were asymptomatic, and the test was terminated because of hypotension only in five patients (2%). The test was terminated because of marked systolic BP increase in two elderly patients and in one younger patient. The impairment of systolic BP response to dobutamine in the elderly patients may be explained by different mechanisms. These include the impairment of compensatory mechanism for hypotension with aging, rendering the patients susceptible to hypotension induced by the action of dobutamine on $\beta_2$ receptors with subsequent peripheral vasodilation. It has also been demonstrated that elderly subjects maintain cardiac output during exercise by an increase in the end-diastolic dimension. Since dobutamine infusion causes a significant reduction of the end-diastolic dimension, this may deprive the subject from this compensatory mechanism. Peripheral vasodilatation induced by dobutamine may further compromise diastolic filling of the left ventricle. This contention is supported by our finding that dobutamine dose and medication with calcium channel blockers were independent predictors of hypotension during the test. Finally, the elderly had higher baseline systolic BP compared to the younger patients. A higher baseline systolic BP was reported to predict hypotension during dobutamine stress test. In this study, both the age and the baseline systolic BP were independently associated with dobutamine-induced hypotension, which demonstrates that the higher baseline systolic BP in the elderly was contributing (but was not the sole underlying mechanism) to dobutamine-induced hypotension in the elderly.

**Arrhythmias:** Elderly patients had a higher prevalence of supraventricular tachycardia (7% vs 1%), atrial fibrillation (3% vs 0.4%), and premature ventricular contraction (74% vs 32%) during the test compared to the younger patients. There was also a trend to a higher prevalence of ventricular tachycardia in the elderly (5% vs 2%). However, the tachycardia was terminated spontaneously by termination of dobutamine infusion or by administration of metoprolol. No myocardial infarction or death occurred in any patient. The test was terminated because of arrhythmias in four patients (three in the elderly and one in the younger patients). Age was an independent predictor of supraventricular tachyarrhythmias. Previous studies have demonstrated an increased prevalence of spontaneous and exercise-induced arrhythmias with aging, which might explain the higher prevalence of tachyarrhythmias (particularly supraventricular tachycardia and premature ventricular contractions) in the elderly patients in this study. A trend was found to a higher prevalence of ventricular tachycardia in the elderly. However, the severity of resting perfusion abnormalities (and, presumably, resting left ventricular dysfunction) was the only independent predictor of the occurrence of ventricular tachycardia. This may be explained by the higher probability of the presence of substrate for

![Figure 2. The prevalence of myocardial perfusion abnormalities in patients ≥ 70 years old and < 70 years old undergoing dobutamine stress test. PD = perfusion defect; see Figure 1 for abbreviation.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21941/ on 06/27/2017)
arrhythmias in patients with more severe left ventricular dysfunction.\textsuperscript{10}

Studies of Dobutamine Stress Echocardiography in the Elderly: Few reports are available regarding the safety of dobutamine stress echocardiography in the elderly. These studies included smaller numbers of patients compared to our study and did not compare the results with a control group,\textsuperscript{27–29} or compared the elderly with a younger population unmatched for clinical variables that may influence the safety and feasibility of the dobutamine stress test.\textsuperscript{19} Poldermans et al\textsuperscript{27} studied 179 patients \( \geq 70 \) years old by dobutamine-atropine stress echocardiography. Arrhythmias induced during the test were atrial fibrillation in 2\%, nonsustained ventricular tachycardia in 2\%, and premature ventricular contractions in 21\%. Hypotension occurred in 4\%. No control group was studied. Baudhuin et al\textsuperscript{28} studied 63 patients \( \geq 60 \) years old compared to 63 patients \( < 60 \) years old by dobutamine stress echocardiography. Elderly patients had a higher prevalence of symptomatic hypotension and ventricular arrhythmias and a similar prevalence of supraventricular arrhythmias as compared to the younger patients. In their study, age was an independent predictor of hypotension but not of arrhythmias. However, the prevalence of different types of supraventricular or ventricular arrhythmias was not reported. Anthopoulos et al\textsuperscript{29} studied 120 elderly patients who underwent coronary angiography by dobutamine echocardiography. Sensitivity, specificity, and accuracy of dobutamine echocardiography for the diagnosis of coronary artery disease were 80\% and 75\% in the older patients and 79\% and 88\% in the younger patients, respectively. The prevalence of minor side effects was similar in both groups. Hiro et al\textsuperscript{19} studied 106 patients \( \geq 75 \) years old by dobutamine stress echocardiography. Elderly patients had a higher prevalence of symptomatic hypotension and ventricular arrhythmias and a similar prevalence of supraventricular arrhythmias as compared to the younger patients. In their study, age was an independent predictor of hypotension but not of arrhythmias. However, the prevalence of different types of supraventricular or ventricular arrhythmias was not reported. Anthopoulos et al\textsuperscript{29} studied 120 elderly patients who underwent coronary angiography by dobutamine echocardiography. Sensitivity, specificity, and accuracy of dobutamine echocardiography for the diagnosis of coronary artery disease were 86.5\%, 84\%, and 86\%, respectively. Although the use of echocardiographic imaging during dobutamine infusion was shown in previous studies to have a reasonable accuracy for the detection of coronary artery disease in the elderly, this study shows that myocardial perfusion imaging is a feasible alternative and should be considered, particularly in centers without adequate experience in stress echocardiographic imaging.

Clinical Implications and Conclusion: Dobutamine-atropine stress myocardial perfusion scintigraphy is a highly feasible method for the evaluation of coronary artery disease in the elderly. The target heart rate is achieved more frequently during the test in elderly patients than in younger patients. Elderly patients are at increased risk for developing supraventricular tachyarrhythmias during a dobutamine stress test. Although dobutamine-induced hypotension is more frequent in elderly patients, it is often asymptomatic and rarely necessitates termination of the test.

REFERENCES

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