Validity of Dobutamine Stress Echocardiography in Detection of Coronary Artery Disease.

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Abstract

Background: To determine validity of myocardial dobutamine stress echocardiography in detection of coronary artery disease.

Methods: In this descriptive study fifty patients with stable angina, undergoing coronary angiography, with or without past history of myocardial infarction were included. Dobutamine stress echocardiography was performed. Then 250 mg of dobutamine was infused. When patient failed to achieve 85% of age predictive maximum heart rate and had no symptoms and signs of ischemia, atropine in a dose of 1mg was added after the last stage. End points for test termination included limiting symptoms, 85% age predicted heart rate, maximum dose of dobutamine, ST- segment depression of > 2mm on ECG, severe hypertension, or a drop in systolic B.P of > 40mmHg from the previous stage or any significant arrhythmia. Images were recorded on video tape at baseline, at minimum dose, at peak dose and at recovery period. The location of segmental wall motion abnormality was correlated with the location of diseased coronary arteries. Left ventricular wall motion was assessed qualitatively and graded as normal, hypokinetic, akinetic or dyskinetic. For coronary angiography Judkin’s technique was used via right femoral artery approach.

Results: Mean age was 53.8±9.7. Men were 70%. Dobutamine stress echo was interpreted as normal in 14%, wall motion abnormality was noted in 86%. Coronary angiography showed 88% had > 50% stenosis in at least one coronary artery. The overall sensitivity, specificity, positive predictive value and negative predictive values of dobutamine stress echo were 93%, 83%, 98%, and 63% respectively while for LAD, RCA, CIRC the sensitivities were 84.6%, 73.3%, 72.2% respectively.

Conclusion: Dobutamine stress echocardiography has a high sensitivity for identifying patients with coronary artery disease.

Key Words: Dobutamine Stress Echocardiography, Coronary angiography

Introduction

In developing countries diagnosticians and cardiologists are not much attracted to this simple bedside technique which provides on-line results. Stress Echocardiography (SE) can be performed even at private consultation office (with proper arrangements). Most important is that dobutamine stress echocardiography (DSE) diagnostic laboratories are not dependant upon the arrival of weekly shipments of radioactive materials from international suppliers. SE, as a noninvasive imaging modality, can identify low-risk and high-risk subsets. Two-dimensional echocardiography has higher sensitivities than the electrocardiogram for identification of patients in the emergency department with myocardial infarction (MI) and ischemia.

Stress perfusion Scintigraphy is a sophisticated and sensitive technique in detecting the abnormalities due to coronary artery disease but is expensive and needs large equipment, isotope cost, personnel work and physician interpretation fees. Apart from low cost of SE, as compared to myocardial perfusion imaging, echo provides additional information about cardiac valves, pericardium and wall thickness at no extra cost.

Echocardiography has been used in combination with different drugs including dobutamine, dipyridamol and adenosine. The latest 2006 European Society of Cardiology (ESC) guidelines for stable angina concludes that dipyridamol and Dobutamine stress echocardiography have very similar applications and the choice as to which is employed depends largely on local facilities and expertise. Apart from diagnosis of CAD, stress echocardiography is used for assessing the results of various revascularization procedures and for risk stratification. Dobutamine stress echo can identify high risk patients after uncomplicated myocardial infarction i.e helpful in risk stratification after acute myocardial infarction. A normal stress echo carries a very low risk (< 1% per year) of major events in the subsequent 4–5 years.
Coronary angiography remains the gold standard for identifying the presence or absence of arterial narrowing due to atherosclerosis. It is the only helpful modality in determining the choice of intervention either percutaneous or coronary artery bypass grafting. Coronary angiography may be warranted in young patients with acute infarction to define the anatomy of the disease. It cannot be applied as a screening test because it is invasive, costly and needs definite cardiac catheterization laboratory. The rationale of this study was to assess the validity of this modality in our local setup and this will help in selection of non-invasive test required and will aid in selection of patients for coronary angiography and intervention.

**Methods**

This hospital based observational study was conducted from May 2008 to Jun 2009, in cardiology department, Postgraduate Medical Institute, Lady Reading Hospital, Peshawar. Fifty stable patients with angina, undergoing coronary angiography, with or without past history of myocardial infarction were included. Patients with (acute coronary syndrome, (acute ST elevation MI, NSTEMI, and USA), valvular heart diseases, congestive heart failure, acute pulmonary embolism or pulmonary infarction, uncontrolled hypertension (systolic BP >190mmHg, Diastolic BP >120), acute myocarditis or pericarditis, Acute aortic dissection and Uncontrolled arrhythmia) were excluded. Dobutamine dose was calculated for each patient. A 20 gauge needle with a stop cock was placed in right arm vein for the administration of dobutamine infusion. The infusion solution containing 250mg dobutamine in 50ml of 5% D/W was prepared. Patient was made to lie in the left lateral decubitus position. Under resting condition i.e before administration of dobutamine, all standard echocardiographic views were recorded where possible. Parasternal long axis, parasternal short axis, apical four chamber and two chamber views were considered standard views for wall motion analysis. Patient was started dobutamine infusion at 10µg/Kg/min for 03 minutes, and dose was increased by 20, 30, and 40µg/Kg/min, in 03 minutes as per incremental dosing protocol. When patient failed to achieve 85% of age predictive maximum heart rate and had no symptoms and signs of ischemia, atropine in a dose of 1mg was added after the last stage. End points for test termination included limiting symptoms, 85% age predicted heart rate, maximum dose of dobutamine, ST- segment depression of > 2mm on ECG, severe hypertension( systolic B.P>220 and diastolic B.P >120mmHg), or a drop in systolic B.P of > 40mmHg from the previous stage or any significant arrhythmia. Images were recorded on video tape at baseline, at minimum dose, at peak dose and at recovery period. Sixteen segment model represented regions of supply of the three major epicardial blood vessels i.e. left anterior descending (LAD), right coronary artery (RCA) and left circumflex (LCX) artery. Apical septal, mid septal, basal septal, basal anteroseptal, mid anteroseptal, apical anterior, mid anterior and basal anterior segments were assigned to LAD artery. Apical inferior, mid inferior, basal inferior, mid posterior and basal posterior segments were assigned to RCA. While apical lateral, mid lateral and basal lateral segments were assigned to Lt CX artery. The location of segmental wall motion abnormality was correlated with the location of diseased coronary arteries. Left ventricular wall motion was assessed qualitatively and graded as normal, hypokinetic, akinetic or dyskinetic. A score of 1(normal) to 4(dyskinetic) was assigned to each segment under resting conditions and during the test. A wall motion score index was derived by summation of individual segment score divided by the total number of segments. A test was considered positive if new wall motion or worsening of previous wall motion abnormality developed in ≥ 1 segment and score increased by ≥ 1 grade.

Coronary angiography was performed in all patients, using Judkin’s technique. Coronary stenosis was considered significant if the vessel diameter was narrowed by ≥ 50% in a major epicardial coronary artery or a major branch vessel.

**Results**

Out of 50 patients, 70% were male. The age was from 26 to 75 years (Table 1). Dobutamine stress test was interpreted as normal in 8 patients (14%). Wall motion abnormality was noted in 42 patients (86%) (Table 2). Fourteen (28%) patients had single vessel disease, double vessel disease in 44%, while triple vessel disease was found in 12%. Left anterior descending artery involvement was found in 68% (Table 2 & 3). On coronary angiography, Significant CAD was detected in 44 patients (88%). Twenty one patients (42%) had single vessel disease, 14 (28%) had double vessel disease, 9 (18%) had triple vessel disease and 4 patients (8%) had left main stem disease (Table 2). Significant disease in left anterior
descending artery was detected in coronary angiography in 78% (Table 3).

Out of 42 patients detected as positive by DSE, 41 patients were true positive, 1 patient was false positive. Among 8 patients detected as negative 5 were true negative and 3 were false negative (Table 4&5). The overall sensitivity, specificity, positive predictive value, negative predictive values and accuracy of dobutamine stress were 93%, 83%, 98%, and 63% respectively (Table 5). Thirty-five patients were detected by DSE as having wall motion abnormalities in LAD territory. Thirty-three were true positive and 2 patients were false positive. Dobutamine stress was negative in 15 patients, of which 9 patients were true negative and 6 were false negative (Table 4).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Disease on coronary angiography N(%)</th>
<th>Disease on dobutamine stress echo N(%)</th>
<th>p - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAD</td>
<td>Present</td>
<td>39 (78%)</td>
<td>0.262</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>11 (22%)</td>
<td></td>
</tr>
<tr>
<td>RCA</td>
<td>Present</td>
<td>19 (38%)</td>
<td>0.418</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>31 (62%)</td>
<td></td>
</tr>
<tr>
<td>CIRC</td>
<td>Present</td>
<td>18 (36%)</td>
<td>0.836</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>32 (64%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Diseased vessel on coronary angiography vs dobutamine stress echocardiography

Table no: 4: Sensitivity and specificity of dobutamine stress echo for different vessels

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coronary Angiography</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAD on DSE</td>
<td>Present</td>
<td>33</td>
<td>84.6%</td>
<td>90.9%</td>
<td>97.0%</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>6</td>
<td>71.0%</td>
<td>60.9%</td>
<td>81.5%</td>
</tr>
<tr>
<td>RCA on DSE</td>
<td>Present</td>
<td>14</td>
<td>73.3%</td>
<td>71.0%</td>
<td>60.9%</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>5</td>
<td>91.6%</td>
<td>81.3%</td>
<td>68.4%</td>
</tr>
<tr>
<td>CIRC on DSE</td>
<td>Present</td>
<td>13</td>
<td>72.2%</td>
<td>81.3%</td>
<td>68.4%</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>5</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 5: Validity of dobutamine stress echo

<table>
<thead>
<tr>
<th>Disease on DSE</th>
<th>Disease on Coronary Angiography</th>
<th>Total no. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>41</td>
<td>42</td>
</tr>
<tr>
<td>Absent</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>50</td>
</tr>
</tbody>
</table>

Sensitivity of DSE = 93%; Specificity of DSE = 83%; Positive predictive value of DSE = 98%; Negative predictive value of DSE = 63%

**Discussion**

Stress echocardiography has become a widely used examination, whose clinical utility, over the whole spectrum of CAD manifestations, has been well established by a large number of clinical studies. In present study the overall sensitivity, specificity, positive predictive value, negative predictive values and accuracy of dobutamine stress were 93%, 83%, 98%, and 63% respectively. The calculated sensitivity, specificity, positive predictive value and negative predictive value for LAD were 84.6%, 81.8%, 94.3%,
60.0% respectively. The sensitivity, specificity, PPV and NPV for RCA were 73.3%, 71.0%, 60.9% and 81.5% respectively. Sensitivity, specificity, PPV and negative predictive values for CIRC were 72.2%, 81.3%, 68.4% and 83.9% respectively. In a local study study DSE in comparison with coronary angiography, the sensitivity, specificity, positive and negative predictive values and accuracy of dobutamine stress echo for detection of coronary artery disease were in accordance to our study i.e 91%, 86%, 97%, 60% and 90% respectively. The sensitivities for SVD, DVD and TVD were 76%, 89% and 100% respectively.16Our results are comparable to a study done in Mayo Hospital Lahore ,where , the sensitivity, specificity, PPV and NPV of DSE as a whole compared with angiography were 87.5%, 95.2%, 87.5% and 82.35% respectively.18 Our results are also in accordance with study done by Sawada and associates who, reported their experience in 103 patients who underwent dobutamine stress echocardiography and quantitative coronary angiography In their study, the sensitivity and specificity of dobutamine-induced wall motion abnormalities for coronary artery disease were 89% (31 of 35) and 85% (17 of 20), respectively.19

In present study the possible bias could be the patients with old myocardial infarction. Majority of patients in present study were men (70%) in whom the prevalence of CAD is high, this could also have raised the sensitivity. High prevalence of severe disease could also potentially raise sensitivity. Most of these patients were being referred for angiography because of high pretest probability of CAD. Non quantitative interpretation of echocardiographic images was a limitation of the study.

Conclusion

1. Dobutamine stress Echo is a sensitive, specific and accurate method for the non invasive diagnosis of CAD.

2. The sensitivity of DSE is high for multivessel disease as compared to single vessel disease.

References


