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Utility of squatting stress echo in predicting significant angiographic coronary artery stenosis

Cardiology

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ABSTRACT

Stress echocardiography is one of the most useful non-invasive diagnostic modalities for detection and evaluation of coronary artery disease (CAD). However, dobutamine or exercise stress echocardiography remains underutilized due to its cost, time factor, potential complications and a need for specialized echo lab. So the search for new stress tests remains an important task in the diagnostics of coronary heart disease (CAD). Sharpey -Schafere et al (1) in a study of normal subjects, found that squatting caused an increase in systemic arterial pressure that was followed by bradycardia. Squatting increases left ventricular afterload and preload and will produce regional wall motion abnormalities (RWMA) in patients with coronary artery disease by inducing subclinical segmental dysfunction in normal segments with stenotic coronary arteries (2-5).

Aim. To evaluate the utility of squatting stress echo in diagnosing significant angiographic coronary Objective: To study the development of new or worsening RWMA induced by squatting and its relation with significant angiographic coronary artery stenosis

Methods: We studied 53 consecutive patients who were scheduled to have coronary angiography for the evaluation of chest pain. Each patient had squatting stress echocardiography followed by CAG. For squatting stress echocardiography the echocardiogram in standard views was recorded in the supine position. The procedure was repeated during squatting for 3 minutes. Echocardiography was performed using standard protocol. The squatting stress echocardiograms were interpreted by an observer blinded to the results of coronary angiography.

Results: During squatting, new or worsening Wall Motion Abnormality developed in 34 patients. In these patients CAG showed obstructive CAD in at least one of the major epicardial coronary artery. 38 % have developed RWMA in LAD territory, 22%, 16% in LCX and RCA territory respectively. The sensitivity, specificity, and accuracy of squatting Echocardiography for diagnosis of CAD were 94.1%, 94.4 and 96.9%, respectively. It is found to have significant correlation between squatting stress Echocardiography and coronary angiogram for the diagnosis of CAD.

Conclusion: These data indicate that squatting echocardiography is a NOVEL modality in the diagnosis of coronary artery disease.

KEYWORDS

squatting stress echocardiography, squatting stress test, regional wall motion abnormality, coronary angiography, novel stress test.

Introduction

Stress echocardiography is an established and widely used imaging functional test. The guidelines have recommended the use of functional test in the diagnosis of CAD in patients with low probability (6). Early detection of ischemia in asymptomatic patients can bring more benefit [1, 3,4].The hallmark of stress-induced myocardial ischemia is worsening of wall motion abnormalities or the development of new wall motion abnormalities. Stress echocardiography with physical and pharmacological agents - reliable method of verification of CAD, but has its own disadvantages - such as the occurrence of complications during the study, the high cost of the tools, the need for a special echo lab and a significant duration of the procedure [3, 7]. Thus, the search for new stress tests for CAD diagnosis is an utmost task. The influence of squatting on the hemodynamics of LV indicators and sizes have been previously studied [9, 10]. Chandraratna et al. studied the effect of squatting on the left ventricle and they demonstrated squatting induces regional wall motion abnormality of LV myocardial walls in patients with critical coronary artery stenosis which disappears on standing [10]. We wanted to evaluate the utility of squatting stress echo in diagnosing significant angiographic coronary artery stenosis in patents with intermediate risk for CAD.

Material and methods

It is a Single center, Prospective study of 53 consecutive patients with symptoms of coronary artery disease and awaiting CAG. The study included Patients with sinus rhythm and LV ejection fraction > 55% and we excluded Patients with significant valvular heart disease ,with previous MI and scarred myocardium ,with Congenital heart disease, patients with Mental impairment with limited ability to co -operate and patients with poor acoustic window. Informed consent was obtained from all subjects. The standing heart rate and blood pressure were recorded. After explaining and a mock trial of the procedure resting imaging is done with the patient lying in the left lateral decubitus position. Apical 4-chamber (AP4C),apical 2-chamber (AP2C), apical long axis (APLAX),parasternal long axis (PLAX), and short axis (PSAX) at papillary muscle level were acquired and stored as part of the protocol .The subjects were asked to squat, for 3 min. Blood pressure, heart rate, and echocardiograms were recorded during squatting. A normal stress ECHO result is defined as normal LV wall motion at rest and with stress. Squatting stress test is considered positive when development of new or worsening wall motion abnormalities noted during stress. Abnormal CAG was defined as narrowing of 70% or more of the caliber of at least one major coronary artery.

Statistical analysis

All data were analyzed with IBM SPSS version 20.0.0. Categorical variables were expressed as frequency and percentage. Continuous variables expressed as mean with standard deviation. Specificity, sensitivity and predictive values were calculated for squatting stress echo with coronary angiogram as gold standard. A p value of less than 0.05 was considered statistically significant.

Visual analysis of regional contractility LV was performed by independent operators in the blind mode without knowing the results of CAG. After evaluating the technical adequacy of the images, perform global function assessment to look for any changes in LV size and shape following stress. Segmental wall
motion analysis was done using a 16 segment model. After completing segmental wall motion analysis, the rest and peak WMSI, WMSI change, Hemodynamic data are also reviewed.

Results

The baseline characteristics are listed in **table 1**. There were 53 patients. Demographic data showed male predominance of 82% with a

mean age of 56.65+- 9.246. Only 24% had history of documented acute coronary syndrome. Majority had typical or atypical chest pain. Few patients had baseline RWMA. During squatting, new or worsening Wall Motion Abnormality developed in 34 patients (**FIG 1**). In these patients CAG showed obstructive CAD in at least one of the major epicardial coronary artery. 38 % have developed RWMA in LAD territory, 22%, 16% in LCX and RCA territory respectively. RWMA appeared during squatting quickly disappeared on standing up. The sensitivity, specificity, and accuracy of squatting Echocardiography for diagnosis of CAD were 94.1%, 94.4and 96.9%, respectively. Analysis of heart rate and blood pressure data showed that during squatting stress echo there was significant increase in both SBP and DBP as well as decrease in heart rate (**Table 2**).

Discussion

According to most researchers, stress Echocardiography is one of the best noninvasive method diagnosis of ischemic heart disease [3,8]. It is comparable with radionuclide scintigraphy for diagnosing multivessel CAD [7,11]. Stress echocardiography with pharmacological agents and exercise ergometry has its own drawbacks - the emergence of complications, high cost and long duration of procedure [3]. Studies showed that Stress ECG is known to have sensitivity and specificity in the range of 63%–68% and 74%–77%, respectively and average sensitivity and specificity of exercise echocardiography were 83% and 84%, respectively, whereas the same for DSE were 80% and 85%, respectively [8]. In our study the overall sensitivity is 94.11% and the specificity is 94.4% using CAG as the reference standard which is comparable with both dobutamine stress echo and nucleotide scintigraphy.

Stress echocardiography in the squatting position is useful test to identify significant CAD in patients with low to intermediate probability which does not have difficulty in interpreting results compare to other stress tests. Safety and predictive value of this technique are shown in a number of studies [9,10]. Chandraratna P.A et al note that the Stress echocardiography in the squatting position higher in multivessel lesions and in patients with well-developed collaterals [9]. In another study Chandraratna P.A et al did not find a reliable difference between stress-echocardiography in the squat position and stress- Echo with dobutamine in the diagnosis of CAD ($p = 0.88$).

We observed that squatting was accompanied by a slight increase in measures of the LV cavity at the end of diastole and systole. Heart rate increased insignificantly, but there was a significant increase in both SBP and DBP. Sharpey -Schafere et al (1), in a study of normal subjects, found that squatting caused an increase in systemic arterial pressure that was followed by bradycardia. Squatting produce increase in venous return and peripheral vascular resistance which produce increase in BP and baroreceptor mediated bradycardia [2].

Absence of marked changes in heart rate during squatting makes comparison with the baseline echocardiogram and interpretation of stress-induced WMA easier than when tachycardia is present. The rapid recovery after squatting reduces the risks of adverse effects.

We noted some limitations to squatting stress echo test. Patients with orthopedic disease or extreme obesity may not be able to squat. The operator also has to squat during the procedure, and only those with adequate echocardiography windows are suitable for testing. We got high sensitivity and specificity which may be due to high risk cohort in the study population, but high negative predictive value signify the importance of squatting stress echo as test to evaluate CAD. Considering the low cost, high reproducibility and wide availability squatting stress echo is a novel tool to diagnose significant CAD.

Conclusion

- Based on our study, squatting stress ECHO is a useful imaging modality for the diagnosis of CAD in patients with suspected disease.
- The overall sensitivity is Sensitivity 94.11% and the specificity is 94.4% using CAG as the reference standard.
- Should prompt its clinical use as the preferred non-invasive imaging technique due to its low cost, wide availability and reproducibility
- Prospective large scale and (when possible) randomized outcome studies to support more evidence-based management based on squatting stress echo

Conflict of interest: None

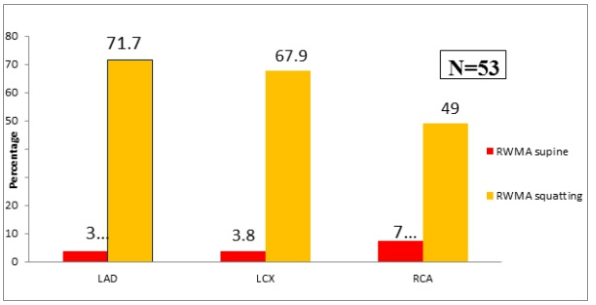
Table 1 : baseline characteristics

	Minimum	Maximum	Mean	Std. Deviation
Age	35	75	56.65	9.246
LV thickness	0	19	12.00	2.290
LV IDD	15	58	43.98	6.388
LV IDS	18	42	27.63	5.533
EF	0	84	63.78	12.738
WMI Squatting	1.0000	2.1800	1.211058	.2616433

Table 2 Heart Rate and Blood Pressure Data

	Standing (s.d)	Squatting (s.d)	p Value
Heart Rate	75.85 (6.231)	73.17 (8.276)	**< 0.001**
SBP(mmHg)	142.40 (10.990)	158.51(13.44)	**<0.001**
DBP(mmHg	83.08 (6.114)	92.06 (9.132)	**< 0.001**

Figure 1 : base line and squatting RWMA



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