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ORIGINAL ARTICLE

Validity of the distance between mitral leaflets coaptation point and annular plane in differentiation between ischemic and dilated cardiomyopathy

Khalid M. Abd El-Salam *, Maha H. El Sebaie, Manar Al Zaky, Ashraf El Saeed

Cardiology Department, Zagazig University, Egypt

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KEYWORDS

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Abstract *Background:* Identification of patients with ischemic cardiomyopathy (ICM) from those with idiopathic dilated cardiomyopathy (DCM) is important therapeutically and prognostically.
Objective: To assess the validity of the distance between the mitral leaflets coaptation point and the mitral annular plane (CPMA) at low dose dobutamine stress echocardiography (DSE) for differentiation between ICM and DCM.
Patients and methods: Echocardiographic indices and CPMA were measured at baseline and during dobutamine infusion for 50 patients who were presenting with heart failure and reduced ejection fraction (EF). Patients were divided into two groups depending on coronary angiographic findings, group I (ICM with significant coronary artery disease) and group II (DCM with normal coronary arteries).
Results: Compared with baseline values, the CPMA at low dose DSE decreased significantly in ICM patients (11.8 ± 2.2 vs 8 ± 1.2 mm, $P < 0.01$) while it showed non-significant change in patients with DCM (11.66 ± 2.3 vs 11.99 ± 2.22 mm, $P > 0.05$). At low dose DSE ICM group showed a high statistically significant negative correlation between CPMA and both EF ($r = -0.749$, $P < 0.0001$) and viability index ($r = -0.782$, $P < 0.0001$) and significant positive correlation with WMSI ($r = 0.79$, $P < 0.0001$). Receiver operating characteristic (ROC) CPMA cut-off value $\leqslant 9$ mm at low dose DSE, had sensitivity of 76.92%, specificity of 85.71% in detecting patients with ICM.

* Corresponding author.
E-mail address: dr.khaledelkomy@yahoo.com (K.M. Abd El-Salam).

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Conclusion: Measurement of CPMA at low dose DSE might help in identifying patients with ICM from those with DCM.

1. Introduction

ICM is chronic LV dysfunction due to the sequel of diffuse coronary artery disease giving a picture which is often indistinguishable from DCM.[1]

Under normal conditions, the coaptation point of the mitral valve leaflets in systole practically reaches the level of the mitral annulus. This point is displaced apically in abnormal conditions, such as morphological abnormalities of the leaflets or dilatation of the left ventricle.[2]

As a result of the chronic hypoperfusion state, the LV becomes larger and more spherically draws the papillary muscles out from the mitral valve annulus and results in abnormal cooptation of the mitral valve.[3,4]

The aim of this study was to assess the validity of (CPMA) at low dose DSE for differentiation between ICM and DCM in patients with LV systolic dysfunction.

Patients and methods

A total number of 50 patients presenting with heart failure and reduced EF $<50\%$ were referred for coronary angiography. According to angiographic findings patients were classified into two groups, group I included 26 patients with significant coronary artery disease (ICM group) and group II included 24 patients with normal coronary arteries (DCM group). All patients gave their informed consent. The study was approved by the ethics committee of our institute.

Dobutamine protocol

Dobutamine was administered intravenously from 5 to 40 μg/kg/min in 3-min dose increments during continuous electrocardiogram and blood pressure monitoring. Atropine (to a total dose of 1 mg) was added if 85% of the maximum age-predicted heart rate was not achieved by the end of the dobutamine protocol. The test was concluded at the peak dose or earlier if the patient developed ischemia or had intolerable side effects.[5]

Stress echocardiography

Before stress testing, baseline echocardiographic study was done with an ultrasound equipment (HP Sonos 5500, USA) with the patient in the supine and left lateral position. Standard 2-dimensional views were obtained from parasternal (long and short axis) and apical (4- and 2-chambers views) windows. Digital acquisition of images was obtained at rest, at low dobutamine dose (10 mg/kg/min), at peak stress, and during recovery for side-by-side display in quad-screen format.[5]

All segments were scored at rest and stress as normal or abnormal (hypokinetic, akinetic, or dyskinetic), with the 16-segment model and the interpretation criteria of the American Society of Echocardiography.[5] The WMSI was calculated as the sum of WMS of each segment divided by total umber of segments and the viability index was defined as the number of dyssynergic segments showing improvement at LDD divided by the total number of dyssynergic segments.[6]

CPMA was measured as the distance between mitral leaflets coaptation point and the mitral annular plane at the end systole.[2] The EF was measured by the modified Simpson method.[7]

Statistical analysis

Continuous variables are expressed as mean ± standard deviation. The unpaired Student *t* test was used to compare continuous variables, and categorical data were compared using the Chi-square (χ^2) test correlation between variables which was done using correlation coefficient (*r*) to detect if changes in one variable were accompanied by changes in other variable. Agreement test (kappa coefficient) was used to relate low dose CPMA with the type of dobutamine response. Cut-off values for CPMA were estimated by receiver operating characteristic curve (R.O.C.). Statistical significance was set at less than 0.05 level.[8]

Results

Table 1 shows the demographic data of the study population. Hypertension, DM and hyperlipidemia were significantly more common in ICM group compared with the DCM group {17 (65.38%) vs 12 (50%), $P < 0.05$}, {10 (38.46%) vs 7 (29.17%), $P < 0.05$} and {22 (84.61) vs 10 (41.67%), $P < 0.05$}, respectively.

Compared with baseline values, patients with ICM showed significant decrease of both CPMA and WMSI, whereas the EF was significantly increased at low dose DSE {11.8 ± 2.2 vs 8 ± 1.2 mm, $P < 0.01$}, {1.3 ± 0.1 vs 1.06 ± 0.07 mm, $P < 0.05$} and {41.8 ± 4.2 vs 44.3 ± 5.3 mm, $P < 0.05$}, respectively (Table 2, Fig. 1).

Table 1 Demographic data of the study population.

Variables	Group I ($n = 26$)	Group II ($n = 24$)	*P*
Age (years)	56 ± 8	54 ± 7	>0.05
Sex (No. & %)			
M	19 (73.07%)	16 (66.67%)	>0.05
F	7 (26.92%)	8 (33.33%)	>0.05
Smoking (No. & %)	17 (65.38%)	14 (58.33%)	>0.05
Hypertension (No. & %)	17 (65.38%)	12 (50%)	<0.05
D.M. (No. & %)	10 (38.46%)	7 (29.17%)	<0.05
Dyslipidemia (No. & %)	22 (84.61)	10 (41.67%)	<0.05

M = Male, F = Female, D.M. = Diabetes mellitus.
$P < 0.05$ = Significant, $P > 0.05$ = Non-significant.