Evaluation of Left Ventricular Systolic and Diastolic Function in Patients with Mitral Stenosis by Different Tissue Doppler Techniques

Thesis

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To My Dad, The Best Father Ever

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Abstract

Evaluation of left ventricular function in patients with pure mitral stenosis by different tissue Doppler techniques

Pure mitral stenosis (MS) affects left ventricular function as a result of myocardial and mechanical factors, we examined the left ventricular (LV) long axis function of the patient with pure mitral stenosis and normal global systolic function as assessed by ejection fraction (EF%).

This study was designed to:- evaluate patients with MS by means of Tissue Doppler imaging (TDI) in patients with MS by assessing Myocardial Performance Index (MPI) and myocardial velocity during systole, early and late diastole. Also to evaluate whether LV dysfunction affects and correlates with pulmonary artery pressure (PAP).

A total of 40 patients with estabilished diagnosis of MS (mean age: 43 ±10 years) and 40 healthy individuals (mean age: 29±7 years) were included in this study. Echocardiography equipped with TDI function was performed on each participant. The mitral valve area (MVA) and PAP were measured. Myocardial velocities were recorded at 4 different sites (septum, lateral, anterior and inferior) of the left ventricle by TDI. The positive systolic velocity when the mitral ring moved towards the cardiac apex and two negative diastolic velocities when the mitral annulus moved towards the base away from the apex were measured. TDI was used to evaluate iso-volumetric contraction time (IVC), iso-volumetric relaxation time (IRT) and ejection time (ET) at two different sites of the mitral annulus (lateral and septum). The MPI was calculated with the formula [(ICT+IRT) / (ET)], the mean MPI was found by dividing the sum of the MPI values into two. Patients with pure MS were compared with healthy participants, and the relationship of TDI variables with (MVA) and PAP were evaluated.

The psitive systolic myocardial velocities of the left ventricle indicating LV systolic function were found to be significantly lower in patients with pure MS and MPI indicating LV systolic and diastolic function to be sugnificantly higher in patients with pure MS. A significant positive correlation could be established between MVA and systolic myocardial velocities (septum, lateral, inferior, anterior) ($r=0.815$, $p=<0.01$; $r=0.821$, $p<0.01$; $r=0.815$, $p<0.01$; $r=0.676$, $p<0.01$; respectively) whereas a significant negative correlation ($r=-0.840$, $p<0.01$) was established between MVA and MPI as well as between PAP and myocardial systolic velocities (septum, lateral, inferior, anterior) ($r=0.754$, $p<0.01$; $r=-0.690$, $p<0.01$; $r=-0.742$, $p<0.01$; $r=-0.514$. $p<0.01$; respectively) , PAP was also found to be singificantly positively correlate with MPI ($r=0.855$, $p=0.01$).

This study shows that pure MS affects LV performance on long axis. The results indicate that the decrease in LV performance is caused by both functional and myocardial factors.

Key words: Mitral Stenosis, Tissue Doppler Imaging, Left Ventricular Function, Myocardial Performance Index.

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ACEI	Angiotensin Converting Enzyme Inhibitor
AF	Atrial fibrillation
AHA/ACC	American Heart Association/American collage of cardiology
ANOVA	Analysis Of Variance
AOVD	Aortic valve disease
AR	Aortic Regurgitation
ASD	Atrial Septal Defect
BMV	Balloon Mitral Valvuloplasty
BNP	B-Natriuretic peptide
CAD	Coronary Artery Disease
COP	Cardiac Output
CT	Computed tomography
DSE	Dobutamine stress echocardiography
DT	Deceleration Time of early left ventricular filling
DTI	Doppler Tissue Imaging
E/A	Peak Early Diastolic Flow Velocity To Late Diastolic Flow Velocity
E/E$^{/}$	Peak Early Diastolic Flow Velocity To Peak Mitral Annulus Velocity
ECG	Electrocardiogram
EF	Ejection Fraction
ESS	End systolic wall stress
ESV	End systolic volume
ET	Ejection time

HF	Heart failure
HR	Heart rate
ICT	Isovolumetric contraction time
IEC	Infective endocarditis
IEM	Inborn errors of metabolism
IRT	Isovolumetric relaxation time
IVCT	Isovolumetric contraction time
IVRT	Isovolumetric relaxation time
IVS	Interventricular setum
LA	Left atrium
LAD	Left atrial diameter
LAF	Long axis function
LQTS	Long QT syndromes
LV	Left Ventricle
LVEDD	Left ventricular end-diastolic diameter
LVEDP	Left ventricular end-diastolic pressure
LVEDV	Left ventricular end-diastolic volume
LVF	Left ventricular function
LVIO	Left ventricular inflow obstruction
MPI	Myocardial performance index
MR	Mitral regurgitation
MS	Mitral stenosis
MV	Mitral valve

MVA	Mitral valve area
MVAP	Mitral valve apparatus
MVG	Myocardial velocity gradient
PAP	Pulmonary artery pressure
PBMV	Percutaneous balloon mitral valvuloplasty
PHT	Pulmonary hypertension
PISA	Proximal isovelocity surface area
RAVD	Radiation-associated valvular disease
RF	Radio frequency
RHD	Rheumatic heart disease
RV	Right ventricle
SERCA	Sarcoendoplasmic reticulum calcium ATP-ase reuptake pump
SRI	Strain rate imaging.
SPAP	Systolic pulmonary artery pressure
SV	Stroke volume
TDE	Tissue Doppler echocardiography
TDI	Tissue Doppler imaging
TR	Tricuspid regurgitation
WMA	Wall motion abnormality

Chapter 1

Introduction & Aim of the work

Introduction and Aim of the work

Rheumatic Mitral Stenosis (MS) is frequently seen in developing countries and cause significant morbidity and mortality. [1]

Echocardiographic studies on left ventricular function (LVF) in MS have yielded conflicting results. Despite our knowledge that myocardial function remains normal in MS, some authors have recently demonstrated abnormalities in left ventricular function (LVF). [2, 3]

The effect of pure MS on left ventricular function (systolic and diastolic) is a complex phenomenon. The pathophysiologic roles for mechanical and myocardial factors for impairment of ventricular performance are not yet clear. [4]

Abnormal passive elastic properties resulting from chamber atrophy due to unloading , myocardial fibrosis, right and left ventricular interaction, or internal restrictions due to rigid mitral valve apparatus affect left ventricular function. [5]

Tissue Doppler imaging (TDI) is a new echographic technique which allows quantitative measurements of myocardial contraction and relaxation velocities of a selected myocardial segment. [6]

These velocities have been shown to reflect impairment of LVF. Even in the presence of preserved global systolic LVF as a measured by ejection fraction, there can be, in some patients, impairment in long-axis function as shown by TDI.