Right ventricular function in patients with diastolic heart failure

Thesis submitted for the partial fulfillment of Master degree in Cardiology

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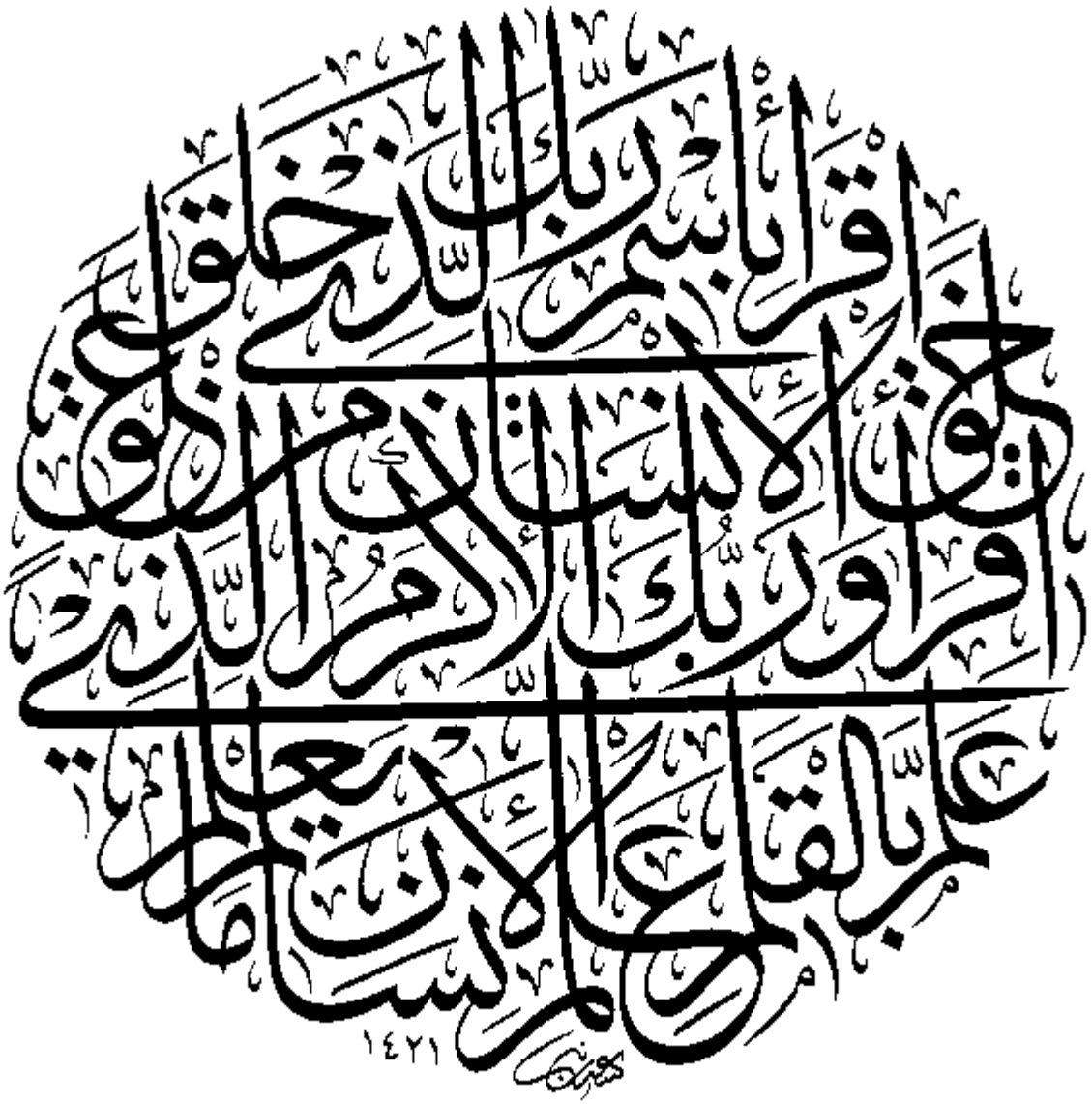
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Dedication

To my dear lovely parents,

Who spent their time, their health, their wealth and their lives to raise me, protect me, guide me, support me, encourage me and love me forever.
You are the source of my energy and motivation

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You are the source of my happiness

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Tamer Ashraf

Contents

List of Abbreviations

2D	Two-dimensional
3D	Three-dimensional
A	Late Diastolic Flow Velocity
A4C	Apical 4 Chamber View
Aa	Peak Velocity during Atrial Contraction
ACE	Angiotensin-Converting Enzyme
Ao	Aorta
ARB	Angiotensin Receptor Blocker
ASD	Atrial Septal Defect
ASE	American Society of Echocardiography
AT	Acceleration Time
BP	Blood Pressure
CAD	Coronary Artery Disease
CHF	Congestive Heart Failure
cm	Centimeter
CS	Coronary Sinus
CT	Computed Tomography
DBP	Diastolic Blood Pressure
DHF	Diastolic Heart Failure
DM	Diabetes Mellitus
DT	Deceleration Time
E	Early Diastolic Peak Flow Velocity
Ea	Peak Velocity during Early Diastole
ED	End Diastole
EF	Ejection Fraction
ES	End Systole
ET	Ejection Time
FAC	Fraction Area Change
FBS	Fasting Blood Sugar
HCM	Hypertrophic Cardiomyopathy
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction

HOI	Hangout Interval
HTN	Hypertension
IAS	Interatrial Septum
in	Inch
IVA	Isovolumic Acceleration
IVC	Inferior Vena Cava
IVCT	Isovolumic Contraction Time
IVRT	Isovolumic Relaxation Time
IVS	Interventricular Septum Thickness
IVV	Peak Myocardial Velocity during Isovolumic Contraction
LA	Left Atrium
LAD	Left Anterior Descending
LV	Left Ventricle
LVEDD	Left Ventricle End Diastolic Diameter
LVEF	Left Ventricle Ejection Fraction
LVESD	Left Ventricle End Systolic Diameter
LVH	Left Ventricular Hypertrophy
MB	Moderator Band
MPI	Myocardial Performance Index
MRI	Magnetic Resonance Imaging
ms	Millisecond
MV	Mitral Valve
NYHA	New York Heart Association
PA	Pulmonary Artery
PADP	Pulmonary Artery Diastolic Pressure
PAP	Pulmonary Artery Pressure
PDPV	Pulsed Doppler Peak Velocity
PEP	Pre-Ejection Period
PFO	Patent Foramen Ovale
PH	Pulmonary Hypertension
PLAX	Parasternal Long Axis
PM	Papillary Muscle
PR	Pulmonary Regurgitation
PSAX	Parasternal Short Axis
PSSR	Peak Systolic Strain Rate

PVR	Pulmonary Vascular Resistance
PWT	Posterior Wall Thickness
r	Correlation Coefficient
RA	Right Atrium
RCA	Right Coronary Artery
RIMP	Right Ventricular Index of Myocardial Performance
RV	Right Ventricle
RVBD	Right Ventricle Basal Diameter
RVD	Right Ventricular Diameter
RVEF	Right Ventricle Ejection Fraction
RVET	Right Ventricle Ejection Time
RVH	Right Ventricular Hypertrophy
RVLD	Right ventricle Longitudinal Diameter
RVMD	Right Ventricle Mid Diameter
RVOT	Right Ventricle Outflow Tract
RVP	Right Ventricular Pressure
RVSP	Right Ventricle Systolic Pressure
s	Second
S′	Pulsed Doppler Peak Velocity at The Annulus
Sa	Peak Velocity During Ejection Period of Systole
SBP	Systolic Blood Pressure
SD	Standard Deviation
SMT	Septo-Marginal Trabeculation
SPAP	Systolic Pulmonary Artery Pressure
SPECT	Single Photon Emission Computed Tomography
SPSS	Statistical Package for the Social Sciences
SR	Strain Rate
SWT	Septal Wall Thickness
TA	Tricuspid Annulus
TAM	Tricuspid Annular Motion
TAPSE	Tricuspid Annular Plane Systolic Excursion
TCO	Tricuspid Valve Closure Opening Time
TDI	Tissue Doppler Imaging
TDMPI	Tissue Doppler Myocardial Performance Index
TDT	Tricuspid Deceleration Time

TR	Tricuspid Regurgitation
TRV	Tricuspid Regurgitant Velocity
TV	Tricuspid Valve
TVI	Time Velocity Integral
U/S	Ultrasound
Vd	Velocity of the Diastolic Wave
VIF	Ventriculo-infundibular Fold
Vs	Velocity of the Systolic Wave

List of Tables

List of Figures

Abstract

Aim: The aim of this work is to determine the prevalence of right ventricular dysfunction in patients with preserved left ventricular ejection fraction heart failure & to compare between right ventricular systolic and diastolic functions in these patients.

Methods: Cross-sectional analytic study included fifty patients with preserved ejection fraction (EF) heart failure (HF) "diastolic heart failure" (LVEF ≥ 50%) and fifty normal subjects, comparable for sex and age. All subjects underwent blood pressure measurement, laboratory blood tests, complete right ventricle (RV) and conventional left ventricle (LV) 2D echocardiographic study.

Results: The prevalence of right ventricular (RV) systolic dysfunction in patients with diastolic heart failure was 30, 34, 32 and 36%, by using right ventricular fractional area change (RV FAC), tricuspid annular plane systolic excursion (TAPSE), peak systolic tricuspid annular tissue velocity (S′) and tissue Doppler myocardial performance index (TD MPI) criteria, respectively. Of those 50 patients with diastolic heart failure, the prevalence of elevated estimated right ventricular filling pressures suggestive of right ventricular diastolic dysfunction in patients with diastolic heart failure was 64, 32, and 48%, by using tricuspid E/A ratio (T E/A), tricuspid deceleration time (TDT) and tricuspid E/E` ratio (T E/E′) criteria, respectively.

Conclusion: The prevalence of right ventricular systolic and diastolic dysfunctions was not uncommon in patients with diastolic heart failure.

Key Words: Right Ventricle; Heart Failure; Dysfunction; Preserved ejection fraction; Echocardiography.

Introduction

Heart failure (HF) with preserved ejection fraction (EF) "Diastolic Heart Failure" has recently become an important health problem. It has been established as a major cause of cardiovascular morbidity and mortality.[1,2] It poses a significant financial burden and increasing consumption of health care resources among the elderly population (i.e., 65 years or older).[3,4] The mortality of this clinical syndrome is similar to that of reduced left ventricular (LV) EF HF, previously called systolic HF.[5]

In heart failure (HF) with reduced ejection fraction (HFrEF), right ventricular dysfunction (RVD) is common,[6] is associated with impaired functional capacity and portends a poor prognosis.[7-12] In HFrEF, ischemic or myopathic processes may directly involve the right ventricle (RV) and lead to RVD. Isolated insults to the left ventricle (LV) can lead to pulmonary hypertension (PH) and neurohumoral and cytokine activation. The resulting RV pressure overload, inflammation and altered RV myocardial gene expression promote RVD in the absence of primary RV myocardial injury.[13]

The prevalence and functional and prognostic implications of RVD in HF with preserved ejection fraction (HFpEF) "Diastolic Heart Failure" are less clear. While infarction or myopathic processes isolated to the RV are uncommon, PH is equally prevalent in HF with reduced or preserved LV ejection fraction (LVEF),[14-16] neurohumoral activation occurs in HFpEF[17] and comorbidities, which are highly prevalent in HFpEF, may play a fundamental role in the pathogenesis of altered myocardial function in HFpEF.[18] Thus, HFpEF patients may be at risk for RVD.

Right ventricular (RV) function is often involved in left ventricular pathologies as a consequence of a direct injury extension, afterload changes or ventricular interdependence, which is mainly due to the close anatomical association between the two ventricles.

For decades, the right ventricle (RV) was considered as the "unstressed" ventricle, unnecessary for the complex cardiac function. The right ventricle (RV) is not often explored by non-invasive techniques because of complex geometry, which precludes an