EARLY DETECTION OF DIABETIC CARDIOMYOPATHY: USEFULNESS OF TISSUE DOPPLER IMAGING

Thesis

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By

Rasha Mohammed Abdel Samie' Abdella

(M.B.B.Ch., M.Sc)

Supervised by

Dr. *RAWYA AHMED KHATER*

Professor of Internal Medicine and Endocrinology

Faculty of Medicine, Cairo University

Dr. *NEHAL HAMDY ELSAID*

Professor of Internal Medicine

Faculty of Medicine, Cairo University

Dr. *ZEINAB ATTIA ASHOUR*

Professor of Cardiology

Faculty of Medicine, Cairo University

Dr. *DAWLAT SALEM*

Professor of Biochemistry

Faculty of Medicine, Cairo University

Faculty of Medicine

Cairo University

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Abstract

Diabetes is a risk factor in 10-30 % of patients who develop heart failure. In type II diabetes, isolated abnormalities of diastolic relaxation in the absence of symptoms or signs of heart disease suggest a diagnosis of 'diabetic cardiomyopathy'. This is thought to result from microangiopathy, deposition of collagen, decreased expression/activation of the potassium channel and sodium pump and decreased myofilament calcium (Ca^{+2}) sensitivity.

Diastolic dysfunction in diabetic patients is believed to represent an earlier stage in the natural history of diabetic cardiomyopathy (Cosson et al., 2003), and its timely recognition may help to avoid or significantly delay the onset of CHF.

Previously published reports about the prevalence of LV diastolic dysfunction in diabetes are conflicting, mainly because of the confounding effect of systemic hypertension and CAD that frequently coexist with diabetes and have significant effects on cardiac diastolic physiology.

Key Words:

Definition and Classification Diabetes, Diabetes and Cardiovascular Disease, Diabetic Cardiomyopathy, Physiology of Diastole, Tissue Doppler Imaging (TDI)

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Contents

List of Abbreviations

A	Late diastolic transmitral velocity
Aa	Late diastolic mitral annular wave
Ac	Aortic valve closure
ACC	Acetyl coenzyme A carboxylase
ACCORD	Action to Control Cardiovascular Risk in Diabetes
ACE	Angiotensin converting enzyme
ACoA	Acetyl-co enzyme A
ACS	Acute Coronary Syndrome
ADP	Adenosine diphosphate
Adur	Duration of A wave
ADVANCE	Action in Diabetes and Vascular Disease
AGE	Advanced glycation endproducts
AM	Myocardial velocities during atrial systole
AOP	Aortic pressure
Ao root	Aortic root
Ar	Atrial retrograde flow velocity
AR	Atrial reversal (retrograde flow)
ARB	Angiotensin Receptor Blocker
AR du	Duration of atrial reversal velocity
ASE	American Society of Echocardiography
ATII	Angiotensin II
ATP	Adenosine triphosphate
AVC	Aortic valve closed
AVO	Aortic valve open
BB	Beta blockers
BMI	Body mass index
BNP	Brain Natrivretic peptide
BSA	Body Surface Area
Ca2+	Calcium
CAD	Coronary artery disease
CAN	Cardiac autonomic neuropathy
COPERNICUS	Carvedilol Prospective Randomized Cumulative Survival
CAVI	Cardio-ankle vascular index
CE	Cardiac efficiency
CFR	Coronary flow reserve
cGMP	Cyclic guanosine monophosphate
CHARM	Candesartan in Heart Failure to Affect Reduction in Morbidity and Mortality
CHD	Coronary Heart Disease
CPT1	Carnitine palmitoyl-transferase l
CRP	C-reactive protein
CV	Cardiovascular
CVD	Cardiovascular Disease

CW	Continuous wave
D	Peak anterograde diastolic velocity
2D	2-Dimensional
DAG	Diacyl glycerol
DBP	Diastolic blood pressure
Db/db mice	(Which have mutations that impair leptin signaling
DD	Diastolic dysfunction
DECODE	Diabetes Epidemiology Collaborative Analysis of Diagnostic Criteria in Europe
DFP	Diastolic filling pressures
DM	Diabetes Mellitus
Dp/dt	First derivative of LVP
DP/dt min	Peqk rate of LVP fall.
DP/DV	Slope of a tangent drawn to the curve at that point.
DT	Deceleration time
E	Early diastolic transmitral velocity
e'	Early diastolic mitral annulus velocity
Ea or EA	Early diastolic mitral annular wave
ECG	Electrocardiogram
ECM	Extracellular matrix
EDPVR	End diastolic pressure volume relationship.
EF	Ejection Fraction
ELITE	Evaluation of Losartan in the Elderly
EM	Myocardial velocities during early filling
ESRD	End Stage Renal Disease
ESPVR	End systolic pressure volume relationship.
ET-1	Endothelin-1
FA	Fatty acid.
FATP1	fatty acid transporter 1
FFA	Free fatty acids
FP	Filling pressures
FPG	Fasting Plasma Glucose
FS	Fraction Shortening of the left ventricle
GAD	Glutamic acid decarboxylase
GADPH	Glyceraldehyde-3-phosphate dehydrogenase
GDM	Gestational Diabetes Mellitus
GFR	Glomerular Filtration Rate
GLUTs	Glucose Transporters
GO	Fasting blood sugar
HbA1C%	Glycated Haemoglobin
HCM	Hypertrophic cardiomyopathy
HDL	High density Lipoprotein
HF	Heart failure
HNF	Hepatic nuclear transcription factor
HOMA-IR	Homeostasis model assessment of insulin resistance
HOPE study	Heart Outcomes Prevention Evaluation study
HPS	Heart Protection Study

HR	Heart rate
HTN	Hypertension
IFG	Impaired fasting Glucose
IGF-1	Insulin-like growth factor-1
IGT	Impaired Glucose tolerance
IO	Fasting insulin
IPF	Insulin promoter factor
IRP	Isovolumic relaxation period
IRT	Isovolumic relaxation time
IVC	Isovolumic contraction phase
IVR	Isovolumic relaxation
IVRT	Isovolumic relaxation time
IVS(D)	Interventricular septum diastolic dimension
IVS(S)	Interventricular septum systolic dimension
IVST(SWT)	Interventricular septum thickness
Kc	The slope
LA	Left atrium
LAP	Left atrial pressure
LDL	Low density lipoprotein
LV	Left ventricle
LVDD	Left ventricular diastolic dysfunction
LVD(D)	Left ventricular dimension in diastole
LVD(S)	Left ventricular dimension in systole
LVEDP	Left ventricular end diastolic pressure
LVET	Left ventricular ejection time
LVFP	Left ventricular filling pressures
LVH	Left ventricular hypertrophy
LVID	Left ventricular internal dimension
LVMI	Left ventricular mass index
LVP	Left ventricular pressure
LVPW(D)	Left ventricular posterior wall diastolic dimension
MADV	Mitral annular displacement velocity
MCD	Malonyl-coenzyme A decarboxylase
MCoA	Malonyl-coenzyme A
MELAS Syndrome	Mitochondrial myopathy, encephalopathy, lactic Acidosis and stroke-like syndrome.
MHC	Myosin Heavy Chain
MI	Myocardial Infarction
MMPs	Matrix metalloproteinases
Mo	Mitral valve opening
MODY	Maturity – onset diabetes of the young.
MR	Mitral regurge
MV	Mitral valve
MVF	Doppler Mitral volve flow velocity
MVG	Mitral velocity gradient
MVO	Mitral valve open
MV'O2	Myocardial oxygen consumption

MVVC	Mitral valve closed
Na+	Sodium
NEFA	Non -esterifed fatty acid
NF-kβ	Nuclear factor kappa β
NGR	Normal glucose regulation
NO	Nitric oxide
NOS1	Nitric oxide synthase-1
NYHA	New York Heart Association
Ob/ob mice	Which lack leptin
OGTT	Oral glucose tolerance test
OPTIMAAL	Optimal Therapy in Myocardial Infarction with the Angiotensin II Antagonist Losartan
PA	Pulmonary artery
PAI-1	Plasminogen Activator Inhibitor-1
PARP	Poly (ADP- ribose) polymerase
PCWP	Pulmonary capillary wedge pressure
PDH	Pyruvate dehydrogenase
PDK4	Pyruvate dehydrogenase kinase 4
PGC-1	Peroxisome proliferators activated receptor gamma coactivator-1
PKA	Protein Kinase A
PKG	Protein kinase G
PNF	Pseudonormal left ventricular filling
PP	Postprandial glucose
PPAR α	Peroxisome proliferators activated receptor-∝
PV	Pulmonary vein.
PV loop	Pressure – volume
PVAR	Pulmonary vein retrograde flow atrial flow reversal
PVD	Pulmonary vein diastolic velocity
PVF	Doppler pulmonary vein flow
PVS	Pulmonary vein systolic velocity
PW	Pulsed-wave
PWD	Pulsed wave Doppler
PWT	Posterior wall thickness
PWTDS	Pulsed-wave tissue Doppler study
RAS	Renin-Angiotensin system
RBC	Red Blood Cells
ROS	Reactive oxygen species
RV	Right ventricular
RVD(D)	Right ventricular dimension in diastole
S	Peak systolic velocity
Sa	Positive systolic wave by TDI or systolic myocardial motion
SERCA	Sarcoplasmic reticulum calcium ATPase pump
SHS	Strong Heart Study
Sm	Peak myocardial systolic velocity
SNS	Sympathetic nervous system
Sod 2	Superoxide dismutase
SOLVD	Studies of Left Ventricular Dysfunction

SR	Sarcoplasmic reticulum
SRI	Strain Rate Imaging
τ	Tau (time constant of isovolumic relaxation)
T	LV relaxation time constant
TD	Tissue Doppler
TE-e'	Time interval between the onset of E and e'
TG	Triglycerides
TGF-β1	Transforming Growth factor-β
Tn	Troponin
Tn-C	Troponin-C
TNF-$\propto$	Tumor Necrosis factor-$\propto$
TVI	Time velocity integral
TVI	Doppler tissue velocity imaging
TZD	Thiazolidinediones
UKPDS	United Kingdom Prospective Diabetes Study
VADT	Veterans Affairs Diabetes Trial
VEGF	Vascular Endothelial Growth Factor
VALIANT	Valsartan in Acute Myocardial Infarction Trial
Vp	Propagation velocity
WHO	World Health organization

List of Figures

List of Tables