Role of Quantitative Gated SPECT in Predicting Response to Cardiac Resynchronization Therapy

Thesis

Submitted for Partial Fulfillment of
MD Degree in **Cardiology**

By

Hesham Mahmoud Abu Shouk
MB BCh, M.Sc. Cardiology

Under Supervision of

Prof. Dr. Salah El-Din Hamdi Demerdash
Professor of Cardiology
Faculty of Medicine – Ain Shams University

Prof. Dr. Mona Mostafa Rayan
Professor of Cardiology
Faculty of Medicine – Ain Shams University

Dr. Ahmad Mohammad Onsy Ibrahim
Assistant Professor of Cardiology
Faculty of Medicine – Ain Shams University

Dr. Haitham Abd AlFattah Badran
Assistant Professor of Cardiology
Faculty of Medicine – Ain Shams University

Dr. Yasser Alaa ElDin Mahmoud
Lecturer of Cardiology
Faculty of Medicine – Ain Shams University

Faculty of Medicine - Ain Shams University
2018

بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgments

*First and foremost, I feel always indebted to **Allah** the Most Beneficent and Merciful.*

*I wish to express my deepest thanks, gratitude and appreciation to **Prof. Dr. Salah El-Din Hamdi Demerdash**, Professor of Cardiology, Faculty of Medicine, Ain Shams University, for his meticulous supervision, kind guidance, valuable instructions and generous help.*

*Special thanks are due to **Prof. Dr. Mona Mostafa Rayan**, Professor of Cardiology, Faculty of Medicine, Ain Shams University, for her sincere efforts, fruitful encouragement.*

*I am deeply thankful to **Dr. Ahmad Mohammad Onsy Ibrahim**, Assistant Professor of Cardiology, Faculty of Medicine, Ain Shams University, for his great help, outstanding support, active participation and guidance.*

*I would like also to express my sincere appreciation and gratitude to **Dr. Haitham Abd Al Fattah Badran**, Assistant Professor of Cardiology, Faculty of Medicine, Ain Shams University, for his continuous directions and support throughout the whole work.*

*Really I can hardly find the words to express my gratitude to **Dr. Yasser Alaa ElDin Mahmoud**, Lecturer of Cardiology, Faculty of Medicine, Ain Shams University for his continuous directions and meticulous revision throughout the whole work. I really appreciate his patience and support.*

I would like to express my hearty thanks to all my family for their support till this work was completed.

Hesham Mahmoud Abu Shouk

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LIST OF ABBREVIATIONS

Abb.	Full term
ACCF/AHA	*American College of Cardiology Foundation/ American Heart Association*
ACEIs	*Angiotensin-converting enzyme inhibitors*
ALT	*Alanine aminotransferase*
AMI	*acute myocardial infarction*
ANP	*A-type natriuretic peptide*
ARNI	*Angiotensin receptor neprilysin inhibitor*
AST	*Aspartate aminotransferase*
AV	*Atrioventricular*
BB	*Beta-blockers*
bpm	*Eats per minute*
BVP	*Biventricular pacing*
CCM	*Cardiac contractility modulation*
CMD	*Cardiac mechanical dyssynchrony*
CRT	*Cardiac resynchronization therapy*
CT	*Computed tomography*
DCM	*Dilated cardiomyopathy*
DENSE	*Displacement encoding with stimulated –echo*
DPD	*Diphosphono-1,2-propanodicarboxylic acid*
DTI	*Doppler tissue imaging*
ECG	*Electrocardiography*
EF	*Ejection fraction*
eGFR	*Estimated GFR*
ESC	*European society of cardiology*
GGTP	*Gamma-glutamyltransferase*
HF	*Heart failure*
LGE	*Late gadolinium enhancement*
LV EF	*Left ventricular ejection fraction*
LV	*Left ventricular*
LVMD	*LV mechanical dyssynchrony*
LVP	*Left ventricular pacing*
MEC	*Mechano-Electric Coupling*

LIST OF ABBREVIATIONS CONT...

Abb.	Full term
MPI	*Myocardial perfusion imaging*
MR	*Mitral regurgitation*
MRAs	*Mineralocorticoid/aldosterone receptor antagonists*
MRI	*Magnetic resonance imaging*
n-3 PUFAs	*n-3 polyunsaturated fatty acids*
NHANES	*National Health and Nutrition Examination Survey*
NOACs	*Non-vitamin K antagonist oral anticoagulants*
NPs	*Natriuretic peptides*
NYHA	*New York Heart Association*
OMC	*Mechanical contraction*
OMR	*Onset of mechanical relaxation*
OMT	*Optimal medical therapy*
PET	*Positron emission tomography*
PHB	*Phased histogram bandwidth*
PSD	*Phase standard deviation*
QALYs	*Quality-adjusted life-years*
QGS	*Quantitative Gated SPECT*
QOL	*Quality of life*
RBB	*Right bundle branch*
RBBB	*Right bundle branch block*
RV	*Right ventricular*
SPECT	*Single photon emission computed tomography*
SVR	*Surgical ventricular reconstruction*
TDI	*Tissue Doppler imaging*
TIBC	*Total iron binding capacity*
TOE	*Transoesophageal echocardiography*
TSI	*Tissue synchronization imaging*
TTE	*Transthoracic echocardiography*

INTRODUCTION

Cardiac resynchronization therapy (CRT) is an established therapeutic option for patients with drug-refractory advanced heart failure and ventricular conduction delay ***(Abraham et al., 2002).*** The merits of CRT have been demonstrated in terms of morbidity and mortality in several randomized clinical trials. Traditionally, a wide QRS complex, in addition to QRS morphology, has served to identify appropriate response to CRT. However, current selection criteria may not reliably portray the magnitude of CRT-remediable LV contraction dyssynchrony, as approximately 30% of patients selected with current selection criteria according to contemporary guidelines do not respond to CRT, a serious limitation for this invasive and costly endeavor ***(Cleland et al., 2005).***

One of the possible explanations of CRT non-response is that a wide QRS complex may reflect interventricular rather than intraventricular dyssynchrony ***(Boogers et al., 2009).*** In addition, a low correlation exists between LV mechanical dyssynchrony and electrical dyssynchrony manifested as prolonged QRS duration, as the QRS duration is an indirect correlate but not a direct reflection of mechanical dyssynchrony, which is the real substrate. Thus, assessment of mechanical dyssynchrony might serve as a better predictor of response to CRT than QRS duration ***(Haghjo et al., 2007; Uebleis et al., 2012).***

Several myocardial imaging techniques have been utilized to identify mechanical dyssynchrony, including echocardiography with tissue Doppler imaging (TDI), strain (rate) imaging, speckle tracking or three dimensional-derived parameters, magnetic resonance imaging (MRI), and nuclear imaging with single photon emission computed tomography (SPECT) ***(Bax et al., 2005; Henneman et al., 2007).***

Gated SPECT is a widely available technique that enables assessment of both perfusion and left ventricular functional parameters with low inter– and intra-observer variability in a single investigation. Recently, phase analysis on gated SPECT has been evaluated for the assessment of LV dyssynchrony and Quantitative Gated SPECT (QGS) algorithm (Cedars-Sinai) has been expanded to provide quantitative parameters for the assessment of LV mechanical dyssynchrony (LVMD) based on the Fourier phase histogram of the LV in which phase histogram band width (PHB) and (PSD) phase standard deviation have been identified as valid markers of LVMD. In addition to preexisting mechanical dyssynchrony, location and extent of scarred myocardium and the position of the left ventricular (LV) pacing lead have been suggested to influence the response to CRT ***(Chen et al., 2010; Trimble et al., 2008).*** Indeed, the region of LV pacing and the area of latest mechanical activation, seem to be important factors in the prediction of outcome to CRT ***(Deplagne et al., 2009; Becker et al., 2007).***