CARDIOVASCULAR MAGNETIC RESONANCE FOR THE ASSESSMENT OF RIGHT VENTRICULAR FUNCTION IN PULMONARY ARTERY HYPERTENSION

Thesis

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ABSTRACT

The most common cause of death among patients with pulmonary hypertension is right ventricular failure. Because cardiac magnetic resonance imaging has emerged as the reference standard for functional and morphologic evaluation of the right ventricle, it may become the most appropriate tool for noninvasive assessment of patients with this disease. Serial examinations may help monitor response to treatment and determine the prognosis. Deterioration of right ventricular function (indicated by increasing right ventricular volumes and decreasing stroke and left ventricular volumes) at follow-up cardiac magnetic resonance imaging is indicative of failed treatment and an unfavorable prognosis.

Key words: Cardiac Magnetic Resonance*;* Pulmonary Hypertension; Right ventricular function.

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ABBREVIATIONS

4Ch	Four Chamber
AA	Ascending Aorta
AT	Acceleration Time
AV	Atrioventricular
BSA	Body Surface Area
cm	Centimeter
CMRI	Cardiac Magnetic Resonance Image
CT	Computed Tomography
CTEPH	Chronic Thromboembolic Pulmonary Hypertension
DNA	Deoxyribonucleic Acid
ECG	Electrocardiographic Gating
EDV	End Diastolic Volume
EDVI	End Diastolic Volume Index
EF	Ejection Fraction
ESV	End Systolic Volume
ESVI	End Systolic Volume Index
ET	Ejection Time
FOV	Field Of Viwe
HLA	Horizontal Long Axis
ICBT	Intercostobronchial Trunk
IPAH	Idiopathic Pulmonary Arterial Hypertension
IVS	Interventricular Septum
Kg	Kilogram
LAD	Left Anterior Descending

LCx	Left Circumflex Artery
LPA	Left Pulmonary Artery
LTGA	Levo Transposition of Great Arteries
LV	Left Ventricle
m	Meter
Max	Maximum
Min	Minimum
mm	Millimeter
MPA	Main Pulmonary Artery
MPAP	Mean Pulmonary Artery Pressure
MRA	Magnetic Resonance Angiography
MRI	Magnetic Resonance Imaging
PA	Pulmonary Artery
PAP	Pulmonary Artery Pressure
PAPVR	Partial Anomalous Pulmonary Venous Return
PC	Phase Contrast
PCW	Pulmonary Capillary Wedge Pressure
PH	Pulmonary Hypertension
PR	Pulmonary Regurge
PVR	Pulmonary Venous Return
Qp:Qs	Pulmonary : Systemic Output Ratio
RHC	Right Heart Catheterization
ROC	Receiver Operating Characteristics
RPA	Right Pulmonary Artery
RV	Right Ventricle
RVH	Right Ventricular Hypertrophy

RVOT	Right Ventricle Outflow Tract
SA	Short Axis
SD	Standard Deviation
Sec	Second
SPAP	Systolic Pulmonary Artery Pressure
SSFP	Steady State Free-Precession
SV	Stroke Volume
SVC	Superior Vena Cava
SVI	Stroke Volume Index
T	Tesla
TE	Time of Eccho
TR	Time of Repetition
VENC	Velocity Encoding
VLA	Vertical Long Axis
VMI	Ventricular mass index

INTRODUCTION

Introduction

Pulmonary hypertension (PH) is clinically defined as the presence of mean pulmonary artery pressure (mPAP) ≥25mm Hg at rest measured at right heart catheterization (RHC). Further detailed assessment using blood testing, echocardiography, lung function, and multimodality imaging is key to identifying the cause of PH, which defines both prognosis and treatment ***(Swift et al., 2012).***

Pulmonary hypertension results from a variety of conditions which affect the pulmonary circulation. A progressive rise in pulmonary vascular resistance (PVR) results from obliteration or obstruction of the pulmonary vascular bed. This rise in PVR leads to a rise in pulmonary arterial pressure (PAP) and eventually these vascular changes result in increased afterload to the right ventricle (RV), which initially undergoes adaptive hypertrophy, but later experiences maladaptive dilatation, fibrosis and valve regurgitation resulting in right ventricular failure and early death in the majority of patients ***(Bogaert et al., 2012).***

The functional capacity of the RV is a major prognostic determinant in pulmonary hypertension. It is unknown why some patients with markedly elevated pulmonary artery pressure maintain well-preserved cardiac function for several years, while others with equal or less severe PH suffer rapidly progressive right heart failure. One factor that has hindered the understanding of right ventricular performance in patients with PH has been a lack of techniques that give a reliable picture of right ventricular morphological and functional change in the face of increasing outflow obstruction ***(McLure and Peacock., 2009).***

Patients with PH usually present with dyspnea, fatigue, syncope and angina like pain more frequent in advanced disease. Symptoms are non-specific and the delay from initial symptoms to diagnosis is often up to 2 years. As a result damage to the pulmonary arterial vasculature is already quite advanced by the time of diagnosis ***(Swift et al., 2014).***

Despite significant improvements in the diagnosis and treatment of PH, this disease remains to be associated with a profound reduction of quality of life and survival ***(Rosenkranz, 2015).***

Over the last decade cardiac magnetic resonance imaging (CMRI) has become accepted as the gold standard technique for the assessment of the proximal pulmonary circulation and the morphology and function of the RV ***(McLure and Peacock., 2009).***

CMRI is a noninvasive tool that provides high-resolution, three dimensional images of the heart. It provides information about right heart structure, volumes and function that is not readily obtained via other methods, such as echocardiography and RHC ***(Andrew et al., 2013).***