Correlations between Right Heart Catheterization, Echocardiography and Six Minute Walk Test in Assessment Severity of Pulmonary Arterial Hypertension

Thesis

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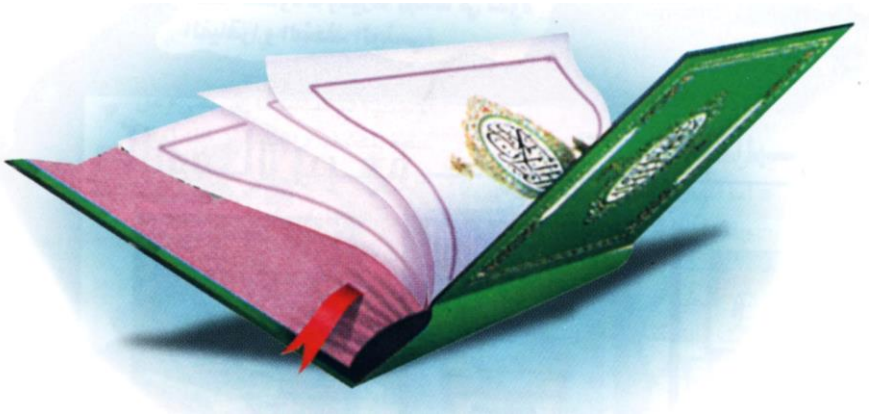
بسم الله الرحمن الرحيم

وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ
عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ



صدق الله العظيم

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Mohamed Adel Mekki

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List of Abbreviations

Abb.	Full term
%	*Percentage*
ABG	*Arterial blood gases*
ANA	*Antinuclear Antibodies*
Anticcp	*Anti-cyclic citrullinated peptide*
AntidsDNA	*Antidouble stranded DNA*
Anti-scl-70	*Antiscleroderma 70*
AUC	*Area under Curve*
BMI	*Body Mass Index*
BP	*Blood Pressure*
CBC	*Complete Blood Count*
CCBS	*Calcium Channel Blockers*
CHD	*Congenital Heart Disease*
CO	*Cardiac Output*
COPD	*Chronic Obstructive Pulmonary Disease*
CTD	*Connective Tissue Disease*
CTD	*Connective Tissue Diseases*
CTEPH	*Chronic Thromboembolic Pulmonary Hypertension*
CXR	*Chest X ray*
DLCO	*Diffusing Capacity of the Lung for Carbon Monoxide*
ECHO	*Echocardiography*
ESC	*European Respiratory Society*
ESR	*Erythrocyte Sedimentation Rate*
ET-1	*Endothelin-1*
ETRA	*Endothelin A*
ETRB	*Endothelin B*

List of Abbreviations cont...

Abb.	Full term
FC	*Functional class*
FEV1	*Forced Expiratory Volume in One Second*
FVC	*Forced Vital Capacity*
HF	*Heart failure*
HIV	*Human Immunodeficiency Virus*
HR	*Heart Rate*
HRCT	*High-Resolution Computed Tomography*
ILD	*Interstitial Lung Disease*
INR	*International Normalized Ratio*
IPAH	*Idiopathic Pulmonary Arterial Hypertension*
ISHLT	*International Society of Heart and Lung Transplantation*
IVS	*Inter-Ventricular Septum*
KFT	*Kidney Function Test*
LA	*Left Atriaum*
LFT	*Liver Function Test*
LV	*Left Ventricle*
mmHg	*Millimeter Mercury*
mPAP	*Mean pulmonary artery pressure*
MRI	*Magnetic Resonance Imaging*
NFAT	*Nuclear Factors of Activated T-Cells*
NO	*Nitrogen Monoxide*
PAH	*Pulmonary Arterial Hypertension*
PaO2	*Oxygen Tension*
PAP	*Pulmonary Artery Pressure*
PASMCS	*Pulmonary Artery Smooth Muscle Cells*

List of Abbreviations cont...

Abb.	Full term
PAWP	*Pulmonary Artery Wedge Pressure*
PCWP	*Pulmonary Capillary Wedge Pressure*
PDE-5	*Phosphodiesterase type-5*
PGI2	*Prostaglandin I2*
PH	*Pulmonary Hypertension*
PVOD	*Pulmonary Veno-Occlusive Disease*
PVR	*Pulmonary vascular resistance*
RA	*Right Atrium*
RAP	*Right Atrial Pressure*
RHC	*Right-Sided Heart Catheterization*
ROC	*Receiver operating Characteristic*
RT	*Right*
RV	*Right Ventricle*
RVP	*Right ventricular Pressure*
SaO2	*Oxygen Saturation*
SD	*Standard deviation*
SE	*Standard Error*
SPAP	*Systolic Pulmonary Artery Pressure*
SSRIs	*Selective serotonin reuptake inhibitors*
TLC	*Total Lung Capacity*
TR	*Tricuspid Regurgitation*
V\Q scan	*Ventilation Perfusion Scan*
VIP	*Vasoactive Intestinal Peptide*
WHO	*World Health Organization*

INTRODUCTION

Pulmonary arterial hypertension (PAH) is a disease of the pulmonary vasculature leading to an increase in pulmonary vascular pressure (mean arterial pulmonary pressure ≥25 mm Hg) causing exertional dyspnea and progressive right heart failure ***(Galie et al., 2015)***.

There is a marked increase in the pulmonary vascular resistance resulting in right ventricular remodeling and eventual failure, which, in the majority of cases, results in the patient death ***(Tuder et al., 2013).***

Given the evolving definition of PH, the incidence and prevalence of the disease is difficult to define ***(Strange et al., 2012).***

Regardless of etiology, PH is characterized by limited exercise capacity and a progressive increase in breathlessness. Until recently, treatment options for PH remained limited and patient prognosis poor. One early registry of PH patients reported a median survival time of 2.8 years post diagnosis without treatment ***(D'Alonzo et al., 1991).***

The World Health Organization functional class (WHO-FC), despite its interobserver variability, remains one of the most powerful predictors of survival, not only at diagnosis, but also during follow-up. A worsening FC is one of the most alarming indicators of disease progression, which should

trigger further diagnostic studies to identify the causes of clinical deterioration ***(Nickel et al., 2012).***

The 6-minute walking test (6MWT), a submaximal exercise test, remains the most widely used exercise test in PH centers. The test is easy to perform, inexpensive and familiar to patients and centers. As with all PH assessments, 6MWT results must always be interpreted in the clinical context ***(Savarese et al., 2012).***

The prognostic value of this parameter lies not in the change of 6MWD in response to treatment, but most of all in its absolute value, particularly if it is lower than 250 m ***(Benza et al., 2010).*** There was significantly lower mortality in patients with 6MWD higher than 440 m ***(Farber et al., 2015).***

Echocardiography is commonly used for diagnostic and treatment monitoring purposes in patients with PAH due to its wide availability, non-invasive nature, and reproducibility ***(Eysmann et al., 1989).***

A comprehensive echocardiographic assessment includes a description of chamber sizes, particularly of the Right Atrium and Right Ventricle area, the magnitude of tricuspid regurgitation, the Left Ventricle eccentricity index and RV contractility, which can be, determined by several variables, including RV longitudinal systolic strain/strain rate and RV fractional area change, Tei index and tricuspid annular plane systolic excursion (TAPSE) ***(Fine et al., 2015).***

European Society of Cardiology Guideline suggests grading the probability of PH based on TRV at rest and on the presence of additional pre-specified echocardiographic variables suggestive of PH. The probability of PH may then be judged as high, intermediate or low ***(Rudski et al., 2010).***

RHC is a technically demanding procedure that requires meticulous attention to detail to obtain clinically useful information. To obtain high-quality results and to be of low risk to patients, the procedure should be limited to expert centers ***(Kovacs et al., 2014).***

RHC is required to confirm the diagnosis of PAH and chronic thromboembolic pulmonary hypertension, to assess the severity of haemodynamic impairment and to undertake vasoreactivity testing of the pulmonary circulation in selected patients. When performed at expert centers, these procedures have low morbidity (1.1%) and mortality (0.055%) rates ***(Hoeper et al., 2006).***

Current diagnostic criteria for pulmonary artery hypertension based on right heart catheter. Mean pulmonary arterial pressure >25mmHg at rest a pulmonary capillary wedge pressure < 15mmHg and by pulmonary vascular resistance >3 Wood Units ***(Frost et al., 2013).***

Haemodynamics assessed by RHC provide important prognostic information, both at the time of diagnosis and during

follow-up. RA pressure, cardiac index (CI) and mixed venous oxygen saturation (SvO2) are the most robust indicators of RV function and prognosis, whereas mPAP provides little prognostic information (except for Calcium Channel Blockers responders) ***(Nickel et al., 2012).***