Tissue Doppler Assessment of Myocardial Dysfunction in Bronchial Asthma

Thesis

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Master Degree in Pediatrics

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تقييم الخلل في وظائف عضلة القلب باستخدام دوبلر الأنسجة في مرضى الربو الشعبي

رسالة

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Summary

Bronchial asthma is a chronic inflammatory disease of the lower respiratory tract characterized by non specific bronchial hyper-responsiveness, which may lead to variable reversible air flow obstruction in affected patients *(Beeh and Buhl, 2001).*

Severe bronchial asthma profoundly alters the cardiovascular status and function *(Spyros et al., 2002).* Diastolic dysfunction of the right ventricle is the earliest hemodynamic change in bronchial asthma. Left ventricular diastolic dysfunction was also observed in severe bronchial asthma *(Chicherina and Shipitsyna, 2003).* This may be due to bronchial obstruction, hypoxemia, dilation, hypertrophy and altered diastolic filling of the right ventricle. Left ventricular diastolic filling improved with attenuation of the exacerbation of bronchial asthma *(Bobrov et al., 2003).*

This study included 63 children 33 males and 30 females. Their age ranged from 6 years to 16 years they were classified into two groups:

Group 1 (cases): Included 48 patients with bronchial asthma as cases.


بسم الله الرحمن الرحيم
وَ أَنْزَلَ اللّٰهُ
عَلَيْكَ الْكِتَابَ
وَالْحِكْمَةَ
وَ عَلَّمَكَ مَالَمْ
تَكُنْ تَعْلَمُ
وَ كَانَ فَضْلُ
اللّٰهِ عَلَيْكَ
عَظِيمًا
صدق الله العظيم
سورة النساء آية

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List of Abbreviations

Abbrev.	Full term
2D	Two dimentional
ACC	American College of Cardiology
AHA	American Heart Association
Am	Late myocardial diastolic wave
Ao	Aorta
Awave	A second diastolic wave (late diastole)
BA	Bronchial asthma
C	The velocity of sound in human tissue at 37^{o}C.
CFD	Color flow Doppler
CO	Cardiac output
CTDI	Color Tissue Doppler Imaging
CW	Continous wave
E wave	Pulsed wave Doppler mitral inflow early diastolic wave
Ea wave	Tissue Doppler Imaging early annular diastolic wave
ECG	Electrocardiogram
EDV	End diastolic volume
EF	Ejection fraction
Em	Ecoho early myocardial diastolic wave
ESC	European Society of Cardiology
ESR	Erythrocyte Sedmination Rate
ESV	End systolic volume
Ewave	Early diastolic velocity of relaxation
Fd	The observed Doppler frequency shift.
FEV1	Forced expiratory volume in 1 second
Fo	The transmitted frequency
FVC	Forced vital capacity
GAS	Group A Streptococcus
GM-CSF	Granulocyte- mcrophage colony stimulating factor

Abbrev.	Full term
IgE	Immunogloblin E
IL- 4	Interlukin-4
IL-11	Interlukin-11
IL-13	Interlukin-13
IL-1B	Interleukin 1 B
IL-5	Interlukin-5
IL-8	Interlukin-8
IL-9	Interlukin-9
IVCT	Isovolumetric contraction time
IVRT	Isovolumic relaxation time
IVsd	Interventricular septal thickness in diastole
IVSS	Interventricular septal thickness in systole
K-T CELLS	Natural killer cells tumer
LA	Left atrial
LABAS	Long acting B2 agonists
LPWd	Left posterior wall thickness in diastole
LPWS	Left posterior wall thickness in systole
LV	Left ventricle
LVIDd	Left ventricular internal diameter in diastole
LVIDs	Left ventricular internal diameter in systole
MCP-1	Macrophage chemottactant
MDC	Macrophages derived chemokines
MIP-1&	Macrophage inhibiting protein1-& IL-6
MM	M mode
MR	Mitral Regurgitation
MRI	Magnetic Resonance Imaging
NYHA	New York Heart Association
O	The intercept angle between the ultrasound beam and the blood flow.
PEF	Peak expiratory flow
PPD	Purified protein derivative
PRF	Pulse repetition frequency

Abbrev.	Full term
PW	Pulsed wave
PW TDI	Pulsed Wave Tissue Doppler Imaging
RA	Right Atrial
RAAS	Renin-angiotensin-aldosterone System
RBC	Red blood corpuscle
RIVGT	Regional iso-volumic contraction
RIVRT	Regional iso-volumic relaxation time
RSV	Respiratory syncitial virus
RV	Right ventricular
S wave	Tissue Doppler Imaging systolic wave
S	Systole
S1	1st heart sound
S2	2nd heart sound
Sa wave	Tissue Doppler annular systolic wave
Sm	Systolic myocardial
SPP	Systolic pulmonary pressure
SPSS	Statistical program for social science version 12
SR	Strain Rate
TARC	Thymus and activation-regulated chemokines
TDE	Tissue doppler cardiography
TDI	Tissue Doppler Imaging
TEE	Transoesophageal Echocardiography
TH1	T helper 1 lymphocyte
TH2	T Helper 2 lymphocyte
TNF	Tumour necrosis factor
TR	Tricuspid Regurgitation
TVI	Tissue velocity imaging
US	Ultrasound
V	Blood flow velocity
VEGF	Vascular endothial growth factor
ε	Strain

Introduction

Bronchial asthma is a chronic inflammatory disease of the lower respiratory tract characterized by non specific bronchial hyper-responsiveness, which may lead to variable reversible air flow obstruction in affected patients *(Beeh and Buhl, 2001).*

Severe bronchial asthma profoundly alters the cardiovascular status and function *(Spyros et al., 2002).* Diastolic dysfunction of the right ventricle is the earliest hemodynamic change in bronchial asthma. Left ventricular diastolic dysfunction was also observed in severe bronchial asthma *(Chicherina and Shipitsyna, 2003).* This may be due to bronchial obstruction, hypoxemia, dilatation, hypertrophy and altered diastolic filling of the right ventricle. Left ventricular diastolic filling improved with attenuation of the exacerbation of bronchial asthma *(Bobrov et al., 2003).*

Spyros et al. (2002) reported that rapid right ventricular filling in inspiration results in shifting of the interventricular septum toward the left ventricle which may lead to left ventricular diastolic dysfunction and incomplete filling. The large negative intrathoracic pressure generated during inspiration

may also increase left ventricular afterload by impairing systolic emptying.

Echocardiography is the most commonly used tool to assess cardiac function *(Aurigemma et al., 2001)* and offers a number of advantages. It is not only non invasive but provides exquisite images of the beating and often tiny heart. This technology is especially beneficial for the pediatric population because it does not cause discomfort and eliminates the need for sedation *(Fratt, 2003).*

Tissue Doppler imaging is an emerging ultrasound technology that measures cardiac function without the invasive and painful elements of cardiac catheterization and biopsy *(Darek and Fyfe, 2003).* It is a new objective method that accurately quantifies myocardial tissue velocities, deformation, time intervals and left ventricular filling pressure *(Shirley et al., 2006).*

Tissue Doppler imaging measures the velocity of the cardiac muscle itself, rather than that of the blood and is a direct measurement of the heart function. It is easy to perform and available on most current echocardiography machines. More importantly it is not affected by factors such as anemia, fluid over load and valve leakage, all of which can cause inaccurate measurements with conventional blood flow Doppler *(Darek and Fyfe, 2003).*

Aim of the Work

The aim of this prospective study was to evaluate global cardiac function in children with bronchial asthma using M mode, two dimensional echocardiography and tissue doppler using speckle track echocardiography of asthmatic children and correlate the results with the severity of the disease.