Evaluation of myocardial injury in children with left-to-right shunt using a highly sensitive cardiac Troponin-I assay

Thesis

Submitted for partial fulfillment of master degree
Of pediatrics

By

Shaima mohsen abdelrahman
MB, BCH Cairo University (2002)

Under supervision of

Professor Doctor Mahmoud Tarek-Abdelmonem
Professor of pediatrics
Faculty of medicine-Ain shams university.

Doctor Nevin Mohamed Mamdouh Habeeb
professor of pediatrics
Faculty of medicine-Ain shams University.

Doctor Eman Saleh AL Hadidi
professor of clinical pathology
Faculty of medicin-Ain shams University.

Faculty of medicine
Ain shams university
(2012)

Acknowledgement

First and foremost, thanks and praise to **ALLAH**, Most Gracious, Most Merciful.

I am greatly thankful to **Professor Doctor Mahmoud Tarek-Abdelmonem** Professor **of** Pediatrics, Faculty of Medicine, Ain Shams University for his great effort, advice and kind help throughout this work.

No word can express my deep gratitude to **Assis. Prof. Dr. Nevin Mohamed Mamdouh Habeeb,** Professor of Pediatrics and Pediatric cardiology, Faculty of Medicine, Ain Shams University for her great support, valuable advice and continuous encouragement. And for her great effort, and kind help throughout this work.

I am also delighted to express my deepest gratitude and cordial thanks to **Professor Eman Saleh AL Hadidi,** Professor of Clinical Pathology, Ain Shams University for her kind care and great assistance throughout this work.

I would like to thank my patients and their parents for their cooperation and trust. I wish them all the best of health.

Last but not least, I would like to express my gratitude and thanks to my family for their kindness, trust, unfailing support and much needed encouragement.

Contents

List of Abbreviations

VSD	Ventricular Septal defect
ASD	Atreal Septal defect
PDA	Patent ductus arteriosus
SVC	Superior vena cava
IVC	Inferior venacava
TEE	Transaosphegeal echocardiography
TTE	Transthorcic echocardiography
MRI	Magnetic resonant image
CFM	Color flow mapping
ACE	Angiotensin-converting enzyme
CK-MB	Creatinen kinase-MB
MYO	Myoglobin
PE	Pulmonary embolism
COPD	Chronic obstructive pulmonary disease
ECV	External current cardio version
EMP	Endomyocardial biopsies
ELBW	Extremely low-birth-weight
cTnT	Cardiac troponin T
IVH	Intraventricular hemorrhage
BNP	Brain natruritic peptide
hsTnI	High-sensitivity troponin I
NYHA class	New York Heart Association Functional Classification.
LVDZ score	Left ventricular dimension Z score
LADZ score	Left atreal dimension Z score
EF%	Ejection fraction%
FS%	Fractional shortening %
CKD	Chronic kidney disease
CAD	Coronary artery disease

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Introduction

In congenital heart diseases with left-to-right shunts oxygenated blood from the left heart (left atrium or left ventricle) or the aorta shunts to the right heart (right atrium or right ventricle) or the pulmonary artery through an abnormal opening between the 2 sides. Blood flows from left to right initially because systemic pressure and vascular resistance are higher than pulmonary artery pressure and resistance. The additional blood flow to the right side increases pulmonary blood flow and pulmonary artery pressure to a varying degree. The greater the increase, the more severe the symptoms; a small left-to-right shunt is usually asymptomatic.

High-pressure shunts (those at the ventricular or great artery level) become apparent several days to a few weeks after birth; low-pressure shunts (atrial septal defects) become apparent considerably later. If untreated, elevated pulmonary artery pressure may lead to Eisenmenger's syndrome. Large left-to-right shunts (e.g., large ventricular septal defect [VSD], patent ductus arteriosus [PDA]) cause volume overload, which may lead to HF and during infancy often results in failure to thrive. A large left-to-right shunt also decreases lung

compliance, leading to frequent lower respiratory tract infections. **(Davlouros et al, 2011)**

Cardiac troponins are very sensitive markers for the detection of myocardial damage, and the ability to assay their serum levels accurately and quickly has revolutionized the concepts of minor myocardial injury .They are also powerful prognostic indicators of future adverse cardiac events. The kinetics of troponins released in the blood are close to that of creatine-kinase MB, but thereturn to normal is observed after longer periods of time. (**Sarko, and Pollack, 2002)**

The first-generation troponin assay has some limitations. These limitations include antibody specificity, assay imprecision, lack of standardization, and the relatively late increase in circulating troponin levels after the onset of ischemia. Recently, a second-generation cTnI assay (Centaur TnI-Ultra assay) has become available. **(Missov et al, 2008)**

However, few reports have described the use of serum cTnI levels for evaluating hemodynamic overload in children with CHD. **(Feraco et al, 2009)**

In the current study we will hypothesis that significant hemodynamic overload due to a left-to-right shunt can induce myocardial injury.

Aim of work

We aim to evaluate myocardial injury as detected by highly sensitive cardiac troponin I. in children with left to right shunt.

Chapter 1

Congenital heart diseases with left to right shunt

Congenital heart diseases are abnormalities of the heart and/or great vessels present at birth. They are not all that uncommon: 1% of live births have a congenital heart defect! The clinical spectrum is broad. Some congenital heart diseases cause death in the perinatal period; others are so mild that there are only minimal symptoms, even in adulthood. **(Hoffman and Kaplan, 2002)**

The high incedence of CHDmay also reflect the high utelization of echocardiography for assessing minor lesion. **(Bolisetty et al, 2004**)

In the study "The Prevalence of Heart Disease In the Neonatal Intensive Care", conducted at NICU pediatric hospital, Ain shams university. It included all newborns admitted to NICU over a period of 6 months founded that, the

commonest cardiac defect by echocardiography was PDA which represent 25% followed by ASD which represent 10% then VSD represent 8.2%. **(kotby et al, 2007**)

Renal disease in addition to positive family history is considered the most important independent predictors of CHD after exclusion of other non significant predictor. **(Kotby et al, 2007)**

Congenital heart defects can be divided into two broad groups, those that cause shunts (abnormal communication between chambers or vessels) and those that cause obstructions (narrowed chambers, valves, or major vessels). Shunts are more common than obstructions; the more common of these are atrial septal defects, ventricular septal defects, patent ductus arteriosus, and tetralogy of Fallot. The most common obstruction is aortic coarctation. **(kapla, 2002)**

Left to Right Shunts

The flow through the systemic and pulmonary circulations is normally balanced and equal. As the two circulations are placed in series with each other; blood first makes its way through the systemic circulation, then the pulmonary circulation, then back to the systemic circulation, and so on. **(Ronald, 1998)**

Left to right shunts are characterized by a "back-leak" of blood from the systemic to the pulmonary circulation. As a consequence, the pulmonary circulation carries not only the blood that legitimately entered the right atrium and ventricle through the superior and inferior vena cava, but also the additional blood entering through an ASD, VSD, or a PDA. Blood volume and pressure in the pulmonary circulation become abnormally high. If the shunt is significant, there is progressive damage to the pulmonary vasculature and gradual development of irreversible pulmonary hypertension. **(Williams et al, 1998)**

VSD, ASD and PDA with volume over load can cause increases in the level of atreal natruritic peptid (ANP) even in absences of heart failure but with treatment with ACE inheptore there will be marked improvement in clinical status, NYHA classification and there will be decrease in ANP level. **(kotby et al 2012)**

The pressure in the pulmonary circuit may ultimately exceed the systemic pressure with reversal of blood flow from the right side of the circulation to the left (Eisenmenger syndrome). **(Marelli et al, 2007)**

Lesions resulting in left to right shunts include:

- Ventricular septal defect (VSD)
- Patent ductus arteriosus (PDA)
- Atrial septal defect (ASD)
- Atrioventricular defect (AVSD)

In VSD and PDA, the direction and magnitude of the shunt depends on the size of the communication and the relative resistance in the pulmonary and systemic circuit.