Assessment of Exercise Testing After Repair of Tetralogy of Fallot

Thesis

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(قَالُوا سُبْحَانَكَ لا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَـا

إِنَّكَ أَنْـتَ الْعَلِيـمُ الْحَكِيـمُ)

(سورة البقرة:32)

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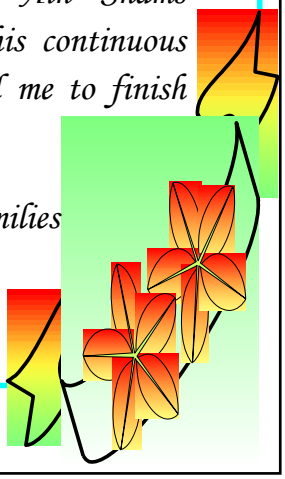

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List of Abbreviations

BBB	: Bundle branch block
BMI	: Body mass index
bpm	: Beat per minute
BSA	: Body surface area
CHB	: Complete heart block
CHD	: Congenital heart disease
CHF	: Congestive heart failure
CMRI	: Cardiac magnetic resonance imaging
DBP	: Diastolic blood pressure
DORV	: Double outlet right ventricle
ECG	: Electrocardiogram
FISH	: Fluorescence insitu hybridization
HRmax	: Maximum heart rate
Kph	: Kilometer per hour
MET	: Metabolic equivalent
PA	: Pulmonary artery
PDA	: Patent ductus arteriosus
PR	: Pulmonary regurgitation
PS	: Pulmonary stenosis
PVCs	: Premature ventricular complexes
RAD	: Right axis deviation
RBBB	: Right bundle branch block
RV	: Right ventricular
RVOT	: Right ventricular outflow tract
SBP	: Systolic blood pressure
TOF	: Tetralogy of Fallot
VO2 max	: Maximum oxygen consumption
VSD	: Ventricular septal defect
WPW	: Wolf Parkinson White.

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Introduction

Tetralogy of Fallot (TOF) is the most common form of cyanotic congenital heart disease. Impairment in exercise tolerance after total repair of tetralogy of Fallot has been frequently reported and speculated to be due to variable causes including residual right ventricular outflow tract (RVOT) obstruction, branch pulmonary artery stenosis, pulmonary insufficiency, pulmonary pathology, and chronotropic incompetence ***(Anji et al., 2001)***.

Pulmonary regurgitation (PR) has been shown to be related to the use of transannular patch during RVOT reconstruction and aggressive infundibulectomy involving the pulmonary valve annulus. Adverse effects of PR include progressive dilatation of RV, reduced exercise capacity, arrhythmia and sudden death (***Bouzas et al., 2005).***

The cardiac limitations in patients with tetralogy of Fallot are expected to improve to a great extent after total correction; however, there are references to decreased aerobic capacity after a successful repair, and among the possible reasons are residual lesions or surgical complications ***(Ercisli et al., 2005).***

Children who underwent total surgical repair of tetralogy of Fallot are usually well during daily life. However, formal exercise testing has repeatedly shown subnormal values for maximum oxygen uptake and also for ventilatory threshold in these patients group ***(Reybrouk et al., 2006).***

Most patients surviving total correction of TOF have an excellent late clinical and hemodynamic outcome without functional disability, significant residual intracardiac defects, or need for cardiac medications and recent studies reported a very mild restrictive pulmonary function and mildly diminished cardiopulmonary exercise capacity as compared with healthy controls ***(Izbicki et al., 2008).***

A number of children have premature ventricular beats after repair of the tetralogy of Fallot. These beats are of concern in patients with residual hemodynamic abnormalities; 24-hr electrocardiographic (Holter) monitoring studies should be performed to be certain that occult short episodes of ventricular tachycardia are not occurring. Exercise studies may be useful in provoking cardiac arrhythmias that are not apparent at rest ***(Bernstein, 2008).***

Aim of the Work

The aim of this study was to examine the exercise performance of young patients following the repair of Tetralogy of Fallot and to assess the influence of different variables related to the surgical repair on exercise testing.

Exercise Stress Testing In Children

Cardiovascular Response to Exercise

Introduction:

Exercise, a common physiological stress, can elicit cardiovascular abnormalities that are not present at rest, and it can be used to determine the adequacy of cardiac function ***(Gerald et al., 2001).***

Three types of muscular contraction or exercise can be applied as a stress to the cardiovascular system: isometric (static), isotonic (dynamic), and resistance (a combination of isometric and isotonic) ***(Paolo and David, 2008).***

Isotonic exercise implies alternate rhythmic contraction (shortening) and relaxation (lengthening) of muscles against a nonfixed resistance. Isometric exercise involves muscular contraction against a fixed resistance with little muscle shortening. Clinical exercise testing can be done using either isotonic or isometric exercise. Usually, however, clinical exercise testing is done using isotonic forms of exercise, such as cycling, walking, and running ***(Paolo and David, 2008).***

Isotonic exercise primarily provides a volume load to the left ventricle, and the response is proportional to the size of the working muscle mass and the intensity of exercise ***(Paolo and David, 2008).***

Isometric exercise imposes greater pressure than volume load on the left ventricle in relation to the body's ability to supply oxygen. Cardiac output is not increased as much as in isotonic exercise because increased resistance in active muscle groups limits blood flow. Resistance exercise combines both isometric and isotonic exercise ***(Paolo and David, 2008).***

Effect of Exercise on Cardiac Output:

In the early phases of exercise in the upright position, cardiac output is increased by an augmentation in stroke volume mediated through the use of the Frank-Starling mechanism and heart rate. The Frank-Starling mechanism means that the greater the heart muscle is stretched during filling, the greater is the force of contraction and the greater the quantity of blood pumped into the aorta ***(Guyton, 2006).***