سورة البقرة الآية: ٣٢

Updates in Perioperative Management of Secondary Pulmonary Hypertension During Mitral Valve Surgeries

Eassy

Submitted for Partial Fulfillment of MSc. Degree in Anesthesiology

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التحديثات في علاج ارتفاع ضغط الدم الرئوي الثانوي أثناء جراحات الصمام الميترالي

رسالة

توطئة للحصول على درجة الماجستير في التخدير

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Asmaa Ahmed Mahmoud

Contents

List of Abbreviations

cAMP	**:**	Cyclic Adenine Mono Phosphate
CCBs	**:**	Calcium channel blockers
cGMP	**:**	Cyclic Guanine Mono Phosphate
CHD	**:**	Congenital heart disease
CI	**:**	Cardiac Index
CO	**:**	Cardiac Output
CPB	**:**	Cardio Pulmonary Bypass
CVP	**:**	Central Venous Pressure
EC	**:**	Endothelial cell
EDP	**:**	End diastolic pressure
EF	**:**	Ejection Fraction
ET	**:**	Endothelin
EtA	**:**	Endothelin-1 receptor type A
EtB	**:**	Endothelin-1 receptor type B
FPAH	**:**	Familial pulmonary artery hypertension
FPAH	**:**	Familial pulmonary artery hypertension
FRC	**:**	Functional residual capacity
FRC	**:**	Functional residual capacity
HPV	**:**	Hypoxic Pulmonary Vasoconstriction Reflex
HR	**:**	Heart Rate
IPAH	**:**	Idiopathic pulmonary artery hypertension
Kg	**:**	Kilogram
L	**:**	Liter
LA	**:**	Left Atrium
LAP	**:**	Left atrial pressure

LV	**:**	Left Ventricle
LVOT	**:**	Left Ventricle Outflow Tract
MAP	**:**	Mean Arterial Pressure
ml	**:**	Milliliter
mmHg	**:**	Millimeter Mercury
MPAP	**:**	Mean Pulmonary Artery Pressure
NO	**:**	Nitric Oxide
NOS	**:**	Nitric Oxide Synthetase
NYHA	**:**	New York Heart Association
PA	**:**	Pulmonary Artery
PAH	**:**	Pulmonary Artery Hypertension
PaO2	**:**	Arterial O2 tension
PAOP	**:**	Pulmonary artery occlusive pressure
PAP	**:**	Pulmonary Artery Pressure
PASP	**:**	Pulmonary Artery Systolic Pressure
PCH	**:**	Pulmonary capillary hemangiomatosis
PCWP	**:**	Pulmonary Capillary Wedge Pressure
PDE	**:**	Phosphodiestrase
PDEI III	**:**	Phospho Di-esterase Enzyme Inhibitor III
PDEI V	**:**	Phospho Di-esterase Enzyme Inhibitor V
PEEP	**:**	Positive end expiratory pressure
PetCO2	**:**	Partial pressure of end tidal co2
PGI	**:**	Prostaglandine inhibitor
PH	**:**	Pulmonary Hypertension
PPH	**:**	Primary Pulmonary Hypertension
PPM	**:**	Prothesis patient mismatch
PVOD	**:**	Pulmonary Veno-Occlusive Disease
PVR	**:**	Pulmonary vascular resistance

PVR	**:**	Pulmonary Vascular resistance
RAP	**:**	Right Atrial Pressure
RV	**:**	Right Ventricle
RVAD	**:**	Right ventricle assist device
RVEDV	**:**	Right ventricular end diastolic volume
RVEF	**:**	Right ventricular ejection fraction
RVP	**:**	Right ventricular pressure
SaO2	**:**	Arterial Oxygen Saturation
ScVO2	**:**	Central venous saturation
SPAH	**:**	Secondary Pulmonary Hypertension
SV	**:**	Stroke Volume
SVR	**:**	Systemic Vascular Resistance
TEE	**:**	Trans Esophageal Echocardiography
TR	**:**	Tricuspid regurge
TSM	**:**	Trabeculae septum marginalis
TTE	**:**	Trans Thoracic Echocardiography
Ve\Vco2	**:**	Ventilatory equivalent
VO2	**:**	Oxygen consumption
WHO	**:**	World Health Organization

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Introduction

The presence of pulmonary arterial hypertension (PAH) is a significant predictor of major perioperative cardiovascular complications in patient undergoing cardiac or non-cardiac surgery. The PAH is commonly considered to exist when the mean pulmonary artery exceeds 25mmHg at rest & 50mmHg during exercise ***(Farber, 2004).***

PAH is a major problem during the perioperative period for adults with congenital heart disease, longstanding valvular heart disease & those undergoing cardiac transplantation.

Although the surgical correction of congenital defect or valvular heart disease often lead to substantial decrease in the pulmonary artery pressure(PAP), careful & stringent perioperative management is curial for improving the outcome in these patients ***(Shim et al., 2006).***

There have been multiple classes of drugs developed for the treatment of PAH such as Nitroglycerine & sodium nitroprusside are the oldest pulmonary vasodilators, later phosphodiestrase inhibitors were introduced such as Milrinone (PDE-3-inhibitors) & Sildenafil (PDE-5-inhibitors) and Prostaglandins, among epoprostenol & iloprost. Also Levosimendan, Adenosine, Bonstan and Brain natriuretic peptide ***(Nieminen et al., 2008).***

All intravenous agents suffers from disadvantage of systemic vasodilatation lead to hypotension therefore, inhaled drugs are more preferable such as inhaled Nitric Oxide, nitroglycerine, sodium nitroprusside, phosphodiestrase inhibitors and prostaglandins. Also the use of inhaled Milrinone was demonstrated. Also, inhaled iloprost has been seen to be effective as a rescue therapy for pulmonary hypertensive crises ***(Limsuwan et al., 2008).***

It is clear that several newer options are now available for management of perioperative PAH and right ventricular failure. However the anesthesiologist must not ignore the basic prinples of anesthesia and must avoid hypoxia, hypercapnia, acidosis and hypothermia which can lead to pulmonary vasoconstriction, also careful airway manipulations and pain management should be considered. The next step should be the use of appropriate inotropes and selective pulmonary vasodilators based on availability of inhaled agents which is the first line of therapy ***(Mandal et al., 2010).***

Aim of the work

Aim of the present work is to highlight the perioperative management of a patient with secondary pulmonary hypertension undergoing mitral valve surgery to prevent episodes of pulmonary hypertensive crises and to decrease the risk of right ventricular failure in such patients.

Functional Anatomy of Right ventricle

The anatomy of the right ventricle (RV) is both unique and complex. The RV appears triangular when viewed laterally, whereas in cross-section, it appears crescent shaped.

Although the RV appears smaller than the Left ventricle (LV) in the four-chamber view, RV volume is, in fact, larger than the LV volume. Based on magnetic resonance imaging, the normal range of RV end-diastolic volume (RVEDV) is 49–101 mL/m^2 (in males, 55–105 mL/m; in females, 48–87 mL/m^2), whereas the normal range of LV end-diastolic volume is 44–89 mL/m^2 (in males, 47–92 mL/m^2; in females, 41–81 mL/m^2) (***Lorenz, 1999)***.

In the normal adult, RV mass is also only about one-sixth that of LV mass ***(Dell 'Italia, 1991).***

In childhood, there is a progressive regression of RV hypertrophy as pulmonary vascular resistance (PVR) decreases.

Traditionally, the RV has been divided into two components: the sinus (inflow) and the conus (infundibulum).

The RV sinus extends from the tricuspid valve (inflow region) and includes the trabeculated (apical) portion of the ventricle (Fig.1-1). The RV conus is usually free of muscular trabeculations and extends from the septomarginal band to the pulmonary valve (arterial trunk). In the anatomic LV, subaortic conal absorption occurs, which explains the absence of an infundibular portion ***(Dell 'Italia, 1991).***

Three prominent muscular bands divide the RV: the parietal, the septal and the moderator band. The parietal band and the infundibular septum make-up the crista supraventricularis which separates the sinus and the conus regions.

The moderator band extends from the base of the anterior papillary muscle to the ventricular septum. In the study of complex congenital heart disease (CHD), it may be more useful to divide the RV into three parts: an inflow region, the trabeculated apical myocardium, and the outflow region (infundibulum) (Fig.1-1).

In hearts with congenital malformations, one or more of the three components may be rudimentary or absent. (Table1_1) summarizes key anatomical and physiological features of the RV and LV ***(Farb et al., 1992)*.**

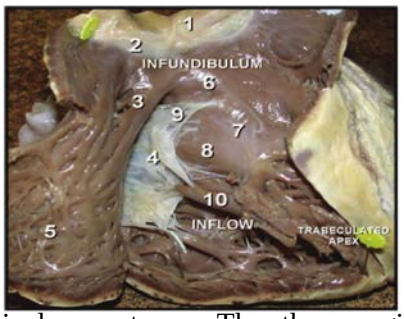

Fig. (1-1): Right ventricular anatomy. The three regions: the inflow, the trabeculated apex, and the infundibulum are shown with detailed anatomical aspect. 1, pulmonary valve; 2, pulmonary annulus; 3, crista supraventricular is; 4, tricus- pid valve; 5, right ventricular anterior wall; 6, anterior limb of trabeculae septum marginalis (TSM); 7, body of TSM; 8, posterior limb of TSM; 9, medial papillary muscle; 10, anterior papillary muscle. Adapted with permission from Denault et al.