Journal of the Egyptian Society of Cardio-Thoracic Surgery 26 (2018) 43–48

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Journal of the Egyptian Society of Cardio-Thoracic Surgery

journal homepage: http://www.journals.elsevier.com/journal-of-the-egyptian-society-of-cardio-thoracic-surgery/

The effects of pulmonary hypertension severity on the outcomes of mitral valve replacement for rheumatic mitral stenosis

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ARTICLE INFO

Article history:
Received 20 December 2017
Received in revised form 14 January 2018
Accepted 23 January 2018
Available online 9 February 2018

Keywords:
Mitral valve replacement
Outcomes
Pulmonary hypertension
Severity

ABSTRACT

Background: We performed this study to evaluate the effects of pulmonary hypertension (PH) severity on the hemodynamic and echocardiographic outcomes of mitral valve replacement (MVR) for rheumatic mitral stenosis (MS).

Methods: Patients with rheumatic MS were divided into two groups: Group-A with mean pulmonary arterial pressure (mPAP) equal to 26–40 mmHg and group-B with mPAP > 55 mmHg. We compared the hemodynamic and arterial blood gases (ABG) data between both groups.

Results: Our analysis showed no significant difference between mild and severe PH groups in terms of all analyzed baseline and pre-operative data ($p < 0.05$), except for NYHA class distribution and O_2 saturation on room-air, which were better in the mild PH group. Moreover, post-induction ABG data and heart rate were similar between both groups; however, post-induction central venous pressure ($p = 0.01$) and systolic blood pressure ($p < 0.001$) were significantly higher in the severe PH group, compared to the mild PH. All analyzed hemodynamic and ABG data in the 24 post-operative hours were comparable between both groups. The hospital stay duration was significantly longer ($p = 0.01$) in the severe PH group than the mild PH group. Concerning the echocardiographic data at three-months of follow-up, the left atrial size was comparable ($p = 0.4$) between both groups; however, the left ventricular end-systolic ($p = 0.009$) and end-diastolic ($p = 0.01$) dimensions were significantly higher in the severe PH group, compared to the mild PH group.

Conclusions: Our study showed that both mild and severe PH groups were comparable in most operative and post-operative hemodynamic and ABG outcomes of MVR surgery.

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Peer review under responsibility of The Egyptian Society of Cardio-thoracic Surgery.

https://doi.org/10.1016/j.jescts.2018.01.004

1. Introduction

Unlike the Western world in which rheumatic disease is becoming rare in the past few decades, the disease remains endemic in the developing world as the most common cause of mitral stenosis (MS) and regurgitation (MR) [1]. Almost 1/3 of rheumatic patients suffer from pure MS, while the remainder suffers from combined MS and MR (Left heart disease) [2]. Both conditions lead to pulmonary hypertension (PH) in advanced stages, which is associated with poor prognosis. Unfortunately, there is no treatment for PH and the best approach is managing the underlying condition [3].

Pulmonary hypertension is a pathophysiological hemodynamic condition defined as an increase in mean pulmonary arterial pressure (mPAP) of ≥25 mmHg at rest [4]. In PH due to left heart disease, both systolic and diastolic dysfunctions are usually present [5]. Therefore, a retrograde transmission of left cardiac pressures to the pulmonary venous and arterial beds occurs, inducing an initial vasoconstriction, followed by pulmonary vascular remodelling (irreversible) [6]. Doppler echocardiography is the best tool for screening purposes. However, more invasive measurements, such as pulmonary wedge pressure (PWP) or left ventricular end-diastolic pressure may be required to confirm the left cardiac origin of condition [7].

The literature contains conflicting reports on the outcomes of corrective surgery in PH patients [8,9]. However, most of these studies were published more than twenty years ago; therefore, outcome reassessment is required with newer anesthetic agents, modern cardioplegia, improved cardiac valve prostheses, postoperative care and advances in interventional procedures [10–13].

We performed this study to evaluate the effects of PH severity on the hemodynamic and echocardiographic outcomes of mitral valve replacement (MVR) for rheumatic MS.

2. Patients and methods

2.1. Study design and patients

This was a multicenter study, performed in El-Kasr Al-Ainy hospital (affiliated to Cairo University, Egypt) and Al-Azhar Faculty of Medicine for girls affiliated hospitals between December 2015 and July 2017. Patients with rheumatic MS were divided into two groups: Group A with mPAP equal to 26–40 mmHg and group B with mPAP >55 mmHg [14]. All patients signed an informed consent, indicating understanding the procedure and its possible complications.

2.2. Inclusion and exclusion criteria

We included all patients with rheumatic MS and functional mild to moderate tricuspid valve regurgitation. We excluded patients with 1) coexisting coronary artery disease, 2) double valve replacement, 3) emergency operation due to infective endocarditis, 4) congestive heart failure, 5) renal dysfunction (serum creatinine ≥2.0 mg/dL), 6) hepatic dysfunction (serum bilirubin ≥3.0 mg/dL) and 7) chronic obstructive airway disease (FEV1/FVC <0.70).

2.3. Preoperative evaluation

Preoperative laboratory investigations were done, including complete blood count, erythrocyte sedimentation rate, C-reactive protein, random and fasting blood sugar, liver and kidney functions, ABO compatibility, coagulation profile, virology screening and lipid profile. Radiological assessment included chest X-ray (postero-anterior and lateral view) and computed tomography chest for every patient older than 60 years. Cardiac investigations, including electrocardiography, echocardiography (ECHO) and coronary angiography for patients older than 40 years were performed. After approval of all preoperative results, patients were scheduled for elective MVR surgery.

2.4. Operative technique

After routine surgical preparation, all patients underwent conventional MVR through median sternotomy. Cannulation of the ascending aorta was done and bicaval venous cannulae were inserted and snared by 3/0 non-absorbable sutures. Cardiopulmonary bypass was initiated and careful dissection of the aortic root from the pulmonary artery and right ventricular outflow tract was performed. Aortic cross clamp was applied and once on full bypass, antegrade blood cardioplegia was infused together with addition of topical cold saline to the myocardium. We used intermittent antegrade cold blood cardioplegia to maintain the arrested heart throughout the procedure. The mitral valve (MV) was exposed through para-septal left atriotomy and the calcified leaflets were excised with chordal sparing as much as possible. The valve annulus was sized appropriately and interrupted, horizontal, everting, pledgetted mattress, braded, double-needled 2/0 polyester sutures were placed circumferentially in the annulus.

After the prosthetic valve was sutured in place, leaflet motion test and venting were done before closure of the atriotomy. Rewarming was completed and conventional de-airing maneuvers were performed. The patient was weaned from bypass at a systemic temperature of 36.5–37 °C with good ventilation parameters. Protamine was given slowly and the patient was decannulated. Meticulous hemostasis was done, midline two-mediastinal drains were placed, and the surgical wound was closed in the standard fashion.