Journal of the Egyptian Society of Cardio-Thoracic Surgery xxx (2017) 1–6

Contents lists available at ScienceDirect

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 affection of trans-valvular gradient on patient's outcome in cases of severe aortic stenosis with impaired left ventricular function

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A R T I C L E I N F O

Article history:
Received 16 March 2017
Received in revised form 19 May 2017
Accepted 19 May 2017
Available online xxx

Keywords:
Aortic stenosis
Trans-valvular gradient
Ventricular function

A B S T R A C T

Background: Severe Aortic stenosis (AS) is an advanced stage of the disease process. Underestimation of symptoms and delay of Aortic valve replacement (AVR) have a bad prognosis. The aim of this work was to study the results of AVR in patients with severe AS with impaired systolic left ventricle (LV) function.

Methods: This is retrospective study, from January 2007 to December 2014 at Zagazig University Hospital, Zagazig, Egypt. Group of 40 patients had severe AS with impaired the LV function. Patients were divided into 2 groups: **Group 1** with mean gradient <40 mmHg (n = 17) and **Group 2** with average gradient ≥ 40 mmHg (n = 23). The patient's outcome was compared and statistically analyzed regarding the terms of the clinical features, associated comorbidities, mortality and 30 days follow-up.

Results: The aortic valve area was smaller in the Group 1 than in Group 2 (0.64 ± 0,2 cm^2 0.66 vs ± 0 cm^2, p = 0.002). In-hospital mortality was comparable in both groups: Group 1: 11.1% vs Group 2 13.6% (p = 0.24). Group 1 had improved its ejection fraction (EF) by 17.8 units and in Group 2, the EF increased by 16.4 units. The average NYHA class increased from 2.71 ± 0.81 to 1.41 ± 0.50 in the Group 1 (p = 0.002) and 3.13 ± 0.63 to 1.33 ± 0.48 in the Group 2. (p = 0.0001).

Conclusions: The surgical outcome in cases with severe aortic stenosis with impaired ventricular function was limitedly affected by the value of the aortic valve mean gradient.

1. Introduction

Patients with severe aortic stenosis (AS) with impaired left ventricular (LV) function, low cardiac output (CO), and low transvalvular gradient (TVG), have a poor prognosis [1,2]. The operative risk increases with the drop of TVG. The operative mortality ranges from 11 to 17% for mean aortic gradient ≤40 mmHg [3,4] and from 21 to 33% when the mean gradient is ≤30 mmHg [5,6].

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

http://dx.doi.org/10.1016/j.jescts.2017.05.006

Aortic valve replacement (AVR) has clear benefit in this situation and documented by several studies [2,5,6]. The dysfunction of LV increases the surgical risk significantly but do not constitute a reason to reject these patients. Similarly, the benefit of AVR is clear and documented by several studies [4,6,7]. Low flow, low gradient severe AS (also it means low output, low gradient severe AS) is defined as a valve area $\leq$1.0 cm^2 with an aortic velocity <4.0 m/s or mean TVG $\leq$40 mmHg [8].

Our objective was to study the results of AVR in cases with severe AS with impaired systolic LV function and analyze the effect of mean TVG value.

2. Patients and methods

This is retrospective study, from January 2007 to December 2014 was done at cardiothoracic surgery department, Zagazig University Hospital, Zagazig, Egypt. We operated 300 cases of AS out of all these cases, a group of 40 patients had severe AS with impaired LV function, defined according to international recommendations [6,7]. All data, including granted informed consent specific to the type of surgery, patients' demographic, preoperative (clinical, echocardiographic and coronary angiography), operative and postoperative data, were collected from our database system. Follow-up (12 months) after surgery was obtained by contacting the attending cardiologist. The protocol of the study was approved by our Department Review Board. Patients were divided into 2 groups: Group 1 (low gradient) with mean gradient <40 mmHg (n = 17) and Group 2 (high gradient) with mean gradient $\geq$40 mmHg (n = 23). The patients' outcomes were compared and statistically analyzed regarding the terms of the clinical features, associated co-morbidities, mortality and 30 days follow-up. Hospital mortality was defined as any death occurring within 30 days of surgery. The low CO was defined by a cardiac index $\leq$2 l/min/m^2 or a need to catecholamines (epinephrine) >6 ug/kg/min.

2.1. Inclusion criteria

- severe AS: aortic surface area <1 cm or indexed aortic surface area <0.65 cm^2/m^2;
- an ejection fraction (EF) $\leq$ 40%;
- patients with moderate valvular nonsurgical regurge: $\leq$ grade II mitral regurgitation, aortic regurgitation grade II and $\leq$ grade II tricuspid regurgitation were selected;
- patients with uncomplicated coronary disease and without myocardial infarction were also included;
- redo surgery was not excluded.

2.2. Exclusion criteria

- age $\leq$18 years;
- another valve disease requiring surgical correction;
- patients with history of myocardial infarction.

2.3. Preoperative investigations

The collected Echocardiographic parameters met the recommendations of the American Society of Echocardiography [8] and the European Society of Echocardiography [9]. LV dimensions were obtained by the two-dimensional method; the aortic surface area was determined by the continuity equation method and TVG by Bernoulli's equation method. LV function was assessed by Simpson's method. The coronary angiography was performed in all patients except one patient operated in an extremely emergency situation, recovered following severe circulatory collapse (cardiac arrest).

2.4. Operative valve replacement

All patients had an AVR through standard median sternotomy with cardiopulmonary bypass (CPB) with moderate hypothermia (32–34° C) using a cold blood cardioplegia. All valves were inserted through an oblique aortotomy, which was closed by a free-sewn technique and double suture lines. The choice of mechanical valve was selected according to the operating surgeon and patient's selection according to his/her condition. The implantation of valves was done by an interrupted single suture line. Duration of inotropic support, the length of mechanical ventilation, hospital mortality and length of ICU and hospital stay were recorded. Postoperative blood loss was defined as total chest tube drainage. Respiratory failure was defined as prolonged ventilator therapy (>72 h) or need for re-intubation or tracheostomy. Renal complications included acute renal failure needing hemodialysis with creatinine more than 200 mmol/L.

Please cite this article in press as: Moursi I, Al Fakharany K, The affection of trans-valvular gradient on patient's outcome in cases of severe aortic stenosis with impaired left ventricular function, Journal of the Egyptian Society of Cardio-Thoracic Surgery (2017), http://dx.doi.org/10.1016/j.jescts.2017.05.006