

Regression of Left Ventricular Volumes After Bentall Procedure

Jayaprakash HM¹, Rajesh Kishan Rao², B Girish³, Bhargavi G⁴

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Authors Affiliation: ¹Assistant Professor, ²Associate Professor, ³Professor, ⁴Senior Resident, Department of Cardiovascular and Thoracic Surgery, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bengaluru, Karnataka 560069, India.

Corresponding Author: Jayaprakash HM, Assistant Professor, Department of Cardiovascular and Thoracic Surgery, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bengaluru, Karnataka 560069, India.

E-mail: jpgenius32@gmail.com

Abstract

Introduction: Bentall and De Bono¹ first described composite valve graft implantation in 1968. This well documented technique of aortic root replacement has been used for a large spectrum of various pathologic conditions involving aortic valve, aortic root, and ascending aorta.^{2,4} Since its introduction, the Bentall operation has been considered as a gold standard in the surgical treatment of combined aortic valve, root and ascending aorta pathology.

In the present study, we retrospectively reviewed the Left ventricular volume regression of our patients who underwent Bentall procedure for various pathology involving aortic valve, root and ascending aorta.

Materials and Method: Retrospective analysis of left ventricular volumes in pre and early post operative period in Patients who underwent Bentall procedure in our unit for combined aortic valve, root and ascending aorta pathology.

Results: LV regression in terms of EDV, ESV, LVIDd and LVIDs is statistically significant. The difference in LVIDd by 0.87 cm and LVIDs by 0.74 cm post operatively compared with pre-operative echocardiography.

Conclusion: En-bloc replacement of aortic valve and ascending aorta is still a commonly advocated procedure for various pathological conditions which involves aortic valve, root and ascending aorta leads to significant regressions in LV volumes in early post-operative period.

Keywords: aortic valve; ascending aorta; bentall procedure; echocardiography; ventricular regression.

Introduction

Bentall and De Bono¹ first described composite valve graft implantation in 1968. This well documented technique of aortic root replacement has been used for a large spectrum of various pathologic conditions involving the aortic valve, aortic root, and ascending aorta.¹⁻⁵

Since its introduction the Bentall operation has been considered as a gold standard in the surgical treatment of combined aortic valve, root and ascending aorta pathology.⁶

In the present study, we retrospectively reviewed the left ventricular regression of our patients who

underwent Bentall procedure for various pathology involving aortic valve, root and ascending aorta.⁸

Materials and Methods

Clinical analysis was made retrospectively in 36 Patients who underwent Bentall procedure in our unit for combined aortic valve, root and ascending aorta pathology.

Patients who underwent valve sparing/root remodeling procedure, patients who underwent partial/ complete arch replacement and patient who underwent endovascular procedure are excluded from the study.

The parameters assessed were,

Pre-operative: Cause, Severity of disease, LVEF, LVIDs/LVIDd, EDV/ESV. Size of aortic annulus, Ascending aorta and Aortic root.

Per-operative: Type and size of Composite graft used and use of sealants.

Post-operative: ECHO (LVEF, LVIDd/LVIDs, EDV/ESV). Statistical analysis was made with mean, standard deviation.

Results

Patient Characteristics

A total of 36 patients underwent Bentall procedure using composite valved conduit in our unit. Of these 66.7% (n=24) are males, 33.3% (n=12) are females and mean age group at surgery was 40.5+/-0.5 years (ranging from 24 yrs to 65 yrs). Sex Ratio (2:1), Male - 24, Female - 12.

Pre-operative diagnosis was Bicuspid aortic valve in 25% (n=9), annuloaortic ectasia in 13.9% (n=5), ascending aortic aneurysm with aortic regurgitation in 44.3% (n=16), Dilated ascending aorta with aortic stenosis in 8.4% (n=3) and Type I Aortic dissection in 8.4% (n=3). Assessment of clinical parameters of these patients retrospectively showed 36.12% (n=13) had essential hypertension, 13.5% (n=11) had Type II Diabetes mellitus, 13.9% (n=5) had associated insignificant coronary artery disease, 5.5% (n=2) had chronic obstructive pulmonary disease and 2.7% (n=1) had h/o of previous cardiac surgery. 30.56% (n=11) patients were in NYHA Class II, 44.44% (n=16) were in NYHA Class III and 25% (n=9) were in NYHA Class IV.

Table 1: Preoperative ECHO.

LVEF	47.22+/-3.22 %
LVIDd	5.55+/-0.10cm
LVIDs	4.0+/-0.05cm
EDV	155.5+/-24.1ml
ESV	88.75+/-19.20ml
Aortic Annulus	27.14+/-0.64mm
Size of Ascending aorta	5.53+/-0.38cm
Aortic Root	4.23+/-0.53cm

Surgical Technique

The operation was performed through a standard median sternotomy, and cardiopulmonary bypass was instituted by cannulation of the ascending aorta, aortic arch, femoral artery, or subclavian

artery, and the right atrium. After establishing cardiopulmonary bypass, the aorta is clamped proximal to the innominate artery and the heart is arrested with cold blood cardioplegia. The aorta is transected beneath the clamp, ensuring an adequate cuff of aortic tissue. Proximally the aortic root is excised leaving only buttons of aortic tissue surrounding each of the coronary arteries. The coronaries are mobilized for 1 to 2 cm to prevent tension during reimplantation. A composite graft is selected based on the size of the aortic annulus. The sewing ring of the composite graft is sutured to the annulus with 2-0 pledgeted polyester mattress sutures placed immediately adjacent to each other. The adjacent placement of sutures and the selection of a conduit that snugly fits within the annulus help to ensure hemostasis. A second suture line with a 4-0 running polypropylene suture can be used to approximate the aortic remnant to the newly secured valved conduit sewing ring to aid in hemostasis. Openings for coronary reimplantation are made in the appropriate position in the Dacron graft with an ophthalmic cautery.

First the left and then the right coronary arteries are attached using 4-0 or 5-0 polypropylene suture in continuous fashion incorporating a thin strip of felt. The distal anastomosis is then performed with a continuous 3-0 or 4-0 polypropylene suture also incorporating a strip of felt. The graft is vented with a needle and the left atrium and ventricle are de-aired. After the patient is decannulated and protamine has been administered, suture line hemostasis is scrutinized.

Analysis of Operative Data

On analysis it was found that 63.88% (n=23) had undergone proposed procedure through RA/Ao Cannulation and 36.12% (n=13) had undergone through RA/Femoral artery or Subclavian artery cannulation.

The mean Cardio-pulmonary bypass time was 198.38min (+/-14.88min). The mean Cross clamp time was 148.08min (+/-13.48min).

Mechanical valve prosthesis was used in all the cases. Of these 44.44% (n=16) had ATS Composite Valve conduit, 36.11% (n=13) had SJM Composite Valve conduit. In 11.11% (n=4) TTK Aortic valve and Dacron tube graft were used. In 5.55% (n=2) SJM Aortic valve and Dacron tube graft were used. In 2.77% (n=1) ATS Aortic valve and Dacron tube graft were used. The mean size of the valve seated in aortic annulus is 24.66mm (+/-0.34mm). Sealants (Coseal, Floseal, Tissil) used in 52.77% (n=19) to

control bleeding at the anastomotic site.

Table 2: Comparison with Post-operative ECHO.

	Pre-OP		Post -OP
EDV	155.5+/-24.1ml	EDV	137.4+/-15.4ml
ESV	88.75+/-19.20ml	ESV	76.61+/-16.61ml
LVIDd	5.55+/-0.10cm	LVIDd	4.68+/-2.30cm
LVIDs	4.0+/-0.05cm	LVIDs	3.26+/-0.06cm
EF	47.22+/-3.22 %	EF	44.22+/-2.22%

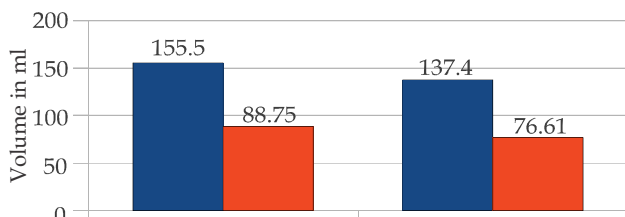


Fig. 1: Differences in EDV/ESV.

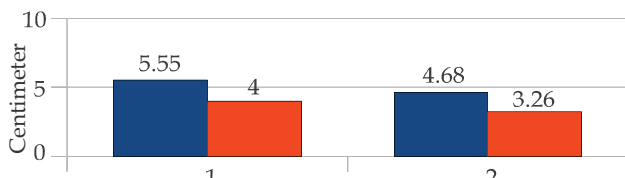


Fig. 2: Differences in LVIDd/LVIDs.

Discussion

The original Bentall procedure has been widely used since 1968 when Bentall and De Bono¹ first described the technique. Over the past decades, several modifications of the originally described technique have been introduced and have helped to improve clinical outcomes.⁹

However due to the complexity of the procedure it is still regarded as a challenging procedure, especially in emergency settings, e.g. cases of acute aortic dissection, and if the damaged aortic valve is combined with dilatation of the aortic root or a dissection, the Bentall procedure is required. The population who underwent procedure are mainly male predominance (66.7% Vs 33.3% in females) of the age group of 30 to 50 yrs, but annuloaortic ectasia commonly seen in younger age group I.e 2nd to 3rd decade.¹⁰

Ascending aortic aneurysm with involvement of aortic valve and root appears to be the commonest indication for the procedure followed by bicuspid aortic valve and annuloaortic ectasia.⁷ It is not uncommon to see patients undergoing Bentall procedure for Type 1 Aortic dissection either emergency or elective in whom regular follow-up is required to monitor the progress of the disease.

Most of the patients who were in NYHA Class III/IV pre operatively had poor LV function (EF<35%) and increased left ventricular volumes which were assessed by measuring EDV/ESV/LVIDd/LVIDs,^{12,13} had an average increase in the size of ascending aorta by 5.33cm, aortic root dilated by 4.23cm and annulus by 27.14 which were suggestive of need for the complex procedure. (Table 1 and fig. 1)

The decision whether to use a mechanical or biologic valve was made on an individual basis by the surgeon and the patient. In majority of the cases composite valve conduit used, still we can use a valve mounted on tube graft instead of composite valve conduit.⁷ Now a days it common to use sealants to manage haemostasis at anastomotic site.

On comparing pre-operative and post-operative trans thoracic echocardiography, it was found that there is a significant decrease in the LV volumes (LV regression),¹¹ there is mean difference in EDV by 18.10 ml and ESV by 12.14 ml, the difference in LVIDd by 0.87 cm and LVIDs by 0.74 cm. There is decrease in EF by 3.0% when compared with pre-operative echocardiography. (Table 2 and fig. 2)

Recovery in the post-operative period mainly depends on pre-operative parameters that is Age, NYHA Class, EF and LV volumes. The survivors had regression in the LV volumes during early post-operative period (EDV, ESV, LVIDd and LVIDs)¹¹ which were statistically significant.

Conclusion

En-bloc replacement of aortic valve and ascending aorta (Bentall procedure) is still a commonly advocated procedure for various pathological conditions which involves aortic valve, root and ascending aorta results in significant regression of LV volume. The procedure is safe and reproducible in a suitable patient where early results were remarkable.

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