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Case Series

Experience of Bentall Procedure in Patients with Low Ejection Fraction < 30%

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ABSTRACT

Background: The Bentall procedure can be performed with excellent short-term and long-term results in relatively uncomplicated elective patients in whom aortic valve disease is combined with dilatation of the ascending aorta. This study was done with the aim to assess results of Bentall procedure in patients with low left ventricular ejection fraction.

Material and Methods: This study involved 32 patients of aortic root and ascending aorta disease with LVEF <40% operated for Bentall procedure at GIPMER, New Delhi from January 2014 to November 2018. Patients with co-existing coronary disease and valvular lesion other than aortic were excluded from the study. Preoperative, intraoperative and post-operative parameters of these patients were recorded and appropriate statistical analysis was performed.

Results: The in-hospital mortality was 15.6%. There were no delayed deaths in follow-up. LV dimensions regressed by 11.88% at 3 months follow-up with marked improvement in mean LVEF and NYHA status.

Conclusion: Bentall procedure provides acceptable results in aortic root disease with severe LVSD in terms of survival and improvement in quality of life indicated by improved NYHA status.

Introduction

Aortic root replacement with artificial composite prosthesis for ascending aorta and aortic valve and re-implantation of left and right coronary arteries to treat aortic disease with ascending aortic aneurysmal dilatation was originally described by Bentall and DeBono in 1968 [1]. The Bentall procedure has led the way for the development of other techniques for root replacement. Investigators have found excellent mid- and long-term survival rates in patients who have undergone surgery via this technique [2,3]. The Bentall procedure improves patients' clinical and hemodynamic status, as well as their quality of life [4]. This procedure has traditionally been the gold standard treatment for aortic root pathology with or without associated aortic valve disease along with its various modifications [1,5].

Various studies have described the results of Bentall procedure in short term, mid-term and long term in large patient cohorts but studies describing results of Bentall procedure in patients with advanced LV dysfunction are not abundant. The present study was done with an aim of analyzing the results of Bentall procedure in this particular patient population in terms of improvement in functional status, left ventricular function and left ventricular regression.

Material and Methods

This study was performed as a retrospective descriptive study which was conducted at Department of CTVS, Govind Ballabh Pant Institute of Postgraduate Medical Education and Research, New Delhi from January 2014 to October 2019. It included review of records of 32 patients of aortic root disease with left ventricular ejection fraction <40% who underwent elective Bentall procedure under a single surgeon. The patients excluded from the study were patients with concomitant coronary artery disease, concomitant other valve pathologies, patients undergoing emergency Bentsll procedure, patients with associated disease in aortic arch and descending thoracic aorta and associated cardiomyopathies.

Review of detailed history and clinical examination with emphasis on pre-existing cardiac lesions and co-morbidities were done for all patients. Preoperative workup of these patients including chest radiograph, ECG, transthoracic echocardiography and CT angiography of ascending aorta was reviewed. Coronary angiography was performed in patients having symptoms suggestive of coronary artery disease or >40 years of age to rule out CAD as per institutional protocol.

As per the protocol of operating unit, all of these patients were transferred to the intensive care unit preoperatively on the evening prior to surgery and invasive cardiac monitoring was started. In all patients, levosimendan infusion was started preoperatively with loading dose of 12.5 mcg/kg and maintenance dose of 0.1 mcg/kg/min and continued for 24 hours.

The note of operative technique was made on the basis of operation notes attached in records. Operation was done through midline sternotomy. For arterial cannulation, ascending aorta was cannulated in 25 patients while in 7 patients, where aneurysmal dilatation was extending up to origin of brachiocephalic trunk, right axillary artery cannulation was performed using 8 mm PTFE side graft. Venous cannulation was done through right atrium and IVC using bicaval venous cannulation and CPB was initiated. Topical and systemic cooling was done up to 28°C and aortic cross-clamp was applied once the heart fibrillated. Aortotomy was performed and antegrade ostial cardioplegia with Del Nido cardioplegia solution was given for myocardial protection. All patients were implanted with St. Judes Medical Masters Series composite mechanical valved aortic graft and coronary reimplantation was done with Button technique. Total circulatory arrest for a maximum duration of 15 minutes after cooling up to 20°C was done in patients in whom distal anastomosis of graft could not be performed with distal clamp in place owing to the extent of aneurysm. Cross-clamp time and CPB time were noted. Patient was weaned off bypass and shifted to ICU after wound closure.

Postoperatively patients were followed up through the hospital stay and the amount of mediastinal and pleural drainage, time period to extubation, ICU stay and total hospital stay was recorded. The need for re-intubation and re-exploration was also noted. As per the usual followup protocol of operating unit, patients were followed up at

15 days interval up to 3 months and then on monthly basis. Clinical examination was done on every visit with echocardiography after 1 month, 3 months, 6 months and 1 year from surgery and CT angiography at 3 months after surgery. All these reports were reviewed for the study. At follow-up, NYHA status of the patient and Left ventricular function on echo were specifically noted.

All study observations were recorded and tabulated in Microsoft Excel worksheet. They were presented as observational data.

Results

Table 1: Patient Characteristics

Characteristic	Overall (N=32)	Survived (N=27)	Died (N=5)
Demographics			
Mean age (Years)	40.2	38.3	44.1
Gender (M:F)	26:6	24:3	2:3
Etiology			
Marfan's syndrome	13	11	02
Atherosclerosis	10	09	01
History of cardiac surgery	02	02	00
Infective	04	03	01
Traumatic	00	00	00
No specific etiology established	03	02	01
Co-morbidities			
Hypertension	09	07	02
Diabetes mellitus	05	04	01
CVA	03	02	01
Clinical Presentation			
Shortness of breath	26	22	04
Palpitations	17	15	02
Chest pain	17	16	01
Preoperative NYHA status - Grade I - Grade II - Grade III - Grade IV	 02 03 16 11	 02 03 13 09	 00 00 03 02
Echocardiography			
Presence of associated aortic	32	27	05

regurgitation			
Presence of bicuspid aortic valve	11	10	01
Mean left ventricular ejection fraction	34.1%	38.2%	27.0%
Mean left ventricular diastolic dimension (mm)	70.7	68.2	78.6
CT Angiography			
Maximum ascending aorta diameter (mm)	60.2	59.9	62.1
Presence of associated aortic dissection	06	04	02

Table 2: Study Parameters

Study Parameter	Overall (N=32)	Survived (N=27)	Died (N=5)
Intraoperative			
Mean CPB time (Mins)	144.2	138.0	160.1
Mean cross-clamp time (Mins)	106.7	104.1	110.7
Number of patients needing TCA	06	03	03
Mean duration of TCA (Mins)	11.2	11.1	11.7
Type of arterial cannulation - Ascending aorta - Axillary	 25 07	 22 05	 03 02
Postoperative			
Mean duration of ventilatory support (Hours)	17.3	14.1	29.2
Mean duration of inotropic support (Hours)	65.2	53.8	89.2
Number of patients requiring IABP support	05	02	03
Number of patients needing re-intubation	03	01	02
Number of patients needing re-exploration	01	00	01
Number of deaths in immediate	05	-	05

postoperative period			
Mean mediastinal drainage (ml)	180.2	181.1	180.0
Mean ICU stay (Days)	7.3	6.2	14.1
Mean hospital stay (Days)	10.8	10.1	16.2

Table 3: Follow-up Data

Observation	Value (N=27)
NYHA status after 3 months of follow-up - Grade I - Grade II - Grade III - Grade IV	 14 09 04 00
Number of deaths during follow-up	00
Number of patients needing re-hospitalization	00
Mean postoperative left ventricular systolic dimension at 3 months of follow-up (mm)	60.1
Mean postoperative left ventricular ejection fraction at 3 months of follow-up	44.7%

Discussion

The modified Bentall-De Bono procedure is considered the standard approach for the repair of an ascending aortic aneurysm or a type A aortic dissection when accompanied by an incompetent, irreparable aortic valve. During the decades, several modifications of the originally described technique have been introduced [6], and have helped to improve outcome. Among these modifications are better myocardial protection, use of brief periods of TCA to allow an open distal anastomosis, and introduction of early elective rather than emergency repair [7]. Although results after the Bentall operation have been steadily improving, there is lack of availability of long term data regarding patients with low left ventricular ejection fractions.

The main finding of our study is that the Bentall procedure improves long-term LV systolic function and decreases LV mass in survivors. In our study, the mean preoperative LV end-diastolic dimension was 70.7 mm for the study group while 68.2 mm in survivors. Postoperatively the mean LV end-diastolic dimension after 3 months was 60.1 mm thus showing 11.88% reduction in LV dimensions over 3 months.

The available literature contains very few data on the long-term impact of the Bentall procedure on LV systolic function, volume, and mass. Jiang et al [8] examined the impact of cardiac surgical procedures in 126 patients who had severe LV dilation caused by either mitral or aortic valve disease. Among these patients, only 6 underwent the Bentall procedure. The mean LV end-diastolic diameter, which was 77 ± 6 mm preoperatively, decreased to 63 ± 12 mm (postoperative days 7–14) and to 58 ± 10 mm (postoperative months 6–12) (P <0.01).

In terms of LV performance, in our study, the overall preoperative mean LVEF was 34.1% while being 38.2% among survivors. The postoperative mean LVEF after 3 months was 44.7%. In study by Jiang et al [8], the mean LVEF, which was 0.49 ± 0.12 preoperatively, decreased to 0.42 ± 0.09 at postoperative days 7 to 14, and returned to 0.51 ± 0.07 after 6 to 12 postoperative months (P <0.01). Tanoue et al [9] analyzed 15 patients with annuloaortic ectasia and AR and concluded that approximately 1 year after a Bentall operation both LV contractility and efficiency were significantly improved, in comparison with preoperative values.

Prior investigators have shown that the Bentall procedure improves long-term functional capacity. In a study by Sun et al [10], which included patients who underwent the Bentall procedure via a ministernotomy, 169/175 (96%) patients who were monitored for 2 weeks to 65 months after surgery were classified as NYHA class I or II at the follow-up examination. Bhan et al [11] showed that 72% of patients, 1 to 96 months after a Bentall operation, were in NYHA class I or II. In our study, preoperatively the proportion of patients in NYHA class I or II was 15.62% which increased to 85.18% postoperatively after 3 months.

In our study, the in-hospital mortality was 15.6%. There were no late deaths or rehospitalizations. The higher mortality can be attributed to the patient study group we selected which already had a severe LV dysfunction. Despite the use of mechanical valved conduit, there were no major anticoagulation-related complications. This can be attributed to strategies of lower INR goals and detailed counseling of patients regarding anticoagulation therapy.

Numerous studies have shown different independent risk factors for death after the Bentall procedure [12,13]. Advanced age, dissection, Marfan syndrome, severe ventricular dysfunction, endocarditis, previous cardiac surgery, emergency status, coronary artery disease, poor preoperative New York Heart Association functional class and left ventricle ejection fraction <35% were known as predictors of early and late death. We observed that higher mortality rates were observed in association with female gender, poor NYHA status, large LV dimensions, low LVEF, requirement of TCA during surgery and presence of associated aortic dissection.

The limitations of our study were the retrospective course, lack of long term follow-up and dependency on subjective parameters (particularly echocardiography which can be highly operator dependent and thus a source of bias in postoperative patients).

Conclusion

The Bentall procedure can be performed with acceptable results in patients with established severe LV dysfunction with aortic root disease. It provides benefit in terms of not only being therapeutic but also improving quality of life by increasing performance status, probably by regression of increased LV mass and better LV contractility.

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