

Surgical Outcome After En-Bloc Replacement of Aortic Valve and Ascending Aorta (Bentall Procedure)

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How to cite this article:

Jayaprakash HM, Rajesh Kishan Rao, B Girish, et al./Surgical Outcome After En-Bloc Replacement of Aortic Valve and Ascending Aorta (Bentall Procedure). J Cardiovasc Med Surg. 2020;6(4):259-262.

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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.^{2,3} 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 surgical outcome after Bentall procedure in respect to morbidity mortality in early post-operative period.

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

Results: Age and sex of the population involved, severity of the disease, pathology of aortic valve, operative data in terms of type of cannulation, CPB time, size of graft used, Xclamp time, use of sealants for haemostasis, post operatively Duration of ventilation, Causes of prolonged ventilation, Post-operative bleeding and reexploration, Cerebrovascular accidents, Renal failure, Arrhythmias, Sepsis, Pulmonary complications, Duration of stay in the ICU as early causes of mortality and morbidity were analyzed and compared.

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 carries low morbidity and mortality rates in early post-operative period. The procedure is safe and can be reproduced in a suitable patient. With the use of sealants and proper technique, early results were remarkable.

Keywords: Aortic valve; Ascending aorta; Bentall procedure; Echocardiography; Enbloc replacement; 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.^{2,3}

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.⁵

In the present study, we retrospectively reviewed the surgical outcome of our patients who underwent Bentall procedure for various pathology involving aortic valve, root and ascending aorta.⁶

Materials and Methodology

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: Duration of surgery in terms of CPBtime, Cross clamp time.
- Type and size of Composite graft used and use of sealants.
- Post-operative: Duration of ventilation, Causes of prolonged ventilation.
- Post-operative bleeding and reexploration, Cerebrovascular accidents, Renal failure, Arrhythmias, Sepsis, Pulmonary complications.
- Duration of stay in the ICU.
- Post-operative ECHO (LVEF, LVIDd/LVIDs, EDV/ESV), Surgical site infection and Duration of hospital stay after surgery.

Statistical analysis was made with mean, standard deviation.

Results

Patient Characteristics

A total of 36 patients underwent bentall procedure using composite valved conduit at our unit. Of these 66.7%(n=24)are males and 33.3%(n=12)are females, the mean age group of the patients at the time surgery was 40.5+/-0.5 years (ranging from 24 yrs to 65 yrs). Total No of Patients (36), Sex Ratio (2:1), Male - 24, Female - 12.

The 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 1 Aortic dissection in 8.4%(n=3). Out

of these 36 patients, clinical parameter assessed 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.

Pre-operative Trans thoracic echocardiography

Preoperative trans thoracic reveals a mean

LVEF of 47.22%(+/- 3.22%)

LVIDd of 5.55cm(+/- 0.10cm) and LVIDs of 4.0cm(+/- 0.05cm)

EDV 155.5ml(+/-24.1ml) and ESV are and 88.75ml(+/-19.20ml)

Size of Aortic Annulus - 27.14mm(+/-0.64mm)

Ascending aorta - 5.53cm(+/- 0.38cm) and Aortic root - 4.23cm(+/- 0.53cm).

Table 1: Operative Data.

| Variables | %(n)(+/-sd) |
|---------------------------|-------------------|
| Type of Bypass | |
| RA/AORTA | 63.88(23) |
| RA/Femoral/Subclavian | 36.12(13) |
| CPB Time | 198.38+/-14.88min |
| CROSS Clamp Time | 148.08+/-13.42min |
| Valve Type | |
| Composite Valve-Graft-ATS | 44.44(16) |
| Composite Valve-Graft-SJM | 36.11(13) |
| TTK Valve +Tube Graft | 11.11(4) |
| ATS Valve +Tube Graft | 2.77(1) |
| SJM Valve+Tube Graft | 5.55(2) |
| Size of Valve | 24.66+/-0.34mm |
| Use of Selants | 52.77(19) |

Surgical Technique

The operation was performed through a standard median sternotomy and cardiopulmonary bypass was instituted by cannulation of ascending aorta, aortic arch, femoral artery or subclavian artery, and 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 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 198.38 min (+/-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. (Table 1)

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: Early Morbidity

| | |
|------------------------------------|------------------|
| Duration of Ventilation | 12.85+/-1.15Hrs |
| Re-Exploration For Bleeding | 5.55(N=2) |
| Low Cardiac Out Put State | (8.33%(N=3) |
| Arrythmias (VT/VF/AV Block) | 11.11%(N=4) |
| Renal Failure | 5.55%(N=2) |
| Sepsis | 2.77%(N=1) |
| Cerebrovascular Accidents | Nil |
| Pulmonary Complications | 5.55%(N=2) |
| Perioperative MI | Nil |
| Duration of Icu Stay | 3.14+/-0.14 Days |
| Duration of Hospital Stay | 9.71+/-0.75 Days |
| Superficial Surgical Siteinfection | 13.88%(N=5) |
| Hospital Mortality | 16.6%(N=6) |

Table 3: Early Mortality

| Cause | N=6,(16.6%) |
|---------------------------|-------------|
| Low Cardiac Out Put State | 3(8.33%) |
| Arrythmias(VT/VF) | 1(2.77%) |
| Sepsis + Renal Failure | 2(5.56%) |

Early results were analyzed in terms of morbidity and mortality. The mean duration of ventilation was 12.85hrs+/-1.15 hrs post procedure, 5.55% (n=2) of patients underwent re exploration for the bleeding, 8.33% (n=3) of patients had low cardiac output state, 11.11% (n=4) of patients had arrythmias (VT/VF/AV Block), 5.55% (n=2) of patients underwent dialysis for acute renal failure, 5.55% (n=2) of patients had a pulmonary complications during ICU stay, 2.77% (n=1) of patients had septicemia and multi organ failure. The mean duration of ICU stay was 3.14 days (+/-0.14 days), In post-operative period 13.88% (n=5) had superficial surgical site infection which were treated according to culture and sensitivity of the discharge from the surgical wound. The mean duration of hospital stay post procedure is (9.71 days+/-0.75 days), In hospital mortality in our study is 16.60% (n=6), (Table 2) The causes of mortality are Low cardiac output state in 8.33% (n=3), Intractable ventricular arrythmias in 2.77% (n=1) and Septicemia with Renal failure 5.56% (n=2). (Table 3)

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.⁷

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,⁸ the Bentall procedure is required.⁹ 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.⁷

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.⁵ It is not uncommon to see patients undergoing Bentall procedure for Type 1 Aortic dissection either emergency or elective in whom regular followup 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 (EE<35%) and increased left ventricular volumes which were assessed by measuring EDV/ESV/LVIDd/LVIDs,^{8,9} 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.

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,⁷ still we can use a valve mounted on tube graft instead of composite valve conduit.⁶ Now a days it common to use sealants to manage haemostasis at anastomotic site.

The average CPB time and Cross clamp time is an expertise variant also dependent on pre-operative NYHA class, ventricular dysfunction, associated coronary artery disease and technique of coronary implantation.⁴ An average CPB time of 198.08+/-14.88 min and Cross clamp time of 148.08+/-13.42 min are comparable to other studies.

Recovery in the post-operative period mainly depends on pre-operative parameters that is Age, NYHA Class, EF and LV volumes, also on duration of ventilation, development of pulmonary complications, sepsis, lowcardiac output state, cerebrovascular accidents, renal failure and arrhythmias. So, the early in hospital mortality can be attributed to NYHA Class IV, poor EF, LCOS, sepsis and multi organ failure.^{8,9}

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 carries low morbidity and mortality rates in early post-operative period. The procedure is safe and reproducible in a suitable patient. With the use of sealants and proper technique early results were remarkable.

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