

Original article

Surgical Outcomes of Bentall Procedure in Patients with Aortic Root Aneurysm: A Prospective Observational Study

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Abstract

Background: Aortic root aneurysm is a potentially fatal cardiovascular condition associated with complications such as aortic dissection, rupture, and aortic regurgitation. The Bentall procedure is the standard surgical treatment for aortic root aneurysm involving replacement of the aortic root, ascending aorta, and aortic valve with coronary artery reimplantation.

Aim: To evaluate the surgical outcomes and postoperative complications of the Bentall procedure in patients with aortic root aneurysm.

Methods: This prospective observational study was conducted over a period of one year in a tertiary care center. A total of 34 patients diagnosed with aortic root aneurysm and undergoing the Bentall procedure were included. Demographic details, clinical profile, operative parameters, and postoperative outcomes were recorded. Data were analyzed using IBM SPSS Statistics version 24.0.

Results: The majority of patients were males (70.6%), with the highest incidence in the 41–50 years age group (29.4%). Degenerative aneurysm was the most common etiology (44.1%). Mean cardiopulmonary bypass time was 142.5 ± 24.6 minutes. Postoperative arrhythmias (17.6%) and bleeding (11.8%) were common complications. Mortality was observed in 8.8% of cases, while successful discharge was achieved in 91.2%.

Conclusion: The Bentall procedure demonstrated favorable surgical outcomes with acceptable morbidity and mortality, making it an effective treatment for aortic root aneurysm.

Keywords: Aortic root aneurysm, Bentall procedure, Surgical outcomes

Introduction

Aortic root aneurysm is a life-threatening cardiovascular condition characterized by pathological dilatation of the aortic root, often involving the sinuses of Valsalva and ascending aorta. (1) Progressive enlargement of the aortic root can lead to serious complications such as aortic dissection, rupture, severe aortic regurgitation, and sudden cardiac death.(2,3) The etiology includes degenerative changes, connective tissue disorders such as Marfan syndrome, bicuspid aortic valve disease, hypertension, and inflammatory or infective conditions. Early diagnosis through echocardiography and computed tomography angiography has improved identification and timely surgical intervention. (4, 5, 6)

The Bentall procedure, first described by Hugh Bentall and Antony De Bono in 1968, remains the gold-standard surgical treatment for aortic root aneurysm associated with aortic valve pathology. This procedure involves composite graft replacement of the aortic valve, aortic root, and ascending aorta with reimplantation of the coronary arteries. Advances in surgical techniques, myocardial protection, and

perioperative care have significantly improved postoperative survival and reduced complications.(6,7) However, postoperative morbidity such as bleeding, arrhythmias, renal dysfunction, and neurological events remains a concern. Evaluating surgical outcomes of the Bentall procedure is essential to assess its safety, efficacy, and long-term prognosis. Therefore, this study was undertaken to analyze the clinical outcomes and postoperative complications in patients undergoing the Bentall procedure for aortic root aneurysm.

Study Methodology

This prospective observational study was conducted in the Department of Cardiovascular and Thoracic Surgery at a tertiary care center over a period of one year. The study included patients diagnosed with aortic root aneurysm who underwent the Bentall procedure during the study period. A total of 34 patients were enrolled based on predefined inclusion and exclusion criteria. Ethical clearance was obtained from the Institutional Ethics Committee before commencement of the study, and written informed consent was obtained from all participants or their legal guardians.

Patients aged above 18 years with diagnosed aortic root aneurysm, with or without associated aortic valve pathology, and who were planned for elective or emergency Bentall surgery were included in the study. Patients undergoing redo cardiac surgery, isolated ascending aortic replacement without root involvement, or those with severe comorbid conditions making them unfit for surgery were excluded. Detailed demographic data, clinical history, presenting symptoms, comorbidities, and preoperative investigations including two-dimensional echocardiography, computed tomography angiography, electrocardiography, and routine blood investigations were recorded.

All patients underwent the Bentall procedure under general anesthesia using standard cardiopulmonary bypass techniques. Intraoperative parameters such as cardiopulmonary bypass time, aortic cross-clamp time, type of graft used, associated procedures performed, and intraoperative complications were documented. Standard myocardial protection strategies and postoperative intensive care protocols were followed for all patients. Patients were monitored in the cardiac intensive care unit for hemodynamic stability and immediate postoperative recovery.

Postoperative outcomes were assessed in terms of duration of mechanical ventilation, intensive care unit stay, total hospital stay, postoperative complications such as bleeding, arrhythmias, renal dysfunction, neurological deficits, infection, and mortality. Follow-up was performed during the hospital stay and at scheduled postoperative visits up to discharge. The collected data were entered in Microsoft Excel and analyzed using IBM SPSS Statistics version 24.0. Quantitative variables were expressed as mean \pm standard deviation, while qualitative variables were presented as frequencies and percentages. Statistical significance was considered at $p < 0.05$.

Results

Table 1: Demographic and Clinical Profile of Study Participants (n=34)

| Variable | Number of Patients | Percentage (%) |
|----------------------------|--------------------|----------------|
| Age Group (years) | | |
| 18-30 | 5 | 14.7 |
| 31-40 | 8 | 23.5 |
| 41-50 | 10 | 29.4 |
| 51-60 | 7 | 20.6 |
| >60 | 4 | 11.8 |
| Gender | | |
| Male | 24 | 70.6 |
| Female | 10 | 29.4 |
| Etiology | | |
| Degenerative aneurysm | 15 | 44.1 |
| Bicuspid aortic valve | 8 | 23.5 |
| Marfan syndrome | 6 | 17.6 |
| Aortic dissection | 5 | 14.7 |
| Presenting Symptoms | | |
| Chest pain | 14 | 41.2 |
| Dyspnea | 10 | 29.4 |
| Palpitations | 6 | 17.6 |
| Syncope | 4 | 11.8 |

Table 2: Intraoperative Parameters and Surgical Details (n=34)

| Variable | Mean ± SD / Number | Percentage (%) |
|--|--------------------|----------------|
| Mean CPB time (minutes) | 142.5 ± 24.6 | — |
| Mean aortic cross-clamp time (minutes) | 104.8 ± 18.2 | — |
| Mean duration of surgery (hours) | 5.8 ± 1.1 | — |
| Mechanical valve conduit used | 22 | 64.7 |
| Biological valve conduit used | 12 | 35.3 |
| Associated CABG performed | 7 | 20.6 |
| Associated arch repair | 4 | 11.8 |
| Intraoperative bleeding | 5 | 14.7 |
| Difficulty in coronary reimplantation | 3 | 8.8 |

Table 3: Postoperative Outcomes and Complications (n=34)

| Outcome Variable | Number of Patients | Percentage (%) |
|---------------------------------------|--------------------|----------------|
| Ventilation >24 hours | 8 | 23.5 |
| ICU stay >5 days | 9 | 26.5 |
| Hospital stay >10 days | 12 | 35.3 |
| Postoperative bleeding/re-exploration | 4 | 11.8 |
| Arrhythmias | 6 | 17.6 |
| Acute kidney injury | 3 | 8.8 |
| Neurological complications | 2 | 5.9 |
| Surgical site infection | 2 | 5.9 |
| Mortality | 3 | 8.8 |
| Successful discharge | 31 | 91.2 |

Discussion

The present prospective observational study evaluated the surgical outcomes of the Bentall procedure in 34 patients with aortic root aneurysm. The findings demonstrated that the Bentall procedure remains an effective and reliable surgical option for managing aortic root pathology, with acceptable postoperative morbidity and mortality. In the present study, the majority of patients belonged to the 41–50 years age group (29.4%), with a male predominance (70.6%). This age and gender distribution is consistent with the natural epidemiology of aortic aneurysmal disease, where males are more commonly affected due to degenerative vascular changes, hypertension, and connective tissue abnormalities. Degenerative aneurysm was the most common etiology (44.1%), followed by bicuspid aortic valve disease and Marfan syndrome. This reflects the major pathological mechanisms responsible for aortic root dilatation, including medial degeneration and structural weakness of the aortic wall. (8)

Among presenting symptoms, chest pain was the most common complaint (41.2%), followed by dyspnea (29.4%). These symptoms can be explained by progressive aortic root enlargement causing altered hemodynamics, aortic regurgitation, and increased myocardial workload. Similar observations have been reported in earlier surgical series, where symptomatic presentation often correlated with advanced disease and larger aneurysm size. Early diagnosis remains crucial, as delayed intervention increases the risk of aortic dissection and rupture. (9,10)

The intraoperative findings in this study showed a mean cardiopulmonary bypass time of 142.5 ± 24.6 minutes and aortic cross-clamp time of 104.8 ± 18.2 minutes, which are comparable to standard operative durations reported in Bentall surgery. Prolonged bypass and cross-clamp times are recognized contributors to postoperative inflammatory response, myocardial dysfunction, and organ injury. Mechanical valve conduits were used in 64.7% of patients, indicating preference for durability in relatively younger individuals, while biological conduits were selected in patients where anticoagulation-

related complications were a concern. Associated procedures such as coronary artery bypass grafting and arch repair were required in some patients, emphasizing the complexity of aortic root surgery.

Postoperative outcomes revealed that prolonged ventilation (>24 hours) occurred in 23.5% of patients, while ICU stay beyond five days was observed in 26.5%. These findings reflect the extensive nature of the procedure and the need for prolonged postoperative monitoring. Arrhythmias were the most common complication (17.6%), likely due to myocardial manipulation, electrolyte imbalance, and ischemia-reperfusion injury. Postoperative bleeding requiring re-exploration occurred in 11.8% of cases, which remains one of the major concerns in complex aortic surgeries due to extensive suture lines and anticoagulation use. Acute kidney injury and neurological complications were relatively low, suggesting effective perioperative organ protection strategies.

Conclusion:

The Bentall procedure demonstrated favorable surgical outcomes with acceptable morbidity and mortality, making it an effective treatment for aortic root aneurysm.

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