Modified Bentall and De Bono Surgery: Experience in a National Hospital of Peru

W. Samir Cubas, Jaime Vásquez-Arias, Ludwig Cáceres-Farfán, Milagros Moreno-Loaiza, Carlos Pachas-Canales, Enrique Velarde-Revilla
Department of Thoracic and Cardiovascular Surgery, Cardiac Surgery Service, Edgardo Rebagliati Martins National Hospital, Lima, Peru

ORCID:
W. Samir Cubas: https://orcid.org/0000-0002-5380-7372
Jaime Vásquez-Árias: https://orcid.org/0000-0001-9252-3391
Ludwig Cáceres-Farfán: https://orcid.org/0000-0001-6905-8196
Milagros Moreno-Loaiza: https://orcid.org/0000-0003-4123-7314
Carlos Pachas-Canales: https://orcid.org/0000-0002-8978-239X
Enrique Velarde-Revilla: https://orcid.org/0000-0001-7858-5959

Abstract

Context: Modified Bentall and De Bono Surgery is the surgical treatment of choice for cardiac pathologies related to the aortic valve, aortic root, and ascending aorta. **Aims:** The aim of this study is to review and analyze the short- and long-term results with the Modified Bentall and De Bono technique in the Cardiac Surgery Service of a Peruvian National Hospital. **Settings and Design:** A retrospective study was conducted from April 2000 to July 2019. **Subjects and Methods:** The main variables studied were grouped into preoperative, operative, and postoperative; also, the *Kaplan–Meier* survival curve was used to analyze the short- and long-term survival of patients undergoing this kind of surgery. **Results:** During the study period, 46 patients (male, 89.13% vs. female, 10.87%; mean age: 57.52 ± 19.5 years) underwent Modified Bentall and De Bono surgery with the main operative diagnosis of anuloaortic ectasia and aneurysm of ascending aorta (52.2%). The overall mortality rate associated with surgery was 56.51% (intraoperative, 13.04%; early, 17.39%; and late, 26.08%). In the analysis of the short-term survival, 50% of patients deaths in the early period (≤30 days) occurred in an average of 5.76 days, mainly due to hemodynamic disorders (37.5%); similarly, 50% of patients deaths in the late period (>30 days) occurred in an average of 3.88 years, mainly due to stroke (41.67%). Cumulative long-term survival rates at 5 years of 71.87%, at 10 and 15 years of 62.5% are reported. **Conclusions:** Despite having found unsatisfactory numbers that are slightly distant from those reported in the rest of the world, our study has described an initial experience, allowing us to identify a series of factors and opportunities that will serve as a reference to improve the critical points of surgical interventions and the perioperative management of patients with this technique.

Keywords: Annuloaortic ectasia, aortic aneurysm, bentall procedure, dissecting, postoperative complications, survival rate

Introduction

More than 50 years ago, Hugh Bentall and Antony De Bono described a novel surgical technique for the combined treatment of aortic valve diseases and the segment of the ascending aorta, which consisted of the union of a tubular dacron graft and a bileaflet aortic valve prosthesis with continuous polypropylene suture.[1]

Over the years, this technique has undergone several modifications; nowadays, it has been accepted that of a tube with a valve in which the coronary buttons are reimplanted, called modified Bentall and De Bono surgery, becoming the surgical treatment of choice in cardiac pathologies related to the aortic valve, aortic root, and ascending aorta.[2-4]

The main indications for this procedure are defined in two categories: emergencies that include acute aortic

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Address for correspondence: Dr. W. Samir Cubas, Department of Thoracic and Cardiovascular Surgery, Cardiac Surgery Service, Edgardo Rebagliati Martins National Hospital, Lima, Peru.
E-mail: wsamircubas@gmail.com

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dissection (Stanford A) and prosthetic graft infections or aortic valve endocarditis with abscess formation; and electively in cases of anuloaortic ectasia with aortic valve incompetence, Marfan syndrome, poststenotic dilatation, and chronic dissection of the ascending aorta.[5-7]

Currently, publications around the world suggest that the morbidity, mortality, and survival rates related to Modified Bentall and De Bono surgery are subject to a series of factors such as the type of surgery, patient population, surgical technique, and management postoperative.[7-9] However, for some years in Peru, this procedure has been applied, and until now, there are no investigations that study the impact of this surgical technique on the population of our environment.

Thus, the objective of this study was to review and retrospectively analyze the short- and long-term results of our experience with the Modified Bentall and De Bono technique in a Cardiac Surgery Service of a Peruvian National Hospital.

Subjects and Methods

Design, population, and sample population size

A descriptive, observational, analytical, and retrospective study was carried out in the Cardiac Surgery Service of a National Hospital belongs to the Social Health Insurance (EsSalud) is located in the Peru (12°03′00″S 77°02′00″W); the number of patients currently affiliated with this hospital corresponds to 10% of the insured national population, being approximate of 2,013,452 inhabitants.[10] The medical records and surgical reports of all tributary patients of the Modified Bentall and De Bono Surgery from April 2000 to July 2019 were evaluated. Medical records and surgical reports with incomplete and unreadable data and records were excluded from the study.

Data collection and study variables

The majority of patients who undergo cardiac surgery in our hospital receive follow-up and outpatient control approximately every 3 months during the 1st year, then every 6–12 months during the following years. The primary source of information was the operative reports and outpatient consultation sheets of the patients who underwent surgery with the Modified Bentall and De Bono technique during the period proposed by the study. The collected information was selected and ordered according to the chronological order of the surgical intervention, and in a second instance, data were collected.

The variables studied were divided into three large groups, preoperative (age, gender, comorbidities, aortic valve status, ejection fraction [%], functional classification according to the New York Heart Association [NYHA], operative diagnosis, and type of surgery), intraoperative (initial and final lactate of the surgery, aortic cross clamp time and extracorporeal circulation [ECC], size of the aortic valve graft, and intraoperative mortality) and postoperative (early complications [≤30 days], late [>30 days] and postoperative survival short [≤30 days] and long term [>30 days]). Regarding mortality, intraoperative (surgery *in situ*), early (≤30 days), and late (>30 days) were evaluated. The data were written twice and reviewed using a checklist.

Surgical technique

The Modified Bentall and De Bono surgical procedure was performed in all patients in a standard way, through a median sternotomy with a cardiopulmonary bypass through right atrial cannulation and in a segment of the ascending aorta proximal to the brachiocephalic trunk, or peripherally (via Femoral or subclavian artery) depending on to the surgical pathology to be treated. Next, in the presence of moderate systemic hypothermia (30°C–32°C), the ascending aorta was clamped and cardiac arrest was performed crystalloid cardioplegia or hyperkalemic cold blood and local hypothermia. Once the pathology to be treated was identified, a transverse aortotomy and resection of the native aortic valve were performed; then, the valved tubular graft is proximally anastomosed to the aortic annulus with a continuous 2/0 polypropylene suture.

With a loop cautery system, two holes were made on the graft and through them the buttons of the coronary arteries were reimplanted to them with continuous 5/0 polypropylene suture. In cases of ascending aortic aneurysm not associated with dissection, the graft was measured, and then, the distal anastomosis was completed, attaching it to the area close to the aortic clamp, while in the case of dissection, the modification of the technique consisted of adding a Teflon material with the purpose of plicating the aortic wall and the graft, achieving obliteration of the false lumen and reinforcement of the anastomosis.

The rewarming phase was started after unclamping the aorta and purging the left cavities through the aortic root and the right superior pulmonary vein (Vent). In some patients, after completing the distal and proximal anastomoses was performed a Cabrol fistula, a procedure that involves the communication between the remnant of aortic tissue that surrounds the valvulated tubular graft towards the right atrium, to avoid the formation of hematoma in the periprosthetic space. Finally, after hemostasis and verification of technical success, the sternotomy was closed in a conventional manner.

Anticoagulation

After Modified Bentall and De Bono Surgery, due to the use of a tubular graft with a mechanical valve, the patients were tributary to permanent anticoagulation with warfarin to maintain an INR (international normalized ratio [INR]) between 2 and 3. Similarly, in patients with an embolic history and/or atrial fibrillation, this value ranged from 2.5 to 3.5.

Statistic analysis

Continuous data were expressed as mean ± standard deviation as appropriate. For the comparison of the continuous variables of two categories, the Student's *t*-test was used; otherwise, the Mann–Whitney *U*-test was used. The parametric data were examined with contingency tables using the Fisher's exact test and the *Kaplan–Meier* method was used to construct the survival curve. The differences were considered significant with a value of $P < 0.05$. In all cases, the data analysis was performed using the STATA/MP version 16 (StataCorp, USA) statistical program for the Windows 10 version.

Ethical aspects

The evaluation and ethical feasibility of this work were carried out by the department of thoracic and cardiovascular surgery, and in the ethics committee of the Edgardo Rebagliati Martins National Hospital (RCEI-7), Lima, Peru; who reviewed and approved the protocol of this study. The confidentiality of the information was respected, and the use of informed consent was not necessary because the data were collected retrospectively and indirectly.

Results

During the period from April 2000 to July 2019, 46 surgical interventions were performed with the Modified Bentall and De Bono technique. The majority of patients were male (89%), with a general mean age of 57.52 ± 19.5 years (*P* = 0.099) [Table 1].

Among the preoperative findings, the main comorbidities were high blood pressure (76.08%), dyslipidemia (60.86%), Marfan syndrome (15.21%), diabetes mellitus (10.86%), smoking (13.04%), alcoholism (8.69%), history of coronary disease (2.17%), chronic kidney disease (4.34%), and Turner syndrome (2.17%) (*P* = 0.085) [Table 1].

Regarding the state of the aortic valve, 45.65% of the studied patients presented some degree of insufficiency, followed by stenosis (28.26%) and double lesion (26.09%) (*P* = 0.105), while 69.56% presented an ejection fraction above 50% at the time of admission (*P* = 0.064) [Table 1].

47.82% of the patients presented a functional class NYHA I (*P* = 0.073); similarly, 91.30% were elective surgeries (*P* = 0.177), and the main surgical pathologies were annuloaortic ectasia and ascending aortic aneurysm (52.2%), isolated ascending aortic aneurysm (19.56%), anuloaortic ectasia (15.21%), Type A aortic dissection (8.69%), and Type A aortic dissection with ascending aortic aneurysm (4.34%) (*P* = 0.046) [Table 1].

The intraoperative value of the initial (1.75 ± 0.97 mmol/L) and final lactate (13.34 ± 4.56 mmol/L) of the surgery, aortic cross clamp time (143.63±40.5 min) and ECC time (164.05±39.5 min) were obtained, number of valved tubular grafts used according to their valvular size (21 mm, 10.87%; 23 mm, 19.56%; 25 mm, 36.95%; 27 mm, 6.52%; 29 mm, 26.10%) (*P* = 0.071), and finally, the intraoperative mortality rate (6, 13.04%), where hemodynamic (4, 66.70%) and heart rhythm disorders (2, 33.30%) stood out [Tables 2 and 3].

Finally, in the postoperative period, the length of stay in the intensive care unit (ICU) was 8 ± 3.6 days; the main disorders within early complications (≤30 days) were heart rhythm disorders such as atrial fibrillation (73.91%), atrial flutter (38.13%), and ventricular fibrillation (26.08%) (*P* = 0.088), respiratory disorders such as pneumothorax (69.56%), acute pulmonary edema (45.65%) and hydropneumothorax (30.43%) (*P* = 0.156), surgical reinterventions mainly due to bleeding (28.26%) and cardiac tamponade (17.39%) (*P* = 0.056), hemodynamic disorders such as vasoplegic syndrome (56.52%), cardiogenic shock (39.13%) and hypovolemic shock (28.26%) (*P* = 0.021), infectious disorders such as ventilator-associated pneumonia (41.30%), mediastinitis (32.60%), urinary infection (23.91%) and infective endocarditis (10.86%) (*P* = 0.097), neurological disorders that included stroke (19.56%) and pontine myelinolysis (6.52%) (*P* = 0.244), acute myocardial infarction (17.39%), hydroelectrolytic disorders (67.39%), acute kidney failure (60.86%), coagulation disorders (54.34%) and early liver failure (13.04%) [Table 2].

Early mortality (≤30 days) was 17.39%, and the main causes were hemodynamic (37.5%), heart rhythm (25%), and severe neurological (25%) disorders [Table 3]. On the other hand, among late postoperative complications (>30 days), heart failure (19.56%), chronic kidney disease on hemodialysis (17.39%), stroke (15.21%), residual atrial fibrillation (13.04%) were described, chronic prostration secondary to stroke (10.86%), residual mental conduct disorder (4.34%), and late mediastinitis (4.34%) [Table 2]. The late mortality (>30 days) was 26.08%, and among its main causes, stroke (41.67%) and chronic kidney disease on hemodialysis (25%) stood out [Table 3].

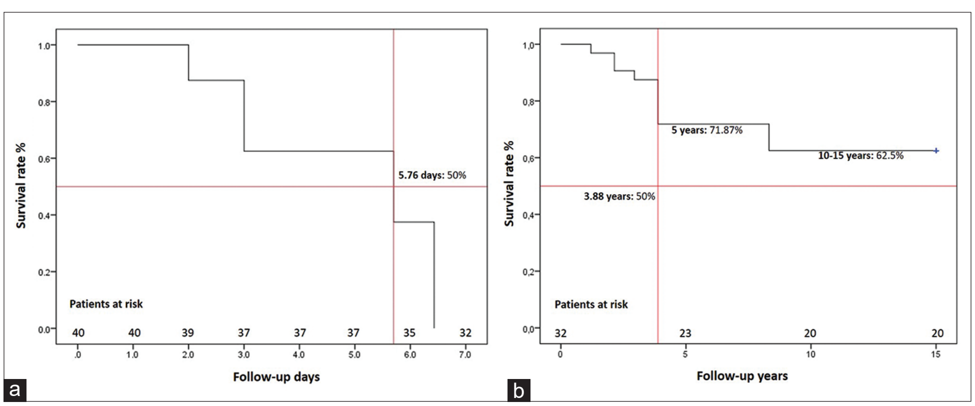

Figure 1: (a) Short-term cumulative survival rate in postoperative patients from Modified Bentall and De Bono Surgery. Kaplan–Meier survival curve. (b) Long-term cumulative survival rate in postoperative patients from Modified Bentall and De Bono surgery. Kaplan–Meier survival curve

Table 1: Clinical and surgical characteristics of the study population

Variables	Value (*n*)	Interval or percentage	*P*
Preoperative			
Number of patients	46	100	
Male	41	89.13	0.099
Female	5	10.87	
Age (mean in years)	57.52±19.5	28.5–79.08	
Comorbidities			
Hypertension	35	76.08	0.085
Dyslipidemia	28	60.86	
Marfan syndrome	7	15.21	
Diabetes mellitus	5	10.86	
Smoking	6	13.04	
Alcoholism	4	8.69	
Previous coronary disease	2	2.17	
Chronic kidney disease	2	4.34	
Turner syndrome	1	2.17	
Aortic valve status			
Valvular insufficiency	21	45.65	0.105
Valvular stenosis	13	28.26	
Double valve lesion	12	26.09	
Ejection fraction (%)			
>50	32	69.56	0.064
<50	14	30.44	
NYHA functional class			
I	22	47.82	0.073
II	12	26.10	
III	9	19.56	
IV	3	6.52	
Type of surgery			
Elective	42	91.30	0.177
Emergency	4	8.70	
Operative diagnoses			
Anuloaortic ectasia + ascending aortic aneurysm	24	52.2	0.046
Ascending aortic aneurysm	9	19.56	
Anuloaortic ectasia	7	15.21	
Type A aortic dissection	4	8.69	
Type A aortic dissection + ascending aortic aneurysm	2	4.34	
Intraoperative			
Initial lactate (mmol/L)	1.75±0.97	0.78–2.72	
Final lactate (mmol/L)	13.34±4.56	8.78–17.9	
ECC time (min)	164.05±39.5	124.55–203.55	
Aortic cross clamp time (min)	143.63±40.5	103.13–184.13	
Valved graft size (mm)			
21	5	10.87	0.071
23	9	19.56	
25	17	36.95	
27	3	6.52	
29	12	26.10	
Intraoperative mortality	**6**	**13.04**	

NYHA: New York Heart Association, ECC: Extracorporeal circulation

The overall mortality related to the surgical intervention amounts to 56.51% (26 of 46 patients) [Table 3]; furthermore, in the construction of the *Kaplan–Meier* curve, an accumulated early and late survival of 50% are described with medians that oscillate between 5.76 days and 3.88 years, respectively. About this last analysis of survival, it was found that at 5 years this was 71.87% (23 patients at risk) and that at 10 and 15 years it was 62.5% (20 patients at risk) [Figure 1].

Table 2: Postoperative findings of the study population

Variables	Value, *n* (%)	*P*
Early postoperative complications		
Heart rhythm disorders		
Atrial fibrillation	34 (73.91)	0.088
Atrial flutter	18 (39.13)	
Ventricular fibrillation	12 (26.08)	
Respiratory/ventilatory disorders		
Pneumothorax	32 (69.56)	0.156
Acute pulmonary edema	21 (45.65)	
Hydropneumothorax	14 (30.43)	
Surgical reinterventions		
Bleeding	13 (28.26)	0.056
Cardiac tamponade	8 (17.39)	
Hemodynamic disorders		
Vasoplegic syndrome	26 (56.52)	0.121
Cardiogenic shock	18 (39.13)	
Hypovolemic shock	13 (28.26)	
Infections		
Ventilator-associated pneumonia	19 (41.30)	0.097
Mediastinitis	15 (32.60)	
Urinary infection	11 (23.91)	
Infectious endocarditis	5 (10.86)	
Neurological disorders		
Stroke	9 (19.56)	0.244
Pontine myelinolysis	3 (6.52)	
Acute myocardial infarction	8 (17.39)	
Hydro-electrolyte disorders	31 (67.39)	
Acute kidney failure	28 (60.86)	
Coagulation disorders	25 (54.34)	
Early liver failure	6 (13.04)	
Early mortality	**8 (17.39)**	
Late postoperative complications		
Heart failure	9 (19.56)	
Chronic kidney disease on hemodialysis	8 (17.39)	
Stroke	7 (15.21)	
Residual atrial fibrillation	6 (13.04)	
Chronic prostration secondary to stroke	5 (10.86)	
Residual behavior disorder	2 (4.34)	
Late mediastinitis	2 (4.34)	
Late mortality	**12 (26.08)**	
Overall mortality	**26 (56.51)**	

Discussion

It is the first time that such an investigation has been carried out in a developing South American country such as Peru, where there is a large influx of patients and the first historical records of this surgical technique date from approximately 2000.

From that date until the middle of 2019, 46 surgical operations were performed over 19 years, with the main operative diagnoses being annuloaortic ectasia with ascending aortic aneurysm, and the ascending aortic aneurysm alone; this findings coincide with various worldwide reports such as Netherlands (56.6% vs. 71.8%), Japan (60.3% vs. 68.9%), Greece (69.7% vs. 23.6%), South Korea (54.4% vs. 26.2%), Italy (41% vs. 22%), and Mexico (43% vs. 22%).[5,9,11-14]

We report overall mortality associated with Modified Bentall and De Bono surgery of 56.51%, numbers that largely differ from those reported in the USA (4.94%), India (5.84%), France (8.02%), South Korea (10.5%), Greece (11.23%), Netherlands (21.17%), Japan (22%), Hungary (22.44%) and Italy (32.93%);[5,6,9,11-13,15-17] nevertheless, only one study has described a mortality rate that is close to ours (42.55%) and was related to male sex ($P = 0.004$), age (71 years; $P < 0.001$), preoperative serum creatinine (1.1 mg/dl; $P < 0.01$) and EuroScore II (3.7%; $P < 0.002$).[4]

A wide number of investigations with multivariate analyzes have suggested that an age >60 years,[18] male gender,[4] NYHA classification ≥III,[15] Marfan síndrome,[16] hypertension,[12] diabetes mellitus,[19] Type A acute aortic dissection,[17] emergency surgery,[7,13,20,21] and ejection fraction <35%[4] are considered the predictors of high early and late in-hospital mortality. Of the aforementioned, we only report the male gender (89.13%), Marfan syndrome (15.21%), hypertension (76.08%), diabetes mellitus (10.86%), Type A acute aortic dissection (8.69%), and emergency surgical programming (8.70%) as risk factors that could explain the results obtained in our study.

Although a multivariate statistical analysis was not performed, intraoperative mortality of 13.04% was determined; among its causes, we describe hemodynamic disorders such as cardiogenic shock (2 patients), hypovolemic shock (1 patient) and vasoplegic syndrome (1 patient), and heart rhythm disorders that mainly included ventricular arrhythmias (2 patients). Khalil *et al*. described similar intraoperative mortality values (14%) in an initial experience in Pakistan, where cardiogenic and hypovolemic shock due to bleeding, ventricular arrhythmias, and acute renal failure were the main causes of it;[22] however, other studies differ with the numbers presented, describing rates that vary between 1.1% and 3.5%.[5,11-13,20]

Literature states that factors related to surgical and/or anesthetic times, surgeon's expertise, and quality of ECC play an important role in relation to intraoperative mortality and patient survival.[18] The operative times are influenced by the factors that include concomitant surgical procedures in the context of an aortic valve with severe calcium degeneration, morphological changes typical of the surgical pathology to be treated (such as the case of Marfan syndrome), and even the inexperience of the surgeon; about the latter, it has been mentioned that in order to reduce intraoperative complications (<2%) and improve survival rates in the short and long-term, it's necessary to perform approximately 25–30 Modified Bentall and De Bono procedures per surgeon.[17]

Regarding to ECC, it has been described that a time of anoxia or aortic cross clamp >90 min are related to a time on mechanical ventilation >24 h (odds ratio [OR] = 1.71; 95% confidence interval [CI], 1.24–2.35; $P < 0.01$); times >120 min,

Table 3: Mortality and postoperative survival time

Variables	Overall mortality (*n*=26)	Percentage (56.51%)	Percentage (100%)	Survival time
Intraoperative mortality				
Hemodynamic disorders	4	8.71	66.70	
Heart rhythm disorders	2	4.35	33.30	
Early mortality				
Hemodynamic disorders	3	6.52	37.5	6.43±2.46 days
Heart rhythm disorders	2	4.35	25.0	2.89±1.78 days
Severe neurologic disorders	2	4.35	25.0	5.76±4.10 days
Cardiac tamponade	1	2.17	12.5	1.98 days
Late mortality				
Stroke	5	10.86	41.67	3.88±1.8 years
Chronic kidney disease on hemodialysis	3	6.52	25.0	8.32±1.43 years
Chronic prostration secondary to stroke	2	4.35	16.67	2.14±0.97 years
Heart failure	1	2.17	8.33	2.94 years
Infections	1	2.17	8.33	1.2 years

with an increased risk of reoperation for bleeding (OR = 2.18; 95% CI, 1.44–3.30; $P < 0.001$), stroke (OR = 3.35; 95% CI, 1.74–6.43; $P < 0.001$) and mediastinitis (OR = 2.48; 95% CI, 1.07–4.70; $P < 0.05$); and values above 150 min are related to high intraoperative mortality (OR = 2.68; 95% CI, 1.66–4.32; $P < 0.001$) and need for dialysis (OR = 1.82; 95% CI, 1.01–3.29; $P < 0.005$).[23] In addition to the aforementioned complications, we found hydroelectrolytic disorders (67.39%), coagulopathies (54.34%), and early liver failure (13.04%) as likely consequences of a long it has an aortic cross clamp time (143.63 ± 40.5 min).

A great number of systematic reviews and meta-analyses (with more than 9500 patients) suggest early mortality rates, which range from 1.8% to 13%,[6,7,14] values that are far from ours (17.39%) but that could be explained by the findings of this study. Among them, surgery's final lactate value stands out (13.34 ± 4.56 mmol/L; Normal values: <2 mmol/L) being considered as an indirect indicator of myocardial injury, circulatory failure, hypoxia, and metabolic disorders;[24] however, high surgery's final lactate values are also related to prolonged length of stay in the ICU (20.4%; lactate: 5–10 mmol/L) and early postoperative morbidity and mortality (52.9%; lactate: >10 mmol/l).[25]

In the short-term cumulative surviving analysis, 50% of the patients who died in the early period (≤30 days) occurred at an average of 5.76 days after surgery, among the main complications that intervened with this outcome were prolonged ICU stay (8 ± 3.6 days vs. 8.79 ± 6.1 days),[8] hemodynamic disorders (37.5% vs. 45.7%),[6] heart rhythm disorders (25% vs. 9%),[17] and severe neurological disorders such as stroke (25% vs. 17.1%),[20] these findings have been also described in a great number of published reports. Another factor that plays an important role in the postoperative survival is the reoperation rate, which value in our study was 45.65%, remarkably different from those described by Mookhoek *et al*. (1.14%),[6] Lechiancole *et al*. (1.41%),[4] Celiento *et al*. (1.51%),[13] Price *et al*. (1.81%),[16] Joo *et al*. (3.2%),[19] and Kaskar *et al*. (9.09%).[15] A possible explanation that could justify this unusual finding is based on the cardiac surgeon's learning curve.[26,27]

A study from the United States retrospectively analyzed the institutional Bentall and De Bono procedures in two different periods (2000–2008 vs. 2009–2018), showing significant differences between both groups regarding the time of mechanical ventilation in the ICU (12.96 [9.4–18.5] h vs. 5.76 [9.1–13.0] h, $P < 0.001$), ICU length of stay (21.12 [14.6–25.7] h vs. 18.24 [6.0–25.2] h, $P = 0.002$), reoperation rates for bleeding (7.8% vs. 3.1%, $P < 0.05$), and postoperative out-of-hospital mortality (2.8% vs. 0.9%, $P < 0.05$). In their conclusions, they highlighted the importance of the surgeons' learning curve and its relationship with the improvement of postoperative survival.[21]

It should be noted that the surgical learning curve is not exclusively related to the acquisition of technique and operative skills, but it's also related to the use of new technological tools that improve the technical success and surgical skills of the surgeon. Under this premise, some reports have suggested the benefit of using surgical sealants or glues in this kind of procedure. These reduce the time of anoxia (94.8 ± 35.79 min vs. 73.7 ± 24.96 min; $P = 0.001$), time of ECC (140.6 ± 65.24 min vs. 114.9 ± 37.60 min; $P = 0.016$), and surgical reinterventions due to bleeding (12.2% vs. 1.7%; $P = 0.036$);[28] however, we did not describe it in the present work, but its use would probably have positively influenced our results.

In the long-term cumulative surviving analysis, 50% of patients who died in the late period (≥30 days) occurred in a mean of 3.88 years after surgery; also showing survival rates of 71.87% at 5 years, and 62.5% at 10 and 15 years. These values are not far different from those recently described at 5 years (73%), 10 years (73%), and 15 years (62%) in the studies made by Karangelis *et al*. and Celiento *et al*.,[11,13] and they are related to late mortality rates around 5% to 48%.[4-6,11,13,15-17] We also report the values that range between those values (26.08%). The main causes described in the literature for late mortality are stroke (25%–50%),[9,29] heart failure (41.2%),[5] chronic kidney disease (25%), postoperative thoracic aortic aneurysm and/or dissection (13.9%),[19] and valve endocarditis (2.7%).[4]

We found that stroke was the main cause of late mortality (41.67%), which was probably related to poor adherence to oral anticoagulation and an erratic control of the values of INR; besides, it has been demonstrated that, in the context of Modified Bentall and De Bono surgery, values above those recommended are associated with hemorrhagic stroke (81.81%; INR = 3.9 ± 3.1; 1.18–13.6) and with lower values, with ischemic stroke (18.19%; INR = 1.3 ± 0.2; 1.12–1.65).[12,18,30]

The main reported predictors of late mortality, (some of which were present in our study) are arterial hypertension (OR = 2.40; 95% CI, 1.06–5.46; P = 0.035), EuroSCORE II >3% (OR = 4.24; 95% CI, 1.73–10.36; P = 0.002), chronic kidney disease (OR = 6.86; 95% CI, 1.33–35.18; P = 0.021), Bentall surgery that required coronary bypass (OR = 5.53; 95% CI, 2.02–15.12; P < 0.001), physical inactivity (low mobility) (OR = 30.83; 95% CI, 1.67–568.10; P = 0.021), embolic events (OR = 12.43; 95% CI, 1.54–100.22; P = 0.018), and the presence of complications in the early postoperative period (OR = 3.13; 95% CI, 1.24–7.88; P = 0.015).[12,17]

Conclusions

Despite having found unsatisfactory numbers that are slightly distant from those reported in the rest of the world, our study has described an initial experience, allowing us to identify a series of factors and opportunities that will serve as a reference to improve critical points of surgical interventions and the perioperative management of patients with this technique. Nevertheless, it should be noted that this surgical procedure continues to be the treatment of choice for the management of pathologies related to the aortic valve, aortic root, and ascending aorta, thus requiring the need for more research studies that will help us to reduce operative complications and improve survival rates associated with it.

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Conflicts of interest

There are no conflicts of interest.

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