Journal of Medicine in Scientific Research

Volume 3 | Issue 2 Article 10

Subject Area:

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Recommended Citation

Ali, Ahmed S. (2020) "Evaluation of early outcomes of modified bentall procedure as a treatment of ascending aortic diseases," *Journal of Medicine in Scientific Research*: Vol. 3: Iss. 2, Article 10.
DOI: https://doi.org/10.4103/JMISR.JMISR_35_20

Original Article

Evaluation of early outcomes of modified Bentall procedure as a treatment of ascending aortic diseases

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Abstract

Back ground

Ascending aortic diseases are life-threatening conditions that have an increasing incidence. The modified Bentall procedure has become the technique of choice used to treat such diseases.

Objectives

This study evaluates early outcomes of patients who underwent modified Bentall procedure as a treatment of ascending aortic diseases.

Patients and methods

A total of 75 patients who underwent modified Bentall operation for ascending aortic diseases at the National Heart Institute during a 3-years period (July 2015 to August 2018) were studied prospectively. The included patients were divided according to the type of aortic disease into two groups: group A included 50 patients with aortic root aneurysm with no dissection, and group B included 25 patients with type A aortic dissection. Short-term outcomes of the two groups were collected and compared with each other.

Results

The mean age was 44.72±12.89 years in group A and 49.77±13.45 years in group B. Male sex represented 76% (38 patients) in group A and 68% (17 patients) in group B. BMI was similar between the two groups. Group A had a statistically significantly lower mean values of operative time (P<0.001), cardiopulmonary bypass time (P=0.024), and cross-clamp time (P=0.007). However, group B had a statistically significant higher mean values of circulatory arrest time (P<0.001). There was no statistically significant difference between the two groups regarding the early postoperative period. Early mortality was 5/50 (10%) patients in group A and 5/25 (20%) patients in group B, with no significant difference between the two groups.

Conclusion

Despite higher mortality rates being noticed in type A dissection group, our results are still comparable to the internationally published results. Modified Bentall operation is reliable and considered the standard practice for surgical treatment of ascending aortic diseases.

Keywords: Aortic dissection, ascending aneurysm, modified Bentall operation

Introduction

One of the main causes of death in people above 65 years is the thoracic aortic aneurysms. Whether complicated or not, these conditions are considered a life-threatening situation that carry a great risk of mortality and ranked among the top 20 leading causes of death in the United States. Nowadays and according to the Centre for Disease Control, the incidence of ascending thoracic aneurysms has doubled in number and is estimated to be around 10/100 000 person-year. The reason for that is the recent advances in imaging modalities, aging of the population, increased use of transthoracic echocardiography, and routine screening of elderly people [1].

Asymptomatic patients with undiagnosed thoracic aortic aneurysms are not uncommon. These patients are usually

Access this article online	
Quick Response Code:	Website: www.jmsr.eg.net
	DOI: 10.4103/JMISR.JMISR_35_20

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Submitted: 09-Mar-2020 **Revised:** 11-Mar-2020 **Accepted:** 05-Apr-2020 **Published:** 24-Aug-2020

How to cite this article: Ali AS. Evaluation of early outcomes of modified Bentall procedure as a treatment of ascending aortic diseases. J Med Sci Res 2020;3:143-9.

discovered accidentally during routine examination or during testing for another diseases [2]. On the contrary, the presence of severe, persistent chest pain at the time of presentation should always alert physicians toward aortic dissection, as chest pain is considered the most common symptom in most cases with this condition [3].

Bentall and De Bono[4] were the first to describe their technique to treat ascending aortic aneurysm, replacing the aortic root with the reattachment of the two main coronary arteries. Although this technique was primarily invented to treat aortic root aneurysms, the indications for total root replacement have been widened recently [5–7].

The procedure was intended to surgically repair ascending aortic or aortic root aneurysms in combination with aortic valve disease. Moreover, it was used to repair aortic dissection affecting the aortic root and valve. During the procedure, a composite aortic valve graft is used to replace the proximal ascending aorta and aortic valve. The procedure is performed through a median sternotomy during cardiopulmonary bypass (CPB). In this modification of the original procedure, coronary artery circulation is maintained by removing a full-thickness ‘button’ of aorta surrounding the coronary ostia, making it easier to implant the proximal end of the coronary arteries into openings made in the aortic vascular graft [8].

Moreover, the Bentall procedure was the cornerstone for the development of the aortic valve-sparing techniques, which has the advantage of freedom from the need for anticoagulation therapy with the resultant less complications and morbidity. On the contrary, the mechanical replacement of the aortic valve during the Bentall procedure requires a lifelong anticoagulation therapy with the subsequent risk of thromboembolism and major hemorrhagic complications [5,9].

The decision of choice regarding the type of proposed operation for ascending aortic diseases is taken according to the preferences of both the patient and surgeon, although younger patients less than 40 years old with minimal valve deformity may benefit from aortic valve-sparing techniques [8]. Elderly patients above 70 years are more likely to receive a biological valve, which has a low risk of degeneration and complications at this age [10]. However, modified Bentall procedure is mostly considered in younger age group with severe aortic valve pathology.

Against this background, we reported our results in 75 consecutive patients who underwent modified Bentall operation for the treatment of either ascending aortic aneurysms or type A aortic dissection in our tertiary highly specialized referral center during a 3-year period.

Patients and methods

Ethical committee approval was taken. A single-center prospective study was carried out at National Heart Institute, Cairo, Egypt, during the period of July 2015 to August 2018. A total of 75 consecutive patients who underwent modified Bentall operation at our institute were divided according to the type of aortic disease into two groups:

Group A: 50 patients who experienced aortic root aneurysm without dissection.

Group B: 25 patients who experienced type A aortic dissection with or without aneurysm.

The study was subjected to inclusion criteria, such as patients with ascending aortic aneurysm including Marfan syndrome, patients with type A aortic dissection (acute or chronic) associated with unrepairable diseased aortic valve, bicuspid aortic valve patients with ascending aorta aneurysms, and patients accepting to participate in the study. Exclusion criteria were patients with ascending aortic aneurysms and normal aortic valve, patients with isolated ectasia of the noncoronary sinus, patients with arch or descending aortic aneurysm with normal aortic root, patients with infective endocarditis or redo surgery, and patients refusing to participate in the study.

All included patients were prepared for the operative room according to the standard protocols, including full history taking with complete physical and cardiac examinations. The patient’s age, sex, and risk factors were taken in consideration. Full preoperative laboratory investigations were done together with imaging studies which were done either as routine preoperative studies or to help in the diagnosis of acute aortic dissection. Patients older than 40 years were subjected to either coronary angiography or multislice computed tomography angiography in case of aortic dissection to exclude the presence of associated coronary artery diseases. Patients with aortic dissection were managed as emergency cases.

Surgical technique

The approach was via a standard median sternotomy incision in all patients. Exposure of femoral vessels was attempted in case of aortic dissections or presence of huge ascending aneurysms, which prohibit the application of aortic cross-clamp.

Initiation of cardiopulmonary bypass

The site of arterial cannulation was influenced by individual factors, and some patients had more than one insertion site for arterial annulation. Table 1 shows the sites of arterial perfusion in both groups.

The venous drainage was achieved through either a two-stage venous cannula in the right atrium or cannulation of both the superior and inferior vena cava in presence of associated mitral or tricuspid disease. When total circulatory arrest was needed, snare of the superior vena cava cannula was applied to initiate retrograde cerebral perfusion. Table 2 shows the different sites for venous cannulation.

All patients received selective antegrade custodiol cardioplegia via the coronary ostia to induce cardiac arrest after aortic cross-clamping by giving 20 ml/kg of HTK cardioplegic solution (Custodiol; Koehler Chemi, Alsbach-Hδhnlein, Germany) once over 10-min duration. Left ventricular vent was

Table 1: Sites of arterial cannulations

Site of arterial cannulation	Group A (n=50) [n (%)]	Group B (n=25) [n (%)]	P
Aortic arch	11 (22.0)	0	
Ascending aorta	35 (70.0)	3 (12.0)	<0.001*
Right femoral artery	4 (8.0)	22 (88.0)	

*Significant.

Table 2: Sites for venous cannulation

Site of venous cannulation	Group A (n=50) [n (%)]	Group B (n=25) [n (%)]	P
Two-stage single venous cannulation	40 (80.0)	17 (68.0)	
Bicaval cannulation	10 (20.0)	8 (32.0)	0.251

applied in all patients to ensure clear field during the procedure and to help de-airing at the end of bypass.

Moderate hypothermia (28–30°C) together with topical ice slush was used to protect the myocardium throughout the procedure, and when total circulatory arrest was needed as in cases of type A aortic dissection, profound hypothermia at temperatures of 18–22°C was reached to protect the brain and safely discontinuing the CPB with removal of the aortic cross-clamp to perform the distal anastomosis using the open technique. Slices of autologous pericardium was used as hemostatic and reinforcement layer throughout the procedure.

During the deep hypothermic circulatory arrest, protection of the central nervous system was promoted by maintaining the blood glucose below 200 mg/dl and administration of methyl prednisolone (7 mg/kg), thiopental (7–15 mg/kg), mannitol (0.3–0.4 g/kg), and furosemide (100 mg) for renal preservation.

Statistical analysis

Results were obtained, and statistical package SPSS, version 20 (IBM, SPSS inc., Chicago, United States) was used to statistically analyze the outcomes. Two types of statistics were done:

(1) Descriptive statistics, which included percentage (%), mean, and SD.
(2) Analytic statistics:
   - (a) Student t test is a test of significance used for comparison between two groups having quantitative variables.
   - (b) χ^2 test was used to study association between two qualitative variables.
   - (c) A P value of less than 0.05 was considered statistically significant.

Results

The mean age was 44.72 ± 12.89 in group A and 49.77 ± 13.45 in group B. Male sex represents 76% (38 patients) in group A and 68% (17 patients) in group B. BMI was similar between the two groups with no significant difference. There was a statistically significant difference between the two groups regarding the New York Heart Association (NYHA) functional class and preoperative CCS class angina, with a P value less than 0.001. Detailed patients characteristics are presented in Table 3.

There was a statistically significant difference between the two groups regarding the site of arterial cannulation; the ascending aorta was the most used site in group A and the right femoral artery was commonly used in group B ($P < 0.001$). Retrograde cerebral perfusion was used only in group B patients 13/25 (52%).

Group A had a statistically significant lower mean values of operative time ($P < 0.001$), CPB time ($P = 0.024$), and cross-clamp time ($P = 0.007$), whereas group B had a statistically significant higher mean values of circulatory arrest time ($P < 0.001$). Other operative data are listed in Table 4.

There was no statistically significant difference between the two groups regarding the early postoperative period. Early postoperative data are listed in Table 5.

The early (30 days) mortality was seen in 5/50 (10%) patients in group A and 5/25 (20%) patients in group B. Five patients died intraoperatively: three (6%) patients in group A and two (8%) patients in group B.

Seven (14.89%) patients were explored for bleeding in group A; four of them were discharged packed from Operative room (OR) owing to coagulopathy. Moreover, three (13.04%) patients were explored for bleeding in group B; two of them were discharged packed from OR owing to coagulopathy.

Acute tubular necrosis occurred in one (2.13%) patient in group A and in two (8.70%) patients in group B. Detailed mortality and morbidity are listed in Table 6.

Female sex, chronic obstructive pulmonary disease, hyperlipidemia, renal dysfunction, NYHA functional class IV, low ejection fraction %, long operative time, long CPB time, long cross-clamp time, and prolonged ventilation were found to be associated with increased risk of 30-day mortality in our group of patients. Other predictors of mortality are present in Table 7.

Discussion

In 1968, Bentall and De Bono were the first to introduce composite mechanical valve conduit as a new technique to replace a large aortic root aneurysm. Various adaptations of this technique have been the cornerstone for management of patients with aortic root lesions [11].

At presentation, aortic dissection may be misdiagnosed for other diseases, and up to 30% of patients are thought to have another diagnosis. Hence, the diagnosis of aortic dissection requires high level of suspicion and should always be considered in the setting of severe, unrelenting chest pain. Furthermore, painless dissection has been reported, but this may occur on top of chronic

Table 3: Patient characteristics

Demographic data	Group A (*n*=50) [*n* (%)]	Group B (*n*=25) [*n* (%)]	*P*
Age (years)			
Mean±SD	44.72±12.89	49.77±13.45	0.119
Sex			
Male	38 (76.0)	17 (68.0)	0.545
Female	12 (24.0)	8 (32.0)	
BMI (kg/m^2)	30.08±8.22	27.11±3.96	0.092
COPD (FEV1)/(FVC <0.7)	10 (20.0)	7 (28.0)	0.435
Diabetes mellitus	14 (28.0)	11 (44.0)	0.165
Hypertension	33 (66.0)	19 (76)	0.375
Hyperlipidemia	15 (30.0)	7 (28.0)	0.858
Smoking	39 (78.0)	21 (84.0)	0.540
Pulmonary hypertension	41 (82.0)	21 (84.0)	0.828
NYHA class			
I	5 (10.0)	2 (8.0)	<0.001*
II	11 (22.6)	4 (16.0)	
III	25 (47.2)	3 (12.0)	
IV	9 (20.8)	16 (64.0)	
CCS class angina			
1	13 (26.0)	1 (4.0)	<0.001*
2	24 (48.0)	4 (16.0)	
3	12 (24.0)	17 (68.0)	
4	1 (2.0)	3 (12.0)	
Severity of aortic valve lesion			
AR	**42 (84.0)**	**25 (100)**	0.106
Moderate	1 (2.0)	0	
Severe	41 (82.0)	25 (100.0)	
AS	**5 (10.0)**	**0**	
Double aortic lesion	**3 (6.0)**	**0**	
LVEDD (mm) (*n*=35-55 mm)	66.78±9.49	66.29±7.43	0.822
LVESD (mm) (*n*=6-22 mm)	47.15±8.99	46.01±6.89	0.579
EF% (*n*≥50%)	53.67±7.34	54.84±7.98	0.529
SWT (mm) (*n*=6-11 mm)	11.51±2.24	11.98±2.81	0.434
PWS (mm) (*n*=6-11 mm)	11.43±1.76	10.99±2.87	0.414
AR (mm) (*n*=2.0-3.7 mm)	51.12±9.23	65.04±11.25	<0.001*
PA pressure (mmHg) (*n*<20mmHg)	29.83±13.28	27.12±9.54	0.366

AR, aortic regurge; AS, aortic stenosis; CCS, Canadian cardiovascular score; COPD, chronic obstructive pulmonary disease; EF, ejection fraction; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; LVEDD, left ventricular end diastolic diameter; LVESD, left ventricular end systolic diameter; NYHA, New York Heart Association; PA, pulmonary artery; PWS, posterior wall thickness; SWT, septal wall thickness. *Statistically significant.

Table 4: Operative data

Operative data	Group A (*n*=50) [*n* (%)]	Group B (*n*=25) [*n* (%)]	*P*
Procedures			
Isolated modified Bentall	31 (62.0)	20 (80.0)	0.115
Bentall with concomitant surgery	19 (38.0)	5 (20.0)	
Site of arterial cannulation			
Ascending aorta	38 (76.0)	2 (8.0)	<0.001*
Aortic arch	6 (12.0)	0	
Right femoral artery	6 (12.0)	23 (92.0)	
Site of venous cannulation			
Two-stage single venous	41 (82.0)	24 (96.0)	0.092
Bicaval	9 (18.0)	1 (4.0)	
Cardioplegia			
Blood enriched cold crystalloid	47 (94.0)	10 (40.0)	<0.001*
Custodiol	3 (6.0)	15 (60.0)	
Retrograde cerebral perfusion	0	13 (52.0)	<0.001*
Extent of aortic resection			
Aortic root and all the ascending aorta	48 (96.0)	13 (52.0)	<0.001*
Aortic root+ ascending aorta+ hemi arch	2 (4.0)	7 (28.0)	
Aortic root+ ascending aorta+ total arch	0	5 (20.0)	
Usage of local hemostatic			
Surgical glue	5 (10.0)	1 (4.0)	0.025*
Surgicel	3 (6.0)	1 (4.0)	
Tissue glue+ surgicel	10 (20.0)	14 (56.0)	
Operation time (min)	315.56±74.85	412.11±131.72	<0.001*
CPB time (min)	153.69±32.96	185.67±87.55	0.024*
Cross-clamp time (min)	123.33±24.82	140.95±29.19	0.007*
Circulatory arrest time (min)	0	9.36±18.0	<0.001*

CPB, cardiopulmonary bypass. *Statistically significant.

aortic aneurysms as patients are unable to distinguish chronic aneurysm pain from the new dissecting pain [3,12].

The mean age in our study was 44.72 ± 12.89 years in group A and 49.77 ± 13.45 years in group B. This is relatively lower than the mean age of similar studies, such as Djokic *et al.* [13], with a mean age of 54 ± 10 years, and Hysi *et al.* [14], with a mean age of 54.4 ± 14.2 years.

In our study, there was a predominance of male sex in both groups: 38/50 (76%) in group A and 17/25 (68%) in group B. This is more or less similar to other studies, such as Nishida *et al.* [15], with male sex representing 58/71 (81.4%), and Castrovinci *et al.* [16], who showed male sex predominance in their surgically treated group of patients (88/119, 74%).

Not surprisingly, our mean CPB time and aortic cross-clamp time was significantly higher in group B than in group A, being 185.67 ± 87.55 and 140.95 ± 29.19, respectively. This is consistent with the fact that aortic dissection is a complex and demanding operations. Etz *et al.*[17] have reported similar timings, with a mean CPB time of 196.8 ± 91 and mean aortic cross-clamp time of 112.3 ± 49.2.

Kallenbacha and colleagues studied different surgical techniques in treating ascending aortic aneurysms and have reported a mean ICU stay of 72 ± 120 h. In comparison, we noticed a prolonged ICU stay regarding group A of our

Table 5: Postoperative data

Early postoperative data	Survived in group A (n=47) (mean±SD)	Survived in group B (n=23) (mean±SD)	P
Ventilation time (h)	14.37±23.19	20.12±24.15	0.321
ICU stay (h)	98.45±56.4	81.49±33.74	0.171
Hospital stay (days)	10.98±6.12	11.29±6.28	0.838
Aortic root diameter (mm)	31.26±9.71	31.38±10.32	0.960
LVEDD (mm)	53.93±13.75	55.74±18.22	0.632
LVESD (mm)	38.41±13.17	38.54±13.72	0.968
LVEF (%)	48.04±16.57	49.61±17.43	0.704
AV peak gradient (mmHg)	16.75±8.65	16.22±8.54	0.802
AV mean gradient (mmHg)	8.31±4.43	9.03±5.02	0.527

AV, aortic valve; LVEDD, left ventricular end diastolic diameter; LVEF, left ventricular ejection fraction; LVESD, left ventricular end systolic diameter.

Table 6: Morbidity and mortality

Early postoperative morbidity	Group A (n=47) [n (%)]	Group B (n=23) [n (%)]	P
Heart block			
Nodal rhythm	2 (4.26)	0	0.464
Complete heart block	1 (2.13)	0	
Atrial fibrillation	4 (8.51)	1 (4.35)	0.525
Exploration for bleeding	7 (14.89)	3 (13.04)	0.835
Wound infection			
Superficial	9 (19.15)	6 (26.08)	0.184
Deep (mediastinitis)	1 (2.13)	0	
Pulmonary			
Aspiration and acute hypoxia	0	1 (4.35)	0.388
Acute respiratory failure	1 (2.13)	0	
Tracheal stenosis	1 (2.13)	0	
Neurological			
Cerebrovascular stroke	2 (4.26)	2 (8.70)	
Brain death	0	2 (8.70)	0.469
Renal (ATN)	1 (2.13)	2 (8.70)	0.186
Rocking sternum	1 (2.13)	0	0.490
LV systolic dysfunction			
Moderate (EF=30-50%)	18 (38.29)	7 (30.43)	0.663
Poor (EF<30%)	1 (2.13)	0	
Postop pericardial effusion			
Mild	4 (8.51)	0	0.245
Moderate	3 (6.38)	1 (4.35)	
Severe	0	1 (4.35)	
Early 30 days mortality	**5 (10.0)**	**5 (20.0)**	
Intraoperative	3 (6.0)	2 (8.0)	0.388
First month postoperative	2 (4.0)	3 (12.0)	
Cause of death			
Myocardial failure	2 (4.0)	2 (8.0)	0.272
Uncontrolled hemorrhage	1 (2.0)	0	
Brain death	0	1 (4.0)	
Cerebral hemorrhage	1 (2.0)	0	
Mediastinitis	1 (2.0)	0	
Acute respiratory failure	1 (2.0)	0	
Acute heart failure	1 (2.0)	0	
Aspiration and severe hypoxia	0	1 (4.0)	
VF	0	2 (8.0)	

ATN, acute tubular necrosis; LV, left ventricle; VF, ventricular fibrillation.

study, being 98.45 ± 56.4 h. This prolonged stay was owing to prolonged ventilation (160 h) in one (2%) patient, bleeding and reopening in seven (14%) patients, and delayed weaning of inotropes in five (10%) patients. On the contrary, the mean ICU stay in group B of our study was 81.49 ± 33.74 h compared with 192 ± 264 in the study by Beckmann and colleagues who used different techniques in treating aortic dissection, including 47 patients who underwent David procedures. The study did not clarify the reason for this prolonged ICU stay [18,19].

Freedom from postoperative arrhythmias was the rule in our study, except for postoperative atrial fibrillation, which occurred in four (8%) patients in group A and one (4.45%) patient in group B. Moreover, postoperative heart block was noticed only in group A, with one (2%) patient developed complete A-V block and two (4%) patients developed nodal rhythm. This was comparable to similar studies, such as Etz and colleagues, who reported a postoperative atrial fibrillation incidence of 10.2% in the aneurysm group and 4.6% in the dissection group of their study [16]. On the contrary, Kallenbacha *et al.*[18] have reported only complete A-V block in their study, with an incidence of 4% postoperatively.

Despite a higher rate of reopening was expected in the dissection group of the study, we were astonished with the fact that higher rate belonged to the aneurysm group of our study, being 13.04 and 14.89%, respectively. This rate was also considerably higher than similar studies, such as in Kallenbacha and colleagues who reported an incidence reopening rate of 6%, Nishida and colleagues with a rate of 2.8%, and Djokic and colleagues with an incidence rate of 2.2%. This remarkable variation may be referred to the lack of fresh blood in elective cases, lack of tissue glue in some cases, and lack of surgical experience in other cases. On the contrary, the dissection group showed a lower incidence rate of reopening when compared with similar studies, such as Etz and colleagues who reported an incidence rate of 21%, Beckmann and colleagues with a rate of 29.3%, and Castrovinci and colleagues with an incidence rate of 17%. The cause of this may be owing to the availability of fresh blood and platelets in emergency cases, the use of pericardium as hemostatic layer

Table 7: Predictors of mortality

Factors	Survived (*n*=65) [*n* (%)]	30-day mortality (*n*=10) [*n* (%)]	*P*
Age (years)			
20-40	20 (30.7)	1 (10.0)	0.379
41-60	32 (49.2)	6 (60.0)	
>60	13 (20.0)	3 (30.0)	
Sex			
Male	51 (78.4)	4 (40.0)	
Female	14 (21.6)	6 (60.0)	0.010*
COPD (*n*=16)	10 (15.4)	6 (60.0)	0.001*
Diabetes mellitus (*n*=22)	17 (26.1)	6 (60.0)	0.030*
Hypertension (*n*=48)	40 (61.5)	8 (80.0)	0.257
Hyperlipidemia (*n*=16)	11 (16.9)	5 (50.0)	0.017*
Tobacco smoking (*n*=61)	45 (69.2)	10 (100.0)	0.040*
Pulmonary hypertension (*n*=63)	54 (83.1)	9 (90.0)	0.578
Renal dysfunction (*n*=12)	8 (12.3)	4 (40.0)	0.026*
NYHA class (*n*=75)			
I	7 (10.8)	0	0.013*
II	15 (23.0)	1 (10.0)	
III	25 (38.5)	1 (10.0)	
IV	18 (27.7)	8 (80.0)	
CCS class angina (*n*=75)			
1	14 (21.5)	0	0.164
2	25 (38.5)	2 (20.0)	
3	23 (35.4)	6 (60.0)	
4	3 (4.6)	1 (10.0)	
LV function (EF=30-50) (*n*=17)	9 (13.8)	8 (80.0)	<0.001*
LVEDD (mm)	65.21±8.23	68.79±8.08	0.203
LVESD (mm)	45.67±8.92	49.05±8.19	0.263
EF%	55.75±8.14	47.53±4.64	0.002*
Aortic diameter (mm)	52.73±10.32	66.94±13.49	<0.001*
Operation time (min)	334.71±87.25	439.12±165.29	0.003*
CPB time (min)	156.87±33.45	226.65±121.95	<0.001*
Cross-clamp time (min)	121.45±24.78	152.03±29.56	<0.001*
Amount of bleeding (ml)	811.74±240.12	454.23±455.93	<0.001*
Amount of blood transfusion (ml)	1545.78±293.39	873.33±923.56	<0.001*
Ventilation time (h)	13.19±6.12	27.93±58.45	0.045*

CPB, cardiopulmonary bypass; CCS, Canadian cardiovascular score; COPD, chronic obstructive pulmonary disease; EF, ejection fraction; LV, left ventricle; LVEDD, left ventricular end diastolic diameter; LVESD, left ventricular end systolic diameter; NYHA, New York Heart Association.
*Statistically significant.

throughout the procedure, and the competency of surgeons operating upon dissection cases [13,15–19].

Although our mortality was comparable to the internationally published results with a 20% mortality rate in the dissection group (group B), yet this rate was relatively high in the aneurysm group when compared with similar studies. We believe that a 10% incidence of mortality rate was not in line with the simplicity of the aneurysm cases. Moreover, three of the five mortalities have occurred intraoperatively, and this is of course a questionable issue. In the same context, Vendramin and colleagues have reported a mortality rate of 2.6% in their study, and also Nishida and colleagues and Djokic and colleagues reported a mortality rate of 2.8 and 2.2%, respectively. The high mortality rate in the aneurysm group of our study may be related to the presence of multiple risk factors associated with patients of this group. On the contrary, group B showed a total mortality of five patients: two (8%) of them died intraoperatively and the other three (12%) died within 1 month from operation. These values are comparable with other studies, such as Beckmann and colleagues, who reported 30-day mortality rate of 22%; Etz and colleagues, who reported 30-day mortality of 20%; Castrovinci and colleagues, who reported a mortality rate of 21%; Hysi and colleagues, who reported 30-day mortality of 20%; and Wang and colleagues, who reported 30-day mortality rate of 13.6% [13–17,19–21].

In our study, risk factors that influenced mortality rate and considered as early (30 days) mortality predictors are similar to other studies that showed different independent risk factors for death after modified Bentall procedure. Gott and colleagues have reported age more than 65 years, presence of aortic dissection, aneurysm rupture into pleura or pericardium, emergency status, previous cardiac intervention, associated coronary artery disease (CAD), poor preoperative NYHA functional class, and left ventricular ejection fraction less than 35% as strong predictors of early death in their study. Moreover, Bachet and colleagues have pointed to the emergency status and aortic arch replacement as strong predictors for hospital death in their study. Furthermore, Prifti and colleagues in their study on 212 patients, by univariate analysis revealed that age more than 65 years, aortic dissection, aortic rupture into pleura or pericardium, NYHA functional class, left ventricular ejection fraction less than 35%, emergency/urgency status, reoperation, and associated CAD to be strong predictors of in-hospital mortality. Finally, Etz and colleagues, in their study on 448 patients have reported that patient age and prolonged cross-clamp time were risk factors for overall, early, and long-term mortality. Moreover, emergency surgery has tripled overall mortality and increased the risk of early death almost six-fold and influenced longevity even after hospital discharge and after 30 days, regardless of the etiology [17,22–24].

Conclusion

We concluded that modified Bentall technique can provide a reliable surgical outcome for diseases of the ascending aorta. Despite higher mortality rates were noticed in the aneurysm group of our study compared with similar studies, our results are still comparable to the internationally published reports. The increased mortality was related to the presence of higher incidence of associating risk factors. In the future, long-term outcomes of this standard technique should be compared with the more advanced techniques, such as valve-sparing surgeries.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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