THREE-YEAR RESULTS FROM THE SURGICAL TREATMENT OF DISEASES OF THE AORTIC VALVE AND AORTIC ROOT

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ABSTRACT

PURPOSE: Pathology of the aortic root and aortic valve is subjected to adult cardiac surgery and includes Stanford A aortic dissection, annuloaortic ectasia or chronic aneurysm of the ascending aorta. In such cases, Bentall-De Bono procedure is usually preferred. Aortic valve reimplantation by using Tirone David's technique presenting with the advantages of valve-sparing surgery can be performed in selected cases.

MATERIAL AND METHODS: A retrospective analysis of a three-year experience with the complex surgical treatment of diseases of the aortic valve and root was carried out. During the period from January 1, 2009 to December 31, 2012, fifty-three patients with aortic valve and aortic root pathology were treated in the Division of Cardiac Surgery, St. Marina University Hospital of Varna. Bentall procedure was carried out in 37 patients (Group B). In 19 of them (51%) emergency surgery was done for acute aortic dissection of type Stanford A. The rest 18 patients underwent elective surgery for dilated ascending aorta and aortic valve dysfunction. Aortic valve-sparing surgery by David's technique for aortic aneurysm was accomplished in 16 patients (Group D). This technique was emergently applied in one patient with aortic dissection, too. Baseline data, intraoperative details, early results and complications were compared.

RESULTS: Early (30-day) mortality after Bentall-De Bono procedure was 10,5% (0% after elective surgery and 21,1% after dissection repair). All the patients survived after David's procedure that proved the significant advantages of the valve-sparing surgery.

CONCLUSION: The aortic valve reimplantation provides long-term results that are comparable to those after the Bentall-De Bono procedure such as high survival rates, low incidence rate of endocarditis, and slightly higher risk of reinterventions. There is no need of life-long anticoagulation that improves patient's quality of life.

Key words: *aortic valve-sparing surgery, David's technique, aortic root, aortic aneurysm, aortic dissection*

INTRODUCTION

Pathology of the aortic root and aortic valve is subjected to adult cardiac surgery and includes Stanford A aortic dissection, annuloaortic ectasia or chronic aneurysm of the ascending aorta. In such cases, Bentall-De Bono procedure is usually preferred. Aortic valve reimplantation by using Tirone David's technique presenting with the advantages of valve-sparing surgery can be performed in selected cases.

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Received: November 4, 2013
Accepted: November 22, 2013

MATERIAL AND METHODS

A retrospective analysis of a three-year experience with the complex surgical treatment of diseases of the aortic valve and root was carried out. During the period from January 1, 2009 to December 31, 2012, fifty-three patients with aortic valve and aortic root pathology were treated in the Division of Cardiac Surgery, St. Marina University Hospital of Varna. Bentall-De Bono procedure was carried out in 37 patients (Group B). In 19 of them (51%) emergency surgery was done for acute aortic dissection of type Stanford A. The rest 18 patients underwent elective surgery for dilated ascending aorta and aortic valve dysfunction. Aortic valve-sparing surgery by David's technique for aortic aneurysm was accomplished in 16 patients (Group D). This technique was emergently applied in one patient with aortic dissection, too. Baseline data, intraoperative details, early results and complications were compared. The results from the follow-up between 2 and 39 months (mean of 20 months) were analyzed. Thorough transthoracic echocardiographic examinations were performed prior to surgery, during the early postoperative period and at follow-up. In 61% of the patients transoesophageal echocardiography (TOE) in the operating theatre after induction of anesthesia was additionally used to complete the preoperative evaluation.

Indications for surgery

Aortic valve stenosis or regurgitation not suitable for valve sparing and combined with aortic root disease was diagnosed in all the patients of group B. In 19 of them (51%) the pathogenetic mechanism included type Stanford A acute aortic dissection requiring emergency surgery. The rest 18 patients were scheduled for elective surgery determined by the aortic valve dysfunction with dilated aortic root.

Aortic root aneurysm with aortic valve insufficiency was the surgical indication in 15 patients of group D. Only one patient (6%) presented with acute aortic dissection.

Statistical analysis

Continuous variables were presented either as mean ± standard deviation (SD) in case of normal distribution, or as median and interquartile range (IQR). Discrete variables were presented as percentages. Comparison of results was made using the $\chi 2$-test, independent samples t-test or paired samples t-test. Values of $p<0,05$ were considered statistically significant. Patient's survival rate was examined using the Kaplan-Meier curve.

RESULTS

Baseline patients' characteristics

Patients from both groups were predominantly male at a mean age of 56±12 years (range, 25-76 years). Table 1 shows detailed data in this respect.

Intraoperative details

All the patients were operated through a standard median sternotomy using cardiopulmonary bypass (CPB), mild to moderate hypothermia (mean lowest temperature on CPB 29±4°C in group B and 31±2°C in group D; p=0,02) and cold crystalloid cardioplegic arrest after aortic cross-clamping. Mean aortic cross-clamp times were 126±33 min. in group B and 153±26 min. in group D (p=0,006). Mean CPB times were 244±100 min. and 224±39 min., respectively (p>0,05). Mechanical valve prostheses were implanted in 66% of the patients of group B. Mean aortic graft size was 27±4 mm in group B and 29±3 mm in group D (p=0,05).

Aortic arch surgery was necessary for 40,5% of Bentall-De Bono technique patients and 18,8% of David's procedure ones. This corresponded to the usage of circulatory arrest, i.e. in 46% of the patients of group B and in 12,5% of those of group D. Circulatory arrest was also performed using selective bilateral cerebral perfusion. Mean arrest times were 32±18 min. and 29±3 min., respectively (p>0,05). Additional surgical procedures were performed in 18,9% of the patients of group B and in 12,5% of those of group D.

Postoperative period

Early (30-day) mortality after Bentall-De Bono procedure was 10,5% (0% after elective surgery and 21,1% after dissection repair). Table 2 summarizes the causes of early death. Early survival rate after David's procedure was 100%.

All-causes mortality rate of group B patients reached up to 21,1% (5,3% for elective and 36,8% after emergent surgery). Only one elective patient (6,7% of all the cases or 7,1% of the elective operations) with David's procedure died during the follow-up period (Fig. 1). Three months after the primary procedure he developed aortic valve endocarditis with fulminant course and died before the redo surgery.

Table 1. Baseline patients' characteristics

Parameters	Group B	Group D	p-value
number of patients	37	16	
male gender (%)	78	87	NS
age (years)	55±12	56±11	NS
Comorbidity (%)			
Marfan syndrome	5,4%	0 %	NS
diabetes mellitus	0%	6.3 %	NS
arterial hypertension	89,2%	93.8 %	NS
dyslipidemia	51,4%	75 %	NS
history of cerebral ischemia	5,4%	6.3 %	NS
renal failure	0%	0 %	NS
risk profile (%)			
III/IV NYHA class	51,4%	62,5%	NS
emergent procedures	51,4%	6,3%	0,002
EuroSCORE	5,7±4,3	3,2±1,9	0,005
LVEF (%)	54±14	54±10	NS
Ao ascendens D_{max} (mm)	59±12	59±10	
aortic valve			
3+/4+ regurgitation	37,8%	81,3%	0,006
cusp number			
monocuspid	2,7%	-	
bicuspid	43,2%	-	
tricuspid	54,1 %	100%	

Postoperative complications

Only one patient of group D (6,7% of the cases) developed infective endocarditis three months after surgery. No cases of prosthetic endocarditis were registered in group B at all. One patient of group B died because of brain hemorrhage possibly due to anticoagulation. No other anticoagulation-related complications were registered.

Table 2. Causes of early postoperative mortality

Causes for death	n
respiratory distress syndrome	1
cerebral ischemia, multiorgan failure	1
multiorgan failure	1
circulatory failure	1
total	4

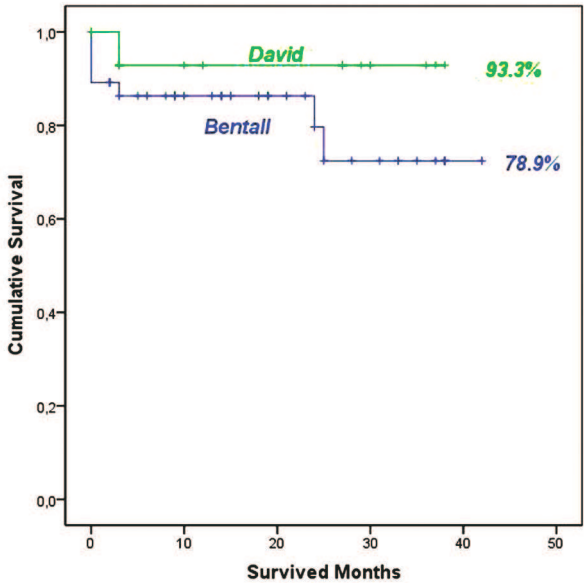

Fig. 1. Cumulative patients' survival in both groups

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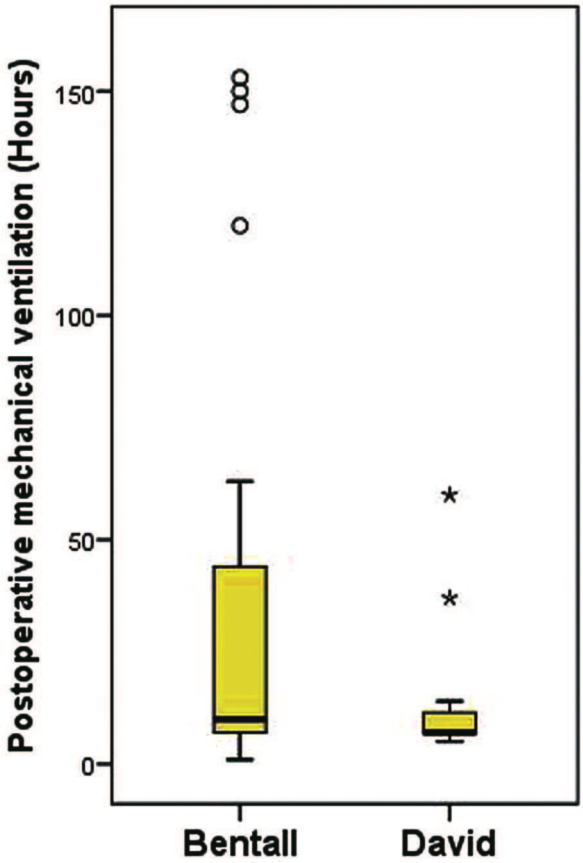

Fig. 2. Postoperative mechanical ventilation of the patients in both groups

Redo surgery

Second aortic cross-clamping or a second CPB run during the primary operation was necessary in 5,4% of the patients of group B always caused by bleeding from suture lines. On the contrary, in group D a second CPB run needed 25% of the patients due to residual aortic valve regurgitation which dictated additional surgical maneuvers and in one of the cases even aortic valve replacement. No early redo surgeries were necessary in both groups.

During the follow-up period, a recurrent 2+ aortic valve insufficiency was found out in one patient of group D (6,7%). He was on tight echocardiographic control. The rest survivors presented with normally functioning valve prostheses (group B) or native aortic valves (group D). The mean peak gradient was 26±8 mm Hg in group B and 14±7 mm Hg in group D. No indications for late redo surgery existed in any of the survivors.

Excessive mediastinal bleeding necessitated emergency mediastinal reexploration and hemostasis in 15,8% of the patients of group B and in 6,7% of those of group D.

Intensive care unit (ICU) and hospital stay

The patients of group B needed longer postoperative mechanical ventilation. Due to the asymmetrical distribution of values, medians and IQRs were much more informative than means. The median for group B was 10 hours (IQR - 39) versus 7 hours (IQR - 6) for group D (Fig. 2).

ICU stay was longer for the Bentall-De Bono patients - 132±73 hours (median - 116 and IQR - 70) versus 109±40 hours (median - 90 and IQR - 56) for the patients of group D. However, this difference did not reach any statistical significance (Fig. 3). The differences in hospital stay were insignificant, too - 16±7 days (median of 15 and IQR of 9) for group B and 15±3 days (median of 14 and IQR of 4) for group D (Fig. 4).

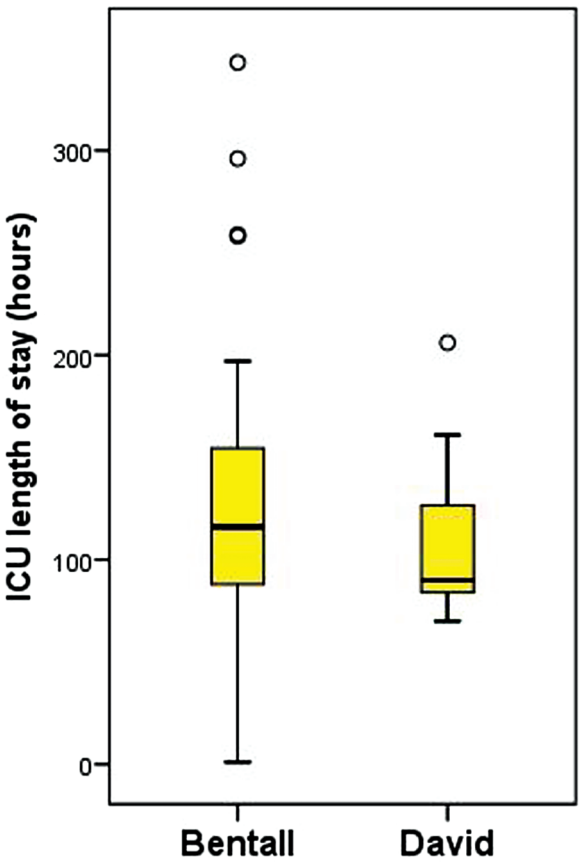

Fig. 3. ICU stay duration in both groups

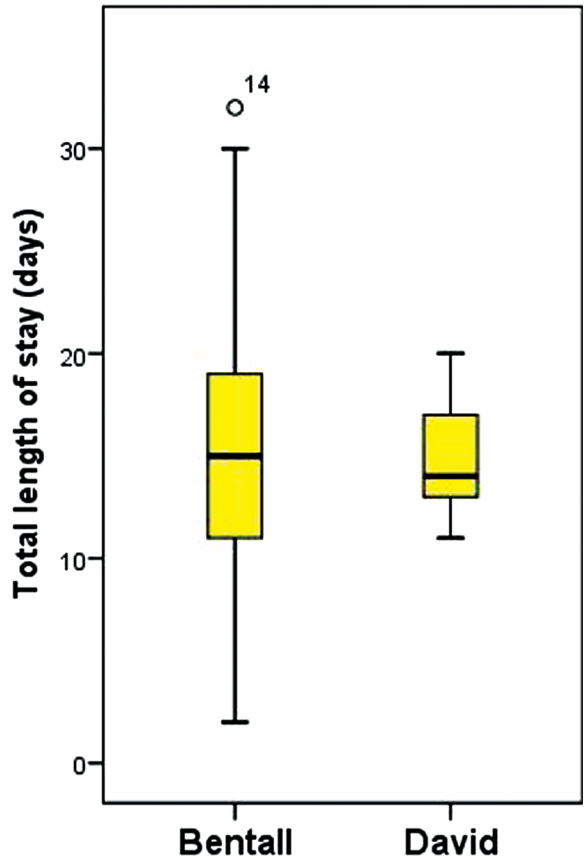

Fig. 4. Hospital stay duration in both groups

DISCUSSION

The Bentall-De Bono procedure remains the golden standard in the surgical treatment of combined pathology of the aortic valve and root. However, its disadvantages are a driving force when seeking for a safer and effective alternative.

Since its beginning onwards (4), the aortic valve sparing surgery continues its development, the techniques evolve, and the surgical indications become wider. Nowadays it can be a first-choice procedure even in cases of aortic dissection, bicuspid aortic valve, or Marfan syndrome.

There is no doubt that the exact preoperative evaluation is crucial for the success of a selected surgical procedure. On the other hand, the aortic valve reimplantation features some critical surgical details as aortic root mobilization, adequate sizing of the prosthesis (3) and its proper trimming and precise valve resuspension. Even a minimal inexactness in any of these details could compromise the result and most often lead to leaflet prolapse and residual regurgitation (1). The introduced vascular prostheses simulating the anatomical Valsalva sinuses eliminate the primary disadvantage of the early valve-sparing surgery and are easier to manipulate. However, this type of procedures requires exceptional surgical technique. Especially during the "learning curve", in absent standardization, the success often comes on the account of longer aortic cross-clamp times. A target cross-clamp time amounts to 180 min. (2).

The success of an aortic valve-sparing procedure is always verified by intraoperative TOE. Apart from the obligatory no more than 1+ regurgitation, other criteria for enduring results are coaptation more than 4 mm and coaptation zone beginning just above the aortic annulus (8).

Sometimes an unsatisfactory echocardiographic result requires second aortic cross-clamping and additional surgical maneuvers to correct the residual regurgitation (7) or even a valve replacement. In contrast, bleeding from suture lines is rarely a problem unlike the Bentall-De Bono procedure.

The transvalvular gradient after different types of procedures represents another parameter to be more commonly compared. The peak transvalvular gradient should be less than 20 mm Hg and higher gradients correlate to shorter freedom from reintervention periods (9). On the other hand, mechanical prostheses in composite grafts often create higher gradients that could indicate patient-prosthesis mismatch.

CONCLUSION

The aortic valve reimplantation provides long-term results that are comparable to those after the routine Bentall-De Bono procedure (5,6) such as high survival rates, low incidence rate of endocarditis, and slightly higher risk of reinterventions. Besides following David's procedure there is no need of lifelong anticoagulation that improves patient's quality of life.

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