AORTIC ROOT REPLACEMENT (BENTALL PROCEDURE): SINGLE SURGEON EXPERIENCE

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ABSTRACT

Objective: This study was prompted in part by a theory based on the impression that aortic root replacement (ARR) in the elderly has a high morbidity and mortality.

Methods : Retrospective analysis of 58 patients following ARR was carried out between 1996-2002. All the operations were performed by the author-an experienced surgeon. The choice of first assistant was based solely on availability; certified cardiovascular surgeon or experienced registered nurse. Patients were divided into two groups: group 1 patients were < 70 years of age and group 2 were > 70 years of age. The distribution of patients was similar in each group, as was the surgical strategy and concomitant surgical procedures.

Results : The hospital mortality was 3 (8.3%) for group 1 patients and 2 (9.1%) for group 2 patients. The mortality and morbidity rates were dependent of the patient NYHA status, as were the cardiopulmonary bypass time, the aortic cross clamp time, blood loss, adjusted blood transfusion volume and concomitant procedures.

Conclusion : ARR in the elderly is safe, the long term result is good and it remains the treatment of choice unless there is an absolute contraindication.

Key Words: Aort, Aortic root, Aort valve replacement, Mitral valve replacement, Coronary artery bypass grafting.

INTRODUCTION

Aortic root replacement (ARR) is the treatment of choice for the symptomatic or asymptomatic patient with aortic root aneurysm (1, 2). This study was prompted in part by a theory based on the impression that ARR in the elderly has a high morbidity and mortality (3). This retrospective study of patients younger and older than 70 years of age following ARR was carried out to define the role of age, as well as to examine the long-term outcome of ARR in the elderly patient.

MATERIAL AND METHODS

Between July 1996 and October 2002, the author had 58 consecutive patients who underwent ARR. Patients were arbitrarily divided into two groups: group 1 patients were under 70 years of age while group 2 patients were 70 years of age or older (Table I). There were 36 patients in group 1 with a mean age of 52 ± 10 years (± standard deviation) and a male-to-female ratio of 3:1. This was compared to 22 patients in group 2, with a mean age of 74 years± 2 years and male-to-female ratio of 4:1. Preoperatively, 22.2 % in group 1 were New York Heart Association

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Table I: Clinical characteristic and preoperative diagnoses of the patients

	Group 1	Group 2
Patients (n)	36	22
Mean age (years)	52±1	74±2
NYHA Class III patients (%)	52.8	54.5
NYHA Class IV patients (%)	22.2	22.7
Left ventricle ejection fraction (average)(%)	38.9	42.7
Aortic stenosis (n)	20	18
Hypertension (n)	14	17
Type I dissections	10	2
Coronary artery disease (CAD) (n)	10	7
Previous CABG op.	2	1
Mitral stenosis (n)	5	3
Chronic obstructive lung disease (n)	5	5
Marfan syndrome(n)	3	-
Annoloaortic ectasia (n)	3	2
Diabetes Mellitus (n)	3	3
Chronic renal failure (n)	2	4
Prostat Ca.(n)	-	2

(NYHA) class IV, 52.8 % were NYHA class III, compared to 22.7 % NYHA class IV and 54.5 % NYHA class III in group 2. The remainder of both groups were essentially NYHA class III. Preoperative diagnoses of the patients are shown in table I. Aortic stenosis, coronary artery disease and hypertension were the predominant diseases in both groups. Bioprostheses were not used in both groups. Sorin beleaflet mechanical valves were used. Valve sizes of 21, 23 and 25 mm were used in both groups. All vascular grafts were dacron tubular grafts (collagen coated). Graft sizes of 26, 28 and 30 mm were used in both groups. Appropriate size of the grafts and valves were tailored before the implantation. Urgent surgery was required in 27.8 % (n:10 patients) of group 1, compared to 9 % (n : 2) of group 2. Concomitant coronary artery bypass grafting (CABG) was performed in 27.8 % (n:10) and 31.8 % (n:7) of group 1 and 2 patients, respectively. In group 1, 3 patients had a single graft, 3 patients had two grafts, and 4 had three or more bypass grafts. In group 2, 2 patients underwent single graft surgery, 2 had two grafts and 3 had three or more bypass grafts. The internal mammary artery was utilized in 6 group 1 patients, but was not used in any group 2 patients. Concomitant surgical procedures are shown in table II.

Table II: Concomitant surgical procedures

	Group 1	Group 2
Bentall + Mitral Valve Replacement	5	3
Bentall + CABG op.	9	7
+LV apical aneurysmectomy	2	1
Bentall + Redo CABG op.	1	-
Bentall + Arcus Aorta Replacement	2	1
Bentall + ASD closure	1	1
Bentall + Graft-left superficial femoral bypass	1	-
Bentall + Carotid Endarterectomy	-	2

Standard median sternotomy and extracorporeal circulation techniques were used in all of the patients. Systemic hypothermia (perfusate temperature of 25°-28°C) was used when circulatory arrest was not required. Concomitant arcus replacement cases were performed under deep hypothermia (below 20°C) and total circulatory arrest. In such cases, femoral artery cannulation was employed. Retrograde cerebral perfusion was not utilized. Except concomitant mitral valve replacement cases, venous return was through single atrial cannulation. During the first half of the study period (1996-1999) operations were performed using antegrade single doses of cold crystalloid cardioplegia in 55.5 % and 54.5 % of group 1 and group 2 patients. During the second half of the study period (1999-2002) antegrade single doses of tepid blood potassium cardioplegia was used in the rest of the patients for myocardial protection (additional cardioplegic solution was given in cases of concomitant coronary surgery). Cardioplegic solution was infused through the coronary ostia immediately after aortic cross-clamping. The heart was topically cooled by cold serume saline (4°C). In all patients, aortic valvular tissue was excised, any calcium was debrided from the surrounding annulus using a rongeur and coronary ostia were prepared for anastomosis. Diseased aortic tissue was resected. When arcus replacement surgery was needed, it was done after the root replacement procedure under deep hypothermia and total circulatory arrest. When CABG or valve surgery were needed, distal coronary anastomosis and valve replacement were carried out before the root replacement procedure. Distal anastomosis was applied first to the most critically stenosed coronary artery, so that additional cardioplegic solution could be delivered to the ischemic

myocardium through the graft. Graft and valve were implanted in the aortic annulus with single separate sutures, and coronary ostia were anastomosed to the graft with the coronary button technique. After this, distal graft anastomosis to the arcus aorta was performed. Proximal anastomosis of the sapheneous vein grafts were applied to the prosthetic graft when performing CABG concomitantly. Aortic cross-clamp time (ACC) and cardiopulmonary bypass time (CPB) were noted. Mean aortic cross-clamp time was 69.33±14.08 min. in group 1 patients and 73.56±17.89 min. in group 2 patients. Mean cardiopulmonary bypass times were 89.37±13.30 min. and 95.00±16.64 min. in group 1 and group 2 patients. From the first postoperative day on ward, all patients started a regimen of lifelong treatment with coumadin and aspirin. The target International Normalized Ratio (INR) was 2 to 2,5.

Perioperative mortality was defined as any death occuring within 30 days postoperatively or death during initial hospitalization. Perioperative morbidity was defined and analyzed in six areas (1) myocardial infarction, (2) stroke or embolic complication defined as development of a new neurologic deficit, (3) renal failure, (4) respiratory failure requiring reintubation or prolonged intubation, (5) hemorrhage requiring reoperation and/or massive transfusion, (6) heart failure requiring high dose of inotropic agents and/or intraaortic ballon pumping (IABP).

Follow-up information was obtained by retrospective review of medical records or by direct telephone interviews or by office visits. Follow-up was completed in 84.9 % (n:45 patients). If the cause of death could not be determined because it occurred suddenly outside the hospital, the death was then classified as cardiac-related. Five patients had a transesophageal echocardiography (TEE) and 18 patients had a transthoracic echocardiography (TTE) in group 1. 2 patients had a TEE and 10 patients had TTE in group 2. The following features were examined during the follow-up period: Prosthetic aortic valve function, morphology and the dimensions of the tubular graft and perigraft aneurysm, arrhythmia and coronary ischemia.

The mean follow-up in group 1 was 33±18 months (range 5-66 months: total 110 patient-years); in group 2, it was 32±16 months (range 7-64 months: total 90 patient-years).

An analysis of the significance of differences in preoperative and postoperative characteristics was performed by chi-square analysis or student t-test. Acturial causes for mortality were obtained by the life table methods. Multivariant analysis of factors that might affect hospital morbidity and mortality was performed by stepwise logistic regression analysis (two tailed Fisher's exact test). A "p value" of less than 0.05 was judged to be statistically significant.

RESULTS

Early mortality was 8.3% in group 1 and 9.1% in group 2. Postoperative early mortality was similar in both groups and was not significantly different. The causes of early death were hemorrhage and massive blood transfusion (1 patient in group 1 and 1 patient in group 2), low cardiac output (1 patient in group 1) and fatal multiorgan failure (1 patient in group 1) . In both groups, univariate significant predictors for early deaths were: NYHA class IV ($p<0.001$), concomitant surgical procedures($p<0.01$), emergency surgery for aortic dissection ($p<0.01$), hemorrhage ($p<000.1$), cross-clamp time ($p<00.1$), and CPB time ($p<0.01$). Independent significant risk factors for early mortality at multivariate analysis were: concomitant surgical procedures ($p<0.01$), emergency operation for aortic dissection ($p<0.01$), hemorrhage ($p<0.001$), cross-clamp-time ($p<0.01$), and CPB time ($p<0.01$).

Perioperative morbidity was similar in both groups. They included reoperation for hemorrhage (6 patients in group 1 versus 4 patients in group 2), low cardiac output (7 in group 1 and 5 in group 2), transient neurologic disfunction(1 in group 1 and 1 in group 2), renal failure(3 in group 1 and 4 in group 2), pulmonary failure(4 in group 1 and 5 in group 2) and arrhythmia(8 in group 1 and 5 in group 2). Renal and pulmonary failure occurred more frequently in group 2 ($p<0.01$). Blood or crystalloid cardioplegia were not found to be significant risk factors for early morbidity and mortality. The mean length of stay in intensive care for group 1 was 2.15±0.99 days, and 3.41±1.34 days in group 2 ($p<0.01$).

The hospital stay for the NYHA class III and IV patients in group 2 was longer than group 1. The average length of stay for group 1 was 9 days, and 12 days in group 2 ($p<0.05$).

The linearized occurrence rate for late mortality (cardiac or non-cardiac related) in group 1 was 2.2 % per patient year and 6.3 % per patient year in group 2. Cardiac related mortality was not significantly different in both groups, with cancer as the major cause of death in the older (group 2) patients. The overall acturial freedom from death was 96 % after 1 year and 85 % after 5 years (group 1). Comparable survival rates for group 2 patients were 94 % at 1 year and 64 % at 5 years. Age ($p<0.001$) was found to be an independent significant risk factor for late mortality at multivariate analysis.

There were no cases of prosthetic valve endocarditis or thrombosis, reoperation for prosthetic valvular disfunction or perigraft complication, serious wound infection or coronary restenosis in the late postoperative period. Anticoagulant-related hemorrhage rate was higher in the younger group, but this was not statistically significant. The incidence of anticoagulant-related hemorrhage was 0.4 % per patient year in group 1 patients, and 0.3 % per patient year in group 2 patients. There was a higher tendency towards a low cardiac output state in the older group, the difference was significant ($p<0.05$). At follow-up, 79 % of the surviving patients in group 1 and 63 % in group 2 reported symptomatic improvement. This was low, despite objective evidence of hemodynamic improvement as well as of less cardiac medication required.

DISCUSSION

In 1968 Bentall and De Bono described the total replacement of the ascending aorta and aortic valve with a composite tubular graft containing a prosthetic valve with side-to-end reimplantation of the coronary artery ostia to the graft (4). With the introduction of this procedure reduced the risk of complications after the ascending aortic aneurysm operations and it shortly became the treatment of choice for patients with annoluaortic ectasia, DeBakey Type I aortic dissection and other diseases of the ascending aorta and aortic valve (5 , 6). In the elderly patient population, especially in borderline cases, the choice of treatment is controversial because of high mortality and morbidity rates (7). Our results document a relatively low morbidity and mortality in patients older than 70 years of age undergoing ARR. The risk factors studied predictive of perioperative mortality were NYHA class IV ($p<0.01$), concomitant surgical procedures ($p<0.01$), emergency operation for aortic dissection ($p<0.01$), hemorrhage ($p<0.001$), cross-clamp-time ($p<0.01$), and CPB time ($p<0.01$) in both groups. Age did not influence the patients' outcome following ARR in in this study as compared to others. In group 2, patients with preoperative NYHA class III and IV symptoms who survived surgery required a significantly longer hospital stay than their group 1 counterparts despite no difference in morbid complications. The most likely explanation of this difference is related to their poorer nutritional status and difficulties of early mobilization.

The overall acturial freedom from death (hospital or late cardiac, non-cardiac related) was 94 % at 1 year and 64 % at 5 years for the older group. This is surprising and slightly low compared to the yearly risk of death in an age-matched and sex-matched general population in the United States (8). Also, no significant differences could be detected between group 1 and 2 patients for cardiac related deaths. The author believes that conservative surgery such as external wrapping or others, especially in borderline cases, should be considered only in bed-ridden, neurologically less-intact patients or in patients in whom other terminal diseases might substantially limit their life expectancy.

The author has performed over 6000 cardiovascular surgical procedures with experienced registered nurses, and certified surgeons. Since clinically significant mortality and morbidity rates are low in this study, it is difficult to test the hypothesis that the experienced surgeon affects the surgical outcome and the risk of complication. But, it is certain that short aortic cross-clamp time and short cardiopulmonary bypass time are directly related to the experience of a surgeon. In spite of difficult conditions in Turkey, such as the low

cost of the operation (only 3500 $ per open heart operation-all inclusive, plus graft and valve prices), higher NYHA class IV patient rates becase of low medical attention before surgery, and unavailability of some technical medical instrument, the results are surprisingly good and it seems that experience is the major determinant of the low mortality and morbidity in this study. The results of the study are also important because they demonstrate these essential personnel-certified surgeon and experienced nurse- are associated with equally satisfactory open heart surgery and can therefore be safely interchanged. In the past decade, the author has worked with certified surgeons and with experienced nurse first assistants, and has been comfortable with either. A nurse experienced in surgery and blood circulation is also important for this type of surgery.

In conclusion, ARR, in this study, has proven to be as safe and effective in the elderly population as in the younger age group in experienced hands. It should be considered the procedure of choice, if there is no absolute contraindication for surgery such as neurological impairment or terminal disease.

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