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Research Article

Postoperative Results of Aortic Valve Replacement in Elderly Patients with Isolated Aortic Stenosis: A Comparative Retrospective Study

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Abstract

Objective: This study was conducted to evaluate the clinical outcomes of aortic valve surgery in elderly patients and to determine the factors associated with atrial fibrillation.

Methods: Between 2011 and 2015, 54 patients who underwent isolated aortic valve replacement for aortic stenosis without preoperative arrhythmia were divided into two groups: 50-69 years old (Group I; n=25) and 70 years and older (Group II; n=29). Patients' medical records were retrospectively reviewed. Pre-, peri- and post-operation data were compared. The deaths that occurred in the first 30 days were evaluated as mortality, and the complications were evaluated as morbidity.

Results: The mortality rate was found to be 9.2% (5/54) (p=0.358) in the first 30 days and 8.1% (4/49) in the first six-month follow-up, and no difference was found between the two groups (p=0.153). The following parameters were observed in Group II and were found to be statistically significant: age (p<0.01), Euroscore (p<0.01), duration of cardiopulmonary bypass (p<0.01),duration of mechanical ventilation (p<0.01), duration in intensive care unit (p<0.01), duration of hospital stay(p=0.01), acute renal failure (p=0.03), the need for dialysis (p<0.01), atrial fibrillation (p=0.04), pneumonia (p=0.03), and pleural fluid(p=0.01). We found that new-onset atrial fibrillation was associated with advanced age (p=0.02), hypertension (p=0.04), duration of cardiopulmonary bypass (p=0.03), duration of aortic cross-clamp (p<0.01), postoperative anemia (p=0.04), high creatinine values (p<0.01), and cerebrovascular events (p<0.01).

Conclusion: This study showed that isolated aortic valve replacement could be performed with acceptable risks in elderly patients, and atrial fibrillation risk factors should be determined.

ABBREVIATIONS

Af: Atrial Fibrillation; ECG: Electrocardiography; TTE: Transthoracic Echocardiography; CABG: Coronary Artery Bypass Grafting; CPB: Cardiopulmonary Bypass; ACC: Aortic Cross-Clamp; DMV: Duration of Mechanical Ventilation; ICU: Duration of Intensive Care Unit; DHS: Duration of Hospital Stay; HT: Hypertension; DM: Diabetes Mellitus; COPD: Chronic Obstructive Pulmonary Disease; NYHA: New York Heart Association; EF: Ejection Fraction; LAD: Left Atrial Diameter; LVESd: Left Ventricular End-Systolic Diameter; LVEDd: Left Ventricular End-Diastolic Diameter; ARF: Acute Renal Failure

INTRODUCTION

Today, because of the high incidence of symptomatic aortic valve diseases, elderly patients are more evaluated in terms of aortic valve operation [1]. Although aortic valve surgery is a risk factor for morbidity and mortality in elderly patients, long-term results are satisfactory [2]. Bleeding, infection, stroke, arrhythmia, and respiratory pathologies such as respiratory failure and prolonged mechanical ventilation are the most common causes of morbidity [3]. Atrial fibrillation (Af) remains the most common form of arrhythmia after cardiovascular operations with a rate of 10–65% [4]. Despite the surgical techniques and pharmacological advances, the aging of the population and the increase in the number of operations contribute to the prevalence of Af and advanced monitoring methods facilitate the identification of Af. Af increases morbidity rates, prolongs hospital stays, and increases health expenditures. There is no certain information about the incidence of Af after aortic valve surgery, and it is not sufficiently discussed as in other cardiac operations [5].

This study aims to present the clinical results of isolated aortic valve surgery in elderly patients and the factors affecting Af development in these patients compared to younger patients.

MATERIALS AND METHODS

The study was approved by the local ethics committee.

Between 2011 and 2015, in our clinic, 54 patients who underwent isolated aortic valve replacement for aortic stenosis without preoperative arrhythmia were divided into two groups: 50–69 years old (Group I; n = 25) and 70 years and older (Group II; n = 29). Medical history and physical examination findings of the patients were recorded, Euroscore-II (http://www.euroscore.org/) values were calculated, and daily electrocardiography (ECG), transthoracic echocardiography (TTE), and coronary angiography were performed.

Patients undergoing other simultaneous cardiac surgery, such as coronary artery bypass grafting and aortic dissection, patients with reoperations and emergency operations,and patients with carotid artery disease, stroke, arrhythmia, infective endocarditis, renal failure, and dialysis were excluded from the study.

Anesthesia, surgery, and cardiopulmonary bypass (CPB) methods were the same for all patients. CPB with membrane oxygenator and non-pulsatile roller pump was maintained in moderate hypothermia (rectal temperature 32–34^{0}C), and mean arterial pressure was 60–80 mmHg. Cardiac arrest was achieved with antegrade and retrograde cold blood cardioplegia, and aortic mechanical valve replacement (St. Jude Medical, St Paul, MN, USA) was applied to the patients. CPB and aortic cross clamp (ACC) durations of the patients were recorded.

In the postoperative period; 24-hour drainage amount (milliliter = ml), duration of mechanical ventilation, intensive care unit (ICU), and hospital stay were recorded. Deaths within the first 30 days were accepted as hospital mortality. The presence of motor deficits lasting more than 48 hours and loss of consciousness lasting more than 12 hours were defined as cerebrovascular events. Af was defined as irregular heart rhythm without "p" wave in ECG. For the detection of Af, 24-hour 12-lead ECG was performed in the ICU and service follow-up, routine ECG in outpatient follow-up after discharge, and 24-hour Holter monitoring in patients suspected to have Af. New-onset Af was accepted as operation-related Af within 30 days postoperatively. Warfarin 5 mg/day treatment was started on the first postoperative day. The warfarin dose was regulated so that the international normalization ratio values were between 2.0–3.0.

RESULTS

Preoperative findings

Group I (50–69 years old) consisted of 25 patients (male/female, 15/10) with a mean age of 60.1 ± 4.4 years. Group II (≥70 years) consisted of 29 patients (male/female, 19/10) with a mean age of 74.9 ± 3.09 years. Both groups were matched in terms of age (p<0.01), gender distribution (p=0.675), body mass index (p=0.547), body surface area (p=0.845), hypertension (p=0.430), diabetes mellitus (p=0.212) and smoking habit (p=0.223). The number of patients treated for chronic obstructive pulmonary disease was higher in Group II (p=0.014).

The functional capacities of patients were evaluated according to New York Heart Association functional capacity. The functional capacity of the patients in both groups was usually Class-II (p=0.461). Fatigue, effort dyspnea, and angina were the most common symptoms. Five patients had syncope, and two patients had congestive heart failure.

Preoperative TTE values were recorded. Ejection fraction (p=0.458), left atrial diameter (p=0.611), left ventricular end-systolic diameter (p=0.659), left ventricular end-diastolic diameter (p=0.344), interventricular septum thickness (p=0.821), and valve area (p=0.951) did not reveal any significant differences between the two groups. Although the maximal gradient values of the patients in Group II were higher, there was no difference between the two groups (70.16 ± 14.4 vs. 76.45 ± 16.8, p=0.162, respectively). None of the patients had coronary artery disease, aortic aneurysm, or other diseases, such as mitral valve or carotid artery disease (Table 1,2).

According to preoperative laboratory values, preoperative hemoglobin levels were lower in Group II patients than in Group I patients (14.4 ± 0.76 vs. 13.1 ± 1.03, p<0.01, respectively), and creatinine levels in Group II were higher (0.97 ± 0.18 vs. 1.23 ± 0.26, p<0.01, respectively).The preoperative demographic and clinical findings of the patients are shown in Table 1. Three (12%) patients in Group I and four (13.7%) patients in Group II were on medication for hypothyroidism. The risk scores of the patients were calculated with EuroScore, and the risk scores of Group II patients were higher (p<0.01).

OPERATIVE FINDINGS

Mechanical aortic valve replacement (St. Jude Medical, St Paul, MN, USA) was performed for all patients. The mean mechanical valve diameters were 20.2 ± 1.13 mm in Group I and 20.03 ± 1.26 mm in Group II (p=0.364). There was no significant difference between the two groups in terms of ACC (49.92 ± 9.09 vs. 56.66 ± 8.71 minutes; p=0.08, respectively), whereas duration of CPB was significantly longer in Group II (79.7 ± 9.2 vs. 94.4 ± 10.9; p<0.01, respectively). Epicardial pacemakers were implanted in all patients after CPB.

Postoperative findings

The hospital mortality rate within the first 30 days was 9.2% (5/54), and there was no significant difference between the two groups (p=0.358). In Group I, one patient died because of low cardiac-output syndrome, and four patients in Group II died because of low cardiac-output syndrome, respiratory failure, acute renal failure, and cerebrovascular events. The mortality rate of the patients followed-up in the first six months was 8.1% (4/49). No difference was found between the two groups (p=0.153). Type 1 aortic dissection developed on the 68th day in a patient in Group I, while one patient died because of sepsis, one patient died from cerebral hemorrhage due to a warfarin overdose, and one patient in Group II died from gastrointestinal hemorrhage.

Early postoperative findings are listed in Table 3, and early postoperative complications are listed in Table 4.

The duration of mechanical ventilation (p<0.01), duration of intensive care unit stay (p<0.01), and duration of hospitalization (p=0.01) were longer in Group II patients. In the first 30 days, atrial fibrillation occurred in 16(29.6%) of 54 patients, and 12 of them were in Group II (p=0.04). Patients who developed Af had mechanical ventilator durations longer than 12 hours, five had cerebrovascular events, and four had acute renal failure. When logistic regression analysis was performed, it was found that

Table 1: Demographic characteristics of the studied population..

Variable	Group I (n=25)	Group II(≥70 age) (n=29)	p value
Average age (years)	60.1±4.4	74.9±3.09	<0.01
Male patients n (%)	15(60%)	19(65.5 %)	0.675
BSA, m^2	1.84±0.17	1.85±0.16	0.845
BMI, kg/m^2	25±2.2	24.3±2.3	0.547
HT (n,%)	14(56%)	18(62%)	0.430
DM (n,%)	11(44%)	17(58.6%)	0.212
COPD(n,%)	8(32%)	19(65.5%)	0.014
Smoking habits (%)	13(52%)	11(38%)	0.223
Preoperative ECHO data			
EF(%)	56.88±7.2	55.17±8.5	0.458
Max. gradient	70.16±14.4	76.45±16.8	0.162
Left atrial diameter	40.16±3.5	39.62±4.1	0.611
(mm)	35.88±3.08	36.31±3.9	0.659
LVESd (cm)	51.76±4.5	50.48±5.1	0.344
LVEDd (cm)	1.44±0.8	1.43±0.98	0.821
IVS thickness (cm)	1.05±0,03	1.07±0,05	0.951
Valve area, cm^2			
NHYA			
Class I	3(12%)	0	N
Class II	21(80.4%)	24(82.7%)	0.461
Class III	1(4%)	5(17.2%)	N
Class IV	0	0	N
EuroScore	0.89±0.39	1.62±0.72	<0.01
Haemoglobin, gr/dl	14.4±0.76	13.1±1.03	<0.01
Creatinine, mg/dl	0.97±0.18	1.23±0.26	<0.01
HbA1c, %	5.92±0.36	6.88±1.2	0.312

Abbreviations: HT: Hypertension; DM: Diabetes Mellitus; BSA: Body Surface Area; BMI: Body Mass Index; EF: Ejection Fraction; LVESd: Left Ventricular End-Systolic Diameter; LVEDd: Left Ventricular End-Diastolic Diameter; IVS: Interventricular Septum; NHYA: New York Heart Association Functional Capacity; COPD: Chronic Obstructive Pulmonary Disease

Table 2: Operative findings.

Variable	Group I (n=25)	Group II (n=29)	p value
Mechanical valve diameter, mm	20.2±1.13	20.03±1.26	0.364
Duration of CPB, min.	79.7±9.2	94.4±10.9	<0.01
Duration of ACC, min	49.92±9.09	56.66±8.71	0.08

Abbreviations: CPB: Cardiopulmonary bypass; ACC: Aortic Crossclamp

new-onset Af was associated with advanced age, hypertension, duration of CPB, duration of ACC, postoperative anemia, cerebrovascular event, and high creatinine values (Table 5). Sinus rhythm was achieved in 11 patients with antiarrhythmic treatment and cardioversion. Permanent pacemaker implantation due to atrioventricular block was performed for three patients in Group II (10.3%, 3/29).

Although the amount of 24-hour drainage was higher in Group II, no significant difference was found (p=0.07), but in Group II, more blood transfusions (red blood cell) were used (p=0.03). Nine patients (6 patients in Group II) had revision due to bleeding. Six of the seven patients (7/54,12.9%) who developed cerebrovascular events were in Group II (p=0.06). Three of these patients had transient hemiparesis. Eight patients had sternal infection (three patients in Group I and five patients in Group II), and three patients had mediastinitis (one patient in Group I and two patients in Group II). These patients were diabetic patients with HbA1c levels above 7%. Acute renal failure (ARF) was developed in 11 patients in Group II, and dialysis was performed in eight of these patients.These patients had preoperative creatinine values >1.2 mg/dl. Three patients who developed ARF in Group I did not require dialysis.

All patients were checked with TTE at the first month follow-up. The mean gradient was 15.2 ± 1.3 mmHg in Group I and 16.4 ± 0.92 mmHg in Group II. (p=0.216). New-onset Af was not detected at the first and sixth-month follow-up controls. The warfarin dose was 5.5 ± 1.7mg for Group I and 5.7 ± 2.4 mg for Group II (p=0.639).

Table 3: Early postoperative findings.

Variable	Group I (n=25)	Group II (n=29)	p value
MV (h)	6.92±1.7	12.9±8.8	<0.01
Drainage (cc)	740±173	865.5±151.8	0.07
ES(unit)	0.84±0.6	1.46±0.7	0.03
Haemoglobin, gr/dl	11.3±1.25	9.78±2.1	0.04
Creatinine, mg/dl	1.03±0.78	1.58±1.1	<0.01
IABP	2	5	0.313
ICU (day)	2.76±2	4.79±3.2	<0.01
DHS (day)	9.32±1.4	12.4±1.5	0.01

Abbreviations: MV: Duration of Mechanical Ventilation; ES: Erythrocyte Suspension; IABP: Intraaortic Balloon Pump Support; ICU: Duration of ICU Stay; DHS: Duration of Hospital Stay

Table 4: Early postoperative complications.

Variable	Group I (n=25)	Group II (n=29)	p value
Revision due to bleeding	3	6	0.393
ARF	3	11	0.03
Dialysis	0	8	<0.01
Af, n(%)	4 (16%)	12 (41.3%)	0.04
CVE	1	6	0.06
Sternum infection	3	5	0.589
Mediastinitis	1	2	0.643
Pneumonia	2	9	0.03
Pleural fluid	5	15	0.01
Sternum revision	1	5	0.123
Mortality			
First month (5/54)	1	4	0.358
Sixth month (4/49)	1	3	0.153

Abbreviations: ARF: Acute Renal Failure; Af: Atrial Fibrillation; CVE: Cerebrovascular Event

Table 5: Variables associated with Af.

Variables	p value
Advanced Age	0.02
HT	0.04
COPD	0.07
DM	0.675
EuroScore	0.207
CPB duration, minute	0.03
ACC duration, minute	<0.01
Mechanical valve diameter	0.374
Postoperative anemia	0.04
High creatinine value	<0.01
CVE	<0.01
MV	0.263
ICU	0.107
DHS	0.108

Abbreviations: HT: Hypertension; COPD: Chronic Obstructive Pulmonary Disease; DM: Diabetes Mellitus, CPB: Cardiyopulmonary Bypass; ACC: Aortik Cross Clamp; CVE: Cerebrovascular Even; MV: Duration of Mechanical Ventilation; ICU: Duration of ICU Stay; DHS: Duration of Hospital Stay

DISCUSSION

Aortic stenosis is more common due to the increase in societies where life expectancy. This means which increase in the number of elderly patients who have been evaluated in terms of operation [2]. The widespread use of non-invasive diagnostic methods, in particular, contributes to this increase [6]. Although these patients are in the older age group, the age factor alone does not constitute a contraindication to surgery [7]. In the literature, it is stated that aortic valve surgery can be performed with acceptable mortality and morbidity rates in elderly patients due to satisfactory long-term results [8,9].

In our study, the data of 29 patients ages 70 years and older (min-max: 70–86) who underwent isolated aortic valve replacement due to aortic stenosis were compared with the data of 25 younger patients (min-max: 50–69) who underwent isolated aortic valve surgery. The mortality rate in the older patient group (Group II) was found to be 13.7% (4/29) for the first 30 days. Low cardiac output syndrome, respiratory failure, acute renal failure, and cerebrovascular events were the causes of mortality. These causes of mortality were similar to those that Langanay et al. [10] found in their study. In addition, two patients died at the 6-month follow-up from hemorrhage. This situation was thought to be due to the use of warfarin and mechanical valve application because of an inability to provide a bioprosthetic valve for various reasons, including economic.

Postoperative complications after aortic valve surgery increase mortality and morbidity rates, and more than half of elderly patients have postoperative complications [1,2]. The cumulative complication rate in our young patients (Group I) was 20%, whereas this rate was 62% in the elderly patient group (p<0.01; Table 4). While pleural fluid and Af were predominant in young patients, pleural fluid, pneumonia, acute renal failure, and Af ratio were high in the elderly patient group.

Af continues to still be the most common form of arrhythmia after open-heart surgery and paves the way for postoperative complications such as stroke and low cardiac output syndrome. In addition, it increases hospital mortality, prolongs the duration of intensive care and hospital stay [11,12], and causes cardiac dysfunction in the late postoperative period [13]. A study by Banach et al. [14] reported that Af developed in nearly 50 percent of the 150 patients with aortic stenosis who were operated on, and new-onset Af was associated with advanced age, poor ejection fraction, high gradient levels, and interventricular septum thickness. In the same study [14], low cardiac output syndrome, stroke, and mortality rates were found to be significant in patients with Af. Filardo et al.[15] reported that postoperative new-onset Af was 37% and was more common in elderly patients. Júnioret al.[16] found that the new-onset Af rate was 32.8% in 348 patients aged 70 years and older, and Af was more frequent in patients older than 80 years of age.

In our study, postoperative new-onset Af was higher in older patients (41.3%) than in younger patients. In addition, with logistic regression analysis, we significantly found new-onset Af to be associated with advanced age (p=0.02), hypertension (p=0.04), duration of CPB (p=0.03), duration of ACC (p<0.01), postoperative anemia (p=0.04), cerebrovascular events (p<0.01), and high creatinine values (p<0.01) (Table 5). The fact that four patients with Af in Group II died from low cardiac output syndrome and cerebrovascular events may explain that Af is associated with mortality. The factors affecting Af development, the effect of Af on the mortality rate, the length of intensive care, and the length of hospital stay are similar to the literature [14,16–18].

This study showed that isolated aortic valve replacement could be performed with acceptable risks in advanced-age patients, and Af risk factors should be determined preoperatively. Sustaining CPB with moderate hypothermia and high mean arterial pressures without prolong duration of CPB and ACC may reduce the Af rate. Given the poor clinical condition caused by Af, it is clear that electrocardiographic monitoring is important. Correction of aortic valve stenosis by operation prolongs life expectancy and increases functional capacity as compared with patients without operations performed [8].Accordingly, we think that aortic valve replacement should be performed at any age under acceptable risk.

The fact that Af has a multifactorial etiology [16] makes it difficult to evaluate all risk factors. The most important factors limiting our study are the low number of patients and the lack of long-term results. However, we believe that the present study is informative in terms of determining the factors affecting new-onset Af with preoperative risk analysis.

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