

Analysis of Early Term Results of Elective Ascending Aortic Aneurysm Surgery

Elektif Asendan Aort Anevrizması Cerrahisinin Erken Dönem Dönem Sonuçlarının Analizi

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Abstract

Objective: Ascending aortic aneurysms carry a high mortality risk with increased aortic diameter and accompanying genetic risk factors. In this study, we aimed to share our surgical results in our patients who were operated for this reason.

Methods: Demographic, operative, preoperative and postoperative data of 45 patients who were electively operated for ascending aortic aneurysm between August 2018 and February 2024 were retrospectively analysed.

Results: The mean age of the 45 patients included in the study was 58.98 years, 60% were male and 40% were female. The most common associated risk factors were HT (55.6%) and smoking (52.4%). Preoperative echocardiography revealed severe aortic regurgitation in 17 patients and severe aortic stenosis in 9 patients. The most common surgical procedures were Weath (42.2%) and Bentall (40%) procedures. Permanent pacemaker requirement and stroke development were not observed in the postoperative period. In 3 patients, reexploration was performed due to bleeding. 30-day in-hospital mortality was 6.7% and 1-year survival of discharged patients was 92.8%.

Conclusion: In-hospital mortality and 1-year survival rates of the operations performed in our clinic are compatible with the studies in the literature, but more patient data and longer follow-up periods are required.

Keywords: Aortic Aneurysm, Elective, Surgery

Öz

Amaç: Asendan aort anevrizmaları aort çapının artması ve eşlik eden genetik risk faktörleri ile yüksek mortalite riski taşımakta olup çalışmamızda bu nedenle opere edilen hastalarımızda cerrahi sonuçlarımızı paylaşmayı amaçladık.

Yöntem: Ağustos 2018- Şubat 2024 tarihleri arasında asendan aort anevrizması nedeniyle elektif olarak opere edilen 45 hastanın demografik, operasyonel ve preoperatif ile postoperatif verileri retrospektif olarak incelendi.

Bulgular: Çalışmaya dahil edilen 45 hastanın yaş ortalaması 58.98 olup %60'ı erkek %40 ise kadın idi. En sık eşlik eden risk faktörleri HT(%55.6) ve sigara kullanımı (%52.4) olarak gözlemlendi. Preoperatif ekokardiyografide 17 hastada ileri Aort Yetmezliği 9 hastada ise ciddi aort darlığı mevcuttu.

Anahtar Kelimeler: Aort anevrizması, Elektif, Cerrahi

En sık uygulanan cerrahi proesedürler Weath(%42.2) ve Bentall(%40) prosedürü idi. Postoperatif dönemde kalıcı pacemaker gereksinimi ve inme gelişimi gözlenmedi. 3 hastada kanama nedeniyle reeksplorasyon yapıldı. 30 günlük hastane içi mortalite %6.7 olarak saptanmış olup taburcu edilen hastaların 1 yıllık sağkalımı %92.8 olarak saptandı.

Sonuç: Kliniğimizde yapılan operasyonların hastane içi mortalite ve 1 yıllık sağkalım oranları literatürdeki çalışmalarla uyumlu olup daha fazla hasta verisi ve daha uzun takip süreleri gereksinimi mevcuttur.

Material Methods

Ethics committee approval for the study was obtained from the Balıkesir University Health Sciences Non-Interventional Research Ethics Committee, with decision number 2024/141.

The demographic, operative, preoperative, and postoperative data of 45 patients who underwent elective surgery for ascending aortic aneurysm in our clinic between August 2018 and February 2024 were retrospectively analyzed. Patients requiring emergency surgery due to aortic dissection, penetrating aortic ulcer, rupture, or intramural hematoma were excluded from the study.

The surgical indication thresholds for ascending aortic aneurysm were set at 45 mm for patients with aortic valve pathology (aortic stenosis/insufficiency), 50 mm for those with a bicuspid aortic valve, and 55 mm for patients without high-risk factors and an annual dilatation rate below 5 mm. Surgical procedures performed for the ascending aorta included the Wheat procedure, Bentall operation, supracoronary ascending aortic replacement, and hemiarch/total arch replacement.

Routine antegrade cerebral perfusion was employed in patients requiring total circulatory arrest (TCA). Systemic cooling was applied at 22–26°C when TCA was necessary and at 32°C when TCA was not required, depending on the specific characteristics of the procedure. Del Nido solution was used for cardioplegia. Postoperative in-hospital and one-year all-cause mortality, as well as one-year survival analyses, were conducted.

Statistical Method

The data were analyzed using IBM SPSS Statistics 26 software (IBM Corp., Released 2019). The results were presented as mean ± standard deviation (Mean ± SD) for quantitative variables and as frequency (n) and percentage (%) for categorical variables. A p-value of <0.05 was considered statistically significant in all calculations and interpretations.

(4)

Results

The mean age of the 45 patients included in the study was 58.98 years (range: 28–84). Male patients accounted for 60% of the study population. The mean body mass index (BMI) was 28.05, while the mean body surface area (BSA) was 1.88 m². A total of 52.4% of the patients were smokers. Regarding chronic conditions, hypertension (HT) was present in 55.6% of the patients, diabetes mellitus (DM) in 11.1%, dyslipidemia in 31.1%, chronic obstructive pulmonary disease (COPD) in 11.1%, a history of cerebrovascular events (CVE) in 4.4%, and atrial fibrillation (AF) in 17.8%. The mean EuroSCORE II was calculated as 8.71, while the mean glomerular filtration ratio (GFR) was 77.24. (Table 1) (Tablo 1)

Table 1. Demographic data of the patients

	n / Mean ± SD	Median (min.-max.)
Age	58.98 ± 12.39	59 (28- 84)
Gender		
Female	18	40
Male	27	60
Body Mass Index(BMI)	28.05 ± 4.39	27.7 (18.37- 35.2)
Body Surface Area (m2)	1.88 ± 0.19	1.86 (1.43-2.28)
Smoking	22	52.4
HT	25	55.6
DM	5	11.1
Dyslipidemia	14	31.1
COPD	5	11.1
CVA	2	4.4
AF	8	17.8
EuroScore 2	8.71 ± 2.11	9 (6 - 13)
GFR (creatinine clearance)	77.24 ± 21.08	80.26 (0.68 - 118)

Mean: Average, SD: Standard deviation, min: Minimum, max: Maximum

Severe aortic regurgitation was observed in 37.8% of the patients. Bicuspid aortic valve was detected in 24.4%. Preoperative aortic stenosis was detected in 20% of the patients and the mean gradient was 42.33 ± 17.36 in these patients. The mean preoperative left ventricular ejection fraction (LVEF) value was 57.11. When preoperative Pulmonary Artery Pressure (PAP) levels were analysed, it was observed that 68.9% were normal, 13.3% were moderate and 8.9% were severe.

The mean sinus valsalva diameter was 42.68 mm, the mean ascending aorta diameter was 52.79 mm and the mean arcus aorta diameter was 40.53 mm in CT angiography evaluation. The mean aortic height index (AHI) was 3.24 and the mean aortic body surface area index (ASI) was 2.9. The mean postoperative EF was 56.67 and the mean postoperative gradient was 12.65 in 37 patients who underwent aortic valve replacement. (Table 2)

When the surgical procedures were analysed, it was observed that wheat procedure was performed with the highest rate of 42.2%, Bentall procedure with 40%, and ascending aorta procedure with the lowest rate of 2.2%. In concomitant surgeries, CABG was the most common procedure with a rate of 50%.

Total circulatory arrest (TCA) was applied in all cases in which deep hypothermia was applied and the mean duration was 28.56 min, X-clamp mean was 122.07 min, Cardiopulmonary Bypass (CPB) mean was 158.93 min and antegrade cerebral perfusion mean was 28.6 min. Operations were performed in deep hypothermia in 10 patients (22.2%), moderate hypothermia in 5 patients (11.1%) and mild hypothermia in 30 patients (66.6%) who were resuscitated to TCA and intervened in the arch aorta. Composite graft was used in 18 patients who underwent Bentall procedure and the most commonly used graft was 23 no composite graft (55.5%). Among the tubular grafts used in other procedures, the most commonly used graft was 32 mm dacron graft (40.7%).

Whilst haemorrhage revision was observed in 6.7% of patients and new AF was observed in 8.9% of patients, no patient required permanent pacemaker and no stroke was observed. 30-day mortality was 6.7% and 1-year survival was 92.8% in the group without 30-day mortality (Table 3).

Table 2. Angiographic and Echocardiographic data

	n / Mean \pm SD	Median (min.-max.)
Aortic Regurgitation		
Mild	7	%15.5
Moderate	16	%35.6
Severe	17	%37.8
Bicuspid Aortic Valve	11	24.4
Aortic Stenosis (mean gradient)	9	%20
	42.33 ± 17.36	46 (17 - 72)
Preoperative LVEF	57.11 ± 6.26	60 (35 - 65)
PAP (mmHg)		
Normal	31	68.9
Mild	4	8.9
Moderate	6	13.3
Severe	4	8.9
Sinüs Valsalva Diameter (mm)	42.68 ± 7.44	41.9 (29.3 - 63.5)
Ascendan Aorta Diameter (mm)	52.79 ± 8.81	51.6 (33.8 - 78)
Arcus Aorta Diameter (mm)	40.63 ± 7.22	39.7 (28.3 - 68.5)
AHI	3.24 ± 0.5	3.11 (2.51 - 4.48)
ASI	2.9 ± 0.57	2.69 (2.19 - 4.5)
Postoperative LVEF	56.67 ± 6.76	57.5 (35 - 65)
Postoperative mean gradient	37	%82.2
	12.65 ± 4.92	12 (6 - 29)

Mean: Average, SD: Standard deviation, min: Minimum, max: Maximum

Table 3. Surgical data of the patients

	n / Mean ± SD	Median (min.-max.)
Surgical Procedure*		
Bentall	18	40
Hemiaricus Replacement	9	20
Supracoronary AA Replacement	9	20
Wheat Procedure	19	42.2
Concomitant Surgery*		
CABG	6	50
MVR	4	33.3
Tricuspid Valve Repair	2	16.7
VSD Repair	1	8.3
TCA (min.)	28.56 ± 16.68	24 (14 - 81)
X-Clamp (min.)	122.07 ± 32.48	121 (57 - 210)
CPB (min.)	158.93 ± 36.11	155 (82 - 287)
Antegrad Cerebral Perfusion (min.)	28.56 ± 16.68	24 (14 - 81)
Deep Hypothermia (18-22 C°)	10	22,2
Moderate Hypothermia (24-30 C°)	5	11,1
Mild Hypothermia (32-34 C°)	30	66,6
Composite Graft (18 patients)		
23	10	55,5
25	5	27,8
27	3	16,7
Tubular Graft (27 patients)		
28	2	7,4
30	10	37
32	11	40,7
34	4	14,8
Permanent Pacemaker requirement	0	0
Reexploratin for bleeding	3	6.7
New on-set AF	4	8.9
Stroke	0	0
30 day Mortality	3	6,7
1 Year Survey	39	92,8

*: Multiple response, more than one response in a case. Mean: Average, SD: Standard deviation, min: Minimum, max: Maximum

Discussion

Ascending aortic aneurysm is an important factor in clinical follow-up because it causes symptoms such as rupture, dissection and sudden death and the only treatment is surgery. The Wheat procedure was the most common procedure performed in the operations performed by us, followed by the Bentall procedure, supracoronary ascending aortic replacement and hemiaricus replacement procedures. The mean age was 58.89 years and 60% of the patients were male and 40% were female. The most common associated morbidity was HT. Smoking was also present in 52.4% of the patients. In a study by Beller et al. in which gender and elective AAA surgery outcomes were investigated, 29% of the patients were female, which was lower than in our study.

In this study, normalised aortic diameter (aortic diameter/VAD) was found to be higher in female patients, they were operated at an older age, the duration of intensive care unit stay was longer and postoperative haemodialysis requirement was found to be higher.(5) In the study conducted by Memiş et al. patients under and over 70 years of age were divided into two groups. In the group over 70 years of age, cardiovascular risk factors were found to be higher and aortic diameter was observed to be higher. In-hospital mortality was found to be 3.5% in the group above 70 years of age and 1.5% in the group below 70 years of age and no statistically significant difference was observed. (p=0.16) When 5-year survival was analysed, it was 81.4% in the group above 70 years of age and 93.9% in the group below 70 years of age and a statistically significant difference was observed (p<0.001) (6)

Preoperative echocardiographic findings revealed aortic stenosis in 9 patients and severe aortic regurgitation in 17 patients. Bicuspid aortic valve is an important pathology in determining the prognosis of aortic surgery and was observed in 11 patients (24.4%). Tomographic measurements were performed separately in the sinus of valsalva, ascending aorta and arch and the largest diameter was observed in the ascending aorta with 52.79 ± 8.81 . AHI (3.24 ± 0.5) and ASI (2.9 ± 0.57) measurements included in the new guideline were measured in our study. In the aortic/height index (AHI) study by Zafar et al., 5-year expected survival without dissection, rupture and death was reported as 85.5% in the ASI<2.00 group and 86.6% in the AHI<2.40 group, which decreased to 4.9% in the ASI>4.25 cm/m² group and to 9.5% in the AHI>4.35 cm/m group and was found to be effective in determining expected survival (7)

When the postoperative echocardiograms of the patients who underwent Wheat procedure and Bentall procedure were analysed, the mean gradient was 12.65 ± 4.92 and no patient-prosthesis incompatibility was observed. TSA was performed in all patients who underwent arcus/hemiarctus intervention or in whom X-clamp could not be placed because the aneurysm extended to the arcus aorta, and standard antegrade cerebral perfusion was applied to these patients during the TCA period. The duration of TCA was 28.56 ± 16.68 min and was performed with deep hypothermia.

No postoperative stroke or need for permanent pacemaker was observed in our patients.

New AF was observed in only 6.3% of our patients and sinus rhythm was achieved with medical cardioversion. 30-day in-hospital mortality was 6.7% in 3 patients and 1-year follow-up of the discharged patients was 92.8%.

Vaquero et al. found a postoperative in-hospital mortality of 5.96% in a study of 738 patients. In the long-term follow-up, 3, 5 and 8-year cumulative survival was 94.07%, 89.96% and 82.72%, respectively, and was found to be similar to the life expectancy of the general population.(8) Again, Van Duffel et al. reported in-hospital mortality as 9.7% and 5-year survival as 80.9% in the mortality and survival results of elective ascending aortic operations. (9) In the elective Modified Bentall operations performed by Maureira et al., in-hospital mortality was found to be 4.4% and 5-10 year survival was reported as $93.8 \pm 2.3\%$ and $80.5 \pm 4.5\%$, respectively.(10) In comparison with the literature, 30-day in-hospital mortality and 1-year survival rates of the operations performed in our clinic were found to be similar.

The primary limitations of our study include the relatively small sample size, which prevented a comprehensive analysis of factors influencing mortality and morbidity. Additionally, the retrospective nature of the study may introduce selection bias and limit the ability to establish causal relationships. Furthermore, long-term follow-up data are not yet available, restricting our ability to assess late complications, survival outcomes, and the durability of surgical interventions.

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