ORJİNAL ÇALIŞMA

COMPARISON OF ANTEGRADE AND RETROGRADE CEREBRAL PERFUSION IN THE SURGICAL TREATMENT OF STANFORD TYPE-A AORTIC DISSECTION

Stanford Tip-A Aortik Diseksiyonların Cerrahi Tedavisinde Antegrad ve Retrograd Perfüzyon Sonuçlarının Karşılaştırılması

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ABSTRACT

Objective: Introduction of antegrade (ACP) and retrograde (RCP) cerebral perfusion techniques with deep hypothermic total circulatory arrest (HTCA) significantly decreased neurological complications which are the most important cause of morbidity and early mortality. The cerebral perfusion method is effective on this ratio, as well as factors such as age, presence of co-morbidities, emergency, diameter of the aortic arch and the ascending aorta segment that is replaced.

Material and Methods: We have investigated which perfusion method is superior to the other, the determinants of mortality and complication rates according to the groups in order to find the determinants of mortality, and to evaluate the complication rates. The data of 115 patients who were operated for acute, subacute or chronic Stanford Type A dissection and intramural hematoma (IMH) between January 2001 – March 2013 were retrospectively evaluated.

Results: No significant differences in CPB, XC, TCA, ACP, total amount of post-operative drainage, requirement of blood products, ventilation time, duration of ICU stay, hospital stay and early mortality rates were found in our evaluation of findings and outcomes of patients in whom we either used the ACP or the RCP technique. In the multivariate analysis determinants of mortality were preoperative presence of hypertension, diabetes mellitus, extremity malperfusion, duration of CPB, and postoperative renal complications.

Conclusion: The results of our study and results of others in the medical literature regarding techniques for brain protection in open ascending and aortic arch surgery have suggested that the most effective approach to decrease the neurological complications and to obtain better outcomes may be to decrease the duration of perfusion to the possible extent.

Keywords: *Aortic Dissection; Brain Protection; Cerebral Perfusion;*

ÖZET

Amaç: Serebral perfüzyon tekniklerinin gelişmesiyle beraber Tip-A disseksiyonların cerrahi tedavisinde önemli iyileşmeler sağlanmıştır. Derin hipotermik total sirkulatuar arrestle beraber antegrad (ASP) ve retrograd serebral perfüzyon (RSP) tekniklerinin kullanılması en önemli morbidite ve erken mortalite nedenlerinden biri olan nörolojik komplikasyonları önemli oranda azaltmıştır. Bununla beraber, ameliyat sonrası geçici (GND) veya kalıcı nörolojik disafonksiyon (KND) insidansı %5,5-33,3 arasında değişmektedir. Bu çalışmada amacımız; Tip-A disseksiyon nedeniyle antegrad ve retrograd serebral perfüzyon kullanarak opere ettiğimiz hastaların, operatif ve klinik sonuçlarını karşılaştırmak, mortalite belirleyicilerini saptamak, perfüzyon yöntemlerinin birbirine üstünlüğü olup olmadığını ve komplikasyon oranlarını değerlendirmektir.

Gereç ve Yöntemler: Çalışmada Ocak 2001-Mart 2013 tarihleri arasında akut, subakut ve kronik Stanford Tip A disseksiyon ve intramural hematom (IMH) nedeniyle opere edilen, toplam 115 hastanın verileri retrospektif olarak değerlendirildi. Hangi serebral perfüzyon yönteminin daha iyi olduğunu incelemek adına mortalite ve komplikasyon oranlarına etki eden parametreler değerlendirilmeye alındı.

Bulgular: KPB, Kros klemp, TCA, ACP, postoperatif drenaj, kan ürünü kullanımı, ventilasyon süresi, YBU yatış süresi, hastane kalış süresi ve erken mortalite oranları arasında ACP ve RCP tekniklerinin kullanımına göre fark saptanmadı. Yapılan univariate analizde ameliyat öncesinde renal bozukluk, ekstremite malperfüzyonu olması, ameliyat sonrası kreatin değerinin 1,5 mg/dl üzerinde olması, inotropik ajan kullanma ihtiyacı, pulmoner komplikasyon, renal komplikasyon, hemodiyaliz ihtiyacı mortalite belirleyicileri olarak saptandı.

Sonuç: Sonuç olarak, açık asendan ve arkus aorta cerrahisinde, serebral koruma yöntemi konusunda, çalışmamızın sonuçları ve literatürdeki karşıt sonuçlar birlikte değerlendirildiğinde, her iki teknikte de perfüzyon sürelerinin mümkün olduğunca kısa tutulması, nörolojik komplikasyonların azaltılmasında ve daha iyi sonuçlar alınmasında en etkili yaklaşım olacaktır.

Anahtar Kelimeler: *Aortik Diseksiyon; Beyin Koruma; Serebral Perfuzyon;*

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INTRODUCTION

Substantial improvement has been observed in the surgical treatment of Type-A aortic dissections in parallel with the developments in the cerebral perfusion techniques. Introduction of antegrade (ACP) and retrograde (RCP) cerebral perfusion techniques with deep hypothermic total circulatory arrest (HTCA) significantly decreased neurological complications which are the most important causes of morbidity and early mortality (1). The incidence of temporary (TND) or permanent neurological dysfunction (PND) is still between 5.5 – 33.3% (2). The cerebral perfusion method is effective on the ratio of neurological dysfunction as well as factors such as age, presence of co-morbidities, emergency, diameter of the aortic arch and ascending aorta segment that is replaced (3).

Although ACP was shown to be superior to RCP in many experimental studies, this superiority was not so clear-cut in clinical studies (4).

Our objectives in this study were to compare the operative and clinical outcomes of patients with Type-A dissection operated on using ACP and RCP, to find the determinants of mortality, to find out which perfusion method is superior to the other, and to evaluate the complication rates.

MATERIAL AND METHODS

The data of 115 patients who were operated for acute, subacute or chronic Stanford Type-A dissection and intramural hematoma (IMH) between January 2001-March 2013 were retrospectively evaluated. Patients with less than 15 days of interval between the onset of symptoms and admission were considered as acute cases, while those with an interval between 15 days and 6 weeks were considered as subacute, and those with more than 6 weeks were considered as chronic. Patients in cardiogenic shock, those who were rescuscitated and those with a neurological deficit were excluded. The age of the patients was between 27 and 81 years, and 91 patients were males and 24 females. The demographic characteristics and diagnostic findings of the patients are presented in Table.1.

The patients were divided into two groups, according to those who were administered ACP and those that had RCP. There were 83 patients in the ACP group, and 32 patients in the RCP group. The mean age was 55.26±12.78 in the ACP group and 53.53±10.15 in the RCP group (p=0,493). The male / female ratio was 66/17 in the ACP and 25/7 in the RCP group (p=0,527). All patients were operated via median sternotomy. Direct axillary artery (Elongated One-Piece Arterial Cannulae, Medtronic Inc. Mineapolis, MN55432-5604, USA) and two stage venous cannulation (Two Stage Venous Cannulae, California Medical Laboratories, INC.1570 Sunland Lana Costa Mesa, CA92626, USA) through right atrium was used for extracorporeal circulation. Direct axillary cannulation was used for extracorporeal circulation since 2005. Femoral artery was used for cannulation when axillary artery was not accessible. Femoral artery (Elongated One-Piece Arterial Cannulae, Medtronic Inc. Mineapolis, MN55432-5604,USA) vein (Carpentier Bi-Caval Femoral Cannulae, Medtronic Inc. Mineapolis, MN55432-5604,USA) and selective vena cava superior cannulation using a "Y" connector to the arterial cannula, were used for extracorporeal circulation and RCP during HTCA in patients who were operated between 2001–2005. Left ventricular decompression was achieved via a left ventricular sump inserted through the right upper pulmonary vein. Myocardial protection was obtained by a mini-cardioplegia method that was described in a previous study using a retrograde cannula inserted into the coronary sinus (5). A rectal temperature of 16°C, and jugular venous saturation of SatO2≥95 was required for HTCA and 0.5 g of thiopental was administered to all patients 5 minutes before initiation of circulatory arrest.

ACP was performed during HTCA with 10 mL/kg/min flow from the axillary arterial line, after occlusion of aortic arch branches. In patients with femoral cannulation selective cerebral perfusion was performed via the innominate and left carotid arteries through the line separated from the cardioplegia line, after the part rich in potassium was drained outside. RCP was performed with flows of 300-500 mL/min with perfusion pressure between 20-25 mmHg. Additionally, regional cold application was done to the head for cerebral protection.

"Sandwich" method with internal and external teflon felt support was used in the anastomoses. Preferentially, the distal anastomosis was performed under HTCA in the open manner, while proximal anastomosis was performed under cross clamp in patients with a high degree of aortic regurgitation, in whom adequate left ventricular decompression cannot be provided. Four grams of tranexamic acid and platelet suspension was routinely administered in order to achieve hemostasis, after protamin infusion after weaning from CPB.

Early mortality was defined as all-cause mortality occurring in the first 30 days due to any cause. Mortality occurring after the 30th day was defined as late mortality. Neurological complication and stroke were defined as a neurological deficit newly developing after surgery which persists more than 72 hours. Non-existence of pulse at the extremity or findings of ischemia at hospital admission was considered as extremity malperfusion, a preoperative creatinine level of > 1.5 mg/dL in patients without a history of renal failure was considered as renal disorder (renal malperfusion), and a urinary output ≤ 0.5 mg/kg/hr was considered as acute renal failure.

Statistical Analysis:

Statistical analysis was performed using the statistical package SPSS v 17.0. For each continuous variable, normality was checked by Kolmogorov Smirnov and Shapiro-Wilk tests and by histograms. Comparisons between groups were applied using Student T test for normally distrubited data and Mann Whitney U test were used for the data not normally distrubited. The categorical variables between the groups was analyzed by using the Chi square test or Fisher Excact test. A multiple logistic regression analysis was used to know associations between mortality and other measurements, with mortality as dependent variable. Values of $p < 0.05$ were considered as statistically significant.

RESULTS

According to De Bakey classification, 70 patients (84.3%) in the ACP group were operated with a diagnosis of Type-1, 5 patients (6%) with a diagnosis of Type-2 dissection, 8 patients (9.6%) with a diagnosis of IMH, while 32 patients (100%) in the RCP group were operated with a diagnosis of Type-1 dissection (p = 0.059). Five patients in the ACP group (6%), and 5 in the RCP group (15.6%) had chronic dissection (p=0,138). One patient in the RCP group (3.1%) had Marfan's syndrome, and 5 patients (15.6%) had annuloaortic ectasia. There was annuloaortic ectasia in 1 patient in the ACP group (1.2%) (p=0,278). The most frequent complaints on admission were chest pain (61.7%), chest + back pain (15.7%), and back pain (8.7%) (Table.2).

Durations of CPB, X-clamp, TCA and rectal temperature during TCA were similar between the two groups. Duration of cerebral perfusion was 27.90±14.61 min. in the ACP group and 29.20±4.32 min. in the RCP group. The other operative characteristics are summarized in Table.3.

Surgical procedures were as follows: Replacement of ascending aorta in 54 patients (65.1%), replacement of the ascending + hemiarcus aorta in 9 patients (10.8%), modified Bentall procedure in 7 patients (8.4%) in the ACP group; and replacement of ascending aorta in 17 patients (53.1%), replacement of ascending + hemiarcus aorta in 4 patients (12.5%) and modified Bentall procedure in 6 patients (18.8%) in the RCP group. (p=0.108). The details of the surgical procedures are presented in Table.4.

Neurological complication (stroke) occurred in 6 (7.2%) patients in the ACP group and 4 (12.5%) patients in the RCP group (p=0.461). Renal complication occurred in 16 patients (19.3) in the ACP and 6 patients (18.8%) in the RCP group (p=1.000). Of these renal complications, 9 patients from the ACP group (10.8%) and 5 patients from the RCP group (15.6%) received hemodialysis (p=0.529). The details of postoperative findings and complications are presented in Table.5.

Early mortality occurred in 30 patients (26.1%) (23 patients from the ACP group [27.7%] and 7 patients from the RCP group [21.9%]). The causes of in-hospital mortality were low cardiac output (LCO) (twenty patients, 66.7%), respiratory failure (two patients, 6.7%), sepsis (three patients, 10%), gastrointestinal bleeding (one patient, 3.3%), gastrointestinal malperfusion (one patient, 3.3%), and MOF (three patients, 10%). The distribution of causes of death according to the groups was as follows: in the ACP group, LCO in 15 patients (65.2%), respiratory failure in 2 patients (13.0%), sepsis in 2 patients (8.7%), gastrointestinal malperfusion in 1 patient (4.3%); and in the RCP group; LCO in 5 patients (71.4%), sepsis in 1 patient (14.3%), gastrointestinal bleeding in 1 patient

Table 1. Demographic characteristics

GROUP	**ACP**	**RCP**	**P**
N	83	32	
MALE	66(79.5%)	25(78.1%)	1.000
FEMALE	17(20.5%)	7(21.9%)	
AGE	55.26±12.78	53.53±10.15	0.493
HT	65 (78.3%)	27(84.4%)	0.606
DM	7(8.4%)	4(12.5%)	0.496
SMOKING	25 (30.1%)	13 (40.6%)	0.376
HCOL (hypercholesteloemia)	5(6.0%)	1(3.1%)	1.000
CRF			
COPD	2(2.4%)	1(3.1%)	1.000
PAH	1(1.2%)	1(3.1%)	0.481
FAMILY HISTORY	10(12.0%)	1 (3.1%)	0.286
ARYTHMIA	5(6%)	0(0%)	0.320
BSA	1.92±0.23	1.97±0.17	0.211
INCOMING(hr)			
Min	1	1	
Max	360	360	0.293
Mean	27.6±53.68	41.88±75.39	
Median	6.0	6.0	
INCOMING-OP(hr)			
Min	1	1	
Max	42	72	0.024
Mean	3.89±6.8	8.66±14.16	
Median	2.0	3.0	
DIAGNOSTIC METHOD			
CT	77(92.8%)	22(68.8%)	
TTE	1(1.2%)	2(6.3%)	0.010
TEE	1(1.2%)	2(6.3%)	
CAG	4(4.8%)	4(12.5)	
AORTOGRAPHY	0(0.0%)	2(6.3%)	
DISSECTION TYPE			
TYPE I	70(84.3%)	32(100%)	
TYPE II	5(6.0%)	0(0%)	0.059
IMH	8(9.6%)	0(0%)	
REDO			
CABG	1(1.2%)	2(6.3%)	
AVR	5(6.0%)	0(0%)	0.289
ASC. AO. REPL.	1(1.2%)	0(0%)	
AVR+CABG	1(1.2%)	0(0%)	
TAMPONADE	11(13.3%)	2(6.3%)	0.511
PREOP MI	4(4.8%)	0 (0%)	0.575
EXTR. MALPERF.	8(9.6%)	4(12.5%)	0.736
RENAL IMPAIRMENT (CREA≥ 1.5)	12(14.5%)	10(31.3%)	0.062

Table 2. Complaint at presentation

COMPLAINT			
	ACP	**RCP**	**P**
Chest pain	54(64.1%)	17(53.1%)	0.706
Back pain	6(7.2%)	4(12.5%)	
Chest + back pain	12(14.5%)	6(18.8%)	
Ekstremity pain	2(2.4%)	1(3.1%)	
Chest pain+syncope	4(4.8%)	2(6.3%)	
Chest pain+leg pain	2(2.4%)	0(0%)	
Chest pain+syncope	1(1.2%)	0(0%)	
Syncope	1(1.2%)	2(6.3%)	
Abdominal pain	1(1.2%)	0(0%)	

(14.3%). Late mortality occurred in 9 (10.8%) patients (4 patients in the ACP group (6.9%) and 5 patients in the RCP group (20%), p=0.120). The causes of late mortality were malignancy (1 patient, 11.1%), cardiac events (5 patients, 55.6%), cerebral-vascular event (2 patients, 22.2%) and mediastinitis + sepsis (1 patient, 11.1%). There were no significant differences between the groups with regard to early and late mortality. The mean duration of follow-up was 41.20±38.30 ranging from 1 to 126 months (ACP group; 32.67±29.47 months, RCP group; 63.34±48.0 months). The total actuarial survival rate was 89.2% at ten years (ACP: 93.1%, RCP: 80.0%; p= 0.325; Fig.1).

The determinants of mortality in the univariate analysis were presence of preoperative renal disorder, presence of extremity malperfusion, postoperative creatinine level higher than 1.5 mg/dL, need for an inotropic agent, pulmonary complication, renal complication, and need for hemodialysis. In the multivariate analysis determinants of mortality were preoperative presence of hypertension (p=0.028; OR:21.375; CI:1.385-329.885), diabetes mellitus (p=0.045; OR:33.361; CI:1.088-1023.346), extremity malperfusion (p=0.004; OR:76.463; CI:3.933-1486.487), duration of CPB (p=0.008; OR:0.983; CI:0.971-0.996), and postoperative renal complications (p=0.004; OR:32.525; CI:3.060-345.764).

DISCUSSION

ACP with HTCA was first reported by Frist et al in 1986 (6). This method became more popular after the studies of Bachet and Kazui (7-8). Kazui et al and other investigators showed better neurological outcomes and mortality in complex aortic pathologies by using ACP with both HTCA and mild hypotermic total circulatory arrest (MTCA) (9). ACP is more prominent, with its advantages of being more physiological, homogenous, and providing adequate blood flow and cerebral cooling.

An important disadvantage of ACP is the potential risk of PND originating from direct cannulation of diseased vessels, according to some studies. Another disadvantage is the increased risk of ischemic damage to the spinal cord or viscera with ACP and MTCA (10). This is especially true for MTCA where systemic temperature is 28° C and may result with spinal cord ischemia leading to paraplegia (9). Kazui et al reported that MTCA with arrest duration of less than 60 minutes is safe and they recommend use of HTCA in order to protect the spinal cord and visceral organs in cases which may require more time (10-11). ACP durations longer than 80 minutes expose the patient to risk of PND and mortality (12). In contrast to these expressions, Bartolomeo et al have reported no increase in mortality and risk of neurological events in ACP with MTCA longer than 90 minutes (13). Longer duration of aortic arch reconstruction is associated with adverse neurological events, independent of the technique used (14).

No significant differences in CPB, XC, TCA, ACP, total amount of post-operative drainage, requirement of blood products, ventilation time, duration of ICU stay,

Table 3. Perioperative Findings

	ACP	RCP	P
Cannulatıon site			
Axillary	74(89.2%)	2(6.3%)	
Femoral	5(6.0%)	29(90.6%)	0.000
Innominate	3(3.6%)	0(0%)	
Axillary+femoral	1(1.2%)	1(3.1%)	
Intimal Tear			
Ascending aorta	67(81.7%)	28(87. %5)	
Aortic arch	3(3.7%)	0(0%)	
Descending aorta	2(2.4%)	1(3.1%)	0.102
Ascending +aortic arch	1(1.2%)	3(9.4%)	
Ascending+descending	4(4.9%)	0(0%)	
No tear	5(6.1%)	0(0%)	
Hemopericardium	15(18.1%)	6(18.8%)	1.000
Tamponade	11(13.3%)	2(6.3%)	0.511
CPBtime (min)	220.56±65.60	224.19±68.54	0.797
CC time (min)	55.50±39.48	76.80±37.58	0.012
TCA time (min)	30.45±15.76	36.45±11.16	0.055
ACP time (min)	27.90±14.61		
RCP time (min)		29.20±4.32	
TEMP(°C)	17.93±4.43	13.82±1.22	0.000

hospital stay, and early mortality rates were found in our evaluation of findings. There were no significant differences in terms of neurological, pulmonary, renal, and gastrointestinal complications that could be influenced by the method of cerebral perfusion.

Multivariate analysis showed determinants of mortality as preoperative presence of hypertension, diabetes mellitus, extremity malperfusion, duration of CPB, and postoperative renal complications.

Neurological complications are generally regarded as one of the most devastating complications in cardiac surgery. Permanent neurological deficit (PND) and stroke is known to be associated with prolonged ventilation, ICU and hospital stays (15).

Among the predictors of stroke were aortic arch pathology, emergent disorders, Type A dissection, age, history of central neurological event, renal insufficiency, duration of surgical intervention, long HTCA duration, and duration of total cerebral protection in various studies (16). The rate of PND was 11.3% in the present study, and age, duration of HTCA, extension of aortic arch repair were found to be independent determinants of PND. Incidence of PND was approximately two times higher in patients admitted with Type-A dissection and the 5-year survival in patients with PND was 45% (17).

A progressive development has been observed in cerebral protection methods in the last few decades. The safe time period in avoiding neurological events during HTCA, which is one of the cerebral protection methods, should be shorter than 45 minutes (12-18). Incidence of neurologic deficit increase as the time increases from 30 to 50 minutes (18-19). The safe time period in open aortic arch surgery has shown an increase in time with either RCP or ACP with different degrees of HTCA. These techniques have increased the safety of open aortic procedures, and decreased the rates of permanent or temporary neurological events and mortality.

It is obvious that optimal cerebral protection strategy sis still controversial. There is no complete study describing HTCA temperature and optimal technique. Only, HTCA is considered to be associated with higher

Table 4. Type of surgery

	ACP	RCP	P
Ascending aorta replacemant	54(64.1%)	17(53.1%)	0.119
Bentall	7(8.4%)	6(18.8%)	
Ascending aorta + hemiarcus replacement	9(10.8%)	4(12.5%)	
Ascending aorta + total arch replacement	5(6.0%)	0(0%)	
Elephant trunk+aortic arch	3(3.6%)	0(0%)	
Elephant trunk+ total arch +Bentall	3(3.6%)	1(3.1%)	
Bentall+Hemiarcus replacement	0(0%)	1(3.1%)	
Bentall+Aortic arch replacement	0(0%)	1(3.1%)	
David+Ascending aorta replacement	0(0%)	1(3.1%)	
Ascending+hemiarcus+Cabrol	0(0%)	1(3.1%)	
Ascending+arch+descendant	1(1.2%)	0(0%)	
Ascending aorta+Cabrol	1(1.2%)	0(0%)	
Additional surgery			
CABG	9(10.8%)	5(15.6%)	
Embolectomy	2(2.4%)	0(0%)	
AVR	1(1.2%)	0(0%)	
Innominate reimplantat.	0(0%)	1(3.1%)	
DeVega plasty	0(0%)	1(3.1%)	
CABG+mitral Kay annuloplasty	0(0%)	1(3.1%)	
LC Button +mitral Kay annuloplasty	0(0%)	1(3.1%)	
Intestine+colon resection	1(1.2%)	0(0%)	

mortality and neurologic dysfunction rates (4-20). ACP was reported in this study to have a more protective effect against PND in comparison with RCP and HTCA. On the other hand, early mortality and medium-term survival expectancy was reported not positively affected by the cerebral protection method. This is believed to be due to a higher risk profile of patients operated with ACP who also have Type-A dissection, and who are operated in emergency conditions (17). The total actuarial survival rate was detected 89.2% at ten years (ACP: 93.1%, RCP: 80.0%) and there was no significant differences between the groups.

There are limited number of prospective, randomized, controlled studies comparing ACP and RCP. Okita et al found a lower rate of total neurological deficit in the ACP group (%33-%13), but these authors could not find any difference between these groups in terms of death, stroke, or neurocognitive deficit rates (14). Svensson et al found that RCP was not equal to ACP in terms of brain protection in their randomized and controlled study which included a limited number of patients, and showed that the brain was not perfused completely by RCP (21). Although recent studies have shown a superiority of ACP over RCP, the CPB and ischemia durations seem to be longer in the ACP group (22). We prefer ACP in recent years and have totally stopped using RCP. However our results did not show superiority of antegrade perfusion over retrograde perfusion.

Hagl et al have shown that the methods of cerebral protection did not have an effect on the risk of stroke, but ACP decreased the incidence of TND significantly (23). Matalanis et al have shown in their study that ACP enabled a longer duration in aortic arch cases, but that there was no significant difference between RCP or DHA patients in terms of stroke and TND incidences (24).

We did not observe significant differences between the patients in our study in terms of preoperative, operative and postoperative findings. We feel that the

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Table 5. Postoperative Findings

	ACP	RCP	P
Blood product use (unit)	5.75±4.85	4.03±1.42	0.055
Total drainage (cc)	1089.87±1033.08	1118.75±1115.34	0.897
Inotropic drug requirement	34(41.0%)	15(46.9%)	0.675
IABP	1(1.2%)	1(3.1%)	0.481
Pulmonary complication	11(13.3%)	4(12.5%)	1.000
Neurological complication	6(7.2%)	4(12.5%)	0.461
Renal complication	16(19.3%)	6(18.8%)	1.000
Postop HD	9(10.8%)	5(15.6%)	0.529
GIS complication	3(3.6%)	2(6.3%)	0.617
Postoperative atrial fibrillation	14(16.9%)	3(9.4%)	0.391
Infection	8(9.6%)	5(15.6%)	0.347
Revision (bleeding)	9(10.8%)	1(3.1%)	0.279
Early mortality	23(27.7%)	7(21.9%)	0.638
Intensive care stay (days)	5.40±5.72	7.03±7.77	0.228
Extubation time (hr)	37.47±32.62	63.74±149.66	0.172
Hospital stay (days)	9.08±7.97	10.59±9.31	0.400
Late mortality	4(6.9%)	5(20.0%)	0.120
Follow up (months)	32.67±29.47	63.34±48.0	

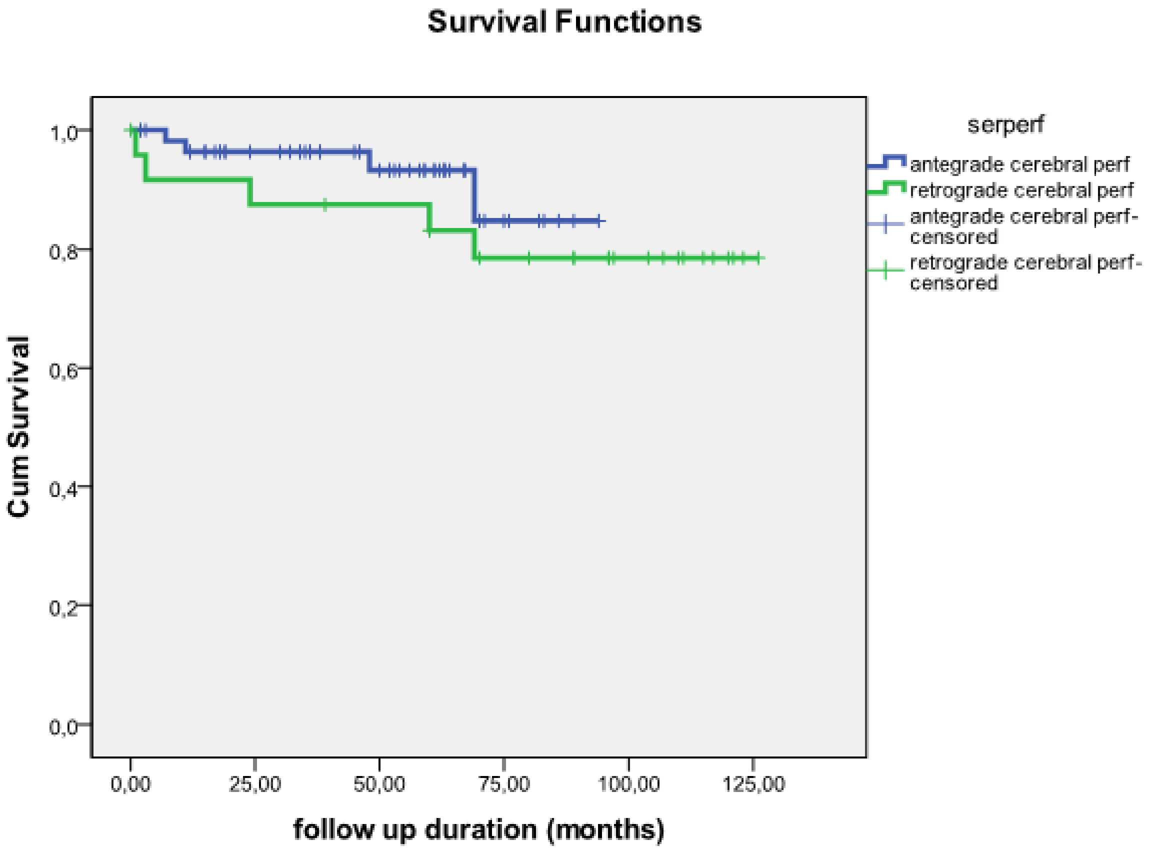
method of cerebral protection used may not have an effect on the postoperative complications, and stroke development. This finding is in accordance with the studies by Hagl et al and Matalanis et al. The mean HTCA and cerebral perfusion duration in the ACP and RCP groups being under 45 minutes may be associated with low complication rates. Although the stroke rate in the RCP group (12.5%) was higher than the ACP group (7.2%), the difference was not statistically significant. These rates seem to be higher than those found in the medical literature, but it should be kept in mind that Type-A dissection diagnosis of the patients in the study group is considered as one of the stroke predictors.

The early postoperative results in Type A dissections are significantly affected by the preoperative condition of the patients (17). The mortality rates were reported as 35% in patients with Type A dissection, and 30% in total aortic arch replacement and elephant trunk operations in the patient series of Misfeld et al. A diagnosis of Type-A dissection and aortic arch replacement which was performed with the “elephant trunk” technique were found to be independent determinants of early mortality in the same study (17). Many more risk factors were detected in the other studies. These include the timing of emergency surgery, age, preoperative hemodynamic instability, history of coronary artery surgery, reoperation, duration of CPB, renal failure, femoral cannulation, extremity and organ malperfusion (13).

The presence of malperfusion is one of the most important factors that increases hospital mortality. Iliofemoral malperfusion is the most frequent malperfusion syndrome (12.7%). It may cause mortality of up to 33.3%, when it is observed together with renal malperfusion (which is manifested by an increased creatinine level) or mesenteric malperfusion (25).

The in-hospital mortality was 26.1% in our patient group. Risk factors of mortality that we determined by univariate and multivariate analysis are consistent with those that are seen in the medical literature. Especially, patients with extremity or visceral malperfusion, who need hemodialysis because of postoperative renal failure are those with a high risk of mortality. Of the patients that mortality have occurred, initial creatinine level was higher than 1.5 mg/dl in 14 patients (46.7%) and 9 had (30%) extremity malperfusion. In 17 of

Figure 1. Kaplan-Meier Survival Curve



patients (56.7%) postoperative renal complication and a need for hemodialysis occurred. These clearly reflect the adverse effects of extremity and renal malperfusion and postoperative renal complications on mortality.

The determinants of mortality were found as preoperative presence of hypertension, diabetes mellitus, extremity malperfusion, duration of CPB, and postoperative renal complications.

We have two significant conclusions. In deep hypothermia, there is no difference between antegrade and retrograde cerebral perfusion. Moreover, results of our study and results of others in the medical literature regarding techniques for brain protection in open ascending and aortic arch surgery have suggested that the most effective approach to decrease the neurological complications and to obtain better outcomes may be to have shorter circulatory arrest times.

The limitations of this study are as follows: the study was retrospective and non-randomized, number of patients and number of patients in the RCP group was limited. RCP was limited because there is a shift of preferences from RCP to ACP in our institution. Inclusion of patients with aneurysm could increase the number of patients, as was done in other studies in the medical literature. But evaluation of a more homogenous patient group was aimed, by inclusion of patients with Type-A dissection only. Nevertheless our group was composed of acute, subacute or chronic Stanford Type-A dissection patients and intramural hematoma and this somewhat may have increased the heterogeneity of our patient group. Another limitation is evaluation of the patients only in terms of PND, and not also TND.

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