

## Evaluation of Acute Aortic Dissection Type a Factors and Comparison the Postoperative Clinical Outcomes between Two Surgical Methods

### Abstract

**Background:** Although aortic dissection is a rare disease, it causes high level of mortality. If ascending aorta gets involved in this disease, it is known as type A. According to small number of studies about this disease in Iran, this study conducted to detect the factors related to acute aortic dissection type A, its surgery consequences and the factors affecting them. **Materials and Methods:** In this historical cohort study, all patients having acute aortic dissection type A referring to Chamran Hospital from 2006 to 2012 were studied. The impact of two surgical methods including antegrade cerebral perfusion (ACP) and retrograde cerebral one (RCP) on surgical and long-term mortality and recurrence of dissection was determined. The relation of mortality rate and hemodynamic instability before surgery, age more than 70 years old, ejection fraction lower than 50%, prolonged cardiopulmonary bypass pump (CPBP) time and excessive blood transfusion, was assessed. **Results:** Surgery and long-term mortality and recurrence of dissection were 35.3%, 30.8% and 30.4%. Surgical and long-term death in the patients being operated by ACP method was lower than those one being operated by RCP ( $P < 0.001$ ). Excessive blood transfusion and unstable hemodynamic condition had significant effect on surgical mortality ( $P = 0.014, 0.030$ , respectively). CPBP time and unstable hemodynamic condition affected long-term mortality significantly ( $P = 0.002$ ). **Conclusion:** The result found that ACP is the preferable kind of surgery in comparison with RCP according to the surgical and long-term mortality.

**Keywords:** Acute aortic dissection type A, antegrade cerebral perfusion, retrograde cerebral perfusion

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### Introduction

Although aortic dissection is a rare disease, it causes high level of mortality. Incidence rate of this disease is 5 to 30 people per million. Its prevalence is 2% to 8% in autopsies.<sup>[1]</sup> If diagnosis and treatment are not done immediately, tearing of intimal layer will take place. A large number of patients usually pass away just during early hours of signs presentation induced by complications. The probability of death increases 1% to 2% per hour during the first hours of this disease attack. Its mortality rate and complications are very higher in the first 2 weeks, especially the first.<sup>[2]</sup>

This disease is classified into two types according to Stanford Classification. If ascending aorta gets or does not get involved in this disease, it is known as type A and B, respectively.<sup>[2,3]</sup> The most common site of aortic dissection is ascending aorta (in 6% of cases). Most of

ascending aorta dissection is rooted from some centimeters above aortic valve.<sup>[4]</sup>

Surgical treatment is the option in type A in which ascending aorta is got involved.<sup>[5]</sup> Some techniques such as antegrade and retrograde cerebral perfusions are applied to protect the brain in surgery.<sup>[6]</sup> If 2 weeks pass from dissection beginning, it is considered as chronic form.<sup>[7,8]</sup> Since aortic dissection has similar sign of other kinds of diseases, it is known as a big simulator.

In fact, recognizing risk factors and controlling them have an important role in dissection prevention. A large number of research works have been conducted in which demographic data and risk factors relating to acute aortic dissection type A have been found. Some variables such as gender, age and hypertension have been known as risk factors for this disease.<sup>[7,9]</sup>

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Although urgent surgery by use of up-to-date techniques is very crucial, recognition of risk factors, surgery consequences such as surgical mortality and long-term morbidity, and survival rate are really so essential. Different research works demonstrate varied rates of consequences in diverse kinds of surgeries.<sup>[10-14]</sup> Some research shows significant difference of survival rate for various sorts of surgeries.<sup>[15]</sup> The studies conducted to investigate surgery consequences in some decades have shown that survival rate of this disease has been progressed increasingly.<sup>[16-18]</sup>

In addition to surgery type, one of the significant matters in studying surgical outcomes and patients treatment progress is the role of some influencing factors affecting surgery success. Different risk factors found in individual studies for this disease include cardiovascular disease and history of CPR, comorbidities before operation, presence of complications before surgery or related to dissection, the history of total arch replacement surgery, renal ischemia, mesenteric ischemia, chronic obstructive pulmonary disease, aortic rupture, undergoing cardiopulmonary bypass pump (CPBP) more than 200 minutes, bleeding more than 500 mL, blood transfusion more than 4 L, diagnosis time of dissection, age, Marfan's syndrome, ST-elevation, coma and shock before surgery, prolonged time of surgery (more than 6 hours), history of cardiac surgery, unstable hemodynamic before operation and history of smoking.<sup>[8,10,13,18,19]</sup> In some cases, the roles of these factors have been reported differently for every individual kind of surgery.<sup>[13,19]</sup>

Since this disease affects patients quality of life, puts a great deal of economic and mental pressures on society, existing high level of mortality rates and its results, different reports about risk factors, various survival rates, death possibility, and also diverse factors influencing surgery consequences, it is very essential to have qualified data of those people being exposed to it, surgery consequences and the risk factors lead to this disease.

According to small number of studies about this disease in Iran, present one was conducted to detect the factors related to acute aortic dissection type A, its surgery consequences and the factors affecting them among the patients referring to Chamran hospital during 6 years (from April 2006 up to February 2012).

## Materials and Methods

This is a historical cohort study in which all patients having acute aortic dissection type A and referring to Chamran hospital being managed by Isfahan University of Medical Sciences from 2006 to 2012 were studied. Excluding criteria consisted of those clients did not refer for follow-up or their medical data were incomplete. A total of 102 patients were selected to participate in this survey. They were supposed to receive regular follow-ups.

Age, gender and hypertension variables were monitored in the present study as potential risk factors of acute aortic dissection type A.

The impact of different surgical methods on surgical and long-term mortality and recurrence of dissection was determined.

The relation of mortality rate and hemodynamic instability before surgery, age more than 70 years old, ejection fraction (EF) lower than 50%, prolonged CPBP time (higher than 200 minutes) and also excessive blood transfusion (more than 4 L), was assessed in this project.

At the same time, the prevalence of abrupt chest pain was studied as the most important cause of referring. Aortic valve insufficiency and irregular pulses of upper extremities as the most significant findings in physical exam were also investigated, respectively.

Four data collection instruments including patient's medical records monitoring, surgery report, calling them up and inviting the cases for interview were applied in order to find the related factors making dissection, its complications and determining their prevalence.

Patient's age and gender were found by use of their medical files data. Abrupt chest pain, possible hypertension and irregular pulses are detected before operation through basic exam. The surgical and long-term mortality rates, of every individual surgery, were determined by telephone calls and files review. Surgical and long-term mortalities are defined as those ones happening in the first month after surgery and beyond this duration, respectively. Antegrade cerebral perfusion (ACP) and retrograde cerebral one (RCP) are two kinds of surgeries which their mortality rates were compared according to cerebral protection. Three methods of cerebral protection have been applied since 1975: Hypothermic circulatory arrest (HCA) as a basic method, either alone or with ACP, or RCP as an adjunctive method.<sup>[20]</sup> ACP is one of the most reliable methods of organ protection during HCA for aortic arch surgery. Applying ACP has some benefits: only moderate hypothermia is required; there is physiological blood flow with ACP; compared to RCP, it provides the luxury of time and the incidence of temporary neurological deficit is significantly lower than RCP.<sup>[21]</sup> RCP is another new method for improving cerebral protection and consequent neurological outcome that has been touted over HCA. However, RCP has been used clinically for durations and at temperatures that are safe for HCA alone.<sup>[22,23]</sup>

The duration of undergoing pump during surgery was found out of patient's medical files. Those ones receiving pump more than 200 minutes were known as prolonged pump cases. Aortic valve insufficiency and EF were available in their files before operation and by echo performance. EF rates more and less than 50% were regarded as normal and low level of EF, respectively. Blood pressure was

measured before operation through basic exam. Systolic blood pressures higher and lower than 90 mm/Hg were defined as unstable and stable hemodynamic conditions before surgery, respectively. Dissection recurrence rate was determined after operation through periodic follow-ups or calling up the patients.

For data analysis, first of all, descriptive indices (consisting of central and dispersion indices) were applied to define studied cases and variables. Then, chi square and multiple logistic regression tests were used to assess any possible relations and effects. All analyses were conducted by SPSS20 and significance level was considered as 0.05.

## Results

Studied cases were monitored in respect of some risk factors of this disease including their age, gender and hypertension [Table 1].

Most of the participants were male suffering from hypertension. The average and standard deviation of their age were, in turn, 52.84 and 13.46. The Chi-square test showed that the number of males were significantly higher than females ( $P < 0.00$ ). Also, the number of those patients having hypertension was significantly higher than the participants not having hypertension ( $P < 0.00$ ). Finally, the cases aged between 35 and 50 and 50 to 65 years old were significantly more than those ones being less than 35 and more than 65 years old, respectively ( $P < 0.00$ ).

Then, frequency of the most important clinical cause of hospital referring (abrupt chest pain) and the most significant finding in medical exams (irregular pulses in upper limbs and aortic insufficiency murmur) were assessed [Table 2].

Most of the studied cases referred to medical centers due to chest pain. 23.5 and 37.3% of them had, in turn, irregular pulses and aortic insufficiency.

Then, frequency of surgery consequences including surgical and long-term deaths and recurrence of dissection, for studied cases, were investigated. The outcomes of two mentioned kinds of surgeries were also compared with each other by use of the Chi-square test and phi and Cramer's V correlation coefficient [Table 3]. Surgery's complications, for 35.3% of the cases, were death due to this operation. 30.8% of survived ones passed away in a long period of time as long-term death cases. 30.4% of these patients have experienced recurrence of dissection.

Surgical death in the patients being operated by ACP method was significantly lower than those one being operated by RCP one ( $P < 0.001$ ). Long-term death in 65 participants getting rid of surgical death was significantly lower in the ACP group rather than RCP one ( $P < 0.001$ ).

The recurrence of dissection in both groups were not different significantly ( $P = 0.80$ ).

**Table 1: The frequency of referring causes and findings of medical exams**

Variable	Group	Frequency	Percent	P
Age	<35	6	5.9	<0.001
	35-50	34	33.3	
	50-65	42	41.2	
	>65	20	19.6	
Sex	Female	38	37.30	0 010
	Male	64	62.70	
HTN	No	33	32.40	<0.001
	Yes	69	67.60	

HTN: Hypertension

**Table 2: The frequency of referring causes and findings of medical exams**

Variable	Group	Frequency	Percent
CP	No	9	8.80
	Yes	93	91.20
Irregular pulse	No	77	75.50
	Yes	24	23.50
	Missing	1	1.00
AI	No	64	62.7
	Yes	38	37.8

CP: Chest pain, AI: Aortic insufficiency

At the end, the relation between surgical and long-term mortalities and also recurrence of dissection with unstable hemodynamic condition before surgery, age above 70, EF lower than 50%, prolonged CPBP time and excessive transfusion were studied. Frequencies of consequences among people having risk factors are shown in Table 4. The results of multiple logistic regression are illustrated in Table 5. They showed that 41, 63, 51, 49 and 8 ones of, in turn, those studied cases undergoing excessive blood transfusion (P.C4), pump duration more than 200 minutes (pump > 200), unstable hemodynamic condition (unstable), EF lower than 50%, were older than 70 years old. It is also found that excessive blood transfusion and unstable hemodynamic condition were the variables which had significant effect on surgical mortality rate.

This kind of mortality in the participants did not receive excessive blood transfusion were significantly lower than those ones received transfusion up to this amount (OR = 0.117,  $P = 0.014$ ). Surgical mortality for those cases did not have unstable hemodynamic condition was lower than the unstable group significantly (OR = 0.104,  $P = 0.030$ ).

Prolonged pump duration and unstable hemodynamic condition affected long-term mortality significantly. In other words, this sort of mortality in those patients not undergoing prolonged pump duration was lower than the opposite group (OR = 0.041,  $P = 0.002$ ).

**Table 3: The frequency of surgical and long-term deaths, recurrence of dissection for both kinds of surgeries**

Surgery	Surgery mortality			Long-term mortality			Recurrence		
	No	Yes	Total	No	Yes	Total	No	Yes	Total
ACP									
Frequency	53	1	54	43	10	53	37	17	54
Percent	98.1	1.9	100	81.1	18.9	100	68.5	31.5	100
RCP									
Frequency	12	36	48	2	10	12	34	14	48
Percent	25	75	100	16.7	83.3	100	70.8	29.2	100
Total									
Frequency	65	37	102	45	20	65	71	31	102
Percent	64.7	35.3	100	69.2	30.8	100	69.6	30.4	100
X <sup>2</sup>	69.67			16.18			0.06		
Phi	0.759			0.542			-0.025		
P	<0.001			<0.001			0.80		

ACP: Antegrade cerebral perfusion, RCP: Retrograde cerebral one

**Table 4: The frequency of surgical and long-term death, recurrence of dissection in the patients having age more than 70 (age), excessive transfusion (PC.4), prolonged pump duration (pump >200) unstable hemodynamic condition before surgery (unstable) and low ejection fraction (EF<sub>50</sub>)**

Variable	Group	Surgery mortality			Long-term mortality			Recurrence		
		No	Yes	Total	No	Yes	Total	No	Yes	Total
Age	<70	60	34	94	41	19	60	64	30	94
		63.8%	36.2%	100%	68.3%	31.7%	100%	68.1%	31.9%	100%
	>70	6	2	8	4	2	6	7	1	8
		75%	25%	100%	66.7%	33.3%	100%	87.5%	12.5%	100%
P.C4	No	57	4	61	43	14	57	44	17	61
		93.4%	6.6%	100%	75.4%	24.6%	100%	72.1%	27.9%	100%
	Yes	8	33	41	2	6	8	27	14	41
		19.5%	80.5%	100%	12.5%	87.5%	100%	65.9%	34.1%	100%
Pump >200	No	38	1	39	36	2	38	30	9	39
		97.4%	2.6%	100%	94.7%	5.3%	100%	76.9%	23.1%	100%
	Yes	27	36	63	9	18	27	41	22	63
		42.9%	57.1%	100%	33.3%	66.7%	100%	65.1%	34.9%	100%
Unstable	No	49	2	51	43	6	49	35	16	51
		98%	2%	100%	87.8%	12%	100%	68.6%	31.4%	100%
	Yes	16	35	51	2	14	16	36	15	51
		31.4%	68.6%	100%	12.5%	87.5%	100%	70.6%	29.4%	100%
EF <sub>50</sub>	No	51	2	53	40	11	51	38	15	53
		96.2%	3.8%	100%	78.4%	21.6%	100%	71.7%	28.3%	100%
	Yes	14	35	49	5	9	14	33	16	49
		28.6%	71.4%	100%	35.7%	64.3%	100%	67.3%	32.7%	100%
Total		65	37	102	45	21	66	71	31	102
		63.7%	36.3%	100%	68.2%	13.8%	100%	69.6%	30.4%	100%

The same occurrence was seen in those ones not suffering from unstable hemodynamic condition (OR = 0.031, P = 0.002).

### Discussion

This study is one of the first ones conducted in Iran to investigate the related factors of acute aortic dissection type A, the cause of any referring after surgery due to its consequences and the factors influencing them.

More than 100 people referred to Chamran hospital in Isfahan city (central Iranian city) due to this disease. It is implied that its incidence in this city is higher than average rate of global one.<sup>[24]</sup>

The study of three risks factors recorded in patients' files including age, gender and hypertension variables showed that the number of males were significantly more than females. They included 60% of all cases. This accompanied by previous studies in which gender was known as one of

**Table 5: The results of multiple logistic regression use to study the relation of surgical and long-term deaths and dissection recurrence with age above 70 years old (age), excessive transfusion (PC.4), prolonged pump duration (pump>200), unstable hemodynamic condition before surgery (unstable) and low ejection fraction (EF50)**

Outcome	Predictor	B	SE	Wald	P	Exp (B)
Surgical mortality	Age	0.425	1.299	0.107	0.743	1.530
	P.C4 (No)	-2.143	0.875	6.000	0.014	0.117
	Pump>200 (No)	0.137	1.525	0.008	0.928	1.147
	Unstable (No)	-2.260	1.044	4.691	0.030	0.104
	EF50 (No)	-1.620	1.095	2.188	0.139	0.198
Long- term mortality	Age	1.187	1.836	0.418	0.518	3.278
	P.C4 (No)	1.219	2.392	0.260	0.610	3.384
	Pump 200 (No)	-3.199	1.048	9.319	0.002	0.041
	Unstable (No)	-3.410	1.095	9.691	0.002	0.033
	EF50 (No)	-0.469	2.080	0.051	0.821	0.625
Recurrence	Age	1.166	1.111	1.101	0.294	3.210
	P.C4 (No)	-0.255	0.839	0.093	0.761	0.780
	Pump 200 (No)	-1.159	0.666	3.025	0.082	0.310
	Unstable (No)	1.122	0.761	2.173	0.140	3.070
	EF50 (No)	-0.112	0.845	0.018	0.894	0.890

the most important risk factors of this disease so that the number of males was two times more than females.<sup>[7,9]</sup>

In addition, two third of studied cases suffered from hypertension which was expected as the other studies found the similar results.<sup>[7,9]</sup>

Around 75% of patients in this research were 35 to 65 years old. It was the same as other studies' results.<sup>[14]</sup>

The main reason of referring to medical centers was chest pain among more than 90% of studied patients. This is also similar to the same studies' outcomes.<sup>[4]</sup> Since patient's files data were incomplete in the present study, this reason was the only cause which was investigated. It is necessary to study other reasons of referring in more developed research.

The findings of medical exams showed that 25% of patients suffered from irregular pulse. Furthermore, less than 40% of them had aortic insufficiency murmur. This is the same as other studies' results as well.<sup>[4]</sup> Considering other important signs, it is recommended to detect other influencing factors in the next studies which will be conducted among Iranian people in future.

The surgery consequence was death for 57 ones (56%) of cases. 37 and 20 of these patients passed away due to surgical and long-term sorts of mortalities. The survival rate for studied cases was 44%. However, it cannot be reliable due to short follow-up time especially for those ones involved in the last months and years of the study.

30.4% of studied cases experienced disease recurrence which is close to other reported studies results.<sup>[5,25]</sup>

The ratio of surgical and long- term mortalities are very low among the patients operated by ACP surgery rather than those ones receiving RCP one. This result proved

that ACP is the preferable kind of surgery in comparison with the latter one. However, the ratio of dissection recurrence is not significantly different in these two groups.

The monitoring of some factors, influencing surgery consequences, showed that surgical mortality rate among the cases receiving more than 4 L during transfusion or having unstable hemodynamic condition was higher than the opposite ones, respectively.

Long-term mortality rate was higher among patients undergoing pump duration more than 200 minutes or having unstable hemodynamic condition rather than those ones having the reverse conditions. The impact of these three variables on patients' mortality has been proved in other research as well.<sup>[12,13,18]</sup> The influence of the age above 70 and EF lower than 50% on their death has not been detected in present study. It did not accompany by results of other similar projects.<sup>[11,18]</sup> The reason of this problem could be the limited number of studied case, particularly those ones older than 70 years old. The possible cause of lacking significant effect of EF lower than 50% is that multiple analysis application, presence of all variables and use of multiple logistic regression test did not lead to make some of significant relationships which were expected. In contrast, use of simple analysis to find the individual relation of every one of risk factors with surgery consequences through the Chi-square test showed that these variables had significant relation with surgery and long-term mortalities.

Since this study is the first one about aortic dissection (type A) in Iran and showed some different results from those ones done in other countries and also the high level of morbidity of this disease in Isfahan, it is suggested conducting broader and more precise projects

about it in Iran. It is, particularly, so necessary to take into consideration, in the next research, some problems found in the present study. They include few number of the cases especially those ones older than 70 years old. This facilitates to assess the impact of age on studied variable more than before.

While the efficiencies of two kinds of surgeries were compared with each other in present study, it is recommended to monitor other types in more developed studies. Since routine sorts of medical files for achieving data were used, it was impossible to study all risk factors related to aortic dissection and also potential factors influencing surgical consequences. In fact, the mentioned files were not designed according to research projects needs. Therefore, it is essential to detect most important kinds of risk factors related to this disease and more factors affecting surgical consequences in an antrograde study.

Moreover, involving a control group including healthy people who are supposed to match with patients conditions is very crucial if more qualified study of acute aortic dissections (type A) and its supposed risk factors.

In all, this study can be considered as the stepping stone of this disease investigation in Iran which has tried to find some related factors to it, recommended surgeries and their consequences. It is also suggested conducting more developed studies, in bigger communities, in a longer period of time, getting involved control group and also considering more important factors.

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### Conflicts of interest

There are no conflicts of interest.

### References

1. Tsai TT, Trimarchi S, Nienaber CA. Acute aortic dissection: Perspectives from the International Registry of Acute Aortic Dissection (IRAD). *Eur J Vasc Endovasc Surg* 2009;37:149-59.
2. Hsue PY, Salinas CL, Bolger AF, Benowitz NL, Waters DD. Acute aortic dissection related to crack cocaine. *Circulation* 2002;105:1592-5.
3. Goland S, Elkayam U. Cardiovascular problems in pregnant women with Marfan syndrome. *Circulation* 2009;119:619-23.
4. Eggebrecht H, Thompson M, Rousseau H, Czerny M, Lönn L, Mehta RH, *et al.*; European Registry on Endovascular Aortic Repair Complications. Retrograde ascending aortic dissection during or after thoracic aortic stent-graft placement: Insight from the European registry on endovascular aortic repair complications. *Circulation* 2009;120(Suppl 11):S276-81.
5. Collins JS, Evangelista A, Nienaber CA, Bossone E, Fang J, Cooper JV, *et al.*; International Registry of Acute Aortic Dissection (IRAD). Differences in clinical presentation, management, and outcomes of acute type a aortic dissection in patients with and without previous cardiac surgery. *Circulation* 2004;110(Suppl 1):II-237-42.
6. Pape LA, Tsai TT, Isselbacher EM, Oh JK, O'Gara PT, Evangelista A, *et al.*; International Registry of Acute Aortic Dissection (IRAD) Investigators. Aortic diameter  $\geq 5.5$  cm is not a good predictor of type A aortic dissection: Observations from the International Registry of Acute Aortic Dissection (IRAD). *Circulation* 2007;116:1120-7.
7. Parish LM, Gorman JH 3<sup>rd</sup>, Kahn S, Plappert T, St John-Sutton MG, Bavaria JE, *et al.* Aortic size in acute type A dissection: Implications for preventative ascending aortic replacement. *Eur J Cardiothorac Surg* 2009;35:941-6.
8. Poullis MP, Warwick R, OO A, Poole RJ. Ascending aortic curvature as an independent risk factor for type A aortic dissection, and ascending aortic aneurysm formation: A mathematical model. *Eur J Cardiothorac Surg* 2008;33:995-1001.
9. Chiappini B, Schepens M, Tan E, Dell' Amore A, Morshuis W, Dossche K, *et al.* Early and late outcomes of acute type A aortic dissection: Analysis of risk factors in 487 consecutive patients. *Eur Heart J* 2005;26:180-6.
10. Inamura S, Furuya H, Yagi K, Ikeya E, Yamaguchi M, Fujimura T, *et al.* Recent surgical outcomes of Acute type-A aortic dissection. *Tokai J Exp Clin Med* 2006;31:109-12.
11. Piccardo A, Regesta T, Zannis K, Gariboldi V, Pansini S, Tapia M, *et al.* Outcomes after surgical treatment for type A acute aortic dissection in octogenarians: A multicenter study. *Ann Thorac Surg* 2009;88:491-7.
12. Kazui T, Washiyama N, Bashar AH, Terada H, Suzuki T, Ohkura K, *et al.* Surgical outcome of Acute type A Aortic Dissection: Analysis of risk factors. *Ann Thorac Surg* 2002;74:75-81.
13. Rylski B, Suedkamp M, Beyersdorf F, Nitsch B, Hoffmann I, Blettner M, *et al.* Outcome after surgery for acute aortic dissection type A in patients over 70 years: Data analysis from the German Registry for Acute Aortic Dissection type A (GERAADA). *Eur J Cardiothorac Surg* 2011;40:435-40.
14. Apaydin AZ, Buket S, Posacioglu H, Islamglu F, Calkavur T, Yagdi T, *et al.* Perioperative risk factors for mortality in patients with acute type A aortic dissection. *Ann Thorac Surg* 2002;74:2034-9.
15. Kawahito K, Adachi H, Yamaguchi A, Ino T. Preoperative risk factors for hospital mortality in acute type A aortic dissection. *Ann Thorac Surg* 2001;71:1239-43.
16. Tasi TT, Fattori R, Trimarchi S, Isselbacher E, Myrmel T, Evangelista A, *et al.*; International Registry of Acute Aortic Dissection. Long-term survival in patients presenting with type B acute aortic dissection: Insights from the International Registry of Acute Aortic Dissection. *Circulation* 2006;114:2226-31.
17. Narayan P, Rogers CA, Davies I, Angelini GD, Bryan AJ. Type A aortic dissection: Has Surgical outcome improved with time? *J Thorac Cardiovasc Surg* 2008;136:1172-7.
18. Stevens LM, Madsen JC, Isselbacher EM, Khairy P, MacGillivray T, Hilgenberg AD, *et al.* Surgical management and long-term outcomes for acute ascending aortic dissection. *J Thorac Cardiovasc Surg* 2009;138:1349-57.e1.
19. Suehiro K, Pritzwald-Stegmann P, West T, Kerr AR, Haydock DA. Surgery for acute type A aortic dissection a 37-year experience in Green Lane Hospital. *Heart Lung Circ* 2006;15:105-12.
20. Apostolakis E, Shuhaiber JH. Antegrade or retrograde cerebral perfusion as an adjunct during hypothermic circulatory arrest for aortic arch surgery. *Expert Rev Cardiovasc Ther* 2007;5:1147-61.
21. Numata S, Thomson DS, Seah FP, Singh T. Simplified Cerebral Protection Using Unilateral Antegrade Cerebral Perfusion and

- Moderate Hypothermic Circulatory Arrest. *Heart Lung Circ* 2009;18:334-6.
22. Bartolomeo RD, Pilato E, Pacini D, Savini C, Eusanio MD. Cerebral protection during surgery of the aortic arch. *Multimedia Manual Cardio-Thoracic Surgery* 2011;2011.10.1510/MMCTS.2010.004457.
  23. Midulla PS, Gandsas A, Sadeghi AM, Mezrow CK, Yerlioglu ME, Wang W, *et al.* Comparison of retrograde cerebral perfusion to antegrade cerebral perfusion and hypothermic circulatory arrest in a chronic porcine model. *J Card Surg* 1994;9:560-75.
  24. Hagan PG, Nienaber CA, Isselbacher EM, Bruckman D, Karavite DJ, Russman PL, *et al.* The International Registry of Acute Aortic Dissection (IRAD): New insights from an old disease. *JAMA* 2000;283:897-903.
  25. Hirst AE Jr, Johns VJ Jr, Kime SW Jr. Dissecting aneurysm of the aorta: A review of 505 cases. *Medicine (Baltimore)* 1958;37:217-9.