A highly fatal intraoperative urgency – aortic dissection complicating heart surgery

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Abstract

Background: Aortic dissection is associated with high mortality. Despite its rarity, it is often fatal.

Aim: We have retrospectively analysed acute aortic dissections occurring intraoperatively (IAAD).

Methods: Patients' preoperative risk factors, and operative and postoperative courses were analysed from the hospital records retrospectively.

Results: From 1985 to 2009, we performed 29 683 cardiac operations. Ten patients (0.43‰) (mean age 66.5 ± 7 years) were diagnosed with IAAD. There were type 2 dissections in 9 and one patient had it extending beyond the arcus. Four patients were operated on for coronary artery disease, 2 for mitral and 2 for aortic valve diseases. Two patients had concomitant valvular or valvular and coronary procedures. IAAD was identified after decannulation in 5, after creating the holes for proximal anastomoses in 3 and after declamping the aorta in 2 patients. Preoperatively, 6 (60%) patients had hypertension and 4 had hypercholesterolaemia (40%). No other significant risk factors could be identified. Hypothermic circulatory arrest was used in 6 operations. The dissected segment was replaced with a graft in 9 patients whereas the remaining patient had concomitant arcus aorta replacement and elephant trunk procedure. Aortoplasty with Dacron patch was used in one patient. All patients required inotropic and 4 patients IABP support postoperatively. Three (30%) patients died.

Conclusions: The IAAD may occur in any patient at any phase of cardiac surgery. The surgeon should always be aware of the possibility of this complication. It is much better to prevent the IAAD than to treat it. When detected, abrupt change of the operation plan and reparative measures for the dissection should be undertaken.

Key words: intraoperative aortic dissection, urgency, intraoperative complication

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Introduction

Intraoperative acute aortic dissections (IAAD) are one of the well known complications of cardiac surgery [1]. Many centres have reported their scant experiences of a few cases. In one of the most cited reports by Still and colleagues, they reported 0.16% incidence in 14 877 patients [1]. Murphy et al. had 0.35% IAADs in 6943 open heart surgery operations [2]. More detailed analyses have not been done recently [3] but the need for further data and analysis continues.

We analysed the IAAD cases seen in our department. Because we are a high-volume centre, our numbers may be significant for incidence, prevalence and risk factor discussions.

Methods

From 1985 to January 2009, we performed 29 683 open heart operations in our department. Ten (0.43‰) patients (mean age 66.5 ± 7 years, 5 females) were diagnosed with acute type A aortic dissection intraoperatively. Operation plans were revised immediately and aortic repairs were commenced. Dissections were limited to the ascending aorta in 9 cases and in one patient it extended beyond the arcus aorta. The operations are listed in Table I. Five patients had a biological mitral prosthesis before and they presented with paravalvular leakage. Mitral valve replacement (MVR) with a mechanical prosthesis was performed. The indication for the two aortic valve replacement (AVR) operations was aortic stenosis. Three

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Table I. Patient data

Patient	Age	Gender	Risk factors	Operation indication	Dissection site	Detection	Repair for the dissection
1	76	F	none	CABG (†X2)	antegrade cannula (up to arcus)	after decannulation	A.A. SGI
2	67	F	HT, HC	CABG (†X4)	proximal anastomosis	after the hole is created	aortoplasty with Dacron patch
3	64	M	HT, DM, HC	CABG (†X2) + AVR	proximal anastomosis	after the hole is created	A.A. SGI
4	67	F	HT, DM, HC	CABG (†X3)	proximal anastomosis	after the hole is created	A.A. SGI
5	63	M	previous cardiac surgery	REDO MVR	aortic cannula	after decannulation	A.A. SGI
6	60	M	HC	CABG (†X2)	aortic cannula	after decannulation	SGI into the ascending and the ar cus aorta (elephant trunk)
7	75	M	none	AVR	cross-clamp	after declamping	A.A. SGI
8	71	F	HT	AVR + MVR	cross-clamp	after declamping	A.A. SGI
9	70	M	HT	AVR	antegrade cannula	after decannulation	A.A. SGI
10	52	F	HT	MVR	cross-clamp	after decannulation	A.A. SGI

Abbreviations: M – male, F – female, CABG – coronary artery bypass grafting, † – number of bypasses, HT – hypertension, HC – hypercholesterolaemia, A.A. SGI – separated graft interposition into the ascending aorta, SGI – separated graft interposition, AVR – aortic valve replacement, MVR – mitral valve replacement

patients had aortic stenosis concomitant with coronary artery disease. Preoperative risk factors are outlined in Table I.

The demographic characteristics, preoperative risk factors, intraoperative and postoperative courses were collected from the hospital records. The diagnosis of IAAD was made according to the haemodynamic changes and the inspection of the aorta and was confirmed by transoesophageal echocardiography (TEE). An unexplained haemodynamic instability causing difficulty in terminating the cardiopulmonary bypass (CPB), blue to purple discolouration in aortic adventitia and rapidly enlarging aortic diameter were the signs of IAAD.

Surgical technique

Premedication, induction and maintenance of anaesthesia were performed according to the standard protocols. Median sternotomy was used in all cases. The site of arterial cannulation was the ascending aorta proximal to the arcus branches in all cases but the right femoral artery was preferred in the redo MVR patient. Venous cannulation was done with dual-stage cannulae in coronary artery by-pass grafting (CABG) and AVR cases, and with double venous cannulation for MVR cases. An antegrade cardioplegia needle was placed approximately 0.5 to 1 cm proximal to the folding in the ascending aorta cases. In the CABG procedures we used cardioplegia cannulae with venting and in the mitral procedures the cardioplegia was given via an aortic needle. After cross-clamping the aorta proximal to the arcus, diastolic arrest was obtained with isothermic retrograde cardioplegia. In aortic valvular procedures intermittent antegrade cardioplegia was given via the coronary ostia together with retrograde cardioplegia via the coronary sinus. Proximal anastomoses were done on the ascending aorta in CABG operations. The holes were gently created by the punch holder (Table II).

The operation plan was changed as soon as IAAD was diagnosed. The time-points of IAAD detection are listed in Table I. For dissection repairs, the preferred site of arterial cannulation for CPB was the right femoral artery. Hypothermic circulatory arrest (HCA) was used in 6 patients. Separated graft interposition to the ascending aorta with a 30 or 32 mm Dacron graft was done in 9 patients whereas one of them had concomitant arcus aorta replacement and elephant trunk procedure. Aortoplasty with a Dacron patch was used in one patient. In the case of graft interposition, proximal anastomoses of the saphenous vein grafts were done on the graft.

Statistical analysis

The preoperative and postoperative ascending aorta, aortic root, interventricular septum, end systolic and end diastolic left ventricular diameters and ejection fraction (EF%) values were compared using paired t-test. A p value < 0.05 was accepted as significant. All calculations were made with SPSS 16.0 (SPSS Inc.) statistical programme.

Table II. Perioperative parameters

Patient	OD [min]	TPD [min]	ACC [min]	Hypothermia [°C]	HCAD [min]	Drainage [ml]	DMV [min]	ICU stay [days]	Hospitalisation [days]	A.C. [French]	A.N.	A.P. [mm]
1	338	300	145	26	115	1100	-	8	-	24	ARC	4
2	187	160	129	29	not used	450	16	2	9	21	ARC	4
3	230	204	123	28	not used	870	22	4	8	21	ARC	4
4	165	145	133	18	57	750	18	3	7	24	ARC	4
5	133	111	78	29	not used	1200	26	6	12	24	needle	not used
6	387	360	138	19	91	1250	-	12	-	28	ARC	4
7	220	190	128	26	not used	900	18	3	9	21	not used	not used
8	190	167	143	19	105	1000	32	6	-	24	needle	not used
9	145	119	102	18	67	450	10	2	9	28	not used	not used
10	210	185	167	16	126	950	-	7	12	24	needle	not used

Abbreviations: OD – operation duration, TPD – total perfusion duration, ACC – duration of aortic cross clamp, HCAD – duration of hypothermic circulatory arrest, DMV – duration of mechanical ventilation, ICU – intensive care unit, A.C. – aortic cannula, A.N. – aortic needle, ARC – aortic root cannula with venting for coronary bypass, A.P. – aortic punch

Table III. Preoperative and postoperative echocardiographic evaluation

	Preoperative	Postoperative	p
Ascending aorta	4.3 ± 0.3	3.1 ± 0.1	0.121
Aortic root	4.2 ± 0.2	3.0 ± 0.1	0.270
LVESD	4.2 ± 0.8	4.0 ± 0.4	0.200
LVEDD	5.3 ± 1.1	5.2 ± 0.7	0.352
IVS	1.1 ± 0.1	1.1 ± 0.2	0.094
EF [%]	54.7 ± 11.2	57.6 ± 13.6	0.038

Abbreviations: LVESD – left ventricular end systolic diameter, LVEDD – left ventricular end diastolic diameter, IVS – interventricular septum, EF – ejection fraction

Table IV. Morbidity

Patient	Morbidity
2	refractory HT
3	renal**
4	refractory HT, renal**
5	none
7	need for inotropic support, refractory HT, pulmonary*
9	need for inotropic support, refractory HT
10	need for inotropic and IABP support

*Abbreviations: HT – hypertension, * – mild hypoxia and need for respiratory physiotherapy and bronchodilators, ** – temporary rise in blood urea nitrogen and creatinine*

Results

The IAAD was seen in 10 of the 29 683 open heart surgery procedures, constituting a prevalence of 0.43‰. The list of these procedures and the patient data are summarised in Table I. The perioperative parameters are outlined in Table II. The results of echocardiographic measurements are seen in Table III. The aortic walls of the patients were atherosclerotic due to the advanced mean age of this patient series.

There were 3 postoperative deaths. Patients 1 and 6 underwent CABG. Postoperatively they were transferred to the intensive care unit with inotropic and IABP support. These two patients did not regain consciousness after the operation. They remained in cardiogenic shock and eventually died on the 8th and the 12th postoperative days, respectively. In patient 8, the IAAD extended beyond the arcus aorta. The operation time was 387 min with 91 min of HCA. He had difficulty in weaning from the CPB. Postoperatively there was 1250 cc drainage from the chest tubes. Large amounts of blood products were used intraoperatively and thereafter. The haemodynamics were stabilised with inotropic and IABP support. He died due to multiorgan failure on the 6th postoperative day.

The postoperative morbidity of the patients is listed in Table IV. All patients received inotropic support postoperatively whereas only 4 of them required IABP support. There were three patients with renal complications (patients 3, 4 and 8). The first two cases had temporary rises in blood urea nitrogen and creatinine values which returned to normal levels in 2 and 3 days. Patient 8 had acute renal failure on the 4th postoperative day and continuous haemofiltration was used.

Discussion

The IAAD is one of the well-known complications of cardiac surgery [1, 2]. The low incidence of this complication may explain the low level of interest in this subject. Previously existing aortic pathologies may pose significant risk [2, 4]. Surgical intimal damage during aortic

cannulation, cross-clamping, partial lateral occlusion, aortotomy and proximal anastomoses have been linked to the development of this complication [4-6]. Aortic manipulation together with the intimal damage may lead to the IAAD. Chavanon and colleagues reported that off--pump surgery may increase the risk of IAAD [5]; however, our patients in this study were all operated on-pump. Nagy et al. described a newborn patient in whom the intramural displacement of the aortic cannula during cardioplegia delivery caused IAAD [7]. In our patients, the most commonly encountered risk factor preoperatively was the presence of hypertension.

When IAAD occurs, a rapid decision algorithm and immediate action are mandatory. Tan et al. analysed type A dissection operations in order to find out the independent risk factors for mortality [8] and found that IAAD was an independent risk factor. Considering the adverse affects of the concomitant procedures on the mortality and morbidity, postoperative courses of these patients were analysed. In literature mortality rates up to 30% in type A dissections have been reported [9, 10]. In the elderly, around 20% mortality rates have been reported [11]. If the IAAD is diagnosed intraoperatively, mortality rates around 20% should be expected [12], which is high but in the acceptable limits for this type of surgery.

Another point is the unpredictable course of this type of dissection. A retrograde dissection from the femoral arteries up to the ascending aorta after femoral cannulation has been reported [7]. In these cases, cerebral hypoperfusion is the prognostic factor. Timely and accurately performed repair increases survival [12].

The course of IAAD differs from the dissections seen in patients who previously had heart surgery. Our experience with these patients was reported before [13]. In the present study, there was a single patient with a previous history of cardiac surgery.

Preventive measures are vital for this fatal complication. The most important is the gentle surgical technique. Sin et al. have reported a successful repair for an IAAD and gave recommendations for prevention [14]. Systolic blood pressure must be kept below 100 mmHg, aortic cannulation must be done away from the aortic plaques, purse sutures on the aorta should be deep partial or full-thickness, high caution in placing and removing the aortic clamp, and decreasing the flow in this phase of the operation are the most important points to remember. Apart from these precautions, every surgeon must be ready for the development of an IAAD and be capable of performing what is necessary in that case. Inspection and palpation are important tools for a surgeon and must not be underestimated. Haemodynamic disturbance is a warning sign but one must remember that an earlier diagnosis confers a better prognosis. Mortality increases with delay in the diagnosis [15]. Another useful instrument is transoesophageal echocardiography (TEE). The high sensitivity of this method and possibility of prolonged monitoring are beneficial. A patient with an intraoperative type B dissection has been reported with favourable outcome [16]. In the postoperative period, computerised tomography has been used as an accurate diagnostic tool [17].

Postoperative mortality has been linked to prolongation of the ischaemic period [4]. We believe that the routine application of myocardial protection techniques may suffice. As a matter of fact, two of our patients who died had 67 and 111 min of HCA whereas the other 4 patients who had HCA and survived had 85, 90, 102 and 108 min of HCA (difference NS). Prolonged HCA is associated with high morbidity. The Kazui method may be considered for these prolonged ischaemic situations. Cerebral protection is said to be superior during deep hypothermic circulatory arrest with or without retrograde cerebroplegia [18, 19]. We have started to use the axillary artery for cannulation and selective antegrade cerebroplegia purposes since 2006. We are experienced in femoral arterial procedures especially in emergency situations. That is why we preferred the femoral route and retrograde cerebroplegia for cannulation purposes in IAAD.

The primary weakness of our study is the low number of cases and the lack of some intra-procedural details because we did not have access to all patients' files. This is a retrospective and observational study. However, since there are not many studies on this subject, we believe that this report is worthwhile.

In conclusion, IAAD is a rare but fatal complication of cardiac surgery. No matter how careful the surgeon is, even in the most experienced centres, he may still face this situation. A high index of awareness will provide a quick response and a favourable outcome. Replacement of the affected segment is the procedure of choice and frequently has a favourable postoperative course.

References

1. Still RJ, Hilgenberg AD, Akins CW, et al. Intraoperative aortic dissection. *Ann Thorac Surg* 1992; 53: 374-80.
2. Murphy DA, Craver JM, Jones EL, et al. Recognition and management of ascending aortic dissection complicating cardiac surgical operations. *J Thorac Cardiovasc Surg* 1983; 85: 247-56.
3. Hurt A, Smith JM, Engel AM. Predictors and outcomes associated with intraoperative aortic dissection in cardiac surgery. *J Card Surg* 2008; 23: 422-5.
4. Ruchat P, Hurni M, Stumpe F, et al. Acute ascending aortic dissection complicating open heart surgery: cerebral perfusion defines the outcome. *Eur J Cardiothorac Surg* 1998; 14: 449-52.
5. Chavanon O, Carrier M, Cartier R, et al. Increased incidence of acute ascending aortic dissection with off-pump aortocoronary bypass surgery. *Ann Thorac Surg* 2001; 71: 117-21.
6. Kuhn-Régnier F, Geissler HJ, Mehlhorn U. The heavily calcified aorta and re-do CABG surgery: technical considerations how to avoid aortic crossclamp. How-to-do-it. *Cardiovasc Surg* 2002; 10: 605-7.
7. Nagy Z, Heinemann MK, Schmid E, et al. Successful repair of intraoperative type-A dissection in an infant. *Eur J Cariothorac Surg* 2002; 22: 636-7.

8. Tan ME, Kelder JC, Morshuis WJ, et al. Risk stratification in acute type A dissection: proposition for a new scoring system. *Ann Thorac Surg* 2001; 72: 2065-9.
9. Gölbaşi İ, Türkay C, Akbulut E, et al. Stanford tip A akut aort disseksiyonlarında cerrahi. *Türk Göğüs Kalp Damar Cer Derg* 2000; 8: 745-8.
10. Tetik Ö, Atay Y, Çalkavur T, et al. Tip I akut aort disseksiyonunda malperfüzyon. *Türk Göğüs Kalp Damar Cer Derg* 2003; 11: 9-13.
11. Erentuğ V, Polat A, Erkanlı K. Yetmiş yaş üstü hastalarda uygulanan tip-A aort diseksiyonlarında cerrahi yaklaşım. *Ulus Travma Acil Cerrahi Derg* 2005; 11: 141-5.
12. Türköz R, Gulcan O, Oguzkurt L, et al. Successful repair of iatrogenic acute aortic dissection with cerebral malperfusion. *Ann Thorac Surg* 2006; 81: 345-7.
13. Erentug V, Erdogan HB, Goksedef D, et al. Aortic dissections following aortic valve replacement in the late period. *Turkish J Thorac Cardiovasc Surg* 2005; 13: 20-3.
14. Sin YK, Shankar S. Iatrogenic aortic dissection complicating cardiac surgery. *Asian Cardiovasc Thorac Ann* 2000; 8: 361-3.
15. De Semet JM, Stefanidis C. Acute aortic dissection after off-pump coronary artery surgery. *Eur J Cardiothorac Surg* 2003; 24: 315-7.
16. Madhu Sankar N, Lai K, Harrison K, et al. Intraoperative dissection of aorta and successful repair. *Ann Cardiovasc Thorac Ann* 1998; 6: 66-7.
17. Tabry I, Costantini E, Reyes E, et al. Early postoperative acute aortic dissection, the leading cause of sudden death after cardiac surgery? Critical role of the computed tomography scan. *Heart Surg Forum* 2003; 6: 382-6.
18. Kazui T, Yamashita K, Washiyama N, et al. Aortic arch replacement using selective cerebral perfusion. *Ann Thorac Surg* 2007; 83: 796-8.
19. Kazui T. Editorial comment: Which is more appropriate as a cerebral protection method – unilateral or bilateral perfusion? *Eur J Cardiothorac Surg* 2006; 29: 1039-40.

Rozwarstwienie aorty jako powikłanie operacji kardiochirurgicznych

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Streszczenie

Wstęp: Śródoperacyjne rozwarstwienie aorty jest powikłaniem występującym sporadycznie, ale wiąże się z wysoką śmiertelnością.
Cel: Retrospektywna ocena częstości i okoliczności występowania śródoperacyjnego rozwarstwienia aorty oraz jego wpływu na rokowanie.
Metody: Analizie poddano dokumentację medyczną chorych, u których wystąpiło to powikłanie.
Wyniki: W latach 1985–2009 wykonano w ośrodku kardiochirurgicznym 29 683 operacje serca. Śródoperacyjne rozwarstwienie aorty wystąpiło u 10 (0,43‰) chorych (średni wiek 66,5 ± 7,2 roku), u 9 był to typ 2 rozwarstwienia, a u jednego chorego dyssekcja wykraczała poza łuk aorty. U 4 chorych wykonywano zabieg rewaskularyzacji wieńcowej, u 2 – zabieg dotyczący zastawki mitralnej, a u 2 – zastawki aortalnej. Dwóch chorych miało jednocześnie zabieg rewaskularyzacji i wymiany zastawki. Rozwarstwienie aorty zostało wykryte po usunięciu kaniuli z aorty u 5 chorych, po wytworzeniu ujść proksymalnych dla pomostów wieńcowych u 3 chorych, a po uwolnieniu zacisku z aorty u pozostałych 2 chorych. Z obciążeń przedoperacyjnych u 6 (60%) pacjentów stwierdzono nadciśnienie, a u 4 (40%) – hipercholesterolemię. Operacje z zastosowaniem hipotermii i zatrzymaniem krążenia wykonano u 6 chorych. Rozwarstwiony fragment aorty został zastąpiony przez przeszczep u 9 chorych, a jeden chory miał równocześnie wykonaną wymianę łuku aorty. Plastykę aorty z użyciem łaty dakronowej wykonano u jednego chorego. Wszyscy chorzy wymagali leków inotropowo dodatnich, a czterech – kontrapulsacji wewnątrzaortalnej. Trzech (30%) chorych zmarło.
Wnioski: Do rozwarstwienia aorty może dojść na każdym etapie zabiegu kardiochirurgicznego. Szybkie rozpoznanie umożliwia skuteczne leczenie tego sporadycznie występującego (0,43‰) powikłania.

Słowa kluczowe: śródoperacyjne rozwarstwienie aorty, śródoperacyjne powikłanie

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