Cardiovascular Surgery

Acute Type A Aortic Dissection Repair in a Community Hospital

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Objectives: The outcome after surgical repair of acute type A aortic dissection has been improving in experienced centers. However, there are limited data about the prognosis in community hospitals.

Methods: Twenty-three consecutive patients (11 men and 12 women) underwent operations for acute type A aortic dissection between January 2002 and June 2006. Patients' ages ranged from 41 to 86 years (mean age 61.0 ± 12.3 years). Surgical procedures included supracoronary ascending aorta (n = 16) or hemiarch graft (n = 7) replacement, with aortic valve resuspension for commissural detachment (n = 22). Cannulation of the femoral artery as the arterial inflow was carried out in all patients except one as well as deep hypothermic circulatory arrest for open distal aortic anastomosis. Retrograde cardioplegia and cerebral perfusion were routinely used. Selective cerebral antegrade perfusion via right axillary artery was used in the last patient in our series. After distal aortic anastomosis, the arterial cannula was inserted into the prosthesis. Cardiopulmonary bypass then resumed with rewarming followed by aortic annuloplasty and proximal anastomosis.

Results: The surgical and in-hospital mortality was 8.69% (2 of 23 patients), with no late death during a mean follow-up period of 36.5 ± 17.3 months. Mean circulatory arrest duration was 47.0 ± 12.0 minutes. Complications encountered included respiratory failure in 2 patients undergoing tracheostomy and minor stroke in one of them with improvement later. Postoperative bleeding which required reoperation happened in 7 patients. Biological glue was used in late of our series. One patient received reoperation 3 years later for progressive dilatation of descending aortic aneurysm.

Conclusion: Femoral arterial cannulation and retrograde cerebral perfusion continue to be useful selections for acute type A aortic dissection repair. Conservative surgical strategy avoiding the replacement of the aortic arch may be an alternative option for less experienced surgeons in a community hospital.

Key Words: Aortic dissection • Circulation arrest • Retrograde cerebral perfusion • Selective cerebral perfusion

Although the repair of acute type A aortic dissection is a surgical emergency carrying considerable operative morbidity and mortality, the outcome has been improving in experienced centers.[1] Many authors attributed this advance to open distal anastomosis under hypothermic circulatory arrest that avoids aortic crossclamping, vigilance in preventing intraoperative malperfusion, and resection of the aortic segment containing the intimal tear.[1-3] On the basis of these considerations, a more aggressive approach to acute aortic dissection has been gaining popularity in experienced centers. Although replacement of the ascending aorta and entire arch is advocated in many recent publications, arch reconstruction does carry a high risk of bleeding and prolonged circulatory arrest.[2] In this study, we reviewed the surgical and mid-term re-

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sults of 23 consecutive patients who all received graft replacement of the ascending aorta.

PATIENTS AND METHODS

Between January 2002 and June 2006, 23 consecutive patients (11 men and 12 women) with acute type A aortic dissection (15 classic aortic dissection and 8 intramural hematoma) were operated on by one surgeon. All patients except three underwent surgery in 24 hours; the remaining took operation on the second, 12^{th} and the 13^{th} days, respectively, due to delayed diagnosis. Patients' ages ranged from 41 to 86 years (mean, 61.0 ± 12.3 years). Preoperative clinical details and operative data are summarized in Tables 1 and 2. Eight patients had significant aortic regurgitation (AR). Three patients (13.0%) were in shock, generally related to cardiac tamponade. One patient (patient 12) had suffered femoral pulse deficit in 1 limb and another (patient 21) had left-side hemiparesis. One patient (patient 17) who presented with acute inferior wall myocardial infarction was treated with thrombolytic therapy first, and received operation on the next day after revised diagnosis.

All patients except one received femoral arterial and median sternotomy for bicaval venous cannulation. Thereafter, cardiopulmonary bypass was instituted and the patient was cooled down to a rectal temperature of 18 °C. A left-ventricular vent was placed through the right superior pulmonary vein and a retrograde cardioplegia perfusion cannula was passed through coronary sinus during cooling. Cardiac massage for relieving heart distension should be checked after fibrillation of the heart. When the rectal temperature dropped to 18 °C, circulation was stopped and retrograde cerebral perfusion was given via the superior vena cava. The patient was placed in slight

Table 1. Preoperative patient characteristics and comorbidities

Patient Number	Age (Years)	Sex	Onset to OP	AD or IMH	AR	Cardiac tamponade	Limb pulse loss	COPD	Renal	Hypertension	Diabetes	CVA	AMI
1	64	F	12 days	IMH						Yes			
2	44	M	< 24 h	IMH						Yes	Yes		
3	66	F	< 24 h	IMH						Yes			
4	67	F	< 24 h	IMH	AR					Yes			
5	51	M	< 24 h	IMH						Yes			
6	78	F	< 24 h	AD				Yes		Yes	Yes		
7	67	M	< 24 h	IMH	AR					Yes		Yes	
8	53	F	< 24 h	AD	AR					Yes			
9	49	M	< 24 h	AD	AR	Yes				Yes			
10	55	M	< 24 h	AD	AR					Yes			
11	72	F	13 days	AD					Yes	Yes			
12	41	M	< 24 h	AD	AR		Yes		Yes	Yes			
13	56	F	< 24 h	AD	AR					Yes			
14	63	M	< 24 h	AD					Yes	Yes			
15	82	F	< 24 h	AD	AR	Yes			Yes	Yes		Yes	
16	86	F	< 24 h	IMH		Yes				Yes			
17	58	M	2 days	AD									Yes
18	69	F	< 24 h	AD									
19	46	M	< 24 h	IMH						Yes			
20	73	F	< 24 h	AD									
21	48	M	< 24 h	AD						Yes		Yes	
22	62	F	< 24 h	AD									
23	52	M	< 24 h	AD									
Mean	61.0												

AD = aortic dissection; AMI = acute myocardial infarction; AR = aortic regurgitation; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; IMH = intramural hemorrhage; OP = operation; Renal = creatinine > 1.5 mg/dl.

Table 2. Operative procedures and outcomes

Patient number	Hemiarch	Concomitant procedures	CPB (min)	CA (min)	Graft (mm)	Re-OP	ICU (day)	LOS (day)	CVA	Renal failure	Q wave infarct	Af	Tracheo-stomy	Follow-up (months)
1		Resuspension of AV	230	50	30	Yes	3	9						54
2		Resuspension of AV	215	50	24		6	9						54
3		Resuspension of AV	197	56	26		18	28						52
4		Resuspension of AV	213	51	26	Yes	5	10						52
5		(-)	191	30	22		3	8						49
6		Resuspension of AV	170	42	30	Yes	27	43	Yes			Yes	Yes	49
7		Resuspension of AV	163	46	28	Yes	6	10						48
8	Yes	Resuspension of AV	173	52	26		3	8						48
9		Resuspension of AV	198	60	26		7	10						48
10	Yes	Resuspension of AV	216	60	30		2	7						45
11		Resuspension of AV	153	34	30		54	56		Yes		Yes	Yes	43
12	Yes	Resuspension of AV	221	75	28	Yes	17	22		Yes				43
13		Resuspension of AV	164	38	28		3	7						38
14		Resuspension of AV	158	34	30		4	10			Yes	Yes		34
15	Yes	Resuspension of AV	195	49	28	Yes	8	18						32
16	Yes	Resuspension of AV	145	46	26		2	2						*
17		Resuspension of AV CABG	235	69	28		4	4						*
18		Resuspension of AV	165	40	28		4	13						28
19		Resuspension of AV	168	48	30		2	8						27
20		Resuspension of AV	147	28	26		4	12						11
21		Resuspension of AV	154	30	22	Yes	5	15						8
22	Yes	Resuspension of AV	181	47	24		3	9				Yes		2
23	Yes	Resuspension of AV	209	47	22		3	9						2
Mean			185	47			8	14						36.5

Af = atrial fibrillation; AV = aortic valve; CA = circulatory arrest; CPB = cardiopulmonary bypass; CVA = left hemiparesis; ICU = intensive care unit; LOS = length of stay; OP = operation; Renal failure = hemodialysis; * = in-hospital mortality.

Trendelenburg's position and the head was packed in ice for topical cooling. Retrograde cold blood cardioplegia was administered at the same time and then every 20-30 minutes. Beginning with the last patient in our series, the

arterial inflow was shifted to the right axillary artery with a Hemashield graft interposition. When the rectal temperature dropped to 20 °C, selective cerebral antegrade perfusion was started at the rate of 10 ml • kg^{-1} • min^{-1} with the proximal innominate artery clamped. Aortotomy of the ascending aorta was done, and the entire ascending aorta was excised after checking the primary tear from inside. Distal aortic anastomosis was performed first after the adjacent aortic stump was reinforced with Teflon felt both inside and outside the aortic wall, and sutured with 3-0 polypropylene horizontally. 22-30 mm Hemashield graft (Boston Scientific, Natick, MA) was used for ascending aorta or hemiarch replacement.

After completion of the open distal anastomosis, another arterial cannula from the side branch was inserted into the graft proximal to the distal anastomosis, and the graft itself was cross-clamped near the arterial cannula proximally. Once the graft was deaired by the femoral arterial perfusion, the retrograde circulation was stopped and antegrade cardiopulmonary bypass was resumed with rewarming. The aortic valve was then examined and reconstructed using resuspension techniques if the aortic valve commissure was involved by aortic dissection (22/23). Aortic valve was preserved in all patients. Proximal anastomosis was then completed as the distal anastomosis with two layers of Teflon felt reinforcing the aortic stump above the coronary ostias. Warm blood cardioplegia was given by a venting cannula near the proximal anastomosis and then the graft was declamped. After checking the hemostasis of both anastomoses, the femoral artery might be decannulated and repaired with 6-0 polypropylene continuous suture before cardiopulmonary bypass ceased.

RESULTS

The duration of cardiopulmonary bypass (including period of circulation arrest) ranged from 153 to 230 minutes (mean, 185.3 ± 28.0 minutes), and the circulation arrest time was 30 to 75 minutes (mean, 47.0 ± 12.0 minutes). The surgical and in-hospital mortality rate was 8.69% (2 of 23 patients): an 86-year-old lady (patient 16) with shock and a 58-year-old man (patient 17) with acute myocardial infarction both died of low cardiac output postoperatively. No late death happened up to the recent follow-up. Complete resection of primary tears was achieved in all patients with aortic dissection except one (patient 9), whose primary tear could not be found despite inspection under circulatory arrest. Postoperative bleeding was not infrequent, and there were 7 patients who underwent reoperation for excessive bleeding. The bleeding sources were all related to either anastomosis of the artificial graft. Postoperatively, two patients (patient 6 & 11) suffered from respiratory failure undergoing tracheostomy. One of them (patient 11), with baseline creatinine level of 2.9, needed permanent dialysis; the other (patient 6) was noted having left-side hemiparesis and was improved after 43 days of hospitalization. One patient (patient 14) was noted with Q wave infarction over the anteroseptal area without hemodynamic compromise, and another patient (patient 12) required hemodialysis temporarily. Late complication was encountered in one patient (patient 5) with poor compliance of medication, who received reoperation for descending aorta due to progressive enlargement 3 years later.

DISCUSSION

Surgical treatment for acute type A aortic dissection is still a challenge, and the optimal surgical strategy remains controversial.[4-7] It carries high morbidity and mortality rates despite recent advances in treatment. After the introduction of hypothermic circulatory arrest, as well as retrograde cerebral perfusion via superior vena cava, open distal ascending aortic anastomosis has been proved superior and well adapted.[8]

In 20% to 30% of patients with acute type A aortic dissection, the intimal tear cannot be found via the ascending aorta, even under circulatory arrest.[2] For patients whose tear site is not resectable with replacement of the ascending aorta or hemiarch, there is a controversy regarding the optimal strategy. Several authors advocate total arch replacement, with the rationale that resection of the aortic arch may decrease the incidence of malperfusion, false lumen patency, and subsequent long-term complication.[9,10] Conversely, others claim that limited operation, i.e., replacement of only the ascending aorta can also be justified because the main object of emergent operation for acute dissection is the immediate survival of the patient. Their argument is that total arch replace-

ment carries a higher risk of bleeding and prolonged cerebral ischemia, which outweighs the long-term benefit if done by less experienced surgeons.[1,2] For us, a surgical team in a community hospital who had little previous experience with aortic dissection, the strategy of avoiding aortic arch replacement helped to keep the results of our aortic dissections in the acceptable range.

Femoral arterial cannulation is a handy procedure for the cardiovascular surgeon and can be performed rapidly. It also spares the operative field over the anterior chest and is seldom complicated with bleeding or oozing problem. It was only argued with the incidence of malperfusion and cerebral embolization from retrograde circulation. However, our experience with femoral arterial cannulation in this small group of patients was very encouraging and supported the evidence of better patient control in emergency situation. One third (8/23) of patients in this series were intramural hemorrhage, and this may be related to the lucky low incidence of the aforementioned complications of femoral arterial cannulation. It is worth highlighting that femoral arterial perfusion was used only during the cooling period of cardiopulmonary bypass without aortic crossclamp, emphasizing the concept of no touch of aorta or the brachiocephalic trunk.

The low incidence of neurological complication in this series might be contributed from the relatively short period of circulation arrest (mean 47.0 ± 12.0 minutes) and the protection of retrograde cerebral perfusion under deep hypothermia. The longest time of systemic circulatory arrest was 75 minutes. Even this patient recovered without any neurological sequela. Resuming cardiopulmonary bypass in antegrade pattern via the arterial cannula inserted on the graft shortened the period of retrograde perfusion, facilitated high flow during rewarming, and speeded decannulation of the femoral artery and closure of the wound in the groin region. We did the distal anastomosis first under circulatory arrest because it was more time-consuming during the rewarming period than the cooling period. Thereafter, we could perform proximal anastomosis comfortably during systemic rewarming in antegrade perfusion after the distal anastomosis was completed and the graft was crossclamped. Thus, the time interval of retrograde systemic perfusion and total cardiopulmonary duration could be reduced.

During a mean follow-up period of 35.9 ± 16.6 months, no recurrent aortic regurgitation more than mild degree was encountered, probably the proximal aortic anastomosis above the coronary ostias had been strongly reinforced with double layers of Teflon felt. But the long-term outcome after remodeling technique was not favorable in other series.[11]

Retrograde cold blood cardioplegia only during aortic repair under deep hypothermia proved timesaving and safe in this small series. No patients suffered from profound cardiogenic shock after cardiopulmonary bypass requiring intraaortic balloon pump (IABP) insertion, and none but one (patient 14) had postoperative Q wave infarction. It is doubtless that combination of antegrade and retrograde cardioplegia infusion may have better myocardial protection. The rationale for using retrograde cardioplegic perfusion only is in its simplicity. The surgeon can pay all his attention to aortic repair without being disturbed by separated coronary ostia perfusion.

Cannulation of the right axillary artery for acute type A aortic dissection has been getting popular recently and proved with better surgical results.[12] It can be used for cerebral protection as selective antegrade right carotid artery perfusion during circulation arrest.[13] Selective cerebral perfusion is physiologically superior to hypothermic circulation arrest and retrograde cerebral perfusion because it supplies, in an antegrade manner, oxygenated blood to the brain and is basically free from time limitation with regard to the protection of the brain. Another advantage of the cannulation of the axillary artery is that it is not necessary to recannulate the tube graft before reestablishing cardiopulmonary bypass.

By report of the International Registry of Acute Aortic Dissection (IRAD) in 2002, the in-hospital mortality rate was 32.5% in type A dissection patients.[14] The more favorable result in our study may be contributed from the composition of patients with intramural hematoma other than classic dissection (8/23), as better short- and long-term prognosis in such patient has been reported.[15,16] Hemiarch replacement was done in 7 cases with their primary tears localized in the lesser curvature and the anterior wall of the transverse aortic arch distal to the innominate artery, and it has been reported with better early and late outcome than extended aortic arch replacement.[1,17]

The biggest drawback of our study was the high incidence of reoperation for bleeding control (7/23).[1-3] The

majority of these patients (6/7) occurred in the first two years in this series. This would be obviated in the experienced surgeon's hands by delicate sutural techniques and careful handling of fragile dissecting aortic tissue, as well as adequate hemostasis after cardiopulmonary bypass and protamine reversal of heparinization. Biological glue applications were used late in our series and proved to be helpful in reducing postoperative bleeding.[18] The other modifications for reducing postoperative bleeding including modified Cabrol's shunt in 2 patients and separate pledget suture over both ends of the graft in the last 3 patients.[19] Aprotinin is also an useful adjunct and will be available in our hospital in the near future.[20]

In conclusion, our favorable experience in this small initial series will require confirmation with larger numbers of patients. Conservative surgical strategy avoiding the replacement of aortic arch would be a viable option for less experienced surgeons in a community hospital.

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急性升主動脈剝離症在區域醫院的手術治療結果

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背景 在手術技巧的進步及經驗的不斷累積下，急性升主動脈剝離症在醫學中心的手術治療結果，近年來一直突飛猛進。在本篇文章中，我們將報告急性升主動脈剝離症在區域醫院的手術治療結果。

方法 從 2002 年 1 月至 2006 年 6 月，共有連續 23 位 (男性 11 位，女性 12 位) 急性升主動脈剝離的病患接受手術治療，病患的年齡從 41 歲到 86 歲 (平均 61.0 ± 12.3 歲)。手術方法包括以人工血管置換剝離的升主動脈及主動脈瓣的修補手術。除了最後一位患者，手術皆是以股動脈插管的逆行性體外心肺循環方式，在將體溫降至攝氏 18 度及循環停止的狀態下，做開放性的遠端升主動脈及人工血管縫合；隨後將體外心肺循環的動脈端建立在人工血管上，改以順行性體外心肺循環及回復體溫，並完成主動脈瓣的修補及近端升主動脈與人工血管的縫合。從最後一位患者開始，我們改用右側腋動脈作為血液回流處，並在循環停止時由此處給予順行性的腦部灌流。

結果 在 23 位病患中有 2 位發生手術後的死亡 (死亡率 8.69%)。平均追蹤 36.5 ± 17.3 個月後，其餘的病患皆仍存活。手術當中循環停止的時間平均為 47.0 ± 12.0 分鐘。在手術併發症方面，有 2 位病患因無法脫離呼吸器而需施行氣管切開術；其中一位病患術後有短暫左半身輕癱情形，但在出院前已逐漸恢復正常。有 7 位術後出血量較多的病患需要重新回到手術室接受止血手術，此併發症在組織黏膠的使用後已減少。有一位手術後拒服藥物的高血壓病患在 3 年後因降主動脈的持續擴大而接受了降主動脈的置換手術。

結論 從我們初步的結果顯示：以股動脈插管及逆行性腦部灌流之傳統手術方式治療急性升主動脈剝離仍是一種安全且有效的方法。以右側腋動脈作為血液回流處則更符合生理，也是當前治療的趨勢。對於區域醫院中手術經驗較為不足之外科醫師，避免置換主動脈弓的保守手術治療或許是個好主意。

關鍵詞：主動脈剝離、循環停止、逆行性腦部灌流、選擇性腦部灌流。