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NON CLAMPING ANASTOMOSIS OF THE ASCENDING AND ARCH ANEURYSM USING RETROGRADE CEREBRAL PERFUSION

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SYNOPSIS

Twelve consecutive patients requiring surgery for replacement of ascending aortic aneurysms (n=3), ascending arch aortic aneurysms (n=2), or type A aortic dissections (n=7) were treated without aortic cross clamping. Retrograde cerebral perfusion (RCP) with circulatory arrest (mean RCP time: 46.0 ± 15.9 minutes, range: 20 to 65 minutes), and continuous retrograde cardioplegia (mean cardiac ischemic time :134.4 ±39.7 minitues, range: 40 to 180 minutes) were employed. In the patients with aortic dissection, the intimal tear at the origin of the brachiocephalic artery (BCA) was resected completely, the aortic wall was trimmed and closed with Teflon felt. The distal anastomosis was created using an open technique. Air and debris were completely evacuated by returning blood from the cerebral vessels and femoral artery. Then the artificial graft was clamped, and cardiopulmonary bypass resumed. The proximal anastomosis was performed during rewarming. The operations were elective in seven cases,

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and emergent in five cases. Graft replacement of the ascending aorta was performed in ten patients (including two BCA reconstructions). The remaining two patients were treated by patch repair (n=1), primary anastomosis (n=1). There were no perioperative deaths. One patient had a transient neurological deficit. The distal false lumen was occluded completely in five of seven patients with aortic dissections. The other two patients had a secondary tears in the descending aorta. Thus retrograde cerebral perfusion and continuous retrograde cardioplegia without aortic cross clamping is an effective technique in the replacement of the ascending and arch aorta.

INTRODUCTION

Recently, patients requiring surgery of ascending or descending arch aortic aneurysms have presented with more advanced age and aortic calcifications. Consequently, the placement of an aortic cross-clamp at the origin of the brachiocephalic artery has become very dangerous because of the risk of embolization to the heart, brain or abdominal organs. In acute type A aortic dissections, a patent and enlarged distal false lumen may result in major complications in the postoperative period. Aortic cross-clamping prevents the inspection of intimal tears in the proximal aortic arch and may result in new tears in the fragile aorta. Since 1990, we have employed in the replacement of the ascending and arch aorta, retrograde cerebral perfusion, and continuous retrograde cardioplegia which has eliminated the need for aortic cross-clamping. Twelve patients were treated using this technique. There were no perioperative deaths. One patient had a transient neurological deficit. A patent distal false lumen was found in only two patients.

PATIENTS AND METHODS

From April 1990 to March 1994, 12 patients underwent surgery for ascending aortic aneurysms (n=3), ascending arch aortic aneurysms (n=2), or type A aortic dissections (n=7). All of the patients were treated without aortic cross-clamping. There were four men and eight women, raging in age from 35 to 76 years (mean : 61.3 ± 12.3 years). The dissections were acute in five patients, and chronic in two patients. The procedures were elective in seven cases, and emergent in five cases.

Table I. Type of aortic lesion and method of treatment.
asc:ascending,Ao:aorta

Patient No.	Age	Sex	Aortic Lesion	Method of Treatment
1	73	F	ascending true	asc Ao patch repair
2	56	F	ascending true	asc Ao graft replacement
3	76	F	ascending true	asc Ao graft replacement
4	61	M	ascending-arch true	asc-arch graft replacement
5	52	F	ascending-arch true	asc-arch graft replacement
6	65	M	Dissection type A acute	asc Ao graft replacement
7	70	F	Dissection type A acute	asc Ao graft replacement
8	35	M	Dissection type A acute	asc Ao graft replacement
9	44	M	Dissection type A acute	asc Ao graft replacement
10	66	F	Dissection type A chronic	asc Ao primary repair
11	66	F	Dissection type A chronic	asc Ao graft replacement
12	63	F	Dissection type A acute	asc Ao graft replacement

Arterial cannulation was accomplished through the femoral artery. Two venous cannulae were placed in the right atrium. Cardiopulmonary bypass and cooling was then initiated. During core cooling, a vent tube was inserted into the left ventricle from the right superior pulmonary vein. Dissection between the aneurysm and right pulmonary artery or pulmonary trunk was performed. Prostagrandin E1 (0.5 μ g/kg), methyl predonisolone (30 mg/kg), and thiopental (5 mg/kg) were administered intravenously to protect the cerebral microcirculation. Rectal and tympanic temperatures were monitored. Circulatory arrest was initiated when the rectal temperature reached 20℃. Retrograde cerebral perfusion (RCP) through the superior vena caval (SVC) cannula was begun, and the jugular vein pressure maintained between 15 and 25 mmHg. Continuous retrograde blood cardioplegia from the coronary sinus was also initiated. The aorta was then opened and incised completely at the origin of the brachiocephalic artery. In the patients with dissections, inspection of the aortic arch was performed to confirm complete resection of the intimal tear. When the intimal tear in the ascending aorta extended to the aortic arch, the incision was extended to the lesser curvature of the arch. The false lumen was obliterated by applying Teflon felt strips outside the aorta and inside the true lumen with horizontal interrupted 3-0 Ti-Cron sutures (Davis + Geck Cynamid of Great Britain, LTD., Gosport, Hampshire, UK) . The distal end of the collagen-coated, zero-porosity Dacron graft (Haemashield, Meadox Medicals, Inc., Oakland, N.J., USA) was anastomosed using an open technique with continuous running 3-0 prolene suture (Ethicon, Inc., Somerville, N. J.,USA) . In the three ascending aortic aneurysms, several pledgetted 2-0 Ti-Cron mattress sutures were placed on the posterior wall. The anterior wall was closed with a running suture. In the two ascending arch aneurysms, the distal anastomosis was created between the origin of the BCA and left carotid artery, and a branch graft was anastomosed to the BCA. Air and debris were completely evacuated by returning blood from cerebral vessels and femoral artery. Then, the artificial graft was clamped. Just prior to termination of RCP, d-mannitol (300 mL), and deferoxamine mesylate (radical scavenger, 30 mg/kg) were administered to prevent the brain edema which can result from reperfusion injury. RCP was terminated and cardiopulmonary bypass with rewarming reinstituted. During rewarming, the proximal anastomosis was created using similar techniques.

RESULTS

Graft replacement of the ascending aorta was performed in eight patients, including one aortic valve resuspension. The ascending aorta and arch were replaced in two patients, while ascending aorta patch repair and primary anastomosis were performed in one patient each (Table I). Retrograde cerebral perfusion time ranged from 20 to 65 minutes (mean : 46.0 ±15.9 minutes), (Table II). The perfusion flow from the SVC cannula was 220 to 500 mL/min. (mean : 293.0 ± 77.0 mL/min.). Rectal temperature was 19.1 to 24.2℃ (mean 20.8 ± 1.8℃) Cardiac ischemia time ranged from 40 to 180

Table II. Operative parameters.
RCP: retrograde cerebral perfusion, T: rectal temerature,
CI: duration of cardiac ischemia,
CPB: duration of cardiopulmonary bypass.

Patient No.	RCP time (min)	RCP flow (mL/min)	T (℃)	CI (min)	CPB (min)	Perioperative Neurologic Deficit	Outcome Mortality
1	33	250	22.6	40	162	none	no
2	40	230	21.2	121	241	none	no
3	65	300	19.5	125	264	none	no
4	49	250	20.1	98	227	none	no
5	38	300	20.2	173	304	none	no
6	27	330	19.1	180	247	none	no
7	44	220	19.7	178	290	none	no
8	64	250	20.1	140	206	transient	no
9	65	500	19.1	150	438	none	no
10	20	250	24.2	142	202	none	no
11	58	300	19.5	115	278	none	no
12	52	300	23.1	114	261	none	no
mean±SD	46±15.9	293±77.0	20.8±1.8	134.4±39.7	263.0±71.5		

minutes (mean :134.4 ± 39.7 min.), and cardiopulmonary bypass time ranged from 162 to 438 minutes (mean: 263.0 ±71.5 minutes). All patients come off cardiopulmonary bypass without difficulty. Low cardiac output syndrome was not encountered. Immediate recovery of consciousness was complete in all patients. One patient had a left hemispheric infarction due to dissection of the left carotid artery from an acute type A aortic dissection. There were no neurologic deficits within 10 days of the operation. In one patient with an acute type A aortic dissection, bleeding from the graft required packing, which was removed on postoperative day 3. All of the patients survived, and discharged from the hospital. Prior to discharge, aortography, computed tomography, and magnetic resonance imaging were performed. Only two patients of the seven with dissections had patent distal false lumens. Those persistent false lumens were the result of secondary intimal tears in the descending thoracic aorta.

DISCUSSION

The advanced age and aortic calcifications in the patients presenting with conditions requiring replacement of the ascending aorta and aortic arch has mandated changes in the surgical approach. It is no longer safe to cross-clamp the aorta at the origin of the brachiocephalic artery. In acute type A aortic dissections, aortic cross-clamping prevents inspection of the intimal tear in the proximal aortic arch, and may result in new tears in the fragile aorta. Since 1990, we have replaced the ascending aorta and aortic arch without the use of a cross-clamping, by employing retrograde cerebral perfusion and continuous retrograde blood cardioplegia. Hypothermic circulatory arrest has recently gained widespread acceptance for the treatment of patients with arch aortic aneurysms (1-6). This technique has allowed for the creation of the distal anastomosis using an open technique. Routine use of hypothermic circulatory arrest for the repair of ascending and aortic arch dissections has also been advocated by a number of investigators (7-9). The introduction of the hemi-arch anastomosis has significantly shortened the circulatory arrest time compared to full arch replacement. The combination of circulatory arrest and hemi-arch replacement has allowed for the safe treatment of most types of aortic arch disease. However, allowable time of circulatory arrest in adults is not well established. Previous reports have shown that cerebral ischemia time greater than 45 minutes were associated with a high risk of stroke, and that ischemia time greater than 65 minutes were associated with a low incidence of survival (10). Ergin et al. have reported that the incidence of temporary neurologic dysfunction with hypothermic circulatory arrest is 19%, which rises linearly in relation to patient age and duration of arrest (11). Furthermore, embolic strokes occurred in 11.8% of patients, and were associated with permanent deficits in 7%. However, permanent neurologic injury was the result of thromboembolic events and was not related to the method of cerebral protection used. Thus additional methods to prevent perioperative embolic strokes are needed. Ueda et al. introduced continuous retrograde cerebral perfusion (RCP) via the superior vena cava in 1986 as an adjunct to the technique of profound hypothermia (12). Since retrograde cerebral perfusion (deep hypothermia plus venoarterial cerebral perfusion) requires no arterial cannulation or aortic-cross clamping, the operative field is simplified, and the risk of air and debris emboli to the brain minimized. The temperature of the brain is maintained at 20 ℃, and the metabolic products is eliminated by RCP. Ischemic damage to the brain may be reduced by RCP during circulatory arrest, allowing for extended arrest time. Another advantage of this method is that it requires only the standard cardiopulmonary circuit. There is no need for dissection, cannulation, or clamping of the cerebral vessels (13). Imamaki et al. have reported that 90 minutes of circulatory arrest can be safely attained using RCP at a rate of 250 to 300 mL/min (14). However, maximum period of RCP has yet to be determined.

The surgical strategy for type A aortic dissection has been designed to accomplish four main objectives: 1) resection of the primary intimal tear, 2) inspection of the aortic arch to confirm elimination of all proximal tears, 3) restoration of aortic valve competence and replacement of all dissected tissue from the ascending aorta, and 4) obliteration of the entrance of the distal false lumen (15). The Teflon sandwich technique, combined with the open distal anastomosis, has yielded reduced patency rates of the false lumen compared with previous reports. In our series, complete resection of the intimal tear in the ascending or ascending arch aorta was possible in five of seven patients with dissections. The other two patients had secondary intimal tears in the descending aorta. With regard to the treatment of these last two patients, there is considerable controversy surrounding the recommended extent of the initial procedure. The question is whether the operation should be limited to replacement of the ascending aorta, or should include total aortic arch repair. The surgical stress associated with the simultaneous graft replacement of the ascending aorta and the total aortic arch is great, and the incidence of postoperative pulmonary failure, low output syndrome, and renal failure is high (16).

In conclusion, replacement of the ascending aorta and aortic arch using retrograde cerebral perfusion and continuous retrograde cardioplegia without aortic cross clamping is a safe and effective technique.

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