Operative management of aortic arch aneurysms using profound hypothermia and circulatory arrest

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INTRODUCTION

Despite numerous advances over the last 30 years, aneurysms of the aortic arch still remain a major challenge for cardiac surgeons. Since the first successful replacement of the aortic arch with perfusion of the head vessels by De Bakey, Crawford, Cooley and Morris [1], the use of various methods have been employed to preserve cerebral function during aneurysm operations. Although deep hypothermia was used for surgery of the aortic arch by Borst et al. as early as 1963 [3], the introduction of prolonged circulatory arrest by Griep [7] and their associates has simplified replacements of the aortic arch. The purpose of our study was to evaluate retrospectively the results of deep hypothermia plus circulatory arrest in patients undergoing aortic arch operations, with particular emphasis on neurological complications.

PATIENTS AND METHODS

1. Patients

Between October 1990 and September 1993, a total of 17 patients with an aneurysm of the aortic arch and various portions of the ascending or descending aorta were operated on at the II. Surgical Clinic at the University of Vienna. Patients, who underwent emergency operation because of acute dissection were excluded from this study. The average age of our patients was 58 years (range 36 - 79), and there were 14 male and 14 female. The cause of the aneurysm was arteriosclerosis in 8 patients, dissection of the aortic wall in 6 patients and degenerative alteration due to untreated hypertension in 3 cases. The aneurism involved the arch...
and ascending aorta in 11 patients, the ascending aorta, arch, and descending aorta in 2 patients, and the arch and descending aorta in 4 cases. 2 patients had previously undergone aortic valve replacement and one patient coronary artery bypass grafting.

All patients were operated on electively. 5 patients underwent concomitant aortic valve replacement, all of them received a composite aortic valve-ascending aortic conduit graft. Two patients underwent coronary artery revascularization for proximal left anterior descending coronary artery disease.

2. Operative technique

General endotracheal anesthesia was used for all repairs. A median sternotomy was employed, and arterial perfusion was through the common femoral artery. The right atrium was cannulled for venous drainage. The left ventricle was vented through a cannula placed in the apex. All patients received 1000 mg of Cortison and 1000 mg of Thiopental for added cerebral protection. At an rectal temperature of 18°C and a nasopharyngeal temperature of 12°C, most of the intravascular blood volume was drained into the pump reservoir. The distal anastomosis was performed between the graft and the normal upper descending thoracic aorta. An oval opening was made with the graft under tension and sutured around the brachiocephalic artery origins. Thereafter, a Dacron graft (8 mm in diameter) was sutured end to side into the ascending aorta and connected to a second arterial line, which was linked by a Y-adapter to the arterial line of the extracorporeal circuit. The aorta was clamped distal the junction of the second arterial line and it was possible to start with the antegrade hypothermic perfusion (3-4 liter/min). Then, the proximal anastomosis was performed. Cardiopulmonary bypass was discontinued at 36°C.

RESULTS

All 17 patients survived the operation (intraoperative mortality 0%). The 30-day mortality was 18% (n = 3). Two patients died of multiorgan failure on the 4th and 7th postoperative day, one patient of a sepsis 44 days after operation. The duration of circulatory arrest was 32 minutes (range 11 - 61 min). Among the operative survivors, mean cardiopulmonary bypass time was 156 minutes, the aortic clamping time 96 minute.

Return to the operating room for control of hemorrhage was only required in one patient (6%). None of the surviving 14 patients developed a neurological deficit, and they were discharged from the hospital on the 13th to 42th postoperative day.

DISCUSSION

Our data show the efficacy and safety of profound hypothermia and circulatory arrest in reducing neurological complications after repair the aortic arch.

Previous techniques in reconstruction of the aortic arch have
included bypass with temporary tubes and separate perfusion on the
carotid or subclavian artery [2].

Since the early 1970's, the combination of profound hypo-
thermia and circulatory arrest [9] has been successfully used for
total replacement of the aortic arch. This technique was sub-
sequently popularized by Cooley [4], Livesay [8] and Crawford [5].
The application of this adjunct in the operative management of aortic
arch aneurysm has several technical advantages. The open, blood-
less arch may be inspected, especially all arch vessels, and the full
extent of the aneurysm can be determined. One of the most
important benefit of hypothermia is the protective effect on the
brain. In the series of Ergin and Griepp [6], none of their patients,
whose time of cerebral ischemia was less than 40 minutes had
neurological complications. In 5 out of 8 patients, who had a
cerebral ischemia time of more than 40 minutes died or developed
a stroke.

In our series the mean circulatory arrest time was 30 minutes
and none of our 17 patients had developed postoperative neuro-
lological complications. Our data, as well as other studies support the
contention that the circulation should not be arrested for longer
than 30 minutes. To decrease long cerebral circulatory arrest time,
we initiated antegrade cerebral perfusion after completion of the
distal anastomosis through the second arterial line, which was sutured
end to side into the graft. In contrast to retrograde perfusion through
the femoral artery, this technique prevents a possible perfusion of
the false lumen in case of chronic dissection.

In accordance to other authors [9] we also advocated the admi-
istration of methylprednisolone and thiopental as well as surface
cooling of the head, for additional cerebral protection.

Another important factor in postoperative mortality are bleeding
complications. In our series, we used Albumin coated grafts (Va-
scutek), which showed sufficient intraoperative hemostasis. One
rethoracotomy due to postoperative bleeding had to be done.

So finally we can conclude, that our experience with aortic arch
replacements using profound hypothermia and circulatory arrest
supports the contention, that it is the method of choice in this very
difficult surgical field.

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