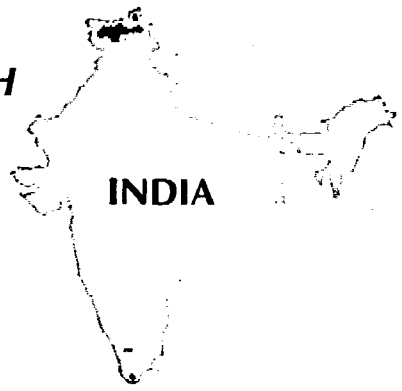
ORIGINAL CONTRIBUTION

SURGICAL TREATMENT OF ANEURYSMS OF THE ASCENDING AORTA AND AORTIC ARCH



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ABSTRACT

Surgery for aneurysms of the aorta is a formidable challenge especially when these aneurysms involve the ascending aorta and the transverse arch. We have used the technique of cardiopulmonary bypass, profound hypothermia and total circulatory arrest with marked reduction in neurological complications. Availability of albumin coated and gelatin sealed grafts, as well as blood components, has reduced the associated bleeding problems. Ninety-six patients with aneurysms of the ascending aorta and the transverse arch were operated upon between 1983 and 1993. Patients with aneurysms of the sinus of Valsalva have not been included in this study. Syphilitic pathology was predominant in the group with late presentation of very large aneurysms. The mortality was 17.71% and was largely due to low cardiac output, prolonged ventilatory support, lung infections, and mediastinitis.

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INTRODUCTION

The first definitive and successful resection of an aneurysm of the ascending aorta was reported more than 25 years ago[1]. Despite this, aneurysm surgery remains a formidable operation especially when it involves the ascending aorta and aortic arch. While in most developed countries the majority of patients nowadays present with aneurysms due to atherosclerotic process or dissection, we, in India, continue to see several patients of leutic pathology. In addition, most patients present late, often with severe compression of major airways or with the aneurysm eroding through the chest wall. In earlier years, results were disappointing and techniques such as carotid shunts and cerebral vessel perfusion were used to preserve cerebral integrity[2,3].

The use of cardiopulmonary bypass with profound hypothermia and circulatory arrest reported by Griepp and colleagues[4] in the treatment of aneurysms, helped overcome the major problems affecting neurological function. The purpose of this study was to analyze our data from patients operated upon for ascending aortic aneurysms and aortic arch aneurysms using cardiopulmonary bypass and deep hypothermia with or without circulatory arrest.

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PATIENTS AND METHODS

We have reviewed retrospectively 96 patients who were operated on for aneurysms involving the ascending aorta and/or transverse aortic arch from January 1, 1984 to December 31, 1993. Thirty-seven patients operated on for aneurysm of the sinus of Valsalva during the same period were excluded from the present study.

The patients were predominantly young males and there were only 4 females in the group. The average age was 38.78 years (range 19 to 70 years). While the majority of patients (n = 53) had syphilitic pathology, 17 patients had annuloaortic ectasia. Three patients had pseudoaneurysms following previous open-heart procedures. Only 2 patients were operated on for chronic dissecting aneurysms and the remaining 21 patients had aneurysms with atherosclerosis as the primary pathology (Table 1).

Clinical presentation was variable with symptoms mainly of dyspnea, cough, hemoptysis, aortic insufficiency and

often a pulsatile swelling on the chest wall. One patient, with a large pseudoaneurysm, presented with superior vena cava obstruction 2 years after coronary artery bypass surgery at the same hospital. All patients with annuloaortic ectasia and aortic valve insufficiency underwent cardiac catheterization and angiography. The remaining patients had a retrograde aortogram before the operation.

OPERATIVE TECHNIQUE

Some of the patients with severe airway obstruction required highly skilled anesthetic maneuvers including awake intubation in the sitting position. The main operative technique consisted of institution of cardiopulmonary bypass with femoral artery cannulation for arterial return and a single cannula in the right atrium for venous drainage. Thirty-eight patients had femoral vein-femoral artery bypass before sternotomy. We used profound hypothermia with total circulatory arrest in 61 of 96 patients. Profound hypothermia was achieved by core cooling with esophageal and rectal temperatures varying between 14°C and 23°C. Mean temperature was 22.28°C. Ice bags were kept around the head and intravenous sodium pentothal, mannitol, and steroids were used for cerebral protection.

Six of the 17 patients with annuloaortic ectasia had aortic valve replacement with tube graft replacement of the ascending aorta, while 10 had Bentall[5] and 1 patient had Cabrol[6] procedures. Patch aortoplasty was done in 22 cases of saccular aneurysms arising from the ascending aorta or the transverse arch of the aorta. Simple tube graft replacement was done in 8 patients with aneurysms of the ascending aorta, while 49 patients with aneurysms of the ascending aorta and/or aortic arch required tube graft replacement with re-implantation of the arch vessels into the tube graft. Varying periods of circulatory arrest were necessary in 61 of these patients.

Preclotted cooked woven grafts[7] were used until 1988, since then albumin or gelatin impregnated grafts have been used (Hemashield, Meadox Medical Inc., New Zealand; Gelseal Triaxial, Vascutek Ltd., Scotland, UK). Circulatory arrest periods varied between 9 and 109 minutes with an average of 41 minutes. Bypass time varied between 56 minutes and 330 minutes with an average of 122 minutes, and aortic clamp time between 40 minutes and 133 minutes with an average of 70 minutes. Re-warming was started after re-establishing circulation and adequate de-airing procedures.

RESULTS

For the purpose of this study, early mortality included all patients who died before they were discharged from the hospital or within 30 days of their original operation. A neurological event was defined as failure to regain consciousness or any localizing or diffuse neurological deficit which was not present during preoperative evaluation. There were 17 hospital deaths, giving a mortality rate of over 17% which is higher than other reported series[8]. Six of these 17 patients died within 24 hours of operation, without regaining consciousness. The immediate cause of death appeared to be related to excessive bleeding, disseminated intravascular coagulopathy and primary myocardial failure. Other causes of death included low cardiac output, renal failure, respiratory infections associated with prolonged ventilatory support and mediastinitis. At least 3 patients who required prolonged ventilatory support had major neurological problem (Table 2). Mortality related to different surgical procedures is illustrated in Table 3.

Neurological deficits of varying severity were also noticed in 4 other patients during their postoperative recovery. Two of these had complete blindness of both eyes with spontaneous recovery after 2 and 3 weeks respectively. Computed Tomography scans in these patients were non-

Table 1. Aetiopathology of Aneurysms of Ascending Aorta and Aortic Arch

Diagnosis	Number	Percentage
Syphilis	53	55.21
Atherosclerosis	21	21.88
Annuloaortic estasia	17	17.71
Dissection	2	2.08
Pseudoaneurysm	3	3.13
Total	96	

Table 2. Hospital Mortality and Causes of Early Deaths

Cause Related to Death	Number	Percentage
Myocardial failure and low cardiac output	6	6.25
Excessive bleeding, DIC	3	3.13
Neurological deficit	3	3.13
Mediastinitis	3	3.13
Renal failure	2	2.08

Table 3. Operative Procedures

Operation Performed	Number	Mortality
Patch Aortoplasty	22	2
Bentall Procedure	10	3
Cabrol Procedure	1	1
Tubegraft Replacement of Ascending Aorta	8	0
Tubegraft Replacement of Ascending Aorta/ Arch with Implantation of Arch Vessels	49	9
Tubegraft Replacement of Ascending Aorta & AVR	6	2
Total	96	17

Table 4. Postoperative Complications

Complication	Number	Percentage
Low cardiac output	17	21.52
Neurological deficit (Permanent deficit n = 2)	4	5.06
Renal dysfunction	12	15.19
Wound infection	6	7.59
Graft infection/infective endocarditis	2	2.53

contributory. Other postoperative complications included mild renal failure, wound infections, and bacterial endocarditis of the prosthetic valve (Table 4).

FOLLOW-UP AND LATE SURVIVORS

Seventy-seven patients were discharged from the hospital, 2 of them returned with infective endocarditis of the prosthetic aortic valve and died. Otherwise, follow-up has been poor, as most patients came from remote places. Letters were sent to all the patients recorded as "discharge from the hospital". Forty-eight patients reported in person and 4 sent letters expressing their inability to come to the hospital.

DISCUSSION

DeBakey and Cooley reported the first successful excision of fusiform aneurysm of the ascending aorta in 1956[1]. There are considerable variations in the techniques and outcome of surgical treatments since then. Inconsistent and often disappointing results made aneurysm surgery a formidable challenge for most cardiovascular surgeons. The variations in the techniques were largely due to the inconsistency in the support techniques used for preserving neurological functions[6,7].

Griepp and coauthors[2] reported the use of profound hypothermia and circulatory arrest for the repair of aneurysms of the ascending aorta and transverse aortic arch. This technique, bereft of all complexities, solved major technical problems and became popular, with most centers reporting acceptable morbidity and mortality rates[8,9]. However, the majority of these reports concerned patients operated on for aneurysms associated with dissection and atherolsclerosis[9] and patients in the advanced age group. In contrast, our patients were young and the majority of them had aneurysms of syphilitic etiology. The higher mortality may be explained by the fact that these patients presented very late and with severe compression of airways and consequent lung infections. As a result, many patients required prolonged ventilation because of lung infection and developed mediastinitis. Neurological complications were minimized by the technique of profound hypothermia and circulatory arrest. More sensitive tests might have detected subtle neurological deficits, which were not evident clinically. Excessive bleeding was noticed in early cases. With the availability of gelatin/albumin coated grafts, as well as fresh frozen plasma, platelet concentrates and cryoprecipitate, the bleeding problems were significantly reduced.

Okamoto and colleagues[10], and Ueda and colleagues[11] have reported better preservation of neurological function using retrograde cerebral perfusion. Bachet and colleagues[12] advocated cold cerebroplegia for cerebral protection. However, these techniques require separate pumps, adding to the complexity of the perfusion techniques. Similarly, there are recent reports of retrograde total body hypothermic perfusion, both experimentally and clinically[13,14] being used in the management of aneurysms of aortic arch. These are all exciting areas for further exploration.

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