SHORT REPORT

Clipping of cerebral aneurysm under hypothermic cardiac arrest and simultaneous coronary artery bypass grafting: case report

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This report describes a case where joint neurological and cardiac surgery teams cooperated to perform simultaneous procedures of clipping a complex internal carotid artery under hypothermic cardiac arrest and coronary artery bypass grafting. A 69 year old man was evaluated for complaints of double vision, pain behind his right eye, and progressively worsening headaches. Examination showed bilateral upgoing toes and difficulty performing a tandem gait. The patient had a history of myocardial infarction. Brain MRI showed a 1.6 cm diameter, partially thrombosed aneurysm of the right internal carotid artery and posterior communicating artery. Cardiac catheterisation showed critical coronary artery disease of the distal segment of the right coronary artery with 90% stenosis of the midcircumflex artery and an ejection fraction of 40%. After initial exposure of the aneurysm, the cardiac team instituted hypothermic cardiac arrest (21°C). The aneurysmal sac was collapsed and dissected from the surrounding perforators. An encircling fenestrated clip was applied and a small part of the neck of the aneurysm was further clipped with straight clips. The cardiac surgery team performed the coronary artery bypass grafting procedure. The patient recovered fully, returned to his normal activities, and is functioning independently.

Hypothermic circulatory arrest has been used successfully during surgery for complex cerebral aneurysms and some cardiac conditions.^{1–4} We report a case in which hypothermic cardiac arrest was used for cerebral protection during clipping of a complex internal carotid artery aneurysm and, at the same time, coronary artery bypass grafting (CABG) was performed. A review of the literature does not show any previous report of simultaneous procedures of cerebral aneurysm clipping and CABG surgery.

CASE REPORT

The patient, a 69 year old man, was evaluated for complaints of double vision, pain behind his right eye, and progressively worsening headaches. Neurological evaluation showed bilateral upgoing toes and mild difficulty performing a tandem gait. Brain MRI showed a 1.6 cm diameter, partially thrombosed aneurysm of the right internal carotid artery (ICA) and posterior communicating artery region.

Vessel angiography showed a large globular aneurysm of the supraclinoid portion of the right ICA arising posteriorly and inferiorly, probably of the right posterior communicating artery or less likely the anterior choroidal artery. The neck of the aneurysm was not clearly defined. The left ICA was complete occluded. The right posterior cerebral artery filled directly from the right internal carotid artery. A patent

anterior communicating artery was present. The distal right vertebral artery was not visualised and the left vertebral artery had moderate narrowing at the origin of the left vertebral artery (fig 1 A).

The patient had a medical history of coronary artery disease after a myocardial infarction and angioplasty 9 years before this current evaluation. With stress testing, ventricular function was moderately depressed. The cardiac team performed a cardiac catheterisation for further evaluation before surgery for the aneurysm. Multivessel coronary artery disease was noted with critical disease in the distal segment of the right coronary artery with 90% stenosis of the mid-circumflex artery and an ejection fraction of 40%. Because of the combined problems of a complex cerebral aneurysm and severe cardiac disease, the surgical teams decided to do concomitant clipping of the aneurysm and CABG procedures.

Surgical procedure

The procedure for using profound hypothermia and cardiac arrest was followed, as has been described by others.² The cisterns were opened and the anterior choroidal vessel was identified. The posterior communicating artery, part of the aneurysmal complex, and the atherosclerotic and calcified parts of the aneurysm were seen. The cardiac team put the patient on the bypass pump, and further dissection was performed under low flow. Hypothermic (21°C) cardiopulmonary arrest was performed by the cardiac team. The aneurysmal sac was collapsed and dissected from the surrounding perforators. An encircling fenestrated clip was applied. A small part of the neck was left and it was clipped with 2 long straight clips (fig 1 B). The clipping procedure was performed during 15 minutes of cardiac arrest. After this, the patient was rewarmed and the cardiac surgery team performed the CABG procedure. The total bypass time was 138 minutes.

Postoperatively, the patient developed some dysphagia requiring PEG tube placement. This resolved in 4 weeks. He also had a mild left hemiparesis, balance deficits, and cognitive impairments, which lasted for about 5 weeks. However, he made a remarkable recovery and at present is able to walk without assistance, drive a car, and is functioning independently. He has returned to all his preoperative activities.

DISCUSSION

This report describes an unusual surgical case in which simultaneous procedures were performed for a complex cerebral aneurysm and severe cardiac disease. The decision to perform both procedures was based on the severity of both conditions. The right ICA aneurysm was large with an ill defined neck, the

Abbreviations: CABG, coronary artery bypass grafting; ICA, internal carotid artery

Figure 1 (A) Anteroposterior radiographic view of an arteriogram of the right carotid before surgery shows a large globular aneurysm with an ill defined neck. (B) The anteroposterior radiographic view that was obtained postoperatively shows complete obliteration of the aneurysm.

left ICA was occluded, and the patient had concurrent significant vertebral artery stenosis with the right posterior cerebral artery filling from the right ICA. Therefore, it was thought that the use of a temporary vessel occlusion technique would be risky and that global cerebral protection using marked hypothermia would be a reasonable way to allow clipping of the aneurysm. Because the patient also had appreciable coronary artery disease, the cardiac surgery team decided that CABG was indicated. The surgeons were concerned about anticoagulation and the possibility that the aneurysm might bleed. Because of significant peripheral vascular disease, a sternotomy was necessary for cardiopulmonary bypass and hypothermic cardiac arrest. Both teams agreed that performing the surgeries concomitantly would be the best and most efficient treatment approach for the patient.

Cerebral aneurysms that are simple and small can be clipped using focal hypotension and temporary clipping. With complex aneurysms that do not have a defined neck, temporary clips can slip off the sac and occlude the parent vessels or its branches.^{1,2,3} Several advantages exist for using hypothermic cardiac arrest during clipping of complex aneurysms. A bloodless surgical field provides for excellent visualisation. The lack of circulation eliminates the danger of aneurysmal rupture and allows for a collapse of the aneurysm, which aids in the identification of the parent artery. The base of the aneurysm is sometimes hidden by the sac, and the parent artery can only be seen by rotating the sac. The ability to manipulate the aneurysmal sac provides for a safer dissection and more precise application of the clips.²

The initial use of extracorporeal circulation and profound hypothermia to treat intracranial aneurysms was not reliably successful.^{6,7} Recent reports, however, have shown that deep hypothermic cardiac arrest can be used safely and effectively with giant and complex cerebral aneurysms.^{1-3,8,9}

When a patient has severe cardiac disease in combination with a complex cerebral aneurysm that would be best clipped under hypothermic cardiac arrest, surgeons have a treatment dilemma. Mayer *et al* describe this dilemma in a case report of a 63 year old man who was evaluated 2 weeks after a subarachnoid haemorrhage.¹⁰ The patient had severe angina and hypertension. An angiogram showed multiple cerebral aneurysms of the basilar artery, anterior communication artery, and portions of the internal carotid arteries. A coronary arteriography showed 70% stenosis of the left main coronary artery and occlusions of the left anterior descending artery and right coronary artery. The cardiac team requested that neurosurgery be done to clip the aneurysms before a CABG procedure could be performed. The neurosurgeon thought that the patient should have myocardial revascularisation before undertaking the risk of neurosurgery. The CABG procedure was performed successfully under mild hypothermia (28°C). There was no report of treatment for the aneurysms.

Even at specialised medical centres, where treatment for complex aneurysms is common, cardiac arrest surgery is performed in only 1% to 5% of cases.¹ To perform simultaneous procedures, as described in this case, a high level of surgical experience and cooperation between two surgical teams is required. Also, sufficient operating room space and electrical supply must be available to accommodate the surgical equipment and personnel needed for both procedures.¹ The occasion will be rare when a surgeon will encounter a patient who might benefit from simultaneous CABG and clipping of an aneurysm under cardiac arrest.

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