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Case Report

Hypothermic cerebral protection for a patient undergoing aorto-carotid bypass

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Abstract

We present a case of Takayasu arteritis with a history of double valve replacement undergoing aorto-carotid bypass and describe the anaesthetic management aimed at preserving cerebral function and protecting the cardiovascular system. The 17-year-old girl presented with recurrent loss of consciousness and absent bilateral radial artery pulses. She had total occlusion of the bilateral carotid arteries and cerebral blood flow was completely dependent on the vertebral artery. Partially clamping the aorta and carotid artery along with hemodynamic effects of general anaesthesia may further compromise the critical cerebral blood flow leading to cerebral injury. So we planned hypothermia for cerebral protection. Since she had to undergo re-sternotomy and with the possibility of haemorrhage during re-sternotomy; femoral artery and vein cannulation was done and cardiopulmonary bypass pump was started before sternotomy. Cooling was started effectively on cardiopulmonary bypass. Our aim was to provide cerebral protection by induced hypothermia at 25 degree Celsius and support of circulation with cardiopulmonary bypass. Aorto-left carotid artery bypass graft was placed with postoperative improvement in symptoms of the patient at one year follow up. A brief review of the perioperative anticoagulant management in such patients with prosthetic mechanical valves is also mentioned. Hence hypothermia and support of circulation with cardiopulmonary bypass can be considered in a patient with critical cerebral blood flow.

Keywords: cardiac valve prosthesis; cerebral revascularization; Takayasu arteritis.

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Introduction

Reestablishing carotid artery flow by aorto-carotid bypass in a patient with Takayasu arteritis is a complex task. The situation becomes more complex if the cerebral blood flow is entirely dependent upon a single vertebral artery. While many interventions like high-normal blood pressure, moderate hypocarbia, barbiturates, placement of shunts have been recommended for brain protection¹; this case highlights the prospects of deep therapeutic hypothermia under cardiopulmonary bypass for cerebral protection.

Case Report

A 17-year-old lady with Takayasu arteritis presented with a history of recurrent dizziness for 2 years and several episodes of loss of consciousness. There was no such history in her family. She had undergone mechanical double valve replacement 3 years back. Preoperative evaluation of the patient revealed absent pulses in radial and carotid arteries bilaterally. Pulses were present in both the lower limbs. Computed tomography angiogram showed complete occlusion of the right brachiocephalic trunk, proximal common carotid artery bilaterally, right subclavian artery. There was critical stenosis of left subclavian artery at its origin. Duplex carotid and vertebral sonography showed no flow in bilateral common carotid arteries and limited flow in right vertebral with the good forward flow in left vertebral arteries. She was anaemic with haemoglobin of 8.8 gm%. Rest of the laboratory values were within the normal range. A lateral chest radiograph suggested adhesions between the sternum and anterior aspect of the heart. Echocardiogram showed normally functioning prosthetic valves. Since all the major arch branches of aorta were affected by the disease process, aorto-carotid bypass was planned.

The patient was on warfarin which was stopped 5 days prior to surgery. Unfractionated Heparin infusion was started next day to achieve aPTT 1.5 to 2 times control. Heparin infusion was stopped four hours before the operation.



Figure 1: CT angiogram of ascending aorta, its major branches and carotid and vertebral circulation. Note the complete occlusion and stumps of all three branches of the aortic arch.

In the operating room, standard monitors were connected; the arterial lines were placed in the left femoral artery and right radial artery under ultrasonographic guidance. Anaesthesia was induced with Propofol, Fentanyl and Vecuronium and orotracheal intubation was performed. Isoflurane in oxygen was used for maintenance of anaesthesia. Overextension of head during laryngoscopy was avoided. The left temporomandibular joint was subluxated and the endotracheal tube was placed in the retromolar space. The central venous catheter was placed in the right subclavian vein. After heparinization, right femoral artery and femoral vein were cannulated and cardiopulmonary bypass was initiated. The patient was cooled down to 25°C. During bypass Propofol infusion was used for maintenance of anaesthesia and perfusion pressure was kept between 60-70 mm of Hg. The patient also received Hydrocortisone 100 mg and PaCO₂ was maintained between 35-45 mm of Hg. Midline sternotomy was done and left carotid artery was dissected. The left common carotid artery was thickened and occluded but a distal 3mm segment in the internal carotid was free of disease. A ringed tube graft was anastomosed end to side at distal left internal carotid artery and ascending aorta.

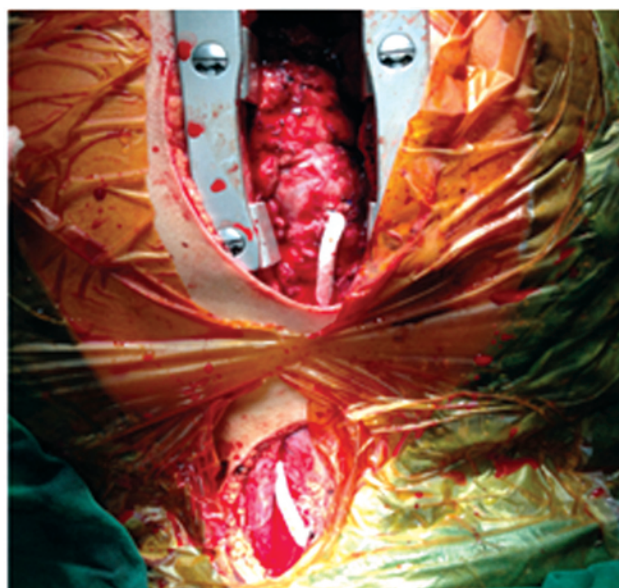


Figure 2: Operative picture after graft placement from ascending aorta to left carotid artery

The patient was rewarmed and weaned off CPB uneventfully. At the end of surgery, jaw was reduced to its natural position. Postoperatively, the patient was kept under controlled ventilation and extubation of trachea was done once completely awake without neurological deficit. Postoperative bridging was achieved with Heparin and Warfarin 5 mg per oral. Antihypertensive and antiplatelets were also started. Heparin infusion was stopped once INR

was 2.6. Postoperative period was uneventful and the patient was discharged on 7th postoperative day. On follow-up after one month and one year, she had no complaint of loss of consciousness or dizziness.

Discussions

Patient with Takayasu arteritis, a non-specific inflammatory granulomatous panarteritis of medium and large-sized arteries, may present with carotid stenosis.¹ Our case had critical cerebral blood flow and prosthetic double valves with anticoagulants. We faced a challenge to come up with the proper anaesthetic plan and special perioperative attention. Cerebral protection was of importance as the cerebral blood flow was critical with occlusion of most of the major vessels supplying the brain.

This case presented with fainting attacks and had critical stenosis of bilateral common carotid arteries. The case was a redo sternotomy with a risk of sudden hemodynamic instability due to tear of cardiac wall during sternotomy and tissue dissection around mediastinum, hypothermia to 25 degrees Celsius was induced for cerebral protection with CPB initiated through the femoro-femoral bypass. Hypothermia reduces cerebral metabolism and reduces the release of the substrate associated with tissue injury.² Hypothermia for cerebral protection in carotid surgeries has been described previously also.³

Intraoperative neurophysiologic monitoring such as electroencephalography, transcranial Doppler, and near-infrared cerebral oximetry are very useful. But such technologies were unavailable and we planned for deep hypothermia for proper cerebral protection.

In Takayasu arteritis patients, a catheter placed in the radial and femoral artery is useful for confirming the presence of adequate perfusion pressure. Hyperextension during ventilation and laryngoscopy should be avoided as limited blood flow to the brain may further become compromised. The assessment of the effect of changes in head position on cerebral function during the preoperative visit should be done.⁴ Chronic corticosteroid therapy may indicate the need for the supplemental perioperative exogenous corticosteroid.

Selection of short-acting anaesthetic drugs and use of volatile anaesthetic like isoflurane for maintenance of anaesthesia is believed to maintain cerebral blood flow and provide neuronal protection by inducing nitric oxide synthase. A normal blood pressure should be targeted. Hyperventilation should be avoided because of its effect on cerebral blood flow.⁵ Bridging of warfarin was achieved with unfractionated heparin according to recent guidelines.⁶ We had subluxated the left temporomandibular joint to expose distal part of the carotid artery to perform anastomosis at more distal level.

The trachea was extubated in the intensive care unit after verifying neurologic integrity. Postoperative baroreceptor dysfunction may indicate the use of vassopressor.⁵

Hyperglycemia should be avoided and has been associated with worsened neurologic recovery. Postoperative resumption of anticoagulants and the antihypertensive agent is important. Heparin bridging and recommencement of warfarin should be delayed after surgery until there is adequate hemostasis.⁶

In conclusion, brain protection with induced hypothermia under cardiopulmonary bypass can be considered for patients with Takayasu arteritis with critical cerebral blood flow. A proper perioperative plan and attention will help one smoothly manage such a complex case.

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