

Rapid Communication

Extended use of cardiopulmonary bypass in a multidisciplinary hospital

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Abstract

Objective: To share our experience highlighting the additional use of cardiopulmonary bypass (CPB) in cases other than the conventional ischemic, congenital and valvular heart diseases.

Methodology: All patients undergoing non-traditional cardiac surgery utilizing the cardiopulmonary bypass during a period from 1999 to 2009 reviewed. Their preoperative presentation, operative strategy and immediate postoperative status were assessed.

Results: A total of six such cases were identified including three female and three male patients. Two patients presented with road traffic accident having aortic transection along with other injuries. They underwent repair utilizing partial cardiopulmonary bypass. One patient presented with large PDA aneurysm and symptoms related to its pressure effect on respiratory system. He underwent repair under hypothermic circulatory arrest. These three patients were done via left thoracotomy. Three patients underwent deep hypothermic circulatory arrest, one for removal of thrombus from right atrium after complicated liver abscess, one patient required vascular graft interposition in left internal carotid artery for aneurysm extending into cranium and the third one underwent resection of vascular tumor of posterior cranial fossa. One patient required exploration for bleeding. One patient died after prolonged hospitalization. Rest of the patient had unremarkable postoperative course and were discharged home.

Conclusion: Our short experience highlights the extended use of cardiopulmonary bypass in a multidisciplinary hospital, facilitating to perform complex, technically challenging non cardiac procedures which otherwise may not be possible.

Key words: *Multidisciplinary hospital, Cardiopulmonary bypass, Deep hypothermia.*

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Introduction

The success of first human cardiopulmonary bypass (CPB) using heart lung machine proved to be the foundation stone of modern cardiac surgery era. Its major components are the pump and an oxygenator taking over the function of heart and lungs hence called heart lung or cardiopulmonary bypass machine. Its effectiveness and efficiency has made it an indispensable tool for the cardiac surgeon today. ⁽¹⁾ CPB circuits can also cool or rewarm blood. Blood cooling using CPB with subsequent deep hypothermic circulatory arrest permits surgical reconstruction of the great vessels and other complex congenital procedure whilst limiting ischemic damage, in particular to the brain and spinal cord. ^(2, 3)

Due to technical advancement and increase safety of cardiopulmonary bypass, its uses are stretched for non-traditional cases and the extended indications are well established. ⁽⁴⁾ The aim of this study is to share our short experience highlighting extended use of CPB for infrequently performed procedures in a multidisciplinary setting in this part of the world.

Methodology

All patients undergoing non-traditional cardiac surgery utilizing the CPB during a period from 1999 to 2009 were reviewed for the purpose of this study. The surgical strategy was variable depending upon the intervention required. All the six cases are described separately due to variable pathology and management.

Results

Clinical Summaries

PATIENT 1. A 32 years old gentleman with long standing history of high grade fever with rigors presented to us and on investigations found to have marked leukocytosis and a liquefied large abscess in the liver which was drained under ultrasound guidance. His CAT scan and subsequent echocardiography confirmed a thrombus in the inferior vena cava (IVC) with its free mobile extension into right atrium with high likelihood of embolization. A decision was made to perform open heart surgery and remove the thrombus. Through a median sternotomy approach (CPB) was

established. The patient was cooled and circulation was stopped at 20°C for 15 minutes. Right atrium was opened and all the clots were extracted from IVC and hepatic vein and atriotomy was closed. The circulation was restarted as well as rewarming with subsequent weaning from CPB.

PATIENT 2. A 30 year old woman presenting with neck swelling diagnosed to have left internal carotid artery aneurysm following a clinical and radiological evaluation **Figure 1**. She was admitted for surgical repair with the understanding that she might require procedure to be done under deep hypothermic circulatory arrest (DHCA) utilizing CPB because of the extension of the aneurysm into the cranium. After initial dissection and achieving proximal control it was acknowledged that distal clamping is not possible so partial median sternotomy was performed to establish CPB and cooling to a depth of 18°C. The circulation was stopped for 30 minutes and a polytetrafluoroethane (PTFE) graft was interposed after resecting the aneurysm.

PATIENT 3. A 25 years old lady presented with road traffic accident sustaining poly trauma. She was investigated and a CAT scanning of chest showed aortic transection with pseudo-aneurysm formation. She was taken to the operating room and thru left thoracotomy the proximal and distal control was achieved with gentle dissection. At this stage patient was heparinized and partial left heart bypass established using cannulation of descending aorta distal to pseudoaneurysm and main pulmonary artery for venous return. The clamps were applied proximal and distal to the aneurysm. Aortic transection identified and a piece of Dacron graft was interposed. She was discharged on 14th post-operative day after gradual and smooth recovery.

PATIENT 4. A 40 years old lady with road traffic accident, sustaining poly trauma including trauma to right kidney, open fracture of right femur and descending aortic transection. She underwent repair with Dacron patch on partial left heart bypass as detailed above. She also underwent IM nailing for femur fracture. She was discharged home on 13th post-operative day.

PATIENT 5. A 35 year old male, diagnosed incidentally with a PDA fifteen years ago, presented with complains of shortness of breath, hoarseness of voice and chest pain radiating to his neck for the past three months. Following clinical evaluation he underwent investigations including echocardiographic analysis and computed tomography angiogram. The results demonstrated aneurysmal dilatation of a patent ductus arteriosus measuring 8 x 8.6 x 9.3 cm with tiny communication with the pulmonary artery. The aneurysm was approached through left posterolateral thoracotomy and after heparinisation CPB was established followed by systemic cooling to achieve circulatory arrest. During cooling dissection continued around PDA aneurysm. Circulation stopped at 24°C. The aneurysm was opened and a communication to pulmonary artery was identified and repaired with a patch of vascular graft (Dacron). The continuity between the aortic arch and descending aorta was restored by interposing size 18 Dacron graft. The perfusion was restarted the distal anastomosis was performed during rewarming and the patient was weaned off from CPB smoothly. He required exploration for bleeding in the immediate post OP period. Subsequent postoperative course was unremarkable.

PATIENT 6. A 35 year old gentleman presented with headache, vertigo and tremors. He was investigated and found to have space occupying lesion in the posterior cranial fossa. Due to the increased vascularity of tumor it was decided to use CPB to achieve deep hypothermia and minimal blood flow to have relative avascular field. The lesion was approached by craniotomy by a neurosurgical team while cardiac surgical team established CPB via femoral artery and vein. Intraoperative trans-esophageal echocardiography was used to monitor the decompression of the heart. A temperature of 17°C was achieved and blood flow was minimized. The tumor was resected and the patient was rewarmed and weaned off CPB. He was shifted to intensive care unit and got extubated; however his subsequent hospital course was complicated by pulmonary embolism and sepsis along with watershed infarct and died on 45th postoperative day.



Figure 1. Angiogram showing extracranial internal carotid artery aneurysm

Discussion

Cardiopulmonary bypass machine represent one of the most important invention of biomedical technology in the history of health Sciences. Application of CPB has not been given much attention in non-conventional cardiovascular surgeries because of two reasons. Firstly, morbidities associated with it including procedural and related to non-physiological and non-pulsatile flow through artificial circuit leading to increased activation of inflammatory mediators with their inherent adverse impact. ⁽⁵⁾ Secondly, it also require multidisciplinary facility since trauma and liver abscesses and even vascular pathology in general are not entertained at hospitals which only caters patients requiring cardiovascular surgeries.

Our unit is a multidisciplinary hospital with various disciplines of Medicine and Surgery and providing care to trauma victims as well in the discipline of Emergency Medicine. In this short experience we have tried to appreciate the extended role of CPB in non-conventional cardiovascular surgeries. Although there are numerous publications about these procedures on CPB from rest of the world, to our knowledge this is first such report about these infrequently performed procedures from our country. Further in our country only a few multidisciplinary units have facility to perform complex cardiovascular and thoracic procedures. In all of the six cases CPB was

established using heart lung machine to facilitate these procedures. The open repair of traumatic aortic transection was performed on partial left heart bypass, however the other possible way of dealing is recently popularized endovascular repair which need appropriate device and expertise in its deployment. ^(6, 7) The internal carotid artery aneurysms extending into cranium are repaired without the use of CPB as well. In our case because of inadequate distal control and to achieve that without CPB might have endangered the cranial nerves in that area so the repair was performed with graft interposition on deep hypothermic circulatory arrest and this technique has been described in several reports including ours. ^(8,9) One of our patients had hemangioblastoma and CPB was used to achieve hypothermia and low flow as these tumors tend to have increased tendency to bleed and at times they even dictate use of DHCA intraoperatively to facilitate resection. ⁽¹⁰⁾ In this patient we established peripheral bypass and to maximize venous drainage, a biomedicus pump was used and intraoperative transesophageal echocardiography helped us monitor the distension of the heart. Thrombosis of the IVC extending into right atrium is one of the rare complications of amoebic liver abscess and can be managed with antimicrobials and radiologically. ⁽¹¹⁾ However in our patient due to embolization into pulmonary tree causing severe dyspnea and hemoptysis, evacuation of thrombus through right atrium was carried out. All the patients did well as far as use of CPB is concerned and there were no perioperative and immediate postoperative complications, except in one case that died after prolonged hospitalization not related to CPB.

Conclusion

This short experience highlights the importance and extended scope of biomedical technology of cardiopulmonary bypass in a multidisciplinary hospital, and is going to help increasing the awareness in our medical community and many more cases that may appear inoperable might be offered a chance of treatment.

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