How-to-do-it

Antegrade cerebral perfusion by axillary artery and left carotid artery inflow at moderate hypothermia

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Abstract

Cerebral protection during hypothermic circulatory arrest was obtained by combining right carotid perfusion through the axillary artery with selective perfusion of the left common carotid artery in ten patients. We believe that the proposed technique offers several advantages. (1) The axillary artery is generally free from atherosclerosis. (2) It eliminates the risk of retrograde embolization. (3) It provides antegrade perfusion of the true lumen in aortic dissection. (4) Antegrade cerebral perfusion is never interrupted. (5) Bihemispheric perfusion is assured. (6) The risk of air embolism during carotid cannulation is reduced.

Keywords: Axillary artery; Cerebral perfusion

1. Introduction

Axillary artery inflow for cardiopulmonary bypass can be directly cannulated or connected to the arterial line by a graft interposition. The occlusion of the innominate artery allows selective cerebral perfusion through the right carotid artery during periods of systemic circulatory arrest but some concern about the safety of the left hemisphere exists. To overcome this potential problem we combined right carotid artery perfusion through the axillary artery with selective perfusion of the common left carotid artery in ten patients: five cases of chronic aneurysms and five cases of acute type A dissection.

2. Surgical technique

The right and left radial artery were cannulated for pressure monitoring. A 6-cm-long skin incision was made under the clavicle. The pectoralis major was divided and when necessary also the pectoralis minor. The axillary vein was retracted. The axillary artery was identified and carefully exposed paying attention to the brachial plexus that lies laterally and anterior to it. After heparin administration, an 8 mm Hemashield Gold vascular graft (Meadox Medicals, Inc, Oakland NJ, USA) was anastomosed end to side to the axillary artery with 6-0 polypropylene suture and connected to the arterial line as described by Baribeau et al. [4]. Atriocaval cannulation was used for venous return. Cardiopulmonary bypass was started. Before the arrest the rectal temperature was lowered to 22°C for visceral protection, the innominate artery was clamped and the pump flow was reduced to 10 ml kg⁻¹ min⁻¹. The aorta was opened and the left carotid artery was identified from the inside of the arch and it was selectively cannulated with a Retrotex perfusion catheter (Baxter Health Corporation, Irvine, CA, USA). Blood flowed back into the carotid catheter which was connected to a separate roller pump avoiding, therefore, the risk of air embolism. The cerebral blood flow was maintained at 10 ml kg⁻¹ min⁻¹ with a right radial artery pressure between 40 and 70 mmHg equally divided between the main second pump (Fig. 1). The left subclavian artery was clamped or occluded from the inside with Foley catheter only when there was too much back flow obscuring the operating field. When the arch procedure was ended the left carotid perfusion stopped, the carotid catheter was withdrawn and the main pump flow was increased to 10 ml kg⁻¹ min⁻¹. The air and debris were easily removed from the arch and the graft was clamped. The innominate artery clamp was then removed and the rewarming started through the appropriate main pump flow. The rest of the procedure was carried out as usual. After protamine administration, the axillary artery graft was cut and oversewn with a 5-0 polypropylene suture leaving a little Dacron patch.

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3. Discussion

For an operation that requires circulatory arrest it is necessary to resolve two main problems: the choice of arterial inflow for cardiopulmonary bypass and the choice of the cerebral protective strategy. For the first, the common femoral artery is the most commonly used site for arterial inflow, but this route cannot be available in all cases because of severe iliofemoral disease and it can expose to the risk of retrograde atheroembolism from atherosclerotic aorta [1]. To overcome these problems the axillary artery and innominate artery have been proposed as an alternative inflow [1–5]. For the second, in order to guarantee cerebral protection there are several options [6]. (1) Deep hypothermic circulatory arrest offers only about 45 min as a relatively safe period to perform the procedure. (2) Retrograde cerebral perfusion has gained popularity in the last decade allowing a longer safe period of circulatory arrest. (3) Antegrade selective cerebral perfusion at 22°C of rectal temperature has been proven a reliable technique to protect the brain without the drawback of more deep hypothermia [7–8]. During the last year we operated on ten patients in hypothermic circulatory arrest, five with chronic aneurysms and five with acute type A aortic dissection. We used the right axillary artery for arterial inflow. Because selective cerebral perfusion was our technique of choice for cerebral protection for several years, we have simplified this procedure by clamping the innominate artery for right carotid perfusion and by using only the selective cannulation of the left carotid artery. Although in our initial experience the number of patients is limited and does not allow any statistic evaluation, our results with this high risk group, are encouraging. The early mortality of 10% and the absence of any major neurologic complications suggest the reliability of the technique. We believe that the proposed technique is easy and offers several advantages over those previously reported. (1) The axillary artery is generally free from atherosclerosis even in the presence of severe aortoiliac disease. (2) In the surgery of aortic dissection it provides antegrade perfusion of the true lumen when the circulation is resumed after distal anastomosis avoiding the need of graft cannulation. (3) Antegrade cerebral perfusion is never stopped. (4) Bihemispheric perfusion is assured having only one cannula in the operating field. (5) The risk of air embolism during the carotid cannulation is reduced because of the back flow through the left carotid artery. (6) Deairing at the end of the arch procedure is very easy to obtain.

References