Cannulation and perfusion strategy in acute aortic dissection involving both common carotid arteries

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INTRODUCTION

Acute aortic dissection involving the common carotid artery (CCA) frequently causes cerebral malperfusion, increasing the risk of adverse surgical and/or neurological outcome. Cases with dissection of both CCAs are particularly challenging and demand a well-considered surgical technique, especially in regard to cannulation and perfusion.

CASE REPORT

A 65-year old female undergoing chemotherapy due to breast cancer suffered acute pain in the neck and both ears accompanied by visual defects in both eyes and paraesthesia in both arms. She was partially lethargic and not responsive. The computed tomographic (CT) angiography of the chest, neck and head revealed an acute type A aortic dissection extending up to the aortic isthmus (Fig. 1). According to our own classification [1], which takes into consideration the distal extent of dissection (D) and the location of the intimal tear (E) in the three main segments of the aorta (a: ascending aorta, b: aortic arch, c: descending aorta), she presented Type D-ab and E-ab. The innominate artery (IA) and both CCAs were also dissected, presenting severely narrowed true lumen (Fig. 2). The patient was referred to our centre and operated on an emergent basis. The intraoperative neurovascular monitoring consisted of arterial pressure lines in both radial arteries, electroencephalography and near-infrared spectroscopy (NIRO 200, Hamamatsu Phototonics, Hamamatsu, Japan). At the beginning of surgery, the regional cerebral tissue oxygenation [tissue oxygen index (TOI)] was ~55–60% without considerable differences between the sides. The arterial line was bifurcated to cannulate the CCA and femoral artery as described previously [2]. After separation of the right CCA on the neck, we encountered circumferential dissection that made side-graft anastomosing, which is normally performed at the undissected part of the artery [3], impossible. Firstly, the femoral artery was cannulated, and mild systemic cooling with an arterial blood temperature of 28°C was initiated. Yet, after establishment of cardiopulmonary bypass, there was continuous decrease of TOI on both sides, indicating insufficient cerebral perfusion. To enable anastomosis of the side graft and improve cerebral perfusion before starting with the arch repair, an ~2-cm-long part of the CCA was resected, and a correspondingly long, 8-mm-wide Dacron graft (InterGard; InterVascular, MAQUET Cardiovascular, La Ciotat, France) was interposed. During the sewing of the end-to-end anastomoses between the graft and the proximal and distal part of CCA with 6-0 continuous sutures, the layers of the dissected wall were approximated, resulting in restoration of the true lumen. A side graft was then anastomosed onto this interposition graft end-to-side, and connected with a second arm of the bifurcated arterial line in the usual manner to ensure sufficient cerebral perfusion during cardiopulmonary bypass and unilateral cerebral perfusion without the need to cannulate the dissected arch arteries with balloon catheters during circulatory arrest [3]. Immediately after establishment of the perfusion through the carotid line, the TOI increased on the right side from 38 to 74% and on the left side from 40 to 66%. A curative aortic replacement of the entire dissected aorta was achieved, for which a total arch repair and a root remodelling with replacement of the dissected non-coronary and right-coronary sinuses were
performed. The arch was replaced using a quadrifurcated prosthesis (InterGard Aortic Arch; InterVascular, MAQUET Cardiovascular). The circumferential dissected left CCA and IA were anastomosed with corresponding arms of the arch graft in the end-to-end manner, approximating the layers of the dissected wall. Yet, because anastomosis of the severely damaged IA was very problematic, and the quality of the anastomosis questionable, we decided to apply an additional aorto-carotid bypass, even if after reestablishment of antegrade perfusion, there were no signs of insufficient right-sided brain perfusion in the neurovascular monitoring. For this purpose, we simply used the cannulation arm from the CCA and the cannulation arm of the arch prosthesis, and anastomosed them end-to-end after terminating cardiopulmonary bypass (Fig. 1).

The circulatory arrest of the lower body (26 min) was performed under moderate hypothermia (29.6°C) and unilateral cerebral perfusion, which lasted 65 min altogether. The patient was extubated 10 h after surgery without any neurological symptoms, and the postoperative course was uneventful.

DISCUSSION

Cerebral malperfusion caused by bilateral involvement of CCAs into the process of acute aortic dissection is generally associated with higher risk of permanent neurological injury, and therefore several sophisticated methods of restoring adequate perfusion have been described [4, 5]. Such an injury can develop from the...
initial cerebral malperfusion that already existed before the patient's presentation or during surgical repair. The low-pressure phases during surgery and extracorporeal circulation can lead to impaired cerebral perfusion, especially if the arterial cannulation site is localized below the critical stenosis of the supra-aortic vessels. As demonstrated in the case reported, the initially encountered low cerebral oxygenation did not improve but even decreased after establishment of cardiopulmonary bypass with an arterial input localized in a femoral artery. The same could be expected, if the aorta or axillary artery had been cannulated. True lumen cannulation of the dissected CCA ensures, in such situations, sufficient cerebral perfusion, and it is therefore strongly recommended by our group [3]. We have previously demonstrated that true lumen cannulation by anastomosing a side graft to the undissected part of the CCA wall can be performed safely and simply [3]. However, in cases with circumferential or almost circumferential dissection, anastomosing a side graft to the dissected artery is impossible. In such cases, however, the side graft cannulation can be performed with an interposition graft. This technical solution offers, as demonstrated, a very efficient tool to maintain sufficient cerebral perfusion during both extracorporeal circulation and arch repair under circulatory arrest of the lower body, avoiding a direct cannulation of the dissected arch arteries with balloon catheters. And lastly, in cases with extensive IA pathology, an additional aorto-carotid bypass can be safely and very easily performed.

Conflict of interest: Paul P. Urbanski is a consultant for and has a financial relationship with Maquet Cardiovascular Inc.

REFERENCES