Pull-through technique for entire thoracic aortic dissection without additional left thoracotomy

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Received 3 September 2010; received in revised form 18 October 2010; accepted 20 October 2010

Abstract

Urgent single-staged replacement of the aortic dissection involving the entire thoracic aorta was performed by using the modified pull-through technique via median sternotomy. Distal anastomosis was achieved via posterior pericardium to avoid the lateral thoracotomy and then the graft was pulled through the false lumen of the descending aorta into the aortic arch. Each lumen between proximal and distal anastomosis was closed for hemostasis. The aortic arch was replaced with a four-branched graft. Postoperative course was uneventful. This procedure might be an alternative in selected patients to the left thoracotomy.

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Keywords: Pull-through technique; Thoracic aorta; Aortic dissection

1. Introduction

Single-staged surgical repair for extensive aortic dissection is challenging, because it involves a large thoracotomy and a prolonged circulatory arrest (CA), which are associated with high mortality and morbidity [1]. The pull-through technique (PTT) was introduced by Cooley in 1995 for treating aortic true aneurysm [2], which may be applicable to selected patients with dissected aortic aneurysm. However, the approach combined with both left thoracotomy and sternotomy is considerably invasive. A two-phase approach is usually suitable for this region, however, it is also associated with the risk of aortic rupture during the interval [3].

Endovascular repair may be useful and its combination with open surgery has been reported with acceptable short-term results [4, 5], its application in the transverse aorta is still debatable [6]. Moreover, since dissections are often complex, the general application for dissected aorta seems limited. Therefore, we present a one-stage, less-invasive modified PTT as an alternative to left thoracotomy.

2. Case

A 68-year-old man who underwent replacement of the ascending aorta for aortic dissection presented with back pain. The magnetic resonance imaging (MRI) scan showed three-channeled aortic redissection and the enlargement of the false lumen (maximum diameter, 70 mm) between the aortic arch and the descending aorta (DA) down to the level of the eighth thoracic vertebra (Fig. 1a). The residual distal DA was slightly dilated (maximum diameter, 30 mm). No significant fenestration or no major intercostal artery (ICA) in DA was detected. One-stage repair was recommended to avoid rupturing the aorta. Because of the need for distal anastomosis in double-barrel fashion, we used a modified PTT in combination with CA and antegrade selective cerebral perfusion (SCP); lateral thoracotomy was omitted.

Medial sternotomy was performed with the patient in the supine position. The cardiopulmonary bypass was initiated through the right atrium and the ascending aorta. The femoral artery was cannulated because cooling of the lower half of the body was not adequate. After the body temperature was reduced to 18 °C, CA was achieved with SCP through the opened aortic arch. Myocardial protection was achieved by intermittent infusion of cardioplegia. Then, a surgical retractor (Octopus retractor OCT-01N, Mednosbro, Switzerland) was used to displace the heart vertically such that DA could be accessed through the posterior pericardium. DA was incised transversely around the level of the eighth thoracic vertebra. The true lumen and the smaller false lumen were closed distally for hemostasis. The graft prosthesis was pulled through the larger false lumen into the aortic arch (Fig. 1b). The larger false lumen was also closed for hemostasis and anastomosed with the distal end of the tube graft. The open distal anastomosis was accomplished by double-barrel fashion. The air in the graft was eliminated, following which retrograde distal perfusion was resumed. The proximal DA was incised distal to the origin.
of the left subclavian artery. After we confirmed that there was no evidence of major blood flow from the each lumen in DA during the distal perfusion, all lumen were closed proximally for hemostasis. The larger false lumen, the proximal edge of the tube graft and the four-branched-graft were anastomosed. Three neck vessels were reconstructed, and the operation was completed by the proximal graft-to-graft anastomosis. The duration of the SCP and CA were 203 and 4 min, respectively. No neurological disorder or respiratory complication occurred during the postoperative period. One year after the operation, MRI showed complete clotting in each lumen of DA, extending to the distal anastomosis without dilatation (Fig. 2).

3. Comment

This modified PTT is better than the original one in that additionally lateral thoracotomy is not performed. This procedure is particularly suitable for the elderly and the very thin patients with impaired respiratory function. However, the applicability of this technique to the aortic dissection seems limited since dissection often has several complex problems.

Distal anastomosis can be limited due to the postmediastinal approach. Preoperative 3D image should be performed to locate the site of the incision in the posterior pericardium, to avoid injury to the adjacent organs. Because the residual dissection distally can be left, modified PTT can be suitable only when the residual dissected aorta distal to the anastomosis is not significantly dilated.

The reconstruction of ICA is also highly limited. Although in our patient no ICA was reconstructed, paraplegia was not observed as Cooley has reported [2].

If a major ICA or a significant fenestration is present between anastomosis, there is a high risk of the dilatation of DA postoperatively and the modified PTT should be abandoned. A detailed preoperative imaging should deny the existence of the large ICA or fenestration and intraoperatively surgeons should exclude the major blood flow from each lumen when the bypass has resumed. We believe that a large ICA or fenestration can be identified using the highly efficient MRI or their computerized tomography (CT) technique. As stated by Tabayashi et al. [7] in his report of six patients, modified PTT can be conducted with thromboexclusion if the existing ICA or fenestration is so small that it cannot be detected even with minute 3D MRI scanning with a thin slice.

Hybrid repair with elephant-trunk technique is another alternative. However, unfortunately the devices including a self-expanding Z-stent are not available in emergency settings of our institution. The risk of intimal damage cannot be dismissed. Although there are some disadvantages in this modified PTT, it is one option in selected patients with entire thoracic aortic dissection.

References