Novel technique for reimplantation of intercostal arteries using tailored patch graft

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Abstract

We developed a simple and secure technique for reimplantation of the intercostal arteries (ICAs) using a patch graft during thoracoabdominal aneurysm repair. With our procedure, a sidearm branch with its base is tailored from a 24 mm one-branch Dacron graft, and then sutured as a patch graft to the trimmed wall of the descending aorta to cover the ICA orifices between Th9 and Th12. The proximal end of the patch graft is then anastomosed to the main tube graft, while the graft is perfused. With this technique, the entire suture lines are clearly visible and hemostasis is secured without difficulty. We used this technique in 6 patients, in whom 2.3 ± 0.8 pairs of ICAs were reimplanted. The time required for reimplantation of the ICAs was 14 ± 6 min and none of 6 patients developed paraplegia. Our results indicate that this novel technique is a simple method to obtain secure hemostasis under direct vision, which may contribute to reduce the risk of paraplegia during thoracoabdominal aneurysm repair.

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1. Introduction

Paraplegia remains a concern during thoracoabdominal aneurysm (TAAA) repair, even in experienced centers [1,2]. The mechanism of paraplegia is multifactorial, however, reimplantation of the major intercostal arteries (ICAs) is considered to reduce the risk of its development [1]. Herein, we present a novel technique for reimplantation of ICAs using a patch graft tailored from a one-branch Dacron graft.

2. Technique

The TAAA is exposed using a left thoracotomy and retroperitoneal approach, then a partial cardiopulmonary bypass is established with body temperature maintained at 33 °C. A sidearm branch with its base is tailored from a 24 mm one-branch Dacron graft (Hemashield Gold Woven Branch vascular graft, Boston Scientific, Natick, MA) as patch graft, and the main part of the remaining 24 mm graft is anastomosed to the cross-clamped proximal descending aorta or a previously implanted long elephant trunk [3]. After the distal cross-clamp is moved to just above the celiac artery (CA), the aneurysm is opened and the ICAs are cannulated with 3 Fr Fogarty balloon catheters. The patch graft is then sutured to the trimmed aortic wall to cover the ICA orifices from Th9 to Th12 (Fig. 1A). After the patch graft is anastomosed to the ICA, the small needle is placed in the patch graft, which is perfused with 20 °C blood at 200 ml/min. While maintaining selective perfusion, the proximal end of the sidearm branch is anastomosed to the main tube graft. Next, the supra celiac cross-clamp is moved to the distal aorta and the remaining aneurysm is opened. The CA, superior mesenteric artery (SMA), and bilateral renal arteries are cannulated and perfused with 25 °C blood at 800 ml/min. The orifice of CA and SMA is sutured to the patch graft as described above and both renal arteries are separately anastomosed to 10 mm Dacron grafts (Hemashield Gold Woven Vascular Graft, Boston Scientific, Natick, MA). After the main tube graft is anastomosed to the distal aorta, each proximal end of the 3 grafts is anastomosed to the main tube graft (Figs. 1B and 2). With this technique, the entire suture lines are clearly visible and hemostasis is secured without difficulty.

Between October 1999 and September 2006 we applied this technique in 6 patients to reimplant 2.3 ± 0.8 pairs (range, 1–3 pairs) of ICAs. The reimplantation time was 14 ± 6 min (range, 9–22 min), which included trimming the descending aorta, and completing the anastomoses between the patch and the trimmed descending aorta that involved the orifices of ICA. Three of those were a Crawford type II TAAA, for which the CA and SMA were reimplanted as...
demonstrated in Fig. 1B. All patients were discharged from the hospital without paraplegia or mortality.

3. Discussion

Preservation of spinal cord circulation plays a pivotal role and reimplantation of critical ICAs in the Th9-L1 zone is considered to be important to reduce the risk of paraplegia [1]. However, ICA reimplantation is not without disadvantages, as the suture lines are not always accessible with a standard inclusion button anastomosis and may result in incomplete hemostasis, which is associated with an increased incidence of paraplegia [2]. Therefore, it is important to secure hemostasis in the anastomosis as well as reduce the ischemic period of the spinal cord by completing quick reimplantation of the ICAs.

Using our novel technique, we reimplanted ICAs within 30 min in all cases and were able to secure hemostasis in the suture lines, as all suture lines were visible around the patch. Recently, onlay patch reconstruction of ICAs has been reported, in which the patch is placed along the entire back wall of the descending aorta to cover all of the ICAs [4,5]. Instead of reimplanting all the intercostal arteries we only reimplanted 1 to 3 pairs of ICAs to avoid long suture lines.

Postoperative magnetic resonance angiograms demonstrated that the grafts were patent in all but one case, for a graft patency rate of 83%. In that patient, a single pair of ICAs was reimplanted with the patch graft and blood flow to only one pair of ICAs, which may not be adequate to prevent blood stagnation in the patch graft. We also consider that configuration of the graft is important to prevent kinking and occlusion. We modified Svensson’s technique for coronary reimplantation during aortic root replacement [6]. With that technique, the graft interposed to the left coronary artery is placed around the ascending aorta graft and anastomosed to the right side of the main tube graft. In this way, the interposing graft forms a loop around the main tube graft with a gentle round curve. They reported use of this technique in 47 patients without any kinking of the graft. We think that such a looped graft could prevent kinking, as it could accommodate the redundancy of the graft by increasing the radius of the loop without causing graft kinking. Therefore, we coil the graft around the main tube graft, as shown in Figs. 1B and 2.

Our results indicate that this novel technique is a simple method to complete secure hemostasis under direct vision, which may contribute to reduce the risk of paraplegia during TAAA repair.

Reference