Adventitial inversion plus prosthesis eversion suture technique in surgical repair of acute type A aortic dissection

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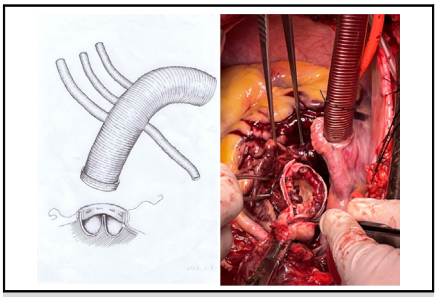


Total aortic arch replacement using this suture technique.

CENTRAL MESSAGE

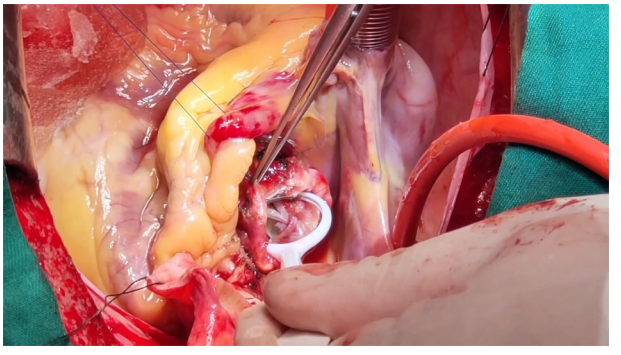
Adventitial inversion plus prosthesis eversion anastomosis is an efficient suture technique that can reduce the risk of postoperative bleeding in acute type A aortic dissection repair.

Video clip is available online.

Acute type A aortic dissection (ATAAD) is a catastrophic event with some severe complications of aortic rupture, cardiac tamponade, aortic regurgitation (AR), and organ malperfusion. The risk of death is estimated to be 1 to 2% per hour, and nonoperative treatment is associated with mortality in nearly 60% of patients.[1,2] Open surgical replacement of the pathologic aorta is a life-saving surgery and remains the standard-of-care for patients with ATAAD.[1] However, aortic wall tissue in ATAAD is extremely friable, so anastomosis tends to be insecure, with easy bleeding and dehiscence in the procedure of graft replacement. We applied an efficient suture technique (named adventitial inversion plus prosthesis eversion) in 79 patients with ATAAD who were randomly assigned to our surgical group and who did not have any shunts for hemostasis in the past 3 years. Table E1 shows the preoperative characteristics of these patients. This study was approved by the ethical committee of Nanjing First Hospital (KY20190404-03-KS-01, April 25, 2022), with a waiver of individual consent granted.

PROCEDURE

Video 1 illustrates the adventitial inversion plus prosthesis eversion suture technique in the proximal anastomosis. The ascending aorta was transected after clamping the aorta. First, the aortic root was fully mobilized and exposed. Care should be taken to avoid injuring the left and right coronary arteries. Next, the adventitia was trimmed 5 mm longer than the level of intimal layer, inverted into the aortic lumen, and then tacked together by using 5-0 polypropylene horizontal mattress sutures at the level of sinotubular junction (STJ). An appropriate-size artificial graft was chosen, from which a 5-mm-wide



VIDEO 1. Adventitial inversion plus prosthesis eversion suture technique in proximal anastomosis for ATAAD patients. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00406-6/fulltext.

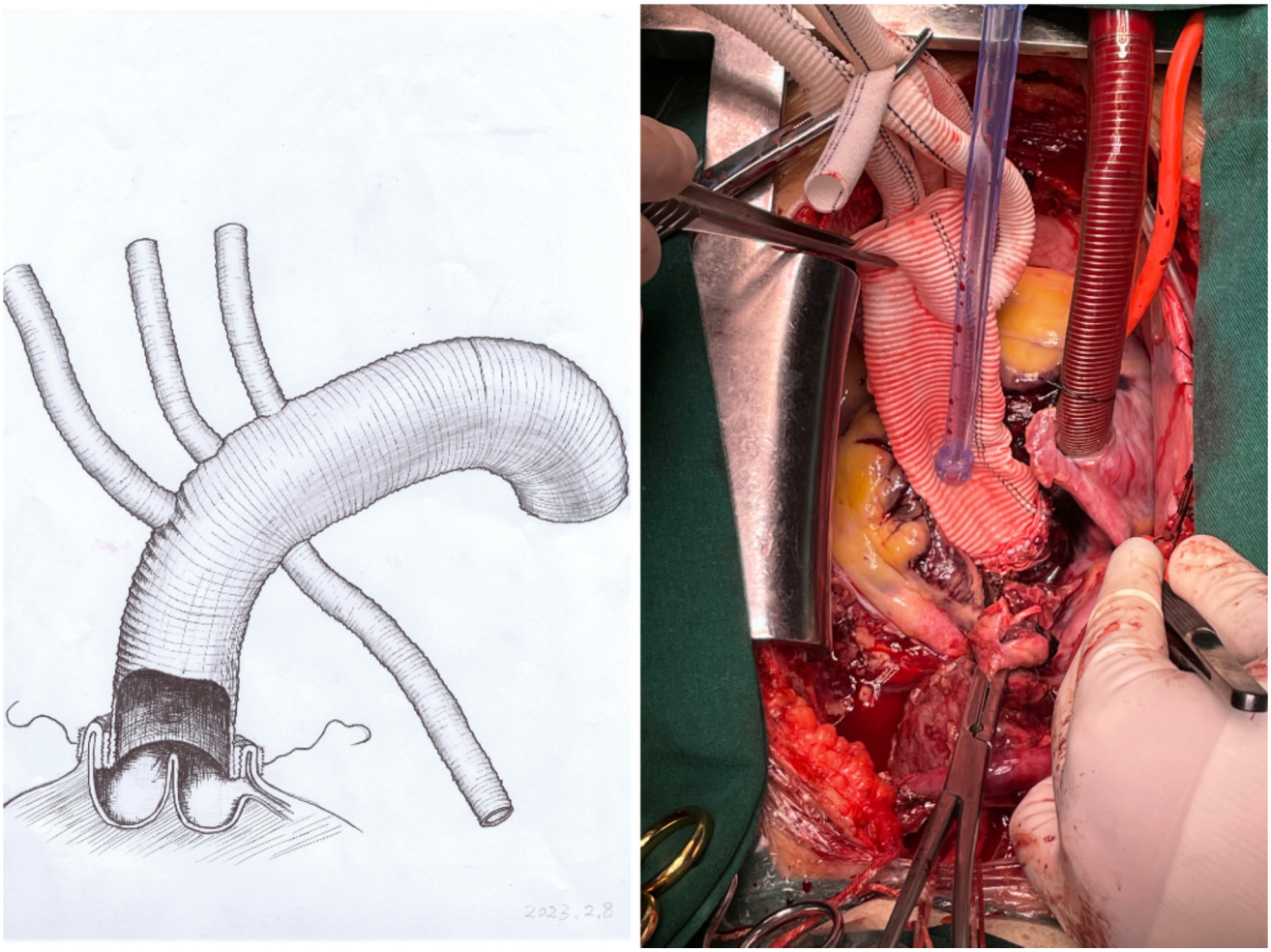


FIGURE 1. The adventitia was trimmed 5 mm longer than the level of intimal layer, inverted into the aortic lumen, and then tacked together by using 5-0 polypropylene horizontal mattress sutures at the level of sinotubular junction (STJ). The end of the graft was everted about 5 mm and the rim was sutured to the reinforced aorta root using 5-0 polypropylene running sutures.

vascular ring was cut and placed outside the root. Subsequently, the end of the graft was everted about 5 mm and the everted rim was sutured to the reinforced root by using 5-0 polypropylene running sutures. Therefore, the anastomosis layers from outside to inside were as follows: vascular ring, native aortic wall, inverted adventitia, and the graft rim (Figure 1).

DISCUSSION

Secure graft anastomosis with fragile aortic tissue and complete hemostasis remains challenging to cardiac surgeons. Longer time of cardiopulmonary bypass and deeper hypothermia affect the coagulation systerm, which makes it more difficult to perform hemostasis in surgical repair of dissection. Despite the fact that BioGlue was reported to decrease bleeding risk at anastomotic sites, it is not commercially available in most hospitals in China and also it has the risk of postoperative pseudoaneurysm formation, BioGlue-induced inflammatory reaction, and even reoperations in long-term. Therefore, making a cabrol shunt to right atrium was a compromise method to control inaccessible bleeding occurring after the surgical repair of ATAAD in past decades. We had been using the cabrol shunt technique to achieve hemostasis in treating nearly 600 patients with ATAAD before January 2020. However, any type of shunt for hemostasis is actually not recommended because it ignores the bleeding of the anastomosis, complicates the operation, is inaesthetic, and has some possible complications of pesudoaneurysm, infection, and reoperations in the long-term follow-up.[3]

Tamura and colleagues[4] reported an approach called the "turn up" or "invert" the end of the artificial vessel for proximal anastomosis, which could help hemostasis in acute aortic dissection surgeries. Inspired by these authors, we began to improve our suture techniques and made the following improvements during dissection surgeries:

TABLE 1. Surgical outcomes

Surgical variables	N = 79
Artery canula position	
Subclavian artery, n	54
Femoral artery, n	9
Femoral artery + Subclavian artery, n	16
CPB time, min	154.0 ± 42.3
Crossclamp time, min	83.3 ± 31.4
Circulatory arrest time of lower body, min	23.5 ± 2.4
Chest drainage in the first 24 h, mL	457.2 ± 234.9
TAR + ET procedure, n	58
HAR procedure, n	21
ICU stay time, d	4.0 ± 3.8
Postoperative complications	
AKI, n	18
CRRT, n*	8
Paraplegia, n	2
Stroke, n	2
Intestinal ischemia, n	1
GI bleeding, n	3
Re-exploration for bleeding, n	2
Hospital mortality, %	8.9

CPB, Cardiopulmonary bypass; *TAR + ET*, total arch replacement plus elephant trunk implantation; *HAR*, hemiarch replacement; *ICU*, intensive care unit; *AKI*, acute kidney injury; *CRRT*, continuous renal-replacement therapy; *GI*, gastrointestinal. *Three patients who need dialysis due to chronic renal dysfunction before operations are included.

(1) cut a piece of the graft and use it as a mattress felt sitting outside of the root to reinforce the anastomosis. (2) Combined graft eversion with aortic adventitial inversion to strengthen the anastomosis. The method of these suture techniques could avoid injuring the root or aortic sinus, help hemostasis, and prevent the coronary ostia from tearing further. Meanwhile, no wrapping or any Cabrol shunt is required, which may reduce extracorporeal circulation time and operation time.

We always chose the downsized graft because the STJ had various degrees of dilatation in most dissection patients and we tended to choose 1 or 2 smaller-sized grafts. Therefore, this suture technique and downsized graft could reduce the grade of AR, especially for type Ia AR. However, if the STJ was not dilated or even smaller than normal, we chose a true-size graft.

We started to use an adventitial inversion plus prosthesis eversion suture technique in 79 patients with ATAAD who were randomly assigned to our surgical group and who did not have any shunts for hemostasis in the past 3 years. There were only 3 cases of re-exploration for postoperative bleeding among the 79 patients, and no patients with anastomosis bleeding. Other detailed surgical outcomes are presented in Table 1. Furthermore, there was no residual dissection or any leakage in the aortic root postoperatively on computed tomography angiography at 3 months, which encourages us to continue using this suture technique in aortic dissection surgical repair. Now, we further extend this suture technique to both proximal and distal anastomosis in all our patients with ATAAD except those who undergo Bentall or valve-sparing aortic root replacement procedure. Furthermore, Oda and colleagues[5] reported that the adventitial inversion technique may facilitate thrombotic closure of the distal false lumen in ATAAD management by hemiarch replacement.

CONCLUSIONS

Adventitial inversion plus prosthesis eversion anastomosis is a useful suture technique in the surgical repair of ATAAD.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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TABLE E1. Preoperative characteristics of patients

Preoperative variables	N = 79
Male, n, %	63, 79.7%
Age, y	53.6 ± 12.7
Hypertension, n	64
Hyperlipidemia, n	2
Diabetes mellitus, n	8
Smoking, n	33
Chronic renal dysfunction (dialysis), n	3
Peripheral vascular diseases, n	2
Carotid artery stenosis, n	1
Pericardial effusion, n	24
Cardiac tamponade, n	8
Aortic regurgitation (moderate or greater), n	32
Mitral regurgitation (moderate or greater), n	2
Organ malperfusion	
Coronary	5
Cerebral	3
Spinal	2
Visceral	4
Lower extremity	8
Location of primary entry site	
Ascending	31
Arch	40
Descending	7
Not identified	1