# Application of the "branch-first technique" in Sun's procedure

**Jun Zheng, Shang-Dong Xu, Chang-Wei Ren, Sheng Yang, Yong-Min Liu, Jun-Ming Zhu, Li-Zhong Sun, Hui-Qiang Gao**

Department of Cardiac Surgery, Beijing Anzhen Hospital, Capital Medical University, Beijing 100029, China.

*To the Editor*: The branch-first technique has been reported in arch replacement for patients with arch lesions in order to provide total cerebral perfusion during the operation. A double "Y," or modified three-branch graft, was used in this technique. Here we reported a branch-first technique combined with Sun's procedure using a "Y" shaped graft.

A 62-year-old man was found having a localized penetrating ulcer at the junction of the ascending aorta and the aortic arch [Figure 1A]. Replacement of the ascending aorta and the arch was planned. Under general anesthesia, the right axillary artery and the right common femoral artery were mobilized. A median sternotomy was made, and 3 arch vessels were mobilized. A "Y" shaped graft was made with a 16 mm straight Dacron graft (Vascutek, Inchinnan, Scotland, UK) and an-8 mm straight Dacron graft (InterGard, France) as shown in Figure 1B. The 16 mm graft was the trunk and the 8 mm graft was the side arm. The right axillary artery, right common femoral artery and right atrium were cannulated to establish the cardiopulmonary bypass (CPB). The CPB was started without lowering the temperature and with a beating heart. The average arterial blood pressure was maintained at about 80 mmHg. The innominate artery was clamped and transected 1 cm distal to its origin. The stump of the innominate artery was closed by continuous suture. The distal end of the innominate artery was anastomosed with the distal end of the main trunk of the "Y" shaped graft. Then the left common carotid artery was transected. The stump was closed. A circular fenestration with the same size as the left common carotid artery was made in the side arm opposite the left common carotid artery. The distal end of the left common carotid artery was anastomosed to the side arm in an end-to-side fashion. The side arm was deaired and its distal end was clamped. At this point, both the innominate artery and the left common carotid artery were supplied by axillary artery perfusion. Then the left subclavian artery was transected. The stump was closed. The distal end of the left subclavian artery was connected to the distal end of the side arm in an end-to-end fashion [Figure 1C]. At this time, all three arch vessels were bypassed with the "Y" shaped graft and the brain had total blood supply. Next, the temperature was cooled down. The ascending aorta was clamped and opened. Cardioplegia solution was perfused directly into the coronary orifices. A straight graft of 28 mm (InterGard, France) was chosen to replace the ascending aorta. The proximal anastomosis site was at the sino-tubular junction. Continuous suture with 4–0 prolene was used. At 28°C, the flow was decreased to 10 mL·kg$^{-1}$·min$^{-1}$. The cannula to the femoral artery was clamped. The arch was opened and transected between the innominate artery and the left common carotid artery. An open stent-graft (30 × 100 mm; Cronus, Microport, Shanghai, China) was deployed into the arch and descending aorta. Its proximal end along with the native aortic wall was anastomosed with the ascending aorta graft with a 3–0 prolene running suture. After the anastomosis was done, systemic perfusion was resumed. Follow deairing of the heart, the cross clamp was opened. A side bite clamp was applied to the ascending aorta graft. A fenestration was made. The proximal end of the 16 mm graft was then anastomosed to the ascending aorta graft in an end-to-side fashion [Figure 1D]. The cross clamp time was 58 min, the CPB time was 107 min and the circulatory arrest with total cerebral perfusion time was 13 min in this case. The patient recovered well after surgery and had no neurological complications. CT angiography showed good results postoperatively [Figure 2].

Surgery of aortic dissections, penetrating ulcers, and aneurysms involving the aortic arch has had difficult problems in cardiac surgery. The emergence of Sun's procedure has solved this problem and has greatly improved the feasibility of aortic arch surgery.[1,2] The procedure introduced in this report, using branch-first technology, is a new variant of Sun's procedure.

The branch-first technique originated from an improvement of Spielvogel's approach to aortic arch surgery.[3,4] He was the first to reconstruct the aortic arch vessels using the three-branch graft. The surgery was performed under the axillary artery cannula. After systemic cooling, the reconstruction of

Access this article online

Quick Response Code:

Website: www.cmj.org

DOI: 10.1097/CM9.0000000000000049

**Correspondence to:** Dr. Hui-Qiang Gao, Department of Cardiac Surgery, Beijing Anzhen Hospital, Capital Medical University, Beijing 100029, China
E-Mail: ghqngys@sina.com



Chinese Medical Journal 2019;132(4)

**Received:** 12-11-2018 **Edited by:** Xin Chen

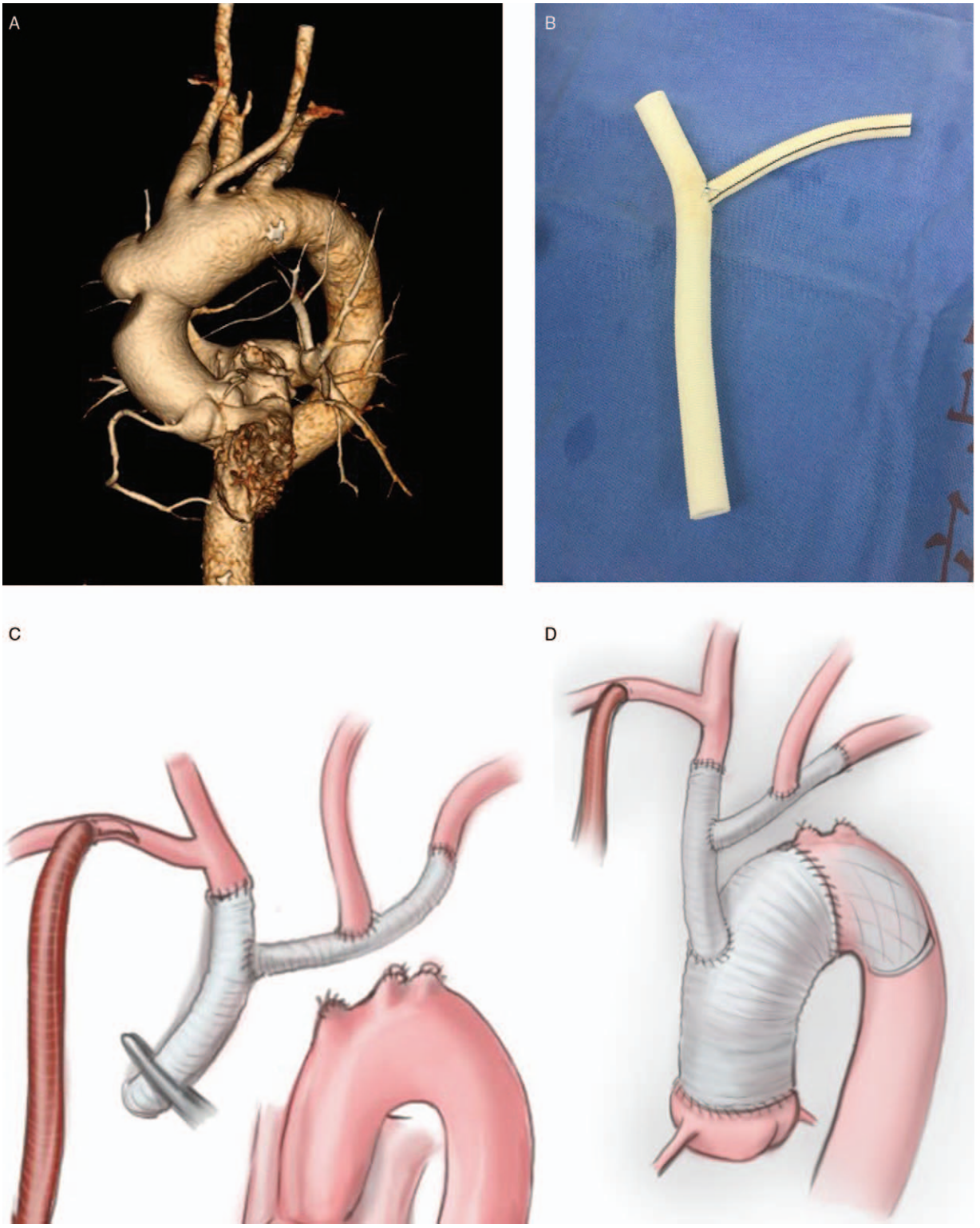


**Figure 1:** A 62-year-old man with arch lesions receiving a branch-first technique combined with Sun's procedure using a "Y" shaped graft. (A) There was a localized penetrating ulcer at the junction of the ascending aorta and the aortic arch; the aortic arch was expended. (B) The 16 mm and 8 mm straight vessels were made an end-to-side anastomosis to make a "Y" shaped graft. (C) The innominate artery, the left common carotid artery, and the left subclavian artery were sequentially reconstructed using a "Y" shaped graft. At the same time of reconstruction, blood was supplied to the brachiocephalic artery by CPB through the axillary artery cannula. (D) The "Y" shaped graft was anastomosed to the ascending aorta artificial blood vessel.

the aortic arch vessels was completed under circulatory arrest and selective cerebral perfusion. The order of vascular reconstruction was the left common carotid artery first, then the left subclavian artery, and finally the innominate artery. Because only the axillary artery cannula is used, the cooling process must be completed before the innominate artery can be reconstructed. In 2011, Matalanis *et al*,[5,6] reported a series of cases and improved the method. In these reports,


**Figure 2:** The image of CT angiography after 6 months in the 62-year-old man with arch lesions receiving a branch-first technique combined with Sun's procedure using a "Y" shaped graft. A: The graft trunk; B: The graft side arm; C: Left subclavian artery; D: Left common carotid artery; E: Innominate artery; F: Right common carotid artery; G: Right subclavian artery.

they simultaneously cannulated the femoral artery and the axillary artery. In this way, the innominate artery was first cut-off for reconstruction without affecting the lower body perfusion, not affecting the cooling and rewarming process. The reconstruction order was changed to the innominate artery first, then the left common carotid artery, and finally the left subclavian artery. A modified 3-branch graft was used in reconstruction of the 3 arch vessels. After the innominate artery and left common carotid artery anastomosis was completed, the 3-branch graft was deaired. The 3-branch graft supplies blood simultaneously to the innominate artery and the left common carotid artery. Finally, the left subclavian artery was reconstructed. By using this method, there was only a temporary ischemia of the left common carotid artery when the left common carotid artery was reconstructed, and during the remaining time, there was continuous bilateral cerebral perfusion.

In comparison with Matalanis technology, we used a space-saving "Y" shaped graft for reconstruction. Also, it required a hypothermic circulatory arrest for approximately 10 to 15 min to implant the open stent-graft into the descending aorta.

One of the difficulties in Sun's procedure is the mobilization of the left subclavian artery, especially for beginners. During the branch-first approach, when the innominate artery and the left common carotid artery are cut-off the arch, the posterior wall of the aortic arch can be dissected from the surrounding tissue. In this way, the arch can be lifted and pulled caudally, so that the left subclavian artery is quite easy to expose. When using the branch-first technique for Sun's procedure, the core temperature is also increased from 23°C to 28°C. This change in temperature is because the brain is perfused bilaterally, which avoids neurological complications and reduces coagulopathy caused by low temperature.

In conclusion, the "Y" shaped graft is feasible in Sun's procedure with the branch-first technique in arch replacement.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

## Conflicts of interest

None.

## References

1. Ma W, Zhu J, Zheng J, Liu Y, Ziganshin B, Elefteriades J, *et al*. Sun's procedure for complex aortic arch repair: total arch replacement using a tetrafurcate graft with stented elephant trunk implantation. Ann Cardiothorac Surg 2013;2:642–648. doi: 10.3978/j.issn.2225-319X.2013.09.03.
2. Sun LZ, Qi RD, Chang Q, Zhu JM, Liu YM, Yu CT, *et al*. Surgery for acute type A dissection using total arch replacement combined with stented elephant trunk implantation: experience with 107 patients. J Thorac Cardiovasc Surg 2009;138:1358–1362. doi: 10.1016/j.jtcvs.2009.04.017.
3. Spielvogel D, Halstead J, Meier M, Kadir I, Lansman S, Shahani R, *et al*. Aortic arch replacement using a trifurcated graft: simple, versatile, and safe. Ann Thorac Surg 2005;80:90–95. discussion 95. doi: 10.1016/j.athoracsur.2005.02.002.
4. Spielvogel D, Etz C, Silovitz D, Lansman S, Griepp R. Aortic arch replacement with a trifurcated graft. Ann Thorac Surg 2007;83:S791–795. discussion S824-731. doi: 10.1016/j.athoracsur.2006.11.015.
5. Matalanis G, Koirala R, Shi W, Hayward P, McCall P. Branch-first aortic arch replacement with no circulatory arrest or deep hypothermia. J Thorac Cardiovasc Surg 2011;142:809–815. doi: 10.1016/j.jtcvs.2011.01.020.
6. Matalanis G, Shi W. An Australian experience with aortic arch replacement: a novel approach without circulatory arrest or deep hypothermia. Heart Lung Circ 2011;20:163–169. doi: 10.1016/j.hlc.2010.06.662.

**How to cite this article:** Zheng J, Xu SD, Ren CW, Yang S, Liu YM, Zhu JM, Sun LZ, Gao HQ. Application of the "branch-first technique" in Sun's procedure. Chin Med J 2019;132:495–497. doi: 10.1097/CM9.0000000000000049