replacement. A 54-year-old woman was referred to our unit for an aortic pseudoaneurysm that occurred 40 years after aortic coarctectomy. The pseudoaneurysm narrowed the old prosthesis to carry out the pattern of a significant recoarctation. Because the thoracic reentry was considered to be potentially dangerous and the femoral perfusion could not accomplish a physiologic perfusion of the upper body, we tried to perform an upper body perfusion. The left subclavian artery was hypertrophied (23 mm in diameter), and a strong pulsation was noted in the left axilla. At operation, the patient was placed in the right decubitus position and the left arm was abducted at 90 degrees and positioned on the armrest. The operative field included the left axilla, the thorax, and the abdomen down to the groin. Before thoracotomy, the left axilla was incised and the distal axillary artery was prepared. An 8-mm side graft was interposed and subsequently cannulated with a 22F aortic cannula. The left femoral vein was cannulated with a long central cannula, and the patient was cooled to 20°C during the thoracic reentry. When the cooling was obtained, the left subclavian artery was clamped and the flow was reduced to 10 mL/kg. The opening of the aortic arch confirmed a good backflow from the left carotid artery and innominate artery. When the prosthesis was inserted between the aortic arch and the post-isthmus descending aorta, the circulation was resumed without difficulty. After heparin neutralization, the interposition graft was stapled. The postoperative course was uneventful.

The arterial inflow via the left distal axillary artery has 3 advantages: (1) The site of cannulation is included in the main operative field and stays clearly visible (blood leakage or interposition graft kinking is easily corrected); (2) minimal perfusion of the central nervous system and spinal cord is ensured during the deep hypothermic circulatory arrest; and (3) an effective de-airing of the ascending aorta

and supra-aortic vessels can be obtained through the cerebral backflow.

In conclusion, both right and left distal axillary artery cannulation can be useful in aortic surgery.

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Reply to the Editor:

We thank Dr Maurizio Salati for his comments on cannulation of the distal axillary artery in descending thoracic aortic surgery using the open proximal aortic anastomosis technique under deep hypothermic circulatory arrest. Actually, since 2001, we also have used a similar technique for more than 100 patients having various types of descending thoracic and thoracoabdominal aortic lesions requiring an open proximal aortic anastomosis around the aortic arch. In our technique, a 10F to 16F thin-walled cannula is directly cannulated into the distal part of the left axillary artery with additional cannulation of the femoral artery. Venous drainage is performed through the right atrium via the femoral vein and main pulmonary artery. Cardiopulmonary bypass is initiated with core cooling to profound hypothermia at approximately 18°C. The flow rate of left axillary artery perfusion is maintained in the range of 1000 to 1500 mL/min to prevent a potential risk of retrograde cerebral emboli caused by the femoral artery perfusion. In patients with aortic valve regurgitation, this technique is not indicated for those with more than moderate aortic valve regurgitation. With mild aortic regurgitation, another

venting tube is inserted into the left ventricle via the left upper pulmonary vein or the apex of the left ventricle to avoid overdistension of the left ventricle caused by ventricular fibrillation during core cooling. At 18°C of the nasopharyngeal temperature, the patient is placed in a head-down position and the central venous pressure is elevated to approximately 15 mm Hg. After cardiac arrest is obtained by administering potassium of 20 to 40 mEq in the pump circuit, profound hypothermic circulatory arrest is induced. Perfusion of the lower body via the femoral artery at a flow rate of 1 to 2 L/min is resumed with the midportion of the descending aorta clamped.¹ Partial antegrade cerebral perfusion via the left axillary artery at a low flow rate of 100 to 200 mL/min is also commenced by clamping the proximal site of the left subclavian artery. Then, an open proximal aortic anastomosis is performed using a 1-branched woven Dacron graft. If necessary, the left subclavian artery is reconstructed. During the open proximal aortic anastomosis, debris and air are flushed out from the arch vessels, predominantly by the left axillary artery perfusion. After completion of the proximal anastomosis, perfusion of the heart and brain is resumed using a side-branch graft and the patient is rewarmed to approximately 25°C. The distal anastomosis is performed in the open aortic technique at approximately 25°C. After the anastomosis, full rewarming is started. The outcome has been favorable with low incidences of cerebral and spinal complications because of the beneficial effects of left axillary artery perfusion, as Dr Salati suggested. In addition, another potential benefit of this perfusion is that the downstream flow via the left axillary artery competes against the retrograde flow via the femoral artery perfusion, which can prevent retrograde cerebral emboli even after the heart falls into ventricular fibrillation because of core cooling.

With the use of left axillary artery perfusion, however, we have to pay

attention to the flow rate of the left axillary artery during the open proximal anastomosis. Too much flow may produce hyperperfusion of the part of the brain perfused via the left vertebral artery. Dr Salati also reduced the flow rate to 10 mL/kg after clamping the left subclavian artery. We concur with him. We use a relatively lower flow of 100 to 200 mL/min. Even with such a lower flow rate, sufficient back flow from the arch vessels is obtained. Further investigation of the appropriate flow rate of the left axillary artery perfusion is required.

In the meantime, as Dr Salati pointed out at the beginning, the axillary artery is generally fragile, whether

on the proximal or distal part. Then, careful cannulation using a soft cannula of adequate size is necessary. If not, artery injury, including dissection, may occur. From this point of view, the side-graft technique is preferred by the majority when using the axillary artery. However, this side-graft technique is more time-consuming and technically demanding. Bleeding from the anastomosis during the systemic perfusion at a higher flow rate can become a nuisance. Even with this side-graft technique, the word is that arterial dissection occurs from a practical standpoint. We therefore prefer simple and easy direct cannulation into the distal axillary artery.

Finally, we also advocate that distal axillary artery perfusion is useful for brain protection in arch to descending thoracic aortic surgery in the lateral approach and the median approach.

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