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# TRANSAPICAL AORTIC CANNULATION FOR HYPOTHERMIC AORTIC OPERATION THROUGH A LEFT THORACOTOMY: AN ALTERNATIVE TO AVOID RETROGRADE ARTERIAL PERFUSION

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With increasing frequency, hypothermic total cardiopulmonary bypass with or without periods of circulatory arrest has been used for aortic reconstruction through a left thoracotomy.[1, 2] In these cases, arterial return is usually by the femoral artery. However, total bypass with retrograde femoral arterial perfusion may be hazardous or impossible in the presence of severe downstream atherosclerotic disease. It also can result in malperfusion of the vital organs when aortic dissection is present. Although the aortic arch has been described as an alternative cannulation site,[3] the limitation is obvious, because the indication for hypothermic circulatory arrest is frequently proximal aortic involvement or technical difficulties during the operation.[1] We used transapical aortic cannulation as an alternative cannulation technique for hypothermic total cardiopulmonary bypass through a left thoracotomy. The patient and technical detail are described.

**Clinical summary.** The technique was applied in a 60-year-old man with chronic expanding type B aortic dissection. In June 1994, he was referred for treatment of an acute type A aortic dissection and occlusion of the superior mesenteric artery. Because dissection in the ascending aorta and aortic arch was retrograde and completely thrombosed, the patient was treated by infrarenal fenestration with Y grafting alone. The thrombosed false lumen in the ascending aorta and aortic arch completely disappeared subsequently. In November 1996, he was readmitted to our service for surgical treatment of aneurysmal expansion of the dissected thoracoabdominal aorta. The left subclavian artery was also dilated and required a separate graft for reconstruction. An echocardiogram revealed no regurgitation on the aortic valve. To avoid placing a clamp on the previously dissected aortic arch and to protect the spinal cord from ischemia during reconstruction of the intercostal arteries,[2] we planned to use profound hypothermia for the operation. However, because the true lumen was narrow in the thoracoabdominal portion and the superior mesenteric artery was also dissected, retrograde arterial perfusion was considered to carry the risk of malperfusion of the superior mesenteric artery. Therefore a technique that provided antegrade blood flow was considered necessary.

The operation was performed on November 20, 1996. The entire thoracoabdominal aorta was exposed through a thoracoabdominal incision with the left hemidiaphragm divided circumferentially. The pleural cavity was entered through the fifth intercostal space. At first, partial cardiopulmonary bypass was initiated from the right femoral vein to the right femoral artery. A second venous cannula was placed into the right ventricle through the pulmonary artery, because the femoral venous cannula was a small-bore (23F) cannula. Then a 24F straight venous cannula (Polystan, Copenhagen, Denmark) was introduced into the ascending aorta through the ventricular apex across the aortic valve, and total cardiopulmonary bypass was established through it (Fig. 1). Correct positioning of the cannula could be confirmed either by palpation from the transverse sinus or by transesophageal echocardiography.

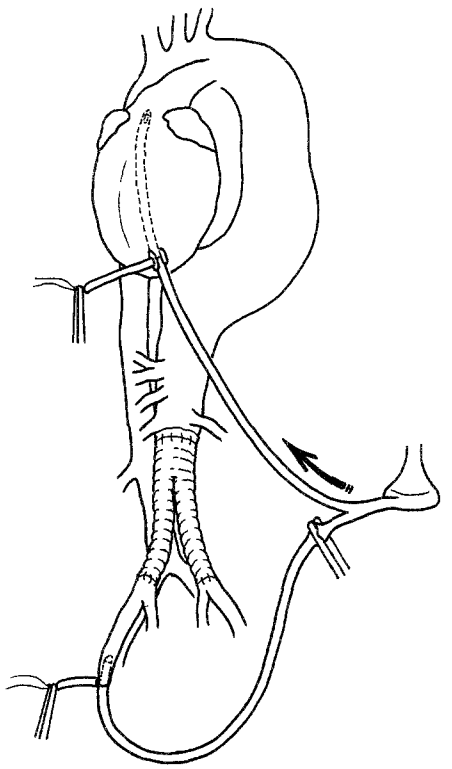

**Fig. 1.** The perfusion technique during the cooling period. A Y connector was used to convert partial bypass through the femoral artery cannula into total bypass through the transapical ascending aortic cannula.

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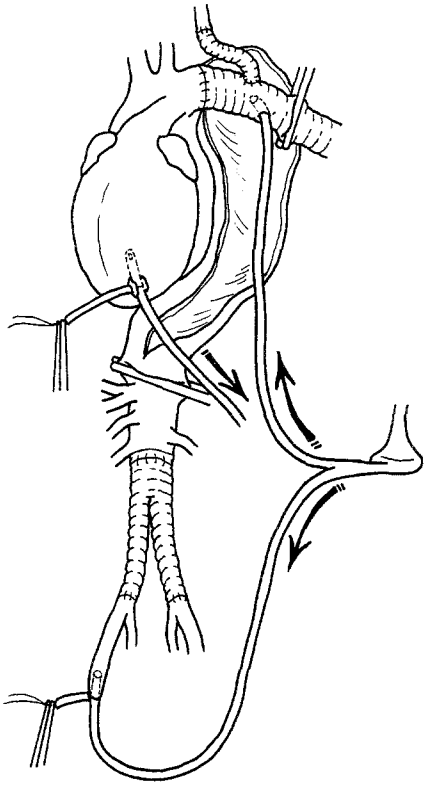

**Fig. 2.** The perfusion technique after completion of the proximal anastomosis. Blood flow to the upper torso was directed through a new cannula placed in the graft, and the transapical cannula was repositioned for decompression of the left ventricle.

Competency of the aortic valve could also be confirmed by transesophageal echocardiography. After the patient was cooled to an esophageal temperature of 17° C, the circulation was arrested while blood flow to the lower torso was maintained through the femoral artery. Cardioplegia was not used. The proximal end of a Dacron tube graft was anastomosed to the aorta just distal to the left common carotid artery. Then blood flow to the heart and two proximal brachiocephalic vessels was restored through a new cannula inserted into the graft, and the transapical cannula was repositioned so that the left ventricle could be vented through it (Fig. 2). The left subclavian artery and the intercostal arteries were reconstructed while hypothermia was maintained. The visceral branches were preserved by beveling the distal end of the graft, because this segment of aorta was not dilated. Blood flow was directed to both the true and false blood channels. The postoperative course was uneventful, and the patient was discharged without neurologic injury.

**Discussion.** Transapical aortic perfusion during cardiac surgery is an old technique that was described in the early 1970s. However, the technique was not widely used, because crossclamping of the ascending aorta and application of cardioplegia became difficult. In addition, the technique is associated with hemodynamic instability during cannulation through a median sternotomy, because the ventricular apex must be elevated. Therefore its application has been limited to special cases, such as patients with a severely calcified ascending aorta.[4]

However, this limitation for cardiac surgery does not seem to be a disadvantage during hypothermic circulatory arrest for aortic reconstruction through a left thoracotomy. In these cases, cardioplegia is not routinely used,[1] as in the present case, or it is applied through an occlusive balloon catheter after the circulation has been arrested.[5] The cannula can be inserted without dislocation of the heart and directed to the ascending aorta without difficulty through a left thoracotomy. In addition, the same cannula can be used for venting the left ventricle after completion of the proximal aortic anastomosis and repositioning of the cannula, as described in the present report. Crawford and associates[1] reported that left ventricular decompression is not always necessary. During perfusion cooling, bypass flow can be reduced to avoid ventricular distention during ventricular fibrillation. During the rewarming phase, however, bypass flow should be maintained, and left ventricular distention may occur in the presence of mild aortic regurgitation or ventricular hypertrophy. Therefore conversion of the arterial cannula into the venting tube during the rewarming period seems to be a simple and effective technique. We believe that transapical aortic cannulation is a useful alternative for hypothermic aortic operations through a left thoracotomy when retrograde femoral artery perfusion is judged inappropriate and no other suitable cannulation site can be found.

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