and regained normal immunity to ensure success. In agreement with other authors,¹ we never found that cervicothoracic access was not needed for simple repair of a TEF. Thus the risks of postoperative assisted ventilation (which constitute the main cause of relapse) are greatly reduced, resulting in an acceptable rate of mortality (about 10% according to Marzelle and associates¹).

A left lateral cervical incision gives very satisfactory access for simple closure of a TEF, with better visibility and adequate operative space compared with the median approach, and has the advantage of being able to be transformed to a cervical incision at the neck if necessary. Placement of a muscular flap between the two viscera is another indispensable element for success. The partial relapse in our second patient was due, in our opinion, to the insertion of a muscular flap that was too thin (omohyoid muscle).

In cases of associated tracheal stenosis, which occurs in about 22% of patients with a TEF,¹ the possible

anastomotic resection of even a small segment (a rare event) greatly increases the surgical risk. For this reason, in two of our patients with associated tracheal lesions, we opted for treatment with a dilating endoprosthesis.

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SURGICAL CORRECTION OF THE HYPOPLASTIC AORTIC ARCH BY THE SUBCLAVIAN FREE FLAP METHOD IN THE NEONATE

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Although several surgical techniques for treatment of aortic arch hypoplasia associated with coarctation of the aorta have been described, the most appropriate method is still controversial. Here we report a technique using a subclavian free flap to enlarge the hypoplastic transverse aorta.

Clinical summary. A female infant, in the thirty-eighth gestational week, was found by predelivery echocardiography to have a hypoplastic left heart and aortic coarctation. On the first day, the infant, weighing 3440 g, was confirmed to have this condition along with tubular hypoplasia of the transverse aortic arch. On the third day,

she underwent surgical treatment through a left posterolateral thoracotomy.

The upper half of the descending thoracic aorta and the transverse aortic arch were dissected and exposed. The left common carotid artery and the left subclavian artery were then mobilized along their entire intrathoracic course. The distance between the origin of the brachiocephalic artery and the origin of the left common carotid artery was longer than normal. The origins of the carotid artery and the left subclavian artery were also rather distant. The diameters of the ascending aorta just proximal to the brachiocephalic artery, transverse aortic arch, and descending aorta were 6.5 mm, 3 mm, and 7 mm, respectively. The transverse arch/ascending aorta diameter ratio was 0.46, and the transverse arch/descending aorta diameter ratio was 0.43. A proximal vascular occlusive clamp was placed at the origin of the brachiocephalic artery as far to the right side as possible, and the appropriate arterial perfusion was judged from the right radial arterial pressure. The left carotid artery was snared, and the isthmus of the aorta was clamped proximal to the patent ductus. After two branches had been treated, the left subclavian artery was ligated as distally as possible and excised from its origin. The distal arch was then cut proximal to the left subclavian artery, and the inferior side of the transverse aortic arch was incised as proximally as possible (Fig. 1, A). The longitudinally opened subclavian

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Fig. 1. **A**, Two clamps were placed on the aorta, and the left carotid artery was snared. The left subclavian artery was excised from its origin and incised longitudinally for use as a free flap. **B**, The subclavian free flap was sutured to the incised transverse aortic arch with 7-0 polydioxanone. **C**, Coarctectomy. **D**, End-to-end anastomosis.

free flap was then sutured to enlarge the transverse aorta with a single running suture of 7-0 polydioxanone (PDS, Ethicon, Inc., Somerville, N.J.). This absorbable suture was used to prevent secondary growth failure (Fig. 1, *B*). The proximal clamp was then moved to the distal aortic arch and the distal clamp to the descending aorta. The patent ductus arteriosus was ligated and divided, and the coarctation was resected along with the origin of the left subclavian artery (Fig. 1, *C*). An end-to-end anastomosis was created with 7-0 polydioxanone suture (Fig. 1, *D*).

The early postoperative course was uneventful, and no neurologic complications were seen. The femoral pulse was well palpable. Postoperative echocardiography showed a well-enlarged aortic arch, and no pressure gradient was detected in the aortic arch and the distal anastomosis. However, echocardiography performed 2 months after the operation showed severe stenosis at the site of the distal anastomosis. Balloon angioplasty was therefore performed 3 months after the operation. The stenosis was successfully dilated, and the pressure gradi-

ent decreased: peak systolic pressure, 56 to 33 mm Hg; mean 29 to 14 mm Hg (Fig. 2).

Discussion. In patients with aortic coarctation and a hypoplastic aortic arch from the brachiocephalic artery down to the isthmus, prevention of residual obstruction reduces mortality in the early postoperative period and also allows normal growth of the aortic arch. If only the isthmic lesion is treated, leaving a long restricted aortic segment, spontaneous growth of the hypoplastic arch is usually inadequate. Therefore hypoplasia of the transverse aortic arch needs to be corrected. Several kinds of surgical treatment for this anomaly, such as extended end-to-end anastomosis, reversed subclavian flap angioplasty, and the combined resection-flap procedure, have been described.¹⁻³ Each has certain advantages and limitations.

The first description of extended resection and anastomosis of the distal aorta to the undersurface of the aortic arch was given by Amato, Rheinlander, and Cleveland.¹ This technique allows excellent reconstruction of the arch but requires more time and extensive dissection, including the possibility of dividing the intercostal arteries to allow good mobilization. When extended end-to-end anastomosis, as described by Lacour-Gayet and associates,⁴ is used, two possible problems may arise: (1) If the aortic opening is insufficient, the risk of residual proximal obstruction increases, and (2) if mobilization of the aorta is insufficient, it may be difficult to approximate the two clamps. Compared with extended end-to-end anastomosis, our technique has certain advantages: (1) Aggressive dissection of the descending aorta is not required, (2) the tension on the anastomosis is reduced, and (3) the ischemic time of the lower body is thought to be shorter because the blood flow of the descending aorta is supplied from the patent ductus arteriosus during reconstruction of the aortic arch. Both the reversed subclavian flap and the free subclavian flap techniques are limited to some extent by the length of the subclavian flap. However, in the case of the reversed flap the distal extent of the flap is fixed, whereas with the free flap method it can be brought more proximally and a beveled anastomosis can then be made. This serves to reduce tension on the anastomosis relative to the standard extended resection and end-to-end anastomosis. The limitations of our technique are as follows: (1) The diameter of the new transverse aortic arch depends on the size of the left subclavian artery, and (2) the length of the new transverse aortic arch depends on the length of the harvested left subclavian artery. However, these factors were not disadvantageous in the present case. Mobilization of the entire intrathoracic course of the left subclavian artery provided enough length for reconstruction of the aortic arch. The diameter of the new aortic arch was thought to be adequate, because no pressure gradient was detected after the operation. In addition, autologous fresh arterial tissues

Fig. 2. Aortography after balloon angioplasty. The transverse aortic arch is well enlarged. Mild stenosis can be seen at the distal anastomosis.

are theoretically better than foreign material for arterial reconstruction because of their potential for growth. The risks of aneurysm formation and infection are also minimized. For these reasons, our technique may be applicable to infants with "severe" arch hypoplasia with arch indices of 0.25 or less.⁵ Unfortunately, severe stenosis at the distal anastomosis was discovered in this case. Residual ductal tissue may have been present in the descending aorta and developed gradually. Balloon angioplasty was effective, but conclusions about the long-term effectiveness of this technique will require further follow-up and more cases.

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