

Rapid Novel Aortic Arch Replacement for Thoracic Aortic Aneurysm Using Three Continuous Sutures and a Felt Cylindrical Collar

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Abstract: This report describes the novel parachute technique of open distal anastomosis at the aortic arch replacement. Two Teflon felt cylindrical collars were initially placed on the anastomotic site of the descending aorta. All four to five outer loops of the stitches used in the parachute technique were tracked by the gathering suture. The anastomotic sutures and three gathering sutures were finally pulled simultaneously. The prosthetic graft and the aortic stump with Teflon felt were safely and completely anastomosed. Surgical or hospital death and serious complications were not found. The mean anastomotic duration (circulatory arrest duration) in 16 patients was 23 minutes. Our novel technique using a Teflon felt cylindrical collar and modified continuous suturing was not only safe but also reduced the duration of anastomosis and minimized blood loss. This technique is simple and can be applied to aortic valve replacement.

Key Words: Aortic arch replacement, Distal anastomosis, Parachute technique.

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The surgical outcomes of total aortic arch replacement have improved through the widespread use of four-branch aortic grafts and advances in cardiopulmonary bypass. Despite these improvements, mortality rates range from 4% to 15%.^{1–3} Especially, the control of bleeding from the distal anastomosis site is important. A precise and complete open distal anastomosis is the rate-determining factor that influences surgical quality. However, the anastomosis between the graft and the distal aorta including a long circling strip of felt is required within a narrow operative field.

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In this report, we describe a novel way to rapidly perform open distal anastomosis and minimize bleeding.

METHODS

We applied this technique to 16 consecutive patients (9 men and 7 women, aged 40–79 y; mean 62.6 ± 13.5 y) between January 2009 and March 2010. True and dissecting aortic aneurysms were found in 10 and 6 patients, respectively. Preoperative comorbidities included aortic valve disease ($n = 5$) and ischemic heart disease ($n = 3$).

The heart was exposed via a median sternotomy and then the left femoral and brachiocephalic arteries were cannulated. Venous cannulae were also placed in the superior and inferior vena cavae. The aorta was cross-clamped under mild hypothermia. The ascending aorta was transected after imposing cardiac arrest by cardioplegia. When the bladder temperature reached 32°C, blood flow from the femoral artery was stopped, and the aortic arch was opened. The right cerebral hemisphere was perfused by the cannula from the brachiocephalic artery. Two 12-Fr balloon cannulae were inserted into the left common carotid and left subclavian arteries for antegrade cerebral perfusion (Fig. 1a). Two Teflon felt cylindrical collars with matching internal and external aortic diameters that were initially placed on both sides of the distal aortic stump were sutured together with a 5-0 suture. The felt collar was marked in three equal segments (Fig. 1b), and the trimmed prosthetic graft was also marked. Continuous sutures were made using three polypropylene 3-0 sutures and the parachute technique. The prosthetic graft was held approximately 5 cm above the aortic stump. Starting at one of the marks, the needle was passed from the outside to the inside of the aorta reinforced with the felt collar, and the suture was pulled upward, passing from the inside to the outside of the prosthetic graft. Loose stitches continued in an anticlockwise direction from one mark to the other. The outer four to five loops were gathered together and tracked with a gathering suture (Fig. 1c). These procedures were repeated three times. By simultaneously pulling both ends of the 3-0 polypropylene and the gathering monocril sutures, the prosthetic graft was slowly lowered onto the aortic stump. Close contact was ensured before the gathering suture was removed. The 3-0 polypropylene sutures were slowly pulled using a nerve hook to tighten all of the

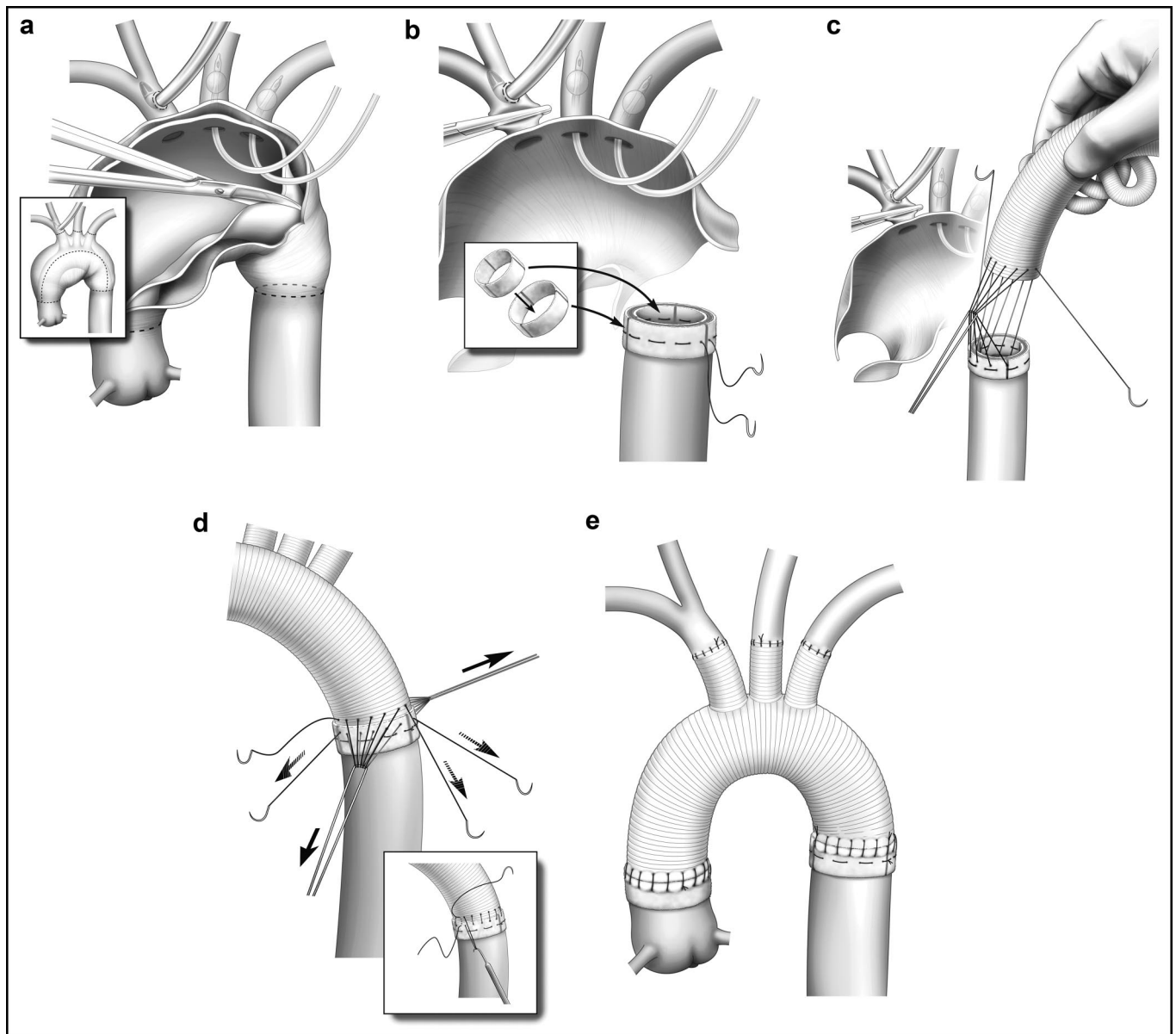


FIGURE 1. Novel aortic arch replacement using three continuous sutures and Teflon felt collar. A, After the aortic arch was opened, the antegrade cerebral perfusion was started. B, Two Teflon felt cylindrical collars on both sides of the distal aortic stump were sutured together. C, Continuous sutures were made using three polypropylene 3-0 sutures and the parachute technique. The outer 4-5 loops were gathered together and tracked with a gathering suture. D, These procedures were repeated three times. Three sutures were slowly pulled to tighten all of the continuous sutures. E, Circulation was restarted after the distal anastomosis. The graft was anastomosed to the supra-aortic arteries or proximal aorta in the standard fashion.

continuous sutures. Finally, the 3-0 polypropylene sutures were tied together to complete suturing (Fig. 1d). Circulation was restarted from the femoral artery after the distal anastomosis. The graft was anastomosed to the supra-aortic arteries or proximal aorta in the standard fashion (Fig. 1e).

RESULTS

Surgical or hospital death and serious complications were not found. The durations of cardiopulmonary bypass,

aortic cross-clamping, and circulatory arrest were 117.6 ± 23.1 , 80.8 ± 21.2 , and 23.3 ± 6.0 minutes, respectively. The mean blood loss was 1128 ± 718 mL. Five and three patients simultaneously underwent the Bentall procedure and coronary artery bypass grafting, respectively.

DISCUSSION

Generally, one monofilament suture is used in one anastomosis. However, accurate stitches with even tension within a deep and narrow operative field are difficult. Our modified

continuous suture comprising three monofilaments involves the initial placement of three loose parachute sutures. Once all of the stitches are completed, the ends of each suture together with the suture gathering the outer loops of each parachute are simultaneously pulled to easily close the parachute without tangling. Because each stitch of the parachute suture is under the same tension, all stitches can be evenly tightened. This method results in essentially no bleeding from the distal arch anastomosis and minimizes the need for supplementary sutures.

Anastomosis using the present method was achieved within 23 minutes, a time frame that permits circulatory arrest at 32°C. Consequently, this technique prevents complications such as brain injury due to cardiopulmonary bypass or hypothermia. The method is simple, and it can be applied to other techniques such as aortic valve replace-

ment. We believe that surgeons will find similar benefits from using this method.

Our novel technique using a Teflon felt cylindrical collar and modified continuous suturing was not only safe but also reduced the duration of anastomosis and minimized blood loss.

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