The effect of false lumen procedures during thoracic endovascular aortic repair in patients with chronic DeBakey type IIIB dissections

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ABSTRACT

Objective: Although thoracic endovascular aortic repair (TEVAR) is commonly used for chronic DeBakey type IIIB (CDIIIB) dissections, aortic remodeling outcomes after the procedure have been unsatisfactory. Persistent retrograde flow to the false lumen (FL) through re-entry tears commonly causes treatment failure. The aim of this study was to clarify the safety and effect of the FL procedure (FLP) for aortic remodeling in patients with CDIIIB dissections.

Methods: From 2012 to 2016, there were 73 patients who underwent TEVAR for CDIIIB dissections. The surgery, accompanied by the FLP, was performed in 41 patients (group A, 56%); 32 patients (group B, 44%) underwent TEVAR alone. The FLP was defined as blocking the retrograde FL flow with commercial materials. Outcomes included whole thoracic aorta FL thrombosis and diameter change in the true lumen and FL. Diameters were measured at three levels (left subclavian artery, pulmonary artery bifurcation, and celiac axis).

Results: No in-hospital mortality was observed. There was one case each of paraplegia and stroke postoperatively. The whole thoracic aorta FL thrombosis rate was significantly higher in group A (83% vs 56%; $P = .002$). Significant aortic remodeling (true lumen expansion and FL regression) was observed in both groups. In multivariable Cox regression analysis, the FLP and the number of re-entries were independent predictors for thoracic FL thrombosis (hazard ratio, 2.339 [$P = .009$] and 0.709 [$P < .001$], respectively).

Conclusions: Full-coverage TEVAR with the FLP seems to be a safe endovascular treatment and promotes thoracic FL thrombosis for patients with CDIIIB dissections. (J Vasc Surg 2018;68:976-84.)

Keywords: Chronic DeBakey IIIB; Dissection; False lumen procedure; TEVAR

Although thoracic endovascular aortic repair (TEVAR) is commonly used for chronic DeBakey type IIIB (CDIIIB) dissections, aortic remodeling outcomes after TEVAR in CDIIIB dissections have been unsatisfactory.[1-3] The false lumen (FL) complete thrombosis rate after TEVAR was reported as 90% in chronic DeBakey type IIIA dissections. However, for CDIIIB dissections, this rate ranged from 30% to 60%.[4-6] Despite full coverage of the descending thoracic aorta (DTA), used as a strategy in our institution, the thoracic FL thrombosis (TFT) rate was only 65%.[7] Persistent retrograde flow to the FL through re-entry tears is a common cause of failure, and a mobile intimal (intimal-medial) flap distal to the stent graft is another factor that negatively affects FL thrombosis in patients with CDIIIB dissections.

The FL procedure (FLP) blocks retrograde FL flow; thus, aorta remodeling after TEVAR seemed to be improved with an additional FLP in CDIIIB dissection patients. Currently, the FLP is performed with commercial materials, such as the Amplatzer vascular plug (AVP; St. Jude Medical, St. Paul, Minn), Nester coil (Cook Medical, Bloomington, Ind), and embolization glue (33% *n*-butyl cyanoacrylate mixed with lipiodol); these materials are inserted into the FL to block retrograde FL flow through intimal tears, visceral branches, or intercostal arteries (ICAs). The Viabahn stent graft (W. L. Gore & Associates, Flagstaff, Ariz) is also inserted into the visceral branches to block retrograde flow through intimal tears within the visceral branches (Video, online only).

Our previous study reported that the FLP seemed safe and effective from preliminary results.[8] However, there is no study comparing the effect of TEVAR combined with the FLP. In this study, we compared the results of two groups, TEVAR alone and TEVAR with the FLP. We sought to clarify the safety and the effect of the FLP for

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aortic remodeling in CDIIIB dissection patients. We were specifically interested in whether the FLP or aortic features were related to TFT.

METHODS

Population of patients and data collection. This study was approved by the Institutional Review Board of Gangnam Severance Hospital, Yonsei University College of Medicine (Yonsei Institutional Review Board No. 3-2015-0065), which waived the need for consent of individual patients. A retrospective review of the Gangnam Endovascular Aortic Registry identified 73 patients who underwent TEVAR for CDIIIB dissections between 2012 and 2016. Of these patients, 41 (group A, 56%) underwent TEVAR with the FLP, and the other 32 (group B, 44%) underwent TEVAR alone. Patients treated for trauma-related disease were excluded. Chronic aortic dissections were defined as dissections persisting for longer than 3 months after the diagnosis of acute aortic dissection.[9] Spinal cord ischemia was defined as any new lower extremity motor or sensory deficit not attributable to intracranial pathologic features, peripheral neuropathy, or neurapraxia. Demographics, comorbidities, procedure-related details, and complications were collected from medical records. Reintervention was defined as the need for a secondary unexpected procedure after the initial procedure. In group A, reintervention was defined as the need for an additional procedure after the FLP. Respiratory failure was defined as the need for intubation, and renal failure was defined as the need for hemodialysis. Stroke was defined as any neurologic deficit lasting >24 hours that was confirmed by imaging and documented by a neurologist.[7]

Indication and treatment method. TEVAR is the preferred treatment at our institution for CDIIIB dissections with suitable anatomy. Indications for TEVAR include newly developed aneurysms, intractable back pain, and aneurysmal degeneration (thoracic aneurysm diameter >55 mm or documented growth rate of 5 mm in 6 months, as observed on serial computed tomography [CT] angiography [CTA]). In our institution, the aim of TEVAR in CDIIIB dissection patients is to try to cover the whole thoracic aorta for stabilization of a mobile intimal flap and to cover all intimal tears within the thoracic aorta. Despite full coverage of the DTA, persistent FL perfusion through communicating channels, such as intimal tears below the celiac axis, visceral branches, and ICAs, is an inevitable limitation of TEVAR. Indications for an additional FLP include a patent FL on postoperative CTA and lack of TFT at 6 months after initial TEVAR. The FLP strategy of our institution is as follows: simultaneous TEVAR and FLP when the FL is not excessively large, in which case the two or three largest AVPs used for occlusion would be insufficient; if thoracic FL flow is maintained on post-TEVAR angiography, FLP is planned; and if post-TEVAR angiography shows decreased thoracic FL flow, imaging follow-up is recommended. Decreased FL flow on postprocedural angiography is defined as follows: no retrograde thoracic FL perfusion at the proximal DTA is observed during three or four cardiac cycles; or no FL perfusion near the procedure site is observed during three or four cardiac cycles. All operations were elective and performed under general anesthesia and systemic heparinization (100 IU/kg) in a hybrid operating room. The need for perioperative adjuncts (eg, spinal drainage, carotid-subclavian bypass, and open or percutaneous vessel access) was at the discretion of the attending surgeon and interventional radiologist. The FL was typically catheterized through retrograde femoral access, but the brachial approach was also used for occluding the FL of the proximal descending aorta. AVPs, coils, stent grafts, and glues were used to occlude the FL. Targets of the FLP included the FL of the thoracoabdominal aorta, visceral re-entries, intimal tears below the celiac axis, and iliac re-entries (Video, online only). Technical success was defined as full material deployment at the intended location, with decreased FL flow on postprocedural angiography and CTA.[7,8]

Degree of FL thrombosis. We evaluated the degree of thrombosis within the thoracic aorta. The degree of FL thrombosis was analyzed using pre-contrast-enhanced, arterial-phase, and delayed-phase postoperative CTA. After the procedures (TEVAR or FLP) were completed, the degree of FL thrombosis was evaluated with delayed-phase CTA and classified as either thoracic FL partial thrombosis if both flow and thrombi were present within the thoracic aorta (above the level of the diaphragm) or TFT if no flow was observed within the whole thoracic aorta. The definition of FL thrombosis after endovascular aortic repair varies considerably according to studies.[4-6] We introduced the term *whole thoracic aorta FL thrombosis*, defined as TFT within the whole thoracic aorta (whole thoracic aorta above the diaphragmatic crus on CTA axial view).

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective single-center cohort study
- **Take Home Message:** In 73 patients who underwent thoracic endovascular aortic repair for chronic DeBakey type IIIB dissections, the false lumen (FL) procedure and the number of total re-entries were associated with FL thrombosis.
- **Recommendation:** The data suggest use of the FL procedure in addition to thoracic endovascular aortic repair in patients with chronic type IIIB aortic dissections.