CLINICAL STUDY

Promoting False-Lumen Thrombosis after Thoracic Endovascular Aneurysm Repair in Type B Aortic Dissection by Selectively Excluding False-Lumen Distal Entry Tears

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ABSTRACT

Purpose: To evaluate the efficacy and clinical outcomes of ancillary endovascular procedures in promoting false-lumen (FL) thrombosis (FLT) and preventing aortic expansion in patients after thoracic endografting for type B dissections.

Materials and Methods: This retrospective review included 15 patients (12 men and 3 women; mean age, 59.6 y). Mean aortic diameter at the time of ancillary treatment was 47.4 mm. Different techniques were used as single procedures or sequentially: covered stent occlusion of detached visceral artery entry tears, occlusion of single entry tears with vascular plugs, or aortic endograft occlusion of multiple FL entry tears. FL embolization with ethylene vinyl alcohol copolymer was performed when selective occlusion was considered insufficient to close distal entry tears. Apart from endovascular aneurysm repair, all procedures were performed percutaneously under local anesthesia. If FL diameter increase persisted after 6-month follow-up computed tomographic (CT) angiography, another intervention was planned; otherwise, yearly follow-up was performed.

Results: Mean clinical follow-up duration was 43.8 months (range, 8 d to 86.8 mo), with no in-hospital mortality. Estimated overall survival rates were 93.3%, 86.6%, and 77% at 12, 24, and 48 months, respectively. Three late deaths occurred, one of which was dissection-related at 40 months. Eight surviving patients (53%) had total FLT and 3 had partial FLT with stable aortic diameter on follow-up CT angiography. FL diameter increased in one patient, requiring further intervention.

Conclusions: Selective exclusion of new distal entry tears remaining after thoracic endovascular aneurysm repair can stabilize abdominal aortic expansion and promote FLT.

ABBREVIATIONS

FL = false lumen, FLT = false-lumen thrombosis, TEVAR = thoracic endovascular aneurysm repair

In acute and early chronic type B aortic dissections, thoracic endovascular aneurysm repair (TEVAR) is now the dominant treatment approach and has replaced open surgical repair, which is associated with high mortality rates (1). When combined with optimal medical treatment, most patients will benefit from this treatment in cases of aortic remodeling, false-lumen (FL) thrombosis (FLT), and stable aortic diameters (2,3). Although TEVAR has proven beneficial in aortic remodeling in the thoracic region adjacent to the endograft, further concern remains regarding the suprarenal and infrarenal aorta. Recent studies (4) have shown that excluding only the primary entry tear in the thoracic aorta may fail to induce thrombosis of the abdominal aortic FL because of persisting distal entry tears at this level. Partial FLT, on the contrary, is directly related to FL aneurysmal dilation and an increased risk of rupture (5,6). FLT is the ideal endpoint of therapy, as it is associated with better long-term prognosis; however, it is rarely achieved with medical treatment alone, and intervention is most

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often required to repair the dissection and promote aortic remodeling (7,8). The aim of the present study is to evaluate the efficacy and clinical outcomes of ancillary endovascular procedures in promoting FLT and preventing aortic dilation in patients after TEVAR for type B dissections.

MATERIALS AND METHODS

Patient Population

This retrospective single-center study was approved by the institutional review board, which waived the need for individual patient consent. Between June 2006 and December 2014, 78 patients underwent TEVAR for acute or chronic type B aortic dissection with delayed thoracic aortic dilation. Among these, during their post-TEVAR follow-up, 15 patients (19%; 12 men and three women; mean age, 59.6 y) had progressive increase in FL diameter in the aorta below the implanted endograft, requiring ancillary endovascular procedures to prevent further aneurysmal expansion and attempt to achieve FLT. Five patients (33.3%) had TEVAR in an acute setting, and 10 (66.6%) had been previously treated for chronic type B dissection. Patient comorbidities are presented in Table 1.

Imaging Protocol

The standard imaging protocol after TEVAR was computed tomographic (CT) angiography performed 6 months after all ancillary interventions. In cases that did not require further intervention, a 12-month follow-up interval was established. In patients in whom an increase of the aortic diameter greater than 3 mm (considered to represent FL expansion) was observed, another examination was scheduled after 6 months. CT angiography of the entire aorta, from the proximal supraaortic vessels to the common femoral arteries, was performed on a 16-row and later on a 64-row multidetector scanner (LightSpeed or Optima 660; GE Medical Systems, Fairfield, Connecticut) with a reconstruction increment of 1.25 mm. Arterial- and delayed-phase images were obtained to determine the status of the FL (ie, patent or thrombosed).

Table 1. Patient Comorbidities and Indications for TEVAR (N = 15)

Comorbidity Risk Factor	Incidence
Hypertension	14 (93)
CAD	11 (73)
Diabetes mellitus	6 (40)
Smoking (current or past)	11 (73)
Hypercholesterolemia	7 (47)
Previous stroke	3 (20)
Cocaine abuse	1 (7)
Connective tissue disease (Marfan, Ehlers–Danlos)	0
Renal insufficiency	2 (13)
Chronic obstructive pulmonary disease	3 (20)

Note–Values in parentheses are percentages.
CAD = coronary artery disease; TEVAR = thoracic endovascular aneurysm repair.

Image Analysis

CT angiographic imaging was used to assess new distal entry tears between the true lumens and FLs. Changes in aortic diameter and FL status were compared at the following seven levels: left subclavian artery, carina, level of the mitral valve, celiac trunk, uppermost renal artery, and largest diameters of the infrarenal aorta and common iliac arteries. The status of the FL was classified as total thrombosis if no flow was present, as partial thrombosis if flow and thrombus were present, and as patent if only flow was present. Changes in aortic diameters between the initiation of ancillary therapies and the achievement of total FLT or stabilization of aortic diameter were calculated using base measurements obtained from axial CTA image analysis on a Syngo MMWP workstation (Siemens Medical Solutions, Erlangen, Germany).

Endovascular Procedures

The intent to treat was based on observed dilation of the FL by more than 5 mm per year with persistent turbulent flow and hyperperfusion of the FL on follow-up. Excluded from the study were patients with a ruptured FL and patients with organ malperfusion as a result of dissection. Mean maximum aortic diameter at the time of initial ancillary treatment was 47.4 mm (range, 34–63 mm). Collected imaging data were used to determine remaining dominant entry tears after TEVAR. Ancillary techniques to close these tears were used in a single stage or sequentially, but always relied on initial selective occlusion of detached arterial ostia with covered peripheral stents (mainly the renal or superior mesenteric artery ostium). This technique was applied in all patients to occlude significant entry tears at the paravisceral level while retaining patency of the dissected visceral vessels. Remaining ancillary techniques included the following: (*i*) implantation of a vascular plug into a major proximal entry tear in the dissection flap was applied when there was direct communication between lumens, no important vessel was present, and direct occlusion could be performed; (*ii*) implantation of a straight or bifurcated endograft in the abdominal aorta or iliac arteries was used when proximal visceral entry tears were already eliminated to occlude the remaining distal reentry tears tears from detached lumbar arteries and to induce remodeling of the infrarenal aorta; and (*iii*) embolization of an FL proximal or distal endoleak with ethylene vinyl alcohol copolymer (Onyx 34; Covidien, Dublin, Ireland) was performed as a last resort in cases in which an entry tear remained but could not be treated with the other described methods. To avoid nontarget embolization,