Am J Transl Res 2026;18(3):2175-2184
www.ajtr.org /ISSN:1943-8141/AJTR0169996

Original Article

Clinical follow-up and predictors of re-intervention following thoracic endovascular aortic repair for Stanford type B aortic dissection

Xinbo Liu*, Weijie Zhang*, Hua Zhang, Haiwen Gong, Fudong Jing, Yazheng Zhang, Youjin Li

Department of Cardiac and Vascular Surgery, People's Hospital of Ningxia Hui Autonomous Region (Affiliated People's Hospital of Ningxia Medical University), Yinchuan 750000, Ningxia Hui Autonomous Region, China.
**Equal contributors and co-first authors.*

Received November 13, 2025; Accepted February 3, 2026; Epub March 15, 2026; Published March 30, 2026

Abstract: Objective: This study observed the clinical effect of Thoracic endovascular aortic repair (TEVAR) for Stanford Type B aortic dissection (TBAD) and identified predictors of re-intervention. Methods: A retrospective analysis was conducted on the clinical data of TBAD patients visiting the People's Hospital of Ningxia Hui Autonomous Region and undergoing TEVAR. Based on illness duration at the time of TEVAR, patients during the subacute or chronic phase were classified into the subacute group and chronic group. The changes in the aorta after the operation and the postoperative complications were evaluated. The risk factors for patients requiring further intervention were analyzed. Results: With a comparable incidence of postoperative complications, the subacute group showed better performance in terms of the false lumen thrombosis status and thrombus complete absorption rate. Postoperatively, the true lumen diameter at the left subclavian artery origin plane and the pulmonary artery bifurcation plane increased, while the false lumen diameter decreased. Multivariate logistic regression analysis showed that tubular graft (OR = 6.782, 95% CI = 1.668-27.582), graft length ≤145 mm (OR = 6.783, 95% CI = 1.623-28.348), postoperative false lumen expansion diameter >5 mm (OR = 6.906, 95% CI = 1.728-27.604), graft oversizing >15% (OR = 26.531, 95% CI = 5.800-121.370), and chronic-phase surgery (OR = 22.378, 95% CI = 2.987-167.637) were risk factors for re-intervention after TEVAR surgery. Conclusion: TEVAR treatment for TBAD has certain short-term and mid-term efficacy, but the aortic remodeling effect is poor in patients in the chronic stage. Surgical timing, graft selection and its impact on false lumen expansion are risk factors for re-intervention after TEVAR surgery. Appropriate surgical timing and graft should be selected to avoid re-intervention.

Keywords: Stanford type B aortic dissection, endovascular repair, aortic remodeling, re-intervention, risk factor

Introduction

The normal human aorta is composed of three layers: the intima, the media, and the adventitia. These layers adhere closely to each other and jointly they bear the high-pressure of the blood flow within the aorta. Aortic dissection (AD) refers to a situation where blood flows through a tear in the intima on the aortic wall and enters the outer layer of the media or the media-adventitia junction. The intima is stripped away and expands, eventually forming a false lumen alongside the true lumen within the aorta, which extends along the aorta towards the distal or proximal end [1]. AD is a rapidly progressing and life-threatening aortic emergency [2]. For the classification of AD, there are different methods based on the dissection anatomy. Currently the most commonly used methods are the Debakey classification and the Stanford classification [3]. The latter divides AD into types A and B based on the extent of the dissection involvement: Stanford type A refers to a dissection involving the ascending aorta, while Stanford type B refers to a dissection affecting the descending aorta beyond the left subclavian artery [4]. The incidence of Stanford Type B aortic dissection (TBAD) is much lower than that of type A. However, once this disease occurs, its severity is often higher than that of myocardial infarction, cerebral infarction, malignant tumors, etc., and it has a high recurrence rate and a low five-year survival rate [5, 6]. Clinically, TBAD is clas-

https://doi.org/10.62347/HRTW6504

sified based on the onset time of the disease as acute (less than 2 weeks), subacute (2 weeks to 3 months), and chronic (more than 3 months) phases [7]. With the improvement of medical diagnostic levels and changes in the disease spectrum, the domestic AD registry studies show that the incidence of TBAD in China is increasing and showing a rising prevalence at a younger age [4].

The causes and mechanisms of TBAD are still not clear. Multiple studies suggest that various pathogenic factors work together to cause the disease [8]. TBAD patients usually present with sudden, severe pain in the chest, back, or abdomen and are admitted to the hospital in an emergency. The situation is critical, and how to select effective treatment measures has always been a challenge. In the past, guideline-directed medical therapy (GDMT) was the major treatment method. The surgical interventions mainly include open surgery and endovascular treatment: One is the traditional open surgery with extracorporeal circulation and graft replacement, which has the advantages of long-term durability and low re-intervention rate. However, extracorporeal circulation and thoracotomy with a large incision are associated with high invasiveness and surgical trauma, consequently inducing serious postoperative complications [9, 10]. The other is thoracic endovascular aortic repair (TEVAR), a technique developed over 10 years ago, featuring minimal invasiveness and safety in the early postoperative period compared with open surgery. For some patients, the late failure rate after GDMT is often very high [6]. Early TEVAR can improve the long-term survival rate and reduce the need for re-intervention. Therefore, TEVAR has gradually been recommended by guidelines and consensus as the preferred treatment option for TBAD [11]. In TBAD patients undergoing TEVAR, the aortic segments covered by the graft usually show good remodeling. However, in some patients, the distal aorta, especially the abdominal aorta, will gradually expand, affecting the perfusion of abdominal branch arteries and even increasing the risk of arterial rupture. Besides, postoperative complications such as endoleak and recurrent dissection will occur, affecting outcomes [12]. Some patients need re-intervention, which not only increases economic pressure, but also wastes medical resources. Therefore, this study comparatively analyzed the preoperative clinical and postoperative follow-up results, explored the clinical outcomes of TBAD patients undergoing TEVAR at different illness phases, and investigated predictors for re-intervention.

Information and methodology

Research population

The clinical data of TEVAR-treated uncomplicated TBAD patients from January 2020 to January 2023 were analyzed retrospectively. Inclusion criteria: (1) TBAD diagnosed by computed tomography angiography (CTA); (2) First-time TEVAR recipients who fulfill TEVAR indications; (3) Preoperative diagnostic and evaluative examinations with digital subtraction angiography (DSA), CTA, or MRI prior to TEVAR; (4) Completeness of clinical and follow-up data. Exclusion criteria: (1) Incomplete imaging data; (2) Initial surgery performed at another hospital; (3) Simple conservative treatment or merely angiography; (4) Open vascular replacement; (5) Abdominal aortic graft implantation; (6) Supra-aortic branch reconstruction; (7) Inflammatory disease of the aorta (aortitis caused by Infection or immune factors); (8) Hereditary diseases (Marfan syndrome, Ehlers-Danlos syndrome, familial thoracic aortic aneurysm/dissection, and other hereditary diseases); (9) True aortic aneurysm or pseudoaneurysm; (10) Defective clinical and follow-up data. Ethical approval has been secured from the People's Hospital of Ningxia Hui Autonomous Region Medical Ethics Committee prior to study initiation. Based on the selection criteria, we enrolled 122 patients and performed grouping according to illness duration at the surgical timing, with patients undergoing TEVAR during the subacute phase classified as the subacute group and those during the chronic phase as the chronic group.

Patient data collection

By reviewing patients' electronic medical records, their clinical information was retrieved, mainly covering: demographic data like gender, age, and underlying diseases; preoperative clinical indexes, including the number of tears, false lumen extension into the abdominal aorta, and true lumen collapse; postoperative follow-up data included imaging parameters, endoleak, and false lumen thrombosis status. Decisions on re-intervention were made based on the follow-up results.

Table 1. Preoperative clinical data comparison

	Subacute group (n=41)	Chronic group (n=81)	χ^2/t	P
Age (years)	58.00±5.75	56.19±5.38	1.721	0.088
Gender (n)			0.319	0.572
Male	30	63		
Female	11	18		
Hypertension	30	58	0.033	0.855
Diabetes	30	52	0.995	0.319
Smoking history	22	37	0.694	0.405
Alcohol consumption history	23	40	0.492	0.483
Tear ≥2	12	26	0.102	0.750
True lumen collapse	14	57	14.681	0.0001
Tumor-like dilation	5	50	26.981	<0.0001
False lumen extension into the abdominal aorta	16	42	1.796	0.180

Surgical methods

All patients were administered nicardipine to control their blood pressure before the operation. TEVAR was performed under general anesthesia. Through DSA, the diameters of the true and false lumens as well as the location of the proximal dissection tears were observed, and the diameter of the proposed anchoring area on the aortic arch was measured. A stent graft with appropriate length and diameter was delivered to the proximal end of the original tear using the stent delivery system and gradually released. Additional aortic angiography was performed to confirm the stent position and to check if the tear was closed. The selection of stent length primarily depends on the type of pathology and anatomical factors; stent diameter must match the anatomical structure of the aortic true lumen. Beyond these considerations, individualized assessment is central to stent selection, requiring comprehensive analysis of the extent of dissection tear, the location of the tear opening, variations in aortic diameter, and the patient's overall condition. Confirming no abnormalities, the introducer aorta and all incisions were sutured. All patients underwent a 9-24-month follow-up (ended in January 2025) and CTA examinations; the median follow-up time was 16 months (13 months to 20 months). The decision on whether to intervene again was based on the follow-up situation, reintervention indications include endoleak, recurrent aortic dissection, partial thrombosis of the false lumen, new aneurysm formation, or retrograde extension of aortic dissection.

Statistical methods

Statistical data were analyzed by SPSS 25.0. The statistical presentation of continuous and categorical variables used mean standard deviation (x±s) and percentages (%), respectively. The normality of continuous data was confirmed by Kolmogorov-Smirnov test. Statistical comparisons employed the t-test for continuous variables and the chi-square exact test for categorical variables. Patients requiring re-intervention were included in the re-intervention group, while those not requiring further intervention were included in the control group. Binary logistic regression was used for multivariate analysis, and a difference was considered statistically significant if $P<0.05$.

Results

Preoperative clinical data

See **Table 1** for the preoperative clinical indices of both patient groups. The subacute and chronic groups were found to exhibit non-significant differences in age, sex, and underlying diseases ($P>0.05$). However, statistical differences were identified in the true lumen collapse and tumor-like dilation ($P<0.05$).

Aortic true/false lumen diameter variations across multiple planes

See **Table 2** for the changes in multiplanar true and false lumen diameters in the aorta, including the left subclavian artery origin, pulmonary artery bifurcation, celiac trunk origin, and aortic

Table 2. Comparison of diameter changes of multiplanar aortic true/false lumens

	Groups	Lumen	Preoperative diameter	Postoperative diameter	t	P
Left subclavian artery origin	Subacute group (n = 41)	True lumen	1.60±0.23	3.02±0.06	38.25	<0.0001
		False lumen	1.69±0.20	0.51±0.11	33.10	<0.0001
	Chronic group (n = 81)	True lumen	1.49±0.19	2.35±0.12	34.44	<0.0001
		False lumen	2.97±0.58	2.18±0.29	10.96	<0.0001
Pulmonary artery bifurcation	Subacute group (n = 41)	True lumen	1.37±0.09	2.51±0.49	14.65	<0.0001
		False lumen	1.59±0.19	0.30±0.10	38.47	<0.0001
	Chronic group (n = 81)	True lumen	1.29±0.20	2.24±0.18	31.78	<0.0001
		False lumen	2.89±0.50	2.39±0.33	7.511	<0.0001
Celiac trunk origin	Subacute group (n = 41)	True lumen	1.14±0.09	1.30±0.07	8.985	<0.0001
		False lumen	1.44±0.12	1.40±0.14	1.389	0.169
	Chronic group (n = 81)	True lumen	1.04±0.10	1.15±0.12	6.338	<0.0001
		False lumen	2.72±0.44	2.87±0.59	1.806	0.073
Aortic bifurcation	Subacute group (n = 41)	True lumen	0.99±0.12	1.03±0.10	2.881	0.005
		False lumen	1.00±0.21	1.04±0.12	1.059	0.293
	Chronic group (n = 81)	True lumen	0.84±0.16	0.90±0.06	0.954	0.342
		False lumen	2.00±0.44	2.01±0.38	0.155	0.877

Table 3. Comparison of maximum aortic lumen diameter

	Preoperative diameter (cm)	Postoperative diameter (cm)	t	P
Subacute group (n = 41)	3.10±0.21	2.90±0.27	3.744	0.0003
Chronic group (n = 81)	4.21±0.50	4.19±0.50	0.255	0.799

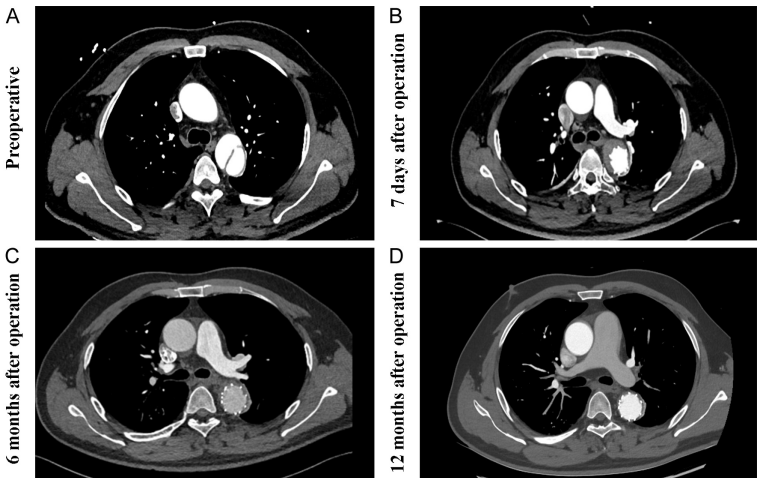

Figure 1. Imaging of Stanford type B thoracic Aortic dissection. A: Before operation; B: 7 days after operation; C: 6 months after operation; D: 12 months after operation.

bifurcation. All post-surgical patients showed increased true lumen diameters in the left subclavian artery origin, pulmonary artery bifurcation, as well as reduced false lumen diameters, with statistical significance (P<0.05). In addition, the true lumen diameter of the celiac trunk origin elevated from baseline in all participants (P<0.05), while the false lumen diameter altered little (P>0.05).

Maximum aortic lumen diameter changes

Alterations in aortic lumen diameters can be found in **Table 3**. The maximum aortic lumen diameter in patients in the subacute phase was notably reduced versus pre-operative (P<0.05). However, patients undergoing the procedure during the chronic phase showed a small difference in the maximum aortic lumen diameter postoperatively (P> 0.05). The image of the typical cases of Stanford type B thoracic aortic dissection before and after surgery were shown in **Figure 1**; Preoperatively, the degree and extent of aortic wall thickening were clearly demonstrated. Postoperatively, the false lumen underwent complete remodeling, with the aorta still exhibiting a dilated appearance.

Table 4. The remodeling condition of the thoracic aorta

	The ratio of true lumen to aortic diameter (TLi)		The ratio of false lumen to aortic diameter (FLi)	
	Preoperative	Postoperative	Preoperative	Postoperative
Subacute group (n = 41)	0.45±0.11	0.86±0.15	0.56±0.16	0.14±0.07
Chronic group (n = 81)	0.42±0.13	0.65±0.18	0.55±0.14	0.40±0.12
t	1.313	6.630	0.251	13.09
P	0.192	<0.0001	0.803	<0.0001

Table 5. Postoperative complications and false lumen thrombosis status

	Postoperative complications			False lumen thrombosis		Aortic-related death
	Endoleak	Recurrent aortic dissection	Retrograde extension of aortic dissection	Complete thrombosis	Partial thrombosis	
Subacute group (n = 41)	1	1	0	31	10	1
Chronic group (n = 81)	7	8	6	39	42	4
χ^2	1.749	2.251	3.194	8.384		0.433
P	0.186	0.134	0.074	0.004		0.512

The remodeling condition of the thoracic aorta

The remodeling status of the thoracic aorta was represented by the true lumen/diameter of the aorta ratio (TLi) and the false lumen/diameter of the aorta ratio (FLi). The study showed that there was no statistically significant difference in the two indicators between the two groups of patients before the operation (P> 0.05). After the operation, both TLi in the two groups increased, and FLi in both groups decreased compared to before the operation. However, the improvement of the two indicators in the subacute group was more significant than that in the chronic group, and the difference was statistically significant. See **Table 4**.

Postoperative complications and false lumen thrombosis

After analysis, we determined no statistical inter-group difference in the incidence of postoperative complications such as endoleak, recurrent AD, and retrograde extension of AD (P>0.05). However, the complete false lumen thrombosis resolution rate was higher in the subacute stage, while patients in the chronic group exhibited poor false lumen thrombosis (P<0.05; **Table 5**).

Univariate analysis of post-TEVAR re-intervention

A univariate analysis was conducted on the risk factors for post-TREVAR re-intervention. The results showed the presence of statistical inter-group differences in terms of graft type, graft length, graft oversizing, postoperative false lumen dilation diameter, distal tear, and surgical timing (P<0.05; **Table 6**).

Multivariate analysis of post-TEVAR re-intervention

Univariate analysis-identified significant variables which were subjected to multivariate analysis using the logistic regression model, with re-intervention (1 = yes, 0 = no) as a dependent variable. Tubular graft (OR = 6.782, 95% CI = 1.668-27.582), graft length ≤145 mm (OR = 6.783, 95% CI = 1.623-28.348), postoperative false lumen expansion diameter >5 mm (OR = 6.906, 95% CI = 1.728-27.604), graft oversizing >15% (OR = 26.531, 95% CI = 5.800-121.370), and chronic-phase surgery (OR = 22.378, 95% CI = 2.987-167.637) were confirmed as risk factors. See **Table 7**.

Discussion

AD is a life-threatening condition. The mortality rate of untreated AD patients within one week of onset is approximately 50% [13]. By using TEVAR to implant stents to seal intima tears, the pressure on the false lumen can be reduced, and thrombosis can be generated, thereby improving the blood supply in the true lumen and reducing the risk of dissection tears [14]. However, the progression degree and patho-

Table 6. Univariate analysis of post-TEVAR re-intervention

	Re-intervention group (n = 28)	Control group (n = 94)	χ^2/t	P
Age (years)	57.43±5.22	56.61±5.65	0.687	0.494
Gender (n)			0.030	0.862
Male	21	72		
Female	7	22		
Hypertension	20	68	0.009	0.925
Diabetes	14	55	0.636	0.435
Smoking history	13	46	0.054	0.816
Alcohol consumption history	12	51	1.122	0.289
Graft type			13.281	0.0003
Tubular	22	37		
Tapered	6	57		
Graft length (mm)			4.864	0.027
≤145	17	35		
>145	11	59		
Graft oversizing (%)			19.831	<0.0001
≤15	18	19		
>15	10	75		
Postoperative false lumen diameter (mm)			5.413	0.020
≤5	10	57		
>5	18	37		
Distal tear			8.816	0.003
Yes	9	60		
No	19	34		
Surgical timing			11.411	0.001
Subacute phase	2	39		
Chronic phase	26	55		

Table 7. Multivariate analysis of post-TEVAR re-intervention

Variable	Assignment	β	SE	Wald	P	OR	95% CI
Constant	-	-8.377	1.609	27.100	0.000	0.000	-
Graft type	1 = tubular, 0 = tapered	1.914	0.716	7.152	0.007	6.782	1.668-27.582
Graft length (mm)	1 = ≤145, 0 = >145	1.914	0.730	6.884	0.009	6.783	1.623-28.348
Graft oversizing (%)	1 = >15, 0 = ≤15	3.278	0.776	17.857	0.000	26.531	5.800-121.370
Postoperative false lumen diameter (mm)	1 = >5, 0 = ≤5	1.932	0.707	7.471	0.006	6.906	1.728-27.604
Distal tear	1 = yes, 0 = no	0.465	0.669	0.478	0.489	1.588	0.428-5.983
Surgical timing	1 = chronic phase, 0 = subacute phase	3.109	1.027	9.151	0.002	22.378	2.987-167.637

logical changes of AD vary among different disease stages, and the postoperative therapeutic effects of TEVAR also differ. For the current treatment of TBAD, the efficacy evaluation of TEVAR mostly focuses on both acute and chronic patients. Evidence has shown that TEVAR for acute-phase patients has a high success rate, with a low risk of postoperative mortality and stable therapeutic effects during the follow-up period [15]. Previous research results have been inconsistent, which is considered to be related to the overly broad division of the chronic phase among the study subjects, resulting in a significant difference in disease severity among patients theoretically belonging to the chronic phase [16]. Therefore, in recent years,

some studies have proposed the concept of the subacute phase, which refers to the period between 2 weeks and 3 months of onset.

This study included 122 cases of TBAD, who were divided into subacute and chronic phases according to different disease stages. According to preoperative imaging examinations, the subacute group had a statistically lower proportion of patients with true lumen collapse and tumor-like dilation than the chronic phase group. After entering the chronic stage, blood flow continuously enters the false lumen, and under high pressure, it gradually expands like a tumor, the true lumen is compressed and shrinks, while the false lumen diameter continues to expand, making thrombosis difficult to occur; in the subacute stage, the dissection is in the transitional state between acute and chronic, but there is already a tendency of true lumen collapse and tumor-like dilation [17]. All cases enrolled were operated on successfully. All post-surgical patients showed a rise in the true lumen diameters in the left subclavian artery origin and pulmonary artery bifurcation from baseline, as well as a decrease in the false lumen diameters, with statistical significance. However, the chronic group displayed a non-significant reduction in the maximum aortic lumen diameter post-operation. This may be due to factors such as thrombosis of the false lumen and fixation of the endocardial flaps in chronic AD. Nevertheless, this finding holds significant clinical reference value. That is, for chronic-stage TBAD patients, whether to opt for interventional surgery or adopt a combination of medical conservative treatment and regular follow-up, should be determined based on the patient's condition. Meanwhile, the observation of postoperative complications indicated no significant between-group differences in the overall incidence; yet, the subacute group performed better in terms of false lumen thrombosis status with a higher complete thrombosis absorption rate. In the past, the efficacy evaluation of TEVAR relied on postoperative thrombus formation within the false lumen as the primary indicator. In recent years, some scholars have proposed that the disappearance of the false lumen (i.e., complete resolution of false lumen thrombosis) should be regarded as the optimal outcome [18, 19]. The principle of TEVAR is to use a covered stent to seal the tear at the proximal dissection, reducing the pressure within the false lumen, causing thrombosis, organization, and resolution in the lumen, and facilitating its absorption. This, in turn, reduces the pressure on the true lumen and facilitates normal function restoration [20]. False lumen thrombosis is an important index of aortic vascular remodeling. Incomplete false lumen thrombosis can cause aortic dilatation and compromise patient prognosis. The existence of a distal tear will affect the degree of false lumen thrombosis [21]. If chronic AD is not effectively treated for a long time, the false lumen diameter will gradually increase as the blood flow in the false lumen gradually increases; after closing the entrance of the dissection, there will be more thrombosis in the false lumen; moreover, due to the long duration, some of the thrombi have undergone fibrosis, which will inevitably influence aortic wall remodeling [22]. During the subacute stage, the inflammatory response of the arteries in patients has somewhat subsided, the edema has lessened, and the thrombus in the false lumen has not yet had time to form. Following grafting, the false lumen is prone to complete thrombosis, which is beneficial for aortic remodeling.

Although TEVAR can isolate the blood from flowing into the false lumen, effectively promote aortic remodeling, and reduce aortic-related deaths, some patients still experience complications like endoleak and recurrent AD, requiring surgical re-intervention. In this study, 28 patients (22.9%) needed post-TEVAR re-intervention for endoleak, recurrent AD, and incomplete false lumen thrombosis. In a previously published meta-analysis involving 27 studies and 2,403 patients with aortic dissection, the overall reintervention rate during a 33.7-month follow-up period was 15.0% [23]. One possible explanation is that this study focused exclusively on uncomplicated thoracic aortic dissections, whereas most data reported in the literature involve mixed cases encompassing all dissections and/or aneurysms. Also, Nozdrzykowski et al. [24] also reported type I endoleak as the most frequent indication for a secondary procedure (26.8%). We further analyzed re-intervention-associated predictors, identifying tubular graft, graft length ≤145 mm, postoperative false lumen expansion diameter >5 mm, graft oversizing >15%, and chronic-phase surgery as risk factors of post-TEVAR re-intervention. Because of its in-

herent self-expanding property, the passive-bent tubular graft has a tendency to return to its straight shape. Moreover, excessive graft oversizing would increase the expansion force exerted on the distal descending aorta of the graft, resulting in significant distal false lumen expansion and new tear formation in the dissection septum [25]. Currently, the optimal oversizing for retrograde type A aortic dissection remains controversial. In a comprehensive data study, Canaud et al. [26] noted that when oversizing exceeds 9%, the relative risk of retrograde type A aortic dissection increases by 14% for each additional percentage point. Tapered grafts are more conducive to aortic remodeling, which can avoid over-expansion of the distal aorta post-grafting and reduce graft-related complications. The aorta of the body gradually narrows from the proximal to the distal end. Graft type and length selection are particularly important in TEVAR. Appropriately increasing the graft length has been indicated to reduce the stress at both ends caused by graft bending. Without affecting the aortic blood supply, a graft length of >145 mm can reduce the risk of re-entry tears at the distal end. In addition, the excessive postoperative false lumen expansion will increase the risk of tears. The tension exerted on the vessel wall is proportional to the diameter of the false lumen. A larger diameter means that the false lumen wall will bear a greater tension load. If a tumor-like dilation has occurred, intervention should be considered to seal it. With regard to the timing of operation, previous views held that surgery should not be performed during the acute phase. However, in the chronic phase, the distal true lumen is chronically compressed by the false lumen, which can lead to complete occlusion. Moreover, due to the fibrosis and partial thrombosis of the intima, the postoperative expansion of the true lumen is restricted. As a result, the graft's distal dissection flap would bear a higher chronic expansion force of the graft, impacting aortic remodeling and inducing new tears [27]. Thus, choosing the subacute phase for surgery can avoid the risk of premature intervention and reduce complications. Therefore, we hold that blood pressure control can be prioritized when a patient experiences physical discomfort. Once the condition stabilizes, performing surgery during the subacute phase can avoid re-intervention.

This study has certain limitations: First, as a single-center retrospective study with a small sample size and low reintervention rate, the analysis may be subject to bias. Second, the retrospective nature of the study, which excluded some patients lost to follow-up, introduces survivor bias; it also lacks more comprehensive long-term follow-up data. Therefore, larger-scale randomized controlled trials with expanded sample sizes are required to compare the long-term clinical outcomes and aortic remodeling between non-complex TEVAR and other approaches.

Collectively, TEVAR treatment for TBAD has certain short- and mid-term efficacy, but the aortic remodeling effect is poor in patients in the chronic phase. Surgical timing, graft type and its influence on false lumen expansion are correlated with re-intervention following TEVAR. Appropriate surgical timing and graft selection should be chosen to avoid re-intervention.

Acknowledgements

This work was supported by the Ningxia Natural Science Foundation, grant number: 2023AAC03454.

Disclosure of conflict of interest

None.

Address correspondence to: Youjin Li, Department of Cardiac and Vascular Surgery, People's Hospital of Ningxia Hui Autonomous Region (Affiliated People's Hospital of Ningxia Medical University), Yinchuan 750000, Ningxia Hui Autonomous Region, China. Tel: +86-0951-5920042; E-mail: 1880958-7797@163.com

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