SYSTEMATIC REVIEW

Efficacy of thoracic endovascular aortic repair versus medical therapy for treatment of type B aortic dissection

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Abstract

Background Techniques in endovascular therapy have evolved to offer a promising alternative to medical therapy alone for Type B aortic dissections (TBADs).

Aim The aim of this meta-analysis was to compare mortality and overall complications between thoracic endovascular aortic repair (TEVAR) and best medical therapy (BMT) in patients with TBADs.

Methods We included randomized control trials and prospective or retrospective cohort studies that compared TEVAR and BMT for the treatment of type B aortic dissection. Multiple electronic databases were searched.

Results Thirty-two cohort studies including 150,836 patients were included. TEVAR was associated with a significantly lower 30-day mortality rate than BMT (RR = 0.79, CI = 0.63, 0.99, P = 0.04), notably in patients ≥ 65 years of age (RR = 0.78, CI = 0.64, 0.95, P = 0.01). The TEVAR group had a significantly prolonged hospital stay (MD = 3.42, CI = 1.69, 5.13, P = 0.0001) and ICU stay (MD = 3.18, CI = 1.48, 4.89, P = 0.0003) compared to the BMT. BMT was associated with increased stroke risk (RR = 1.52, CI = 1.29, 1.79, P < 0.00001). No statistically significant differences in late mortality (1, 3, and 5 years) or intervention-related factors (acute renal failure, spinal cord ischemia, myocardial infarction, respiratory failure, and sepsis) were noted between the groups.

Conclusion Our meta-analysis revealed a significant association between the TEVAR group and a decreased mortality rate of TBAD compared to the medical treatment group, especially in patients aged 65 years or older. Further randomized controlled trials are needed to confirm our findings.

Keywords Thoracic endovascular aortic repair, Medical therapy, Type B aortic dissection

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Introduction

Aortic dissection (AD) is a known component of acute aortic syndrome, in conjunction with intramural hematoma and a penetrating aortic ulcer. It develops when the intimal layer of the aorta tears, allowing blood to leak into the wall and creating a dissection plane along the medial layer. Uncontrolled hypertension and trauma are the frequent causes of dissection. Occasionally, an underlying connective tissue condition predisposes the patient to its pathogenesis [1].

The majority of the 43,000 to 47,000 aortic disease-related deaths that occur annually in the United States are linked to dissection [2]. Type B aortic dissection (TBAD) has a 30-day mortality rate of 10%-20%. When patients with ascending aortic dissection underwent surgery instead of medical care, mortality was dramatically reduced; however, this effect was not observed in patients with descending aortic dissection. For the past 50 years, treatment has been guided by the Stanford classification, which is based on this finding. As a result, type B dissections that are considered complicated, such as those with aortic rupture, neurologic sequelae, hypotension or shock, end-organ malperfusion, recurrent or refractory pain, early aortic dilation, hypertension resistant to medical treatment, or propagation of the dissection, have been saved for surgical intervention [3, 4].

Thoracic endovascular aortic repair (TEVAR) has been a successful alternative to surgery for acute complex TBAD since it was first emerged by DeBakey et al. [5] and Daily et al. [6] in the late 1960s and has a lower perioperative mortality rate. TEVAR's overall effectiveness of TEVAR in treating patients with acute, uncomplicated TBAD is still under discussion. Medical or conservative treatment is used for individuals with uncomplicated TBAD. This involves the management of hypertension and close monitoring [7]. The longterm outcomes of the best medical treatment (BMT) in patients with uncomplicated TBAD, however, tend to be less than desirable, with a recorded false-lumen expansion of 20% to 50% after 4 years and cumulative mortality of 30% to 50% at 5 years [8–10].

In terms of hospital mortality, TEVAR has shown high efficacy in reducing mortality rates, as reported by several studies [11-13]. In contrast, other studies found no significant difference between TEVAR and medical management (MM) in terms of mortality rate [14-16]. Therefore, we aimed to compare MM and TEVAR in the management of TBAD and to resolve these conflicting results.

Methods

Data sources and search strategy

A systematic search of Cochrane Library, PubMed, Scopus and Web of Science up to February 2023 was conducted for appropriate studies using the following search strategy "("Thoracic Endovascular Aortic Repair" OR "Endovascular Stent Grafting" OR "Fenestrated Endovascular Aneurysm Repair" OR "Branched Endovascular Aneurysm Repair" OR "Thoracic Endovascular Aneurysm Repair" OR "Thoracic Endovascular Aneurysm Repair") AND ("Aortic Dissection" OR "Dissecting Aortic Aneurysm"). We included only articles published in English.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed in this meta-analysis.

Study selection

Pre-defined PICOS criteria were followed to select relevant studies (P: acute or chronic type B aortic dissection patients; I: thoracic endovascular aortic repair; C: medical therapy; O: in-hospital mortality and adverse event outcomes). Studies were included in the metaanalysis if they were randomized control trials and prospective or retrospective cohorts that compared thoracic endovascular aortic repair (TEVAR) versus medical therapy for the treatment of acute or chronic type B aortic dissection. Case reports, case series and animal studies were excluded. Awe followed these criteria to perform title and abstract screening of the publications to assess their eligibility for inclusion. Studies that passed this initial screening were then evaluated in full text screening. Each stage involved a duplicate review of the publications, with any disagreements resolved through consensus or by a third reviewer.

Data extraction and assessment of study quality

Data extraction of the baseline characteristics and outcomes were done using a standardized method. Baseline characteristics that were extracted included study year, country, sample size, number of patients in each group, sex, age, length of hospital or ICU stay, extent of dissection at admission, baseline diseases, and baseline medications. Two authors performed title and abstract screening and two authors performed full-text screening. Five authors extracted the Data and another author examined data accuracy. We used The Newcastle Ottawa scale tool to assess quality of the observational studies.

Statistical analysis

Statistical analysis was performed using RevMan software (version 5.4). For continuous outcomes, such as length of hospital stay, the mean difference (MD) and the associated 95% confidence interval (CI) were used. For dichotomous outcomes, such as mortality, the risk ratio (RR) and its corresponding 95% CIs were used. The overall effect of the meta-analysis was estimated using a Z-test. If no heterogeneity was detected, a fixed effects model was used to present the results. If significant heterogeneity was present, a random effects model was applied. Heterogeneity was estimated using the chi-squared test.

Results

Literature search

After conducting an extensive literature search, 1,966 studies were identified. Following the removal of duplicates, 1,673 studies were deemed eligible for title and abstract screening. Of these, 1,607 were found to be irrelevant, leaving 66 studies that were suitable for full-text screening. Ultimately, 32 studies [11, 17–47] were included in the meta-analysis after review of the full-text, (Fig. 1).

The overall quality of the included studies was found good in 23 studies, fair in one study, and poor in seven studies (Table 1).

The total number of included participants in the study was 150,836, 19,512 patients in TEVAR group, and 131,324 patients in medical treatment group, Table 2 shows other baseline data.

Outcomes

In hospital / 30-day Mortality Rate analysis

The overall effect estimate showed a statistically significant association between the TEVAR group and decreased hospital/ 30-day mortality rate compared with the medical treatment group (RR=0.79, CI=0.63, 0.99, P=0.04). Significant heterogeneity was found among studies that wasn't resolved by the leave-one-out test (P < 0.00001, I²=76%), as shown in Fig. 2.

In hospital / 30-day Mortality Rate age subgroup analysis More than or equal to 65 years old

The overall effect estimate showed no statistically significant difference between TEVAR and Medical treatment



Fig. 1 PRISMA flow diagram

	TEVA	R	Medical tre	atment		Risk Ratio			Risk Ratio		
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	Year	M-	H, Random, 95% (1	
Dialetto et al 2005	3	28	0	28	0.6%	7.00 [0.38, 129.55]	2005				
Steingruber 2008	5	38	3	50	2.2%	2.19 [0.56, 8.61]	2008			—	
Zeeshan 2010	2	45	4	12	1.8%	0.13 [0.03, 0.64]	2010		— I		
Garbade 2010	9	46	7	84	4.0%	2.35 [0.94, 5.89]	2010				
McKinsey 2012	48	406	1977	8413	9.4%	0.50 [0.38, 0.66]	2012		-		
Pacini 2012	25	93	260	789	8.6%	0.82 [0.58, 1.16]	2012		+		
Fattori 2013	30	290	74	860	8.1%	1.20 [0.80, 1.80]	2013		+		
Nozdrzykowski 2013	2	32	1	33	0.9%	2.06 [0.20, 21.64]	2013	-			
Qin 2013	3	152	0	41	0.6%	1.92 [0.10, 36.47]	2013				
Ruan2013	1	42	2	21	0.9%	0.25 [0.02, 2.60]	2013				
Dick 2013	0	12	4	72	0.6%	0.62 [0.04, 10.91]	2013				
Shah 2014	43	504	431	4202	9.1%	0.83 [0.62, 1.12]	2014		-+		
Afifi 2015	5	37	13	68	3.8%	0.71 [0.27, 1.83]	2015				
Charilaou 2015	7	10	11	85	5.5%	5.41 [2.73, 10.73]	2015		→		
Zimmerman 2016	112	1417	1274	7964	10.1%	0.49 [0.41, 0.59]	2016		+		
Qin 2016	1	184	4	154	1.0%	0.21 [0.02, 1.85]	2016		<u> </u>		
Lou 2017	6	167	0	172	0.6%	13.39 [0.76, 235.77]	2017		+		
Laquian 2018	0	27	5	74	0.6%	0.24 [0.01, 4.26]	2018				
Xiang 2019	1	145	3	145	1.0%	0.33 [0.04, 3.17]	2019				
Hsieh 2019	606	6687	4490	36244	10.7%	0.73 [0.67, 0.79]	2019		•		
Weiss 2020	37	412	363	2466	8.9%	0.61 [0.44, 0.84]	2020				
Yonghua Bi 2020	1	40	4	13	1.1%	0.08 [0.01, 0.66]	2020	· · · ·	— I		
Lee 2020	38	697	1352	13363	9.0%	0.54 [0.39, 0.74]	2020				
Tian 2022	1	158	2	189	0.9%	0.60 [0.05, 6.53]	2022			-	
Total (95% CI)		11669		75542	100.0%	0.79 [0.63, 0.99]			•		
Total events	986		10284								
Heterogeneity: Tau ² = (0.13; Chi ^z :	= 96.06	, df = 23 (P ≺	0.00001);	I² = 76%					-	100
Test for overall effect: Z	Z = 2.02 (P	= 0.04)		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				0.01 0.1		10	100
	v								IEVAR Medicali	reatment	

Fig. 2 In hospital / 30-day Mortality Rate

group in patients more than or equal to 65 years old (RR=1.41, CI 0.75, 2.68, P=0.29). Significant heterogeneity was found among the studies (P < 0.00001, $I^2 = 91\%$), Fig. 3. So, leave one out test was done by removing the study (Charilaou 2015) and the heterogeneity was solved (P=0.21, $I^2=35\%$) and the overall effect estimate showed a statistically significant association between TEVAR group and decreased in hospital/ 30-day mortality rate in patients more than or equal to 65 years old (RR=0.78, CI=0.64, 0.95, P=0.01).

Less than 65 years old

The overall effect estimate showed no statistically significant difference between the TEVAR and Medical treatment group in patients aged <65 years (RR=0.74, CI 0.32, 1.67, P=0.46). Significant heterogeneity was found among studies that was not not resolved by the leave-one-out test (P<0.00001, I²=84%), Fig. 3.

In hospital / 30-day Mortality Rate age subgroup analysis *Complicated AD*

The overall effect estimate showed no statistically significant difference between the TEVAR and Medical treatment group in complicated AD patients (RR=0.87, CI 0.29, 2.62, P=0.81). Significant heterogeneity was found

among studies that wasn't resolved by the leave-one-out test (P < 0.00001, $I^2 = 87\%$), as shown in Fig. 4.

Uncomplicated AD

The overall effect estimate showed a statistically significant association between the TEVAR group and decreased hospital/ 30-day mortality rate in uncomplicated AD patients compared to the medical treatment group (RR=0.74, CI=0.68, 0.80, P < 0.00001). No significant heterogeneity was found among the studies (P=0.68, I²=0%), as shown in Fig. 4.

In hospital / 30-day Mortality Rate study quality subgroup analysis

Good quality

The overall effect estimate showed a statistically significant association between the TEVAR group and decreased hospital/ 30-day mortality rate compared to the medical treatment group in good-quality studies (RR=0.67, CI 0.53, 0.84, P=0.0006). Significant heterogeneity was found among the studies (P=0.0004, I^2 =59%), Fig. 5. We performed leave-one-out test by removing the study (Qin 2016) and the heterogeneity was solved (P=0.02, I^2 =45%), and the overall effect estimate showed a statistically significant association between AD type B patients who were treated with TEVAR and



Fig. 3 In hospital / 30-day Mortality subgroup analysis according to age

decreased hospital/ 30-day mortality rate in good quality studies (RR=0.71, CI=0.55, 0.91, P=0.006).

Poor quality

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group in poor quality studies (RR=1.43, CI 0.44, 4.67, P=0.56). Significant heterogeneity was found among studies that wasn't resolved by the leave-one-out test (P<0.00001, I²=96%), Fig. 5.

Late mortality rate (MR) analysis

1 year mortality rate (MR)

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.42, CI=0.60, 3.37, P=0.42). Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P<0.00001, I^2 =98%), Fig. 6.

3 year mortality rate (MR)

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.37, CI=0.71, 2.63, P=0.35).

Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P < 0.00001, $I^2 = 98\%$), Fig. 6.

5 year mortality rate (MR)

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.01, CI=0.86, 1.18, P=0.93). Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P<0.00001, I²=89%), Fig. 6.

Length of hospital stay analysis

The overall effect estimate showed a statistically significant association between the TEVAR group and an increased length of hospital stay compared to the medical treatment group (RR=3.42, CI=1.69, 5.13, P=0.0001). Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P<0.00001, I²=96%), Fig. 7.

Length of ICU stay analysis

The overall effect estimate showed a statistically significant association between the TEVAR group and an

	TEVA	R	Medical tre	atment		Risk Ratio		Risk Ratio			
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	Year	M-H, Random, 95% Cl			
1.3.1 Inhospital/ 30-d	lay Mortal	lity Rate	Complicate	ed AD							
Zeeshan 2010	2	45	4	12	5.1%	0.13 [0.03, 0.64]	2010				
Fattori 2013	30	290	74	860	16.5%	1.20 [0.80, 1.80]	2013				
Ruan2013	1	42	2	21	2.7%	0.25 [0.02, 2.60]	2013	· · · · · · · · · · · · · · · · · · ·			
Charilaou 2015	7	10	11	85	12.8%	5.41 [2.73, 10.73]	2015				
Afifi 2015	5	37	13	68	9.7%	0.71 [0.27, 1.83]	2015				
Subtotal (95% CI)		424		1046	46.8%	0.87 [0.29, 2.62]					
Total events	45		104								
Heterogeneity: Tau ² =	= 1.20; Ch	i ^z = 29.7	8, df = 4 (P <	< 0.00001)); I ^z = 87%	6					
Test for overall effect:	Z=0.24	(P = 0.8 ⁻	1)								
1.3.2 Inhospital/ 30-d	lay Mortal	lity Rate	uncomplica	ated AD							
Dialetto et al 2005	3	28	0	28	1.8%	7.00 [0.38, 129.55]	2005				
Dick 2013	0	12	4	72	1.9%	0.62 [0.04, 10.91]	2013				
Qin 2013	3	152	0	41	1.8%	1.92 [0.10, 36.47]	2013				
Shah 2014	43	504	431	4202	17.8%	0.83 [0.62, 1.12]	2014				
Qin 2016	1	184	4	154	3.1%	0.21 [0.02, 1.85]	2016	· · · · · · · · · · · · · · · · · · ·			
Laquian 2018	0	27	5	74	1.9%	0.24 [0.01, 4.26]	2018	←			
Hsieh 2019	606	6687	4490	36244	19.5%	0.73 [0.67, 0.79]	2019	•			
Xiang 2019	1	145	3	145	2.9%	0.33 [0.04, 3.17]	2019				
Tian 2022	1	158	2	189	2.6%	0.60 [0.05, 6.53]	2022				
Subtotal (95% CI)		7897		41149	53.2%	0.74 [0.68, 0.80]		•			
Total events	658		4939								
Heterogeneity: Tau ² =	= 0.00; Ch	i ² = 5.73	, df = 8 (P = I	0.68); I ² =	0%						
Test for overall effect:	Z=7.70	(P < 0.0)	0001)								
Total (95% CI)		8321		42195	100.0%	0.90 [0.60, 1.37]		+			
Total events	703		5043								
Heterogeneity: Tau ² =	= 0.23; Ch	i ^z = 48.6	4, df = 13 (P	< 0.0000	1); I² = 73	%					
Test for overall effect:	Z=0.49	(P = 0.6)	3)					0.00 0.2 I 5 20 TEVAR Medical treatment			
Test for subgroup diff	ferences:	Chi²=0	.09, df = 1 (F	e = 0.76), l	²=0%						

Fig. 4 In hospital / 30-day Mortality subgroup analysis according to complicated or uncomplicated AD

increased length of ICU stay compared to the medical treatment group (RR=3.18, CI=1.48, 4.89, P=0.0003). No significant heterogeneity was found between the two studies (P=0.48, I²=0%), Fig. 8.

Development of Retrograde A dissection analysis

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=0.87, CI=0.68, 1.11, P=0.27). No significant heterogeneity was found between the two studies (P=0.08, I²=37%), as shown in Fig. 9.

Reintervention / dissection related admission analysis

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.20, CI=0.96, 1.49, P=0.12). Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P<0.00001, I²=80%), Fig. 10.

Aortic remodeling analysis

False lumen (FL) obliteration / thrombosis analysis

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.79, CI=0.89, 3.60, P=0.10).

Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P < 0.00001, $I^2 = 88\%$), Fig. 11.

True lumen (TL) expansion analysis

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.46, CI=0.33, 6.46, P=0.62). Significant heterogeneity was found (P<0.00001, I²=90%), Fig. 11. Therefore, we performed a leave-one-out test by removing the study (Laquian 2018) and the heterogeneity was resolved (P=0.40, I²=0%), and the overall effect estimate showed a statistically significant association between the TEVAR group and decreased true lumen expansion (RR=0.56, CI=0.36, 0.89, P=0.01).

Respiratory failure analysis

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.18, CI=0.58, 2.40, P=0.65). Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P<0.00001, I²=94%), Fig. 12.

	TEVA	R	Medical tre	atment		Risk Ratio		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	Year	M-H, Random, 95% Cl
1.2.1 Inhospital/ 30-da	ay Mortalit	y Rate G	lood quality	papers				
Dialetto et al 2005	3	28	0	28	0.7%	7.00 [0.38, 129.55]	2005	
Steingruber 2008	5	38	3	50	2.6%	2.19 [0.56, 8.61]	2008	
Garbade 2010	9	46	7	84	4.5%	2.35 [0.94, 5.89]	2010	
Zeeshan 2010	2	45	4	12	2.1%	0.13 [0.03, 0.64]	2010	
Pacini 2012	25	93	260	789	9.4%	0.82 [0.58, 1.16]	2012	
Dick 2013	0	12	4	72	0.7%	0.62 [0.04, 10.91]	2013	
Nozdrzykowski 2013	2	32	1	33	1.0%	2.06 [0.20, 21.64]	2013	
Qin 2013	3	152	0	41	0.7%	1.92 [0.10, 36.47]	2013	
Ruan2013	1	42	2	21	1.0%	0.25 [0.02, 2.60]	2013	
Afifi 2015	5	37	13	68	4.3%	0.71 [0.27, 1.83]	2015	
Qin 2016	112	1417	1274	7964	10.8%	0.49 [0.41, 0.59]	2016	+
Zimmerman 2016	1	184	4	154	1.2%	0.21 [0.02, 1.85]	2016	
Lou 2017	6	167	0	172	0.7%	13.39 [0.76, 235.77]	2017	
Laquian 2018	0	27	5	74	0.7%	0.24 [0.01, 4.26]	2018	
Hsieh 2019	606	6687	4490	36244	11.4%	0.73 [0.67, 0.79]	2019	•
Xiang 2019	1	145	3	145	1.1%	0.33 [0.04, 3.17]	2019	
Lee 2020	37	412	363	2466	9.7%	0.61 [0.44, 0.84]	2020	-
Weiss 2020	1	40	4	13	1.3%	0.08 [0.01, 0.66]	2020	
Yonghua Bi 2020	38	697	1352	13363	9.8%	0.54 [0.39, 0.74]	2020	
Tian 2022	1	158	2	189	1.0%	0.60 [0.05, 6.53]	2022	
Subtotal (95% CI)		10459		61982	74.8%	0.67 [0.53, 0.84]		◆
Total events	858		7791					
Heterogeneity: Tau ² =	0.07; Chi ² :	= 46.78	df = 19 (P =	0.0004); P	²= 59%			
Test for overall effect: 2	Z = 3.45 (P	= 0.000)6)					
		_						
1.2.2 Inhospital/ 30-da	ay Mortalit	y Rate p	oor quality p	apers				
McKinsey 2012	48	406	1977	8413	10.2%	0.50 [0.38, 0.66]	2012	-
Fattori 2013	30	290	74	860	8.9%	1.20 [0.80, 1.80]	2013	
Charilaou 2015	7	_10	11	85	6.2%	5.41 [2.73, 10.73]	2015	
Subtotal (95% CI)		706		9358	25.2%	1.43 [0.44, 4.67]		
Total events	85		2062					
Heterogeneity: Tau² =	1.04; Chi²	= 48.13	, df = 2 (P ≺ 0	.00001); P	²= 96%			
Test for overall effect: .	Z = 0.59 (P	'= 0.56)						
Total (95% CI)		11165		71340	100.0%	0.79 [0.61, 1.01]		▲
Total evente	040		0962	11540	.00.0/0	0.19 [0.01, 1.01]		•
Hotorogonoity: Touz-	043 011:062	- 94 72	df = 22 (P ~	0 000043-	I ² - 77%			
Test for overall effect:	7 = 1.86 /P	- 09.72 - 0.06\	, ui = 22 (r S	5.50001),	// 20			0.01 0.1 1 10 100
Toet for eubarous diffe	∠ - 1.00 (F arancae: 0	– 0.00) hi≊ – 1.6	3 df = 1 (P =	0.22) 12-	34 696			TEVAR Medical treatment
reactor subgroup unit	erences. C	m = 1.5	o, ar – i (r –	0.22), ("-	- 54.0 %			

Fig. 5 In hospital / 30-day Mortality subgroup analysis according to quality

Extension or dilatation of dissection / new dissection analysis The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=0.93, CI=0.38, 2.25, P=0.87). Significant heterogeneity was found among studies that was not resolved by the leave-one-out test (P<0.00001, I²=95%), Fig. 13.

Aortic rupture analysis

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=0.64, CI=0.39, 1.04, P=0.07). No significant heterogeneity was found between the two studies (P=0.16, I²=34%), Fig. 14.

Sepsis

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=1.22, CI=0.33, 4.46, P=0.76). Significant heterogeneity among the studies was found (P<0.0001, I²=91%), Fig. 15. Therefore, we performed leave-one-out test by removing the study (Williamson 2022) and the heterogeneity was resolved (P=0.69, I²=0%), and the overall effect estimate showed a statistically significant association between TEVAR and increased incidence of sepsis (RR=2.48, CI=1.41, 4.35, P=0.002).

Chest pain

The overall effect estimate showed no statistically significant difference between the TEVAR group and medical treatment group (RR=0.95, CI=0.30, 2.97, P=0.92). Significant heterogeneity was found among the studies (P=0.04, I²=68%), Fig. 16. Therefore, we performed leave -one- out test by removing the study (Afifi 2015) and the heterogeneity was resolved (P=0.31, I²=2%), and the overall effect estimate showed no statistically significant difference between the TEVAR group and the medical treatment group (RR=0.68, CI=0.42, 1.10, P=0.11).

	TEVA	R	Medical tre	atment		Risk Ratio		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	Year	M-H, Random, 95% CI
1.5.1 1-Year MR								
Dialetto et al 2005	25	28	24	28	3.2%	1.04 [0.85, 1.27]	2005	_ -
Steingruber 2008	7	38	44	50	2.5%	0.21 [0.11, 0.41]	2008	←
Steingruber 2009	6	29	9	35	2.1%	0.80 [0.32, 2.00]	2009	
Garbade 2010	12	46	12	84	2.4%	1.83 [0.89, 3.73]	2010	
Pacini 2012	36	93	336	789	3.1%	0.91 [0.70, 1.19]	2012	
Fattori 2013	8	290	35	860	2.4%	0.68 [0.32, 1.44]	2013	
Nozdrzykowski 2013	4	32	1	33	0.8%	4.13 [0.49, 34.94]	2013	
Qin 2013	3	152	0	41	0.5%	1.92 [0.10, 36.47]	2013	· · · · · · · · · · · · · · · · · · ·
Lou 2017	9	167	15	172	2.3%	0.62 [0.28, 1.37]	2017	
Lannuzi 2018	102	266	4053	8717	3.2%	0.82 [0.71, 0.96]	2018	
Xiang 2019	4	145	8	145	1.7%	0.50 [0.15, 1.62]	2019	• · · · · · · · · · · · · · · · · · · ·
Carroll 2020	15	1141	60	4340	2.7%	0.95 [0.54, 1.67]	2020	
Lee 2020	580	697	0	13363	0.5%	22228.66 [1390.17, 355433.85]	2020	
Lou 2022	8	50	8	96	2.1%	1.92 [0.77, 4.81]	2022	
Jeniann A. Yi 2023	4	86	4	83	1.5%	0.97 [0.25, 3.73]	2023	
Subtotal (95% CI)		3260		28836	31.0%	1.42 [0.60, 3.37]		
Total events	823		4609					
Heterogeneity: Tau ² =	2.52; Chi²	= 680.	59, df = 14 (F	° < 0.0000	1); I² = 98	%		
Test for overall effect: 2	Z = 0.80 (F	° = 0.42	2)					
1.5.2 3-Year MR								
umana 2002	48	67	45	122	3.1%	1.94 [1.47, 2.56]	2002	
Dialetto et al 2005	24	28	24	28	3.2%	1.00 [0.81, 1.24]	2005	- + -
Steingruber 2009	13	29	15	35	2.7%	1.05 [0.60, 1.82]	2009	
Garbade 2010	12	46	16	84	2.5%	1.37 [0.71, 2.64]	2010	
Pacini 2012	55	93	473	789	3.2%	0.99 [0.83, 1.18]	2012	
Nozdrzykowski 2013	4	32	1	33	0.8%	4.13 [0.49, 34.94]	2013	
Qin 2013	36	152	14	41	2.8%	0.69 [0.42, 1.16]	2013	
Afifi 2015	29	37	39	68	3.1%	1.37 [1.05, 1.78]	2015	
Lou 2017	27	167	18	172	2.7%	1.54 [0.89, 2.70]	2017	
Lannuzi 2018	184	266	5027	8717	3.3%	1.20 [1.10, 1.30]	2018	-
Laquian 2018	0	27	13	74	0.5%	0.10 [0.01, 1.61]	2018	←
Xiang 2019	5	145	17	145	2.0%	0.29 [0.11, 0.78]	2019	←
Yonghua Bi 2020	1	40	2	13	0.7%	0.16 [0.02, 1.65]	2020	←
Lee 2020	516	697	0	13363	0.5%	19777.95 [1236.72, 316294.12]	2020	
Lou 2022	19	50	23	96	2.8%	1.59 [0.96, 2.62]	2022	
Subtotal (95% CI)		1876		23780	34.0%	1.37 [0.71, 2.63]		
Total events	973		5727					
Heterogeneity: Tau ² =	1.37; Chi ^z	= 806.	57, df = 14 (F	o < 0.0000	1); I² = 98	%		
Test for overall effect: 2	Z = 0.94 (F	P = 0.35	5)					
1.5.3 5-Year MR								
umana 2002	48	67	63	122	3.2%	1.39 [1.10, 1.74]	2002	
Steingruber 2008	12	38	35	50	2.8%	0.45 [0.27, 0.75]	2008	
Steingruber 2009	21	29	19	35	3.0%	1.33 [0.91, 1.95]	2009	
Garbade 2010	20	46	23	84	2.8%	1.59 [0.98, 2.56]	2010	
Dick 2013	0	12	12	72	0.5%	0.22 [0.01, 3.56]	2013	←
Qin 2013	122	152	36	41	3.2%	0.91 [0.80, 1.05]	2013	-++
Afifi 2015	2	37	21	68	1.4%	0.18 [0.04, 0.71]	2015	←────
Charilaou 2015	2	10	0	85	0.5%	39.09 [2.00, 762.56]	2015	
Lou 2017	27	167	35	172	2.9%	0.79 [0.50, 1.25]	2017	
Lannuzi 2018	247	266	6410	8717	3.3%	1.26 [1.22, 1.31]	2018	-
Xiang 2019	12	145	26	145	2.6%	0.46 [0.24, 0.88]	2019	
Lee 2020	472	697	8298	13363	3.3%	1.09 [1.03, 1.15]	2020	+
Tian 2022	8	158	30	189	2.4%	0.32 [0.15, 0.68]	2022	←
Lou 2022	36	50	52	96	3.1%	1.33 [1.03, 1.71]	2022	
Subtotal (95% CI)		1874		23239	35.0%	1.01 [0.86, 1.18]		◆
Total events	1029		15060]
Heterogeneity: Tau ² =	0.04; Chi ²	= 120	92. df = 13 /F	• < 0,0000	I1); I ² = 89	%		
Test for overall effect: 2	Z = 0.08 (F	P = 0.93	3)		.,,			
Total (95% CI)		7010		75855	100.0%	1 04 [0 84 1 30]		-
Total events	2025	1010	26206	10000	100.070	1.04 [0.04, 1.30]		—
Lotar events	2825	- 107/	20390 27 df - 40	/D = 0 000	043-27-0	704		
Toot for ourself offs the	0.38, Chi* 7 = 0.27 //	= 10/5 1 - 0.74	5.37, ut = 431	יה א 1000	017,1*= 9	/ 70		0.5 0.7 1 1.5 2
Test for overall effect 2	⊆ = U.37 (F	-=0.71 Noz=4	1) 105 df - 0.40	- 0.642 12	- 00			TEVAR Medical treatment
TESLIOF SUDDFOUR DITE	a ences: C	aur = 1.	.55. ui = Z (P	= 0.01). I*	- U 70			

Fig. 6 Late mortality rate analysis

	1	TEVAR		Medic	al treati	nent	Mean Difference			Mean Difference
Study or Subgroup	Mean	SD	Total	l Mean SD Total			Weight	IV, Random, 95% CI	Year	IV, Random, 95% CI
Zeeshan 2010	15.9	11.4	45	15.9	10.2	12	3.8%	0.00 [-6.66, 6.66]	2010	
Ruan2013	17.21	2.72	42	12.79	3.63	21	7.9%	4.42 [2.66, 6.18]	2013	
Qin 2013	16.84	6.49	152	13.1	3.8	41	8.1%	3.74 [2.19, 5.29]	2013	
Shah 2014	12	12.4	504	5.6	5.8	4202	8.3%	6.40 [5.30, 7.50]	2014	
Afifi 2015	13.3	9.25	37	14.67	10.98	68	5.9%	-1.37 [-5.33, 2.59]	2015	
Zimmerman 2016	11	11.3	1417	6.8	8.6	7964	8.5%	4.20 [3.58, 4.82]	2016	
Qin 2016	11.1	4.66	184	12.35	3.41	154	8.4%	-1.25 [-2.11, -0.39]	2016	
Lannuzi 2018	11.6	10.2	266	6.7	8.9	8717	8.3%	4.90 [3.66, 6.14]	2018	
Hsieh 2019	7.67	0.74	6687	4	0	36244		Not estimable	2019	
Xiang 2019	10.9	2.8	145	11.2	8	145	8.2%	-0.30 [-1.68, 1.08]	2019	_ _
Carroll 2020	15	13.9	1141	7.6	8.9	4340	8.4%	7.40 [6.55, 8.25]	2020	
Lee 2020	15.67	10.4	697	9	8.16	13363	8.5%	6.67 [5.89, 7.45]	2020	
Lou 2022	8	3.05	50	6.33	3.82	96	8.3%	1.67 [0.53, 2.81]	2022	
Jeniann A. Yi 2023	11.1	8.6	86	6.4	6.9	83	7.4%	4.70 [2.35, 7.05]	2023	
Total (95% CI)			11453			75450	100.0%	3.41 [1.69, 5.13]		•
Heterogeneity: Tau ² =	8 93 C	hi ² = 33	81 66 df	= 12 (P	< 0 000	01) = !	96%	[]		++
Test for overall effect:	7 = 3.89	1 (P = 0	0001	. 2 ()	0.000					-10 -5 0 5 10
. cotto, crotan choor.	2 0.00	· · · - •								IEVAR Medical treatment

Fig. 7 Length of hospital stay analysis

	TEVAR Medical treatment							Mean Difference		Mean Difference			
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI	Year	IV, Fixed, 95% CI			
Laquian 2018	7	74	5	27	18	74	0.1%	-20.00 [-84.99, 44.99]	2018	· · · · · · · · · · · · · · · · · · ·			
Jeniann A. Yi 2023	6.4	7.1	86	3.2	3.8	83	99.9%	3.20 [1.49, 4.91]	2023				
Total (95% CI) Heterogeneity: Chi ² =	: 0.49, df	= 1 (91 P = 0.48	3); I² = 0%	6	157	100.0%	3.18 [1.48, 4.89]					
Test for overall effect:	: Z = 3.65	(P =	0.0003	1)						-20 -10 0 10 20 TEVAR Medical treatment			

Fig. 8 Length of ICU stay analysis

	TEVA	R	Medical treat	tment		Risk Ratio		Risk Ratio			
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% Cl	Year	M-H, Fixed, 95% Cl			
Dialetto et al 2005	3	28	0	28	0.4%	7.00 [0.38, 129.55]	2005				
Steingruber 2008	4	38	1	50	0.7%	5.26 [0.61, 45.20]	2008				
Zeeshan 2010	1	45	0	12	0.6%	0.85 [0.04, 19.60]	2010				
Qin 2013	3	152	2	41	2.5%	0.40 [0.07, 2.34]	2013				
Ruan2013	1	42	1	21	1.1%	0.50 [0.03, 7.60]	2013				
Shah 2014	1	157	5	87	5.2%	0.11 [0.01, 0.93]	2014				
Charilaou 2015	1	10	0	85	0.1%	23.45 [1.02, 541.06]	2015				
Qin 2016	4	184	9	154	7.9%	0.37 [0.12, 1.18]	2016				
Lou 2017	2	167	0	172	0.4%	5.15 [0.25, 106.45]	2017				
Laquian 2018	7	27	17	74	7.3%	1.13 [0.53, 2.42]	2018				
Xiang 2019	2	145	0	145	0.4%	5.00 [0.24, 103.25]	2019				
Weiss 2020	40	412	271	2466	62.6%	0.88 [0.64, 1.21]	2020				
Yonghua Bi 2020	1	40	0	13	0.6%	1.02 [0.04, 23.73]	2020				
Tian 2022	1	157	5	87	5.2%	0.11 [0.01, 0.93]	2022	e			
Jeniann A. Yi 2023	5	86	6	83	4.9%	0.80 [0.26, 2.53]	2023				
Total (95% CI)		1690		3518	100.0%	0.87 [0.68, 1.11]		•			
Total events	76		317								
Heterogeneity: Chi ² =	22.12, df	= 14 (F	² = 0.08); l ² = 3 ³	7%							
Test for overall effect:	Z=1.11 ((P = 0.2	27)					TEVAR Medical treatment			

Fig. 9 Retrograde type A dissection analysis

Discussion

Our meta-analysis compared TEVAR and medical treatment in TBAD treatment and revealed a significant association between the TEVAR group and decreased in-hospital or 30-day mortality rate compared with the medical treatment group. Further subgroup analysis of in-hospital or 30-day mortality rates was performed according to age, which was divided into two subgroups:

	TEVA	٨R	Medical treated	atment		Risk Ratio		Risk Ratio				
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	Year	M-H, Random, 95% CI				
Dialetto et al 2005	18	25	3	28	3.5%	6.72 [2.24, 20.12]	2005					
Garbade 2010	8	46	22	84	6.6%	0.66 [0.32, 1.37]	2010					
McKinsey 2012	11	406	210	8413	8.5%	1.09 [0.60, 1.97]	2012	_ + _				
Nozdrzykowski 2013	9	32	4	33	3.6%	2.32 [0.79, 6.78]	2013	+				
Dick 2013	0	12	32	72	0.6%	0.09 [0.01, 1.32]	2013	•				
Fattori 2013	13	290	28	860	7.7%	1.38 [0.72, 2.62]	2013	- +-				
Charilaou 2015	6	10	22	85	8.1%	2.32 [1.25, 4.31]	2015					
Lou 2017	47	167	0	172	0.6%	97.83 [6.08, 1574.14]	2017					
Laquian 2018	11	27	8	74	5.7%	3.77 [1.70, 8.36]	2018					
Xiang 2019	6	145	12	145	4.4%	0.50 [0.19, 1.30]	2019					
Yonghua Bi 2020	1	40	2	13	0.9%	0.16 [0.02, 1.65]	2020					
Carroll 2020	378	1141	1255	4340	20.9%	1.15 [1.04, 1.26]	2020	•				
Williamson 2022	2504	6132	16258	46985	21.6%	1.18 [1.14, 1.22]	2022	•				
Jeniann A. Yi 2023	9	86	33	83	7.3%	0.26 [0.13, 0.52]	2023	_ -				
Total (95% CI)		8559		61387	100.0%	1.20 [0.96, 1.49]		•				
Total events	3021		17889									
Heterogeneity: Tau ² = (0.06; Chi ^a	'= 65.2	9, df = 13 (P <	< 0.00001); I ^z = 80%	6						
Test for overall effect: Z	Z = 1.57 (F	P = 0.10	2)					U.U1 U.1 I 1U 1UU				

Fig. 10 Reintervension / dissection related admission analysis



Fig. 11 Aortic remodeling analysis

(more than or equal to 65 years old) and (less than 65 years old). Complications were divided into two subgroups: (complicated) and (uncomplicated). Study quality was divided into two subgroups: (good quality) and (poor quality). In age subgroups, there was a significant association between TEVAR group and decreased inhospital or 30-day mortality rate in patients more than or equal to 65 years old; however, there was no significant difference between TEVAR and Medical treatment group in patients less than 65 years old. Similarly, in the

	TEVAR		Medical treatment		Risk Ratio			Risk Ratio					
Study or Subgroup	Events	Total	Events	Total	Weight	Weight M-H, Random, 95% Cl			M-H	l, Rando	m, 95% C	I	
Zeeshan 2010	9	45	3	12	16.7%	0.80 [0.26, 2.50]	2010		-	-			
Zimmerman 2016	64	1417	111	7964	27.9%	3.24 [2.39, 4.38]	2016						
Hsieh 2019	599	6687	2515	36244	29.3%	1.29 [1.19, 1.41]	2019			- I			
Williamson 2022	18	6132	298	46985	26.0%	0.46 [0.29, 0.74]	2022						
Total (95% CI)		14281		91205	100.0%	1.18 [0.58, 2.40]							
Total events	690		2927										
Heterogeneity: Tau ² =	0.45; Chi	² = 53.9	9, df = 3 (P < 0	0.00001);	I ² = 94%				01			10	100
Test for overall effect:	t for overall effect: Z = 0.46 (P = 0.65)							0.01	U.I	EVAR	Medical tr	eatmen	t

Fig. 12 Respiratory failure analysis

	TEVAR	Medical tr	Medical treatment Risk			Risk Ratio				Risk Ratio		
Study or Subgroup	Events To	Total	Weight	M-H, Random, 95% Cl	Year		M-H, Ran	dom, 95%	6 CI			
Dialetto et al 2005	6	28 1	28	11.3%	6.00 [0.77, 46.66]	2005				•	_	
Steingruber 2008	0	35 4	50	7.1%	0.16 [0.01, 2.83]	2008	←	•	+			
Steingruber 2009	24	35 34	50	27.4%	1.01 [0.75, 1.35]	2009		-	+			
Fattori 2013	26 2	90 46	860	26.2%	1.68 [1.06, 2.66]	2013						
Carroll 2020	146 11	41 1536	4340	28.0%	0.36 [0.31, 0.42]	2020		•				
Total (95% CI)	15	29	5328	100.0%	0.93 [0.38, 2.25]							
Total events	202	1621										
Heterogeneity: Tau ² =	0.73; Chi ² =	75.72, df = 4 (P	< 0.00001); I ^z = 95%	6			01	+	10	100	
Test for overall effect:	Z = 0.17 (P =	0.87)					0.01	TEVAR	Medica	al treatment	100	

Fig. 13 Extension or dilatation of dissection / new dissection

	TEVA	R	Medical treatm	nent		Risk Ratio		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% Cl	Year	r M-H, Fixed, 95% Cl
Steingruber 2008	2	35	4	50	8.9%	0.71 [0.14, 3.69]	2008	8
Steingruber 2009	0	35	3	50	7.8%	0.20 [0.01, 3.80]	2009	9
Zeeshan 2010	17	45	3	12	12.8%	1.51 [0.53, 4.32]	2010	0
Qin 2013	4	152	2	41	8.5%	0.54 [0.10, 2.84]	2013	3
Ruan2013	2	42	1	21	3.6%	1.00 [0.10, 10.41]	2013	3
Nozdrzykowski 2013	1	32	0	33	1.3%	3.09 [0.13, 73.19]	2013	3
Qin 2016	6	184	19	154	55.8%	0.26 [0.11, 0.65]	2016	6 — — — — — — — — — — — — — — — — — — —
Xiang 2019	3	145	0	145	1.3%	7.00 [0.36, 134.32]	2019	9
Total (95% CI)		670		506	100.0%	0.64 [0.39, 1.04]		•
Total events	35		32					
Heterogeneity: Chi ^z = 1	10.61, df=	7 (P =	0.16); I ² = 34%					
Test for overall effect: 2	Z = 1.81 (F	P = 0.07	7)					TEVAR Medical treatment

Fig. 14 Aortic rupture

	TEVA	R	Medical trea	atment		Risk Ratio							
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	Year		M-H, F	Random	n, 95% CI		
Steingruber 2008	1	35	1	50	14.9%	1.43 [0.09, 22.08]	2008						
Lannuzi 2018	12	266	155	8717	41.1%	2.54 [1.43, 4.51]	2018			-	-		
Williamson 2022	61	6132	799	46985	44.0%	0.58 [0.45, 0.76]	2022			-			
Total (95% CI)		6433		55752	100.0%	1.22 [0.33, 4.46]							
Total events	74		955										
Heterogeneity: Tau² = Test for overall effect:	0.98; Ch Z = 0.30	i ^z = 21. ⁷ (P = 0.7	75, df = 2 (P < '6)	0.0001);	I² = 91%			L	0.1 TE	VAR M	1 ledical tre	l O atment	100

Fig. 15 Sepsis analysis



Fig. 16 Chest pain analysis

complication subgroups, there was no significant difference between the TEVAR and Medical treatment groups in patients with complicated TBAD; however, there was a significant association between the TEVAR group and decreased in-hospital or 30-day mortality rate in patients with uncomplicated TBAD compared with the medical treatment group. Similarly, in the study quality subgroups, there was a significant association between the TEVAR group and decreased in-hospital or 30-day mortality rates in good-quality studies; however, there was no significant difference between TEVAR and Medical treatment groups in poor-quality studies. In contrast, we found no significant difference between the TEVAR and Medical treatment groups in the late mortality rate at 1,3, and 5 years. In addition, the TEVAR group was associated with an increased length of hospital stay and ICU stay compared with the medical treatment group. However, no significant difference was observed between the TEVAR and Medical treatment groups in other complications, such as acute renal failure, paralysis or spinal cord ischemia, myocardial infarction, development of Retrograde A dissection, respiratory failure, extension or dilatation of dissection or new dissection, aortic rupture, sepsis, and chest pain. Further analysis of true lumen (TL) expansion was performed, and a significant association between the TEVAR group and decreased true lumen expansion compared with the medical treatment group was found; however, no difference in FL obliteration or thrombosis was found between the TEVAR and medical treatment groups in False lumen (FL) obliteration or thrombosis. We found no difference between the two groups in terms of reintervention or dissectionrelated admission rates.

Historically, medical treatment rather than surgical techniques have been used to treat TBADs [9, 10]. The benefits of TEVAR include stabilizing the dissected aorta, causing aortic remodeling processes, and encouraging false lumen thrombosis [48]. A thrombosed false lumen is associated with better survival and fewer late adverse TBAD events [49]. The efficacy of TEVAR in dissected aortic remodeling in the acute phase can be explained by the advantageous mechanical characteristics of the

dissection flap (pliable and dynamic). Aortic endograft coverage of the primary intimal tear stops antegrade FL flow, which depressurizes the FL. FL thromboses, contracts, and in a considerable portion of patients is eliminated as a result, allowing the true lumen (TL) to enlarge. [14] According to the hypothesis of Lou et al. [14], enhanced FL thrombosis or obliteration will result in a reduced need for distal aortic re-intervention, reduced FL aneurysm formation, and improved long-term survival. Therefore, preemptive TEVAR has additionally been carried out in patients with acute, uncomplicated TBAD in an effort to lower late mortality [15, 49-51]. TEVAR's overall effectiveness of TEVAR in treating patients with acute, uncomplicated TBAD is still under discussion. Medical or conservative treatment is used for individuals with uncomplicated TBAD. However, the long-term outcomes tend to be less than desirable. Additionally, it frequently requires many antihypertensive drugs to achieve blood pressure and heart rate targets in outpatients, and this treatment is ineffective in younger and obese patients [52]. Sustainable medical management is further complicated by lack of access to care, particularly for low-income families. Our meta-analysis found that TEVAR was associated with better results and reduced mortality in uncomplicated TBAD; however, no difference was found between TEVAR and medical treatment in managing complicated TBAD.

Our results are also consistent with those of Qin et al. [15], who reported that TEVAR was linked to a reduction in aortic-related adverse events and a lower mortality compared to BMT for uncomplicated type B aortic dissection. The early mortality rates were 0.5% with TEVAR and 2.6% with BMT. The early adverse event rates in their study were 10.3% in the TEVAR group and 4.5% in the BMT group, but the difference was not statistically significant. Although TEVAR was associated with more frequent early events, it was not a major complication of MM. Aortic rupture (32.2%) and aortic enlargement (47.5%) were the main causes of late adverse events in the MM group. In line with earlier studies [53], in patients with uncomplicated TBAD treated with only medical therapy, aortic enlargement was associated with aortic rupture and was therefore a significant late adverse event. Fattori et al. [49] reported similar in-hospital mortality rates for TEVAR and MM in patients with complicated TBAD. Additionally, a similar one-year mortality was observed in both groups. According to the 5-year Kaplan–Meier estimates, aortic growth or new aneurysm was the most frequent adverse event during follow-up, occurring in 73.3% of patients receiving medicinal therapy and in 62.7% of patients receiving TEVAR. However, Kaplan–Meier survival estimates reported that patients who underwent TEVAR had a decreased death rate at 5 years.

Zeeshan et al. [13] found an association between TEVAR and lower in-hospital or 30-day mortality than MM in managing complicated TBAD. The TEVAR group demonstrated markedly improved survival at 1, 3, and 5 years. Patients who underwent TEVAR had a 79% 5-year survival rate. This is in line with recent research published by Khoynezhad et al. [54], which showed a 78% 5-year survival rate and is consistent with a larger series that accessed the International Registry of Acute Aortic Dissection (IRAD) database [55, 56].

The potential benefit of TEVAR in aortic remodeling accounts for the lower mortality and higher survival rates. In the majority of patients who underwent TEVAR, the false lumen in the thoracic aorta at the endograft level was completely thrombosed and obliterated. In spite of complete remodeling in the proximal thoracic aorta, the majority of patients continue to have a patent false lumen in the distal thoracic and abdominal aortas. Interestingly, the Investigation of STEnt grafts in Aortic Dissection (INSTEAD) trial also showed positive aortic remodeling with TEVAR, similar to Zeeshan findings, despite being a study assessing the efficacy of TEVAR in uncomplicated type B aortic dissection [57]. However, in most cases, medical treatment alone did not cause any false lumen shrinkage or thrombus formation. When compared to individuals treated with conventional treatment, larger trials using IRAD have shown that patients treated with TEVAR have a lower 5-year mortality rate [49]. According to Lee et al. [11], the TEVAR and MM groups had in-hospital mortality rates of 5.45% and 10.12%, respectively, and 30-day mortality rates of 8.18% and 12.51%, respectively. The TEVAR group had a 1-year survival rate of 83.2%. The acute phase for patients with type TBAD undergoing surgical treatment has a significant risk of morbidity and mortality due to catastrophic situations such as aortic rupture or impending rupture. Older age was the most significant predictor of in-hospital mortality across all treatment groups, including the entire population. Naturally, age can affect a patient's general health or underlying disorders, which can affect treatment. Other risk factors associated with in-hospital mortality include female sex, hypertension, and chronic kidney disease. According to Lou et al. [17], there was no significant difference in mortality rates between the TEVAR and MM groups, with both groups showing a 0% in-hospital mortality rate. The mean age of the MM group (58.6 years) was slightly higher than that of the TEVAR group (54.4 years); however, this difference was not significant (p = 0.055). The MM group also had a significantly higher proportion of males compared to the TEVAR group (p = 0.005). However, there were no statistically significant differences between the groups in terms of comorbidities, such as hypertension, diabetes, end-stage renal disease, history of stroke, and chronic obstructive pulmonary disease. The TEVAR group did, however, show a trend towards improved survival at 1 and 3 years, but there was no difference in overall survival [14] TEVAR group had a 91% five-year survival, but with MM, it was 82% [14]. Additionally, Complete false lumen (FL) thrombosis was observed in 72.1% of patients with TEVAR and 20.0% with MM, which provided superior aortic remodeling to MM in TBAD, resulting in increased long-term survival [17]. Likewise, Xiang et al. [58] reported that 30-day mortality, stroke, acute renal failure, and retrograde type A dissection rates between the TEVAR and BMT groups were not significantly different, but the early adverse event rates were significantly higher in the TEVAR group than in the BMT group. Although TEVAR was associated with higher complications in the early stage, patients in the TEVAR group had lower late aortic and lower risk of late death than those with MM in uncomplicated acute TBAD.

Future implications

Our study revealed a significant association between the TEVAR group and decreased mortality rate compared to the medical treatment group, mainly in patients aged 65 years and older and patients with uncomplicated TBAD. Randomized controlled trials are warranted to confirm our results and further assess the efficacy of TEVAR for complicated and non-complicated TBAD.

Strengths and limitations

The overall quality of most of the studies included in our analysis was good. The large sample size is an additional strength, as 150,836 patients were included in our study. Additionally, a high number of studies [32] were included in our analysis. Patients categorized under MM in the original primary studies were included because they lacked procedure codes indicating treatment with TEVAR. This suggests a potential bias owing to the likelihood that these patients may have died before receiving any form of treatment. The main limitation was that all of the included studies were observational rather than randomized controlled trials. Therefore, randomized controlled trials are needed to confirm our results and further evaluate the role of TEVAR in TBAD.

Conclusion

Our study revealed a significant association between the TEVAR group and decreased mortality rate compared with the medical treatment group, mainly in patients aged 65 years and older and patients with uncomplicated TBAD. Randomized controlled trials are warranted to confirm our results and further assess the efficacy of TEVAR in complicated and non-complicated TBAD in terms of the incidence of mortality.

Supplementary Information

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Supplementary Material 1. Supplementary Material 2.

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None

Authors' contributions

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Availability of data materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

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Consent for publication

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Competing of interests

The authors declare no competing interests.

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