

Advances in Preemptive TEVAR for Uncomplicated Type B Aortic Dissection

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Abstract: As the indications for thoracic endovascular aortic repair (TEVAR) in the treatment of type B aortic dissection continue to expand, whether and when patients with uncomplicated Stanford type B aortic dissection (uTBAD) should undergo preemptive TEVAR have become pressing clinical questions. Although uTBAD is not accompanied by complications such as rupture or malperfusion during the acute phase, some patients develop persistent false lumen perfusion, aortic dilatation, and late aorta-related events during follow-up, resulting in heterogeneous long-term outcomes. Therefore, avoiding overtreatment in low-risk patients while accurately identifying high-risk patients who may benefit from intervention is essential for improving long-term aortic outcomes. This review first analyzes the optimal timing of preemptive TEVAR based on disease staging, pathological changes in the aortic wall, and current clinical evidence, with particular emphasis on the rationale for the subacute phase as a potential treatment window. It then summarizes the clinical features, morphological characteristics on CTA, false lumen status, and dynamic imaging assessment methods associated with high-risk uTBAD. Finally, it highlights the need to develop multimodal predictive models to enable more precise patient selection and individualized intervention.

Keywords: uncomplicated Stanford type B aortic dissection; thoracic endovascular aortic repair; optimal medical therapy; intervention timing

1. Introduction

With the continued aging of China's population, improvements in emergency diagnostic imaging, and the expansion of chest pain centers and aortic disease centers, both the detection rate of acute aortic syndromes and the demand for standardized treatment continue to increase. Epidemiological data indicate that the annual incidence of acute aortic dissection is approximately 3 to 6 cases per 100,000 population, with Stanford type B aortic dissection accounting for about one-third of all aortic dissections. In the management of descending aortic lesions, thoracic endovascular aortic repair (TEVAR) has gradually become an important therapeutic approach [1-4].

Uncomplicated type B aortic dissection (uTBAD), a subtype of Stanford type B aortic dissection, is generally defined by the absence of complicated features such as rupture, visceral or limb malperfusion, refractory pain, refractory hypertension, or rapid aortic expansion. The conventional management of uTBAD is based on best medical therapy (BMT) and regular imaging follow-up, with the primary goal of controlling blood pressure and heart rate to reduce aortic wall stress [5, 6]. However, some patients with uTBAD may still develop persistent false lumen perfusion, progressive aortic dilatation, aneurysmal degeneration, and late aorta-related events during follow-up [7-10]. These observations have drawn increasing attention to the potential role of preemptive TEVAR in uTBAD. As the efficacy of TEVAR in complicated TBAD has become increasingly established, its indications have expanded from rescue intervention to preemptive intervention. However, this expansion raises concerns about overtreatment, perioperative complications, and inappropriate patient selection [11-13]. Accordingly, identifying high-risk patients with uTBAD who may truly benefit from TEVAR and determining the optimal timing of intervention remain key scientific questions for refining the long-term management strategy for uTBAD.

The therapeutic challenge of uTBAD lies in its relatively stable initial clinical presentation but highly heterogeneous long-term course. For low-risk patients, BMT combined with regular follow-up may be sufficient to achieve favorable outcomes. In contrast, in patients with features such as a large

baseline aortic diameter, persistent false lumen patency, a large or unfavorably located primary entry tear, true lumen compression, or early aortic enlargement, medical therapy alone may be insufficient to prevent unfavorable long-term aortic remodeling [14-16]. Theoretically, TEVAR can reduce false lumen pressure and promote favorable aortic remodeling by sealing the proximal primary entry tear. However, both the magnitude of benefit and the level of risk are closely related to the timing of intervention, as discussed in Section 2. Therefore, the central question surrounding preemptive TEVAR is not simply “whether to intervene,” but how to establish a more precise decision-making framework that integrates individual risk profiles, anatomical suitability, intervention timing, and expected net benefit. The natural history and treatment decision-making pathway for uTBAD are illustrated in Figure 1.

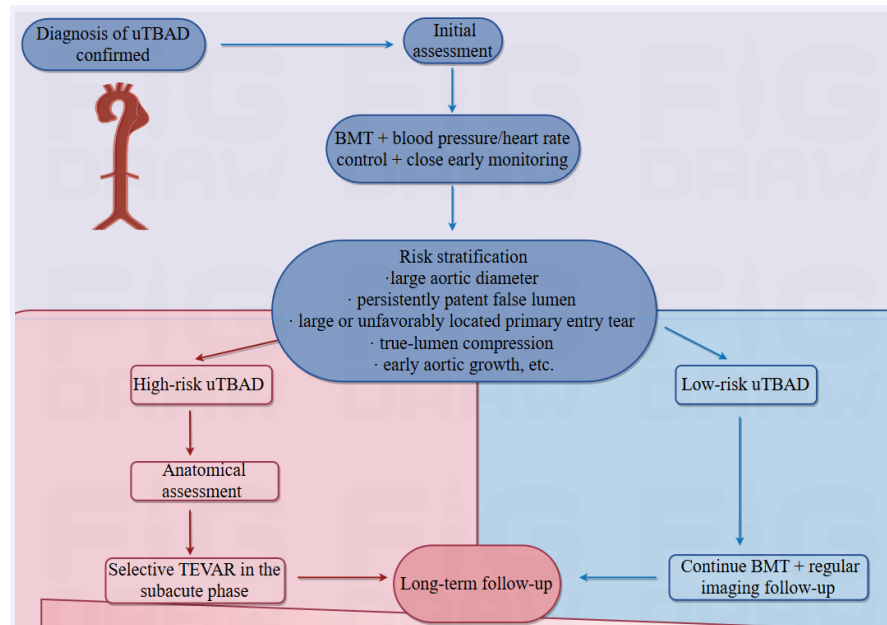


Figure 1. Natural History and Treatment Decision-Making Pathway for Uncomplicated Stanford Type B Aortic Dissection.

In light of the issues outlined above, this review focuses on two key aspects of preemptive TEVAR in uTBAD. First, based on the SVS/STS disease staging system, aortic wall pathology, and current clinical evidence, it analyzes the potential benefits and risks of TEVAR at different disease stages, with particular emphasis on the rationale for the subacute phase as a treatment window for preemptive TEVAR [17]. Second, it systematically summarizes the evidence basis for accurately identifying high-risk uTBAD, including unstable clinical features, morphological characteristics on baseline CTA, false lumen thrombosis status, dynamic imaging changes, and multimodal risk prediction models [18, 19]. Finally, by integrating existing research and guideline recommendations, it summarizes the current limitations in patient selection and timing assessment for preemptive TEVAR in uTBAD and emphasizes that future practice should shift from predicting aortic dilatation risk alone toward an individualized decision-making model that comprehensively weighs the risks associated with BMT, the expected benefits of TEVAR, and perioperative risks.

This narrative review synthesizes the relevant literature. We searched PubMed, Web of Science, Embase, the Cochrane Library, CNKI (China National Knowledge Infrastructure), Wanfang Data, and the VIP Database for studies published from database inception to May 2026. English-language search terms included “uncomplicated type B aortic dissection”, “uTBAD”, “type B aortic dissection”, “thoracic endovascular aortic repair”, “TEVAR”, “preemptive TEVAR”, “pre-emptive TEVAR”, “prophylactic TEVAR”, “subacute”, “high-risk”, “aortic remodeling”, “false lumen” and “computed tomography angiography”. Equivalent Chinese-language search terms related to uncomplicated type B aortic dissection, Stanford type B aortic dissection, TEVAR, preemptive TEVAR, the subacute phase, high-risk features, aortic remodeling, the false lumen, and CTA were used when searching Chinese databases, including CNKI, Wanfang Data, and the VIP Database. Where applicable, subject headings, including MeSH and Emtree terms, were combined with free-text terms, and the reference lists of relevant articles were manually screened to identify additional eligible studies.

During literature screening, priority was given to clinical guidelines, expert consensus statements, randomized controlled trials, prospective cohort studies, large-scale retrospective cohort studies,

registry studies, systematic reviews, and meta-analyses published within the most recent five years, as well as representative studies closely related to the timing of preemptive TEVAR in uTBAD, identification of high-risk patients, aortic remodeling, and long-term aorta-related events. Case reports, small-sample studies with substantially overlapping findings, articles with incomplete data, and studies with limited relevance to the topic of this review were excluded. The final synthesis was structured around three major themes: timing of preemptive TEVAR, the basis for identifying high-risk uTBAD, and future directions in risk stratification.

2. Timing of Preemptive TEVAR in Uncomplicated Stanford Type B Aortic Dissection

As outlined in Section 1, although uTBAD is not accompanied by conventional complicated features during the acute phase, its long-term clinical course is highly heterogeneous, and some patients may subsequently develop adverse aortic remodeling or require aortic intervention [8]. In this context, determining the optimal timing of preemptive TEVAR has become a central challenge in clinical decision-making.

As the safety and efficacy of TEVAR in treating complicated TBAD have been progressively established, the scope of its application has gradually expanded from rescue intervention to preemptive intervention. Clinical studies and evidence syntheses have demonstrated that TEVAR can promote favorable aortic remodeling by sealing the proximal primary entry tear [20-22]. However, in uTBAD, the key to preemptive TEVAR does not lie in universally earlier intervention but rather in answering two interrelated questions: first, which patients have a sufficiently high long-term aortic risk such that the potential benefits of TEVAR outweigh the risk of perioperative complications; and second, among these patients, when intervention should be performed to maximize the benefits of aortic remodeling while avoiding late aortic events associated with delayed intervention and the increased perioperative risks associated with overly early intervention [17, 23-25]. This section focuses primarily on the second question—the timing of preemptive TEVAR—whereas the accurate identification of high-risk uTBAD is discussed further in Section 3.

2.1. Theoretical Basis and Clinical Evidence Regarding the Timing of Preemptive TEVAR

According to the SVS/STS staging system, TBAD is classified into hyperacute (HA), acute (A), subacute (SA), and chronic (C) phases. The degrees of aortic wall inflammation, intimal flap mobility, tissue fragility, and aortic remodeling potential differ considerably across these stages, and the evolution of these pathophysiological characteristics forms the theoretical basis for determining the timing of preemptive TEVAR [18]. Specifically, during the acute phase, the intimal flap is relatively pliable and the aorta retains considerable plasticity, making it theoretically easier to achieve false lumen decompression, true lumen expansion, and favorable aortic remodeling after sealing the primary entry tear. However, this phase is characterized by active aortic wall inflammation and fragility of both the intimal flap and adventitial structures; stent-graft deployment, the radial force exerted by the stent graft, and proximal anchoring may all increase the risk of complications such as aortic rupture, retrograde type A aortic dissection, stroke, and spinal cord ischemia [23, 24]. In contrast, the chronic phase exhibits different characteristics: the aortic wall is structurally more stable and perioperative risk may be reduced, but the intimal flap gradually becomes fibrotic and stiff, the false lumen architecture tends to become fixed, and the ability of TEVAR to induce false lumen thrombosis and promote aortic remodeling may therefore be limited. Based on these considerations, the subacute phase is considered to potentially combine the dual advantages of preserved aortic plasticity and lower perioperative risk than in the acute phase, making it the treatment window of greatest interest in current research on the timing of preemptive TEVAR [23-25].

The existing evidence can be summarized at three levels. First, theoretical studies and small observational studies have proposed the hypothesis that early intervention favors aortic remodeling. Earlier studies mostly focused on whether TEVAR could improve the relationship between the true and false lumens and long-term aortic morphology; these studies suggested that sealing the proximal entry tear could promote aortic remodeling but did not adequately address procedural risk during the acute phase [26, 27]. Second, meta-analyses have further compared the safety of TEVAR performed during the acute and subacute phases. Overall, these studies have shown that, compared with TEVAR performed during the subacute phase, acute-phase TEVAR is often associated with higher rates of 30-day complications, 30-day mortality, stroke, and early reintervention. However, comparisons between the two timing strategies with respect to long-term mortality, dissection-related mortality, and certain late

aortic events have not yet yielded consistent conclusions [23-25]. These findings indicate that the potential remodeling advantage of acute-phase TEVAR may be partially offset by its higher perioperative risk, whereas the advantage of the subacute phase is primarily reflected in improved perioperative safety.

Third, real-world registry studies and single-center long-term follow-up studies have provided additional evidence supporting this interpretation. Large registry studies comparing TEVAR outcomes across different time windows according to the SVS/STS chronicity staging system have found that TEVAR performed during the hyperacute or acute phase is associated with higher rates of perioperative stroke, spinal cord ischemia, overall complications, and reintervention, with the highest risk observed in the hyperacute phase [17]. Single-center cohort studies have shown that TEVAR performed during the acute and subacute phases may not differ significantly with respect to long-term mortality, late reintervention, aorta-related events, or aortic remodeling, but that the acute-phase group tends to have higher 30-day mortality and a greater incidence of severe early complications [18]. Taken together, the evidence across these three levels indicates that, in hemodynamically stable patients with uTBAD without rupture, malperfusion, or persistent symptoms, preemptive TEVAR should not be guided by a simple “the earlier, the better” strategy.

In recent years, multiple systematic reviews, real-world studies, and clinical guidelines have further reinforced this cautious approach. A systematic review and single-arm meta-analysis focusing on high-risk uTBAD has shown that TEVAR is associated with a low overall early mortality rate and may confer mid- to long-term survival and aortic remodeling benefits, thereby supporting selective intervention in high-risk patients [28]. However, it should be noted that a Medicare real-world study indicated that, among elderly patients who were stabilized and discharged after initial medical therapy and had no clearly identified high-risk anatomical features, elective TEVAR within 90 days did not improve long-term overall survival or reintervention-free survival compared with continued medical therapy and was associated with a slightly higher reintervention rate [29]. Studies addressing specific anatomical scenarios, such as TEVAR with Zone 2 as the proximal landing zone, have suggested that, when performed in carefully selected patients during the subacute or early chronic phase, favorable long-term control of aortic events and remodeling outcomes can be achieved, although the relevant evidence remains limited to retrospective studies with small sample sizes [30]. The 2026 ESVS guidelines also explicitly state that, for uTBAD in general, TEVAR should not be routinely performed outside clinical trials; however, in patients with early aortic enlargement or a larger initial aortic diameter and suitable anatomical conditions, TEVAR may be selectively considered, preferably during the subacute phase, although the level of evidence supporting this recommendation remains low [4].

In summary, the timing of preemptive TEVAR should be determined based on a comprehensive assessment of disease stage, aortic remodeling potential, perioperative risk, and the patient's baseline clinical status. Acute-phase intervention, while offering a strong theoretical advantage in terms of aortic remodeling, carries a higher perioperative risk; chronic-phase intervention, although associated with greater structural stability, has diminished remodeling potential; and intervention during the subacute phase is more likely to achieve a reasonable balance between these competing considerations. The existing evidence does not support routine TEVAR during the hyperacute or acute phase in hemodynamically stable patients with uTBAD; rather, it supports the subacute phase as a preferred intervention window for high-risk patients who have been stabilized after initial BMT and whose high-risk status has been confirmed through risk stratification [4, 23-25].

2.2. Rationale for TEVAR during the Subacute Phase and Future Research Directions

Based on the above evidence, a rational pathway for preemptive TEVAR in uTBAD should follow the principle of stabilizing first, then stratifying risk, and subsequently intervening selectively. For patients who initially present without rupture, malperfusion, or refractory symptoms, the primary task during the acute phase remains the implementation of BMT, together with early follow-up CTA to monitor changes in aortic morphology [3]. Only when high-risk clinical or imaging features are identified after initial stabilization and the anatomical conditions are suitable for endovascular repair should preemptive TEVAR be considered.

The rationale for the subacute phase as the currently more appropriate intervention window is based primarily on the following three considerations. First, intervention during this phase avoids the period in which aortic wall inflammation is most intense and the intimal flap is most fragile, thereby helping to reduce the risk of serious complications such as retrograde type A dissection, aortic rupture, stroke, and spinal cord ischemia [17, 23, 24]. Second, during the subacute phase, the aorta has not yet fully

entered the stage of chronic fibrosis, the intimal flap still retains a degree of plasticity, and conditions remain favorable for TEVAR to promote true-lumen expansion, false-lumen thrombosis, and favorable aortic remodeling [18]. Third, the subacute phase provides an important observation window for clinical decision-making, allowing clinicians to reassess the patient's risk profile by monitoring indicators such as changes in symptoms, blood pressure control, short-term aortic diameter growth, false-lumen status, and entry-tear characteristics, thereby reducing the risk of overtreatment in low-risk patients with uTBAD [4, 14, 16, 31, 32].

It should be emphasized that subacute-phase TEVAR does not imply that all patients with uTBAD should undergo intervention within 15–90 days. The prerequisites are the accurate identification of high-risk patients and the exclusion of those in whom the anticipated benefit is limited or the procedural risk is unacceptably high. Specifically, elderly patients, patients with severe comorbidities, and patients without high-risk imaging features who remain clinically stable on medical therapy are unlikely to derive a clear survival benefit from elective TEVAR [29]. In contrast, patients with a larger aortic diameter, a persistently patent false lumen, a large or unfavorably located primary entry tear, early aortic enlargement, and suitable anatomical conditions may derive greater benefit from subacute-phase TEVAR, including favorable aortic remodeling and a reduced risk of late aortic events [28].

Therefore, the following conclusion can be drawn at present: hemodynamically stable patients with uTBAD should not routinely undergo preemptive TEVAR during the very early acute phase after onset. Instead, after initial stabilization with BMT, the subacute phase may represent a more appropriate intervention window for carefully selected high-risk patients with uTBAD. However, existing studies remain limited in the timing windows they have compared. Future research should move beyond a simple comparison of acute versus subacute intervention and instead evaluate the net benefit of TEVAR performed within different time windows for distinct risk phenotypes. To this end, prospective, multicenter, randomized controlled trials should be conducted using uniform SVS/STS chronicity staging, standardized CTA measurement methods, and long-term aorta-related endpoints. These studies should incorporate factors such as age, comorbidities, anatomical features, false-lumen hemodynamics, and quality of life to clarify which patients, at which stage, and with which TEVAR strategy can derive meaningful long-term benefit [4].

The key characteristics, potential advantages, limitations, and clinical implications of different timing strategies for preemptive TEVAR in uTBAD are summarized in Table 1.

Table 1: Comparison of Different Timing Strategies for Preemptive TEVAR in Uncomplicated Stanford Type B Aortic Dissection.

Disease phase	Aortic wall characteristics	Potential benefits of TEVAR	Key limitations	Overall judgment
Acute phase	High plasticity	Can seal the proximal entry tear early	High risk of complications	Not suitable as a routine surgical phase
Subacute phase	Some remodeling potential retained	Better balance between safety and long-term benefit	Various conditions need to be evaluated	A relatively reasonable window
Chronic phase	Remodeling potential declining	More stable aortic wall	Reduced value of preventive intervention	Appropriate for those with indications for reintervention

3. Precise Identification and Risk Stratification of High-Risk Patients with uTBAD

As discussed above, the subacute phase may represent a reasonable time window for hemodynamically stable patients with uTBAD to undergo preemptive TEVAR. However, appropriate timing selection depends on the accurate identification of high-risk patients who are most likely to benefit from intervention. If preemptive TEVAR is performed indiscriminately in all patients with

uTBAD, it may result not only in overtreatment of low-risk patients but also in unnecessary exposure to procedure-related risks, including stroke, spinal cord ischemia, retrograde type A dissection, endoleak, stent graft-induced new entry tear, and the need for reintervention [17, 23, 24]. Therefore, the central question in uTBAD management should not be limited to when to intervene, but should also address which patients truly require intervention. Precise identification of high-risk patients with uTBAD is therefore a critical link connecting BMT, subacute-phase TEVAR, and long-term aortic remodeling management [31].

Although the traditional complicated/uncomplicated binary classification provides guidance for acute-phase management, it treats uTBAD as a homogeneous, static, low-risk condition and may therefore underestimate the true long-term risk in a subset of patients. High-risk uTBAD can be understood as a dynamic risk state between typical uTBAD and complicated TBAD. Its clinical significance lies in identifying patients who require closer surveillance and may need more proactive and individualized management [32]. This section systematically summarizes the basis for identifying high-risk patients with uTBAD from four perspectives: clinical presentation, baseline imaging features, false-lumen status, and dynamic multimodal assessment.

3.1. Clinical Manifestations of Instability

Clinical presentation constitutes the first dimension in identifying high-risk patients with uTBAD and is the factor most directly linked to bedside decision-making. Persistent or recurrent chest or back pain, pain refractory to adequate analgesia, refractory hypertension, hemorrhagic pleural effusion, early readmission, young age at onset, connective tissue disease, and severe comorbidities may suggest instability of the dissected aorta or an elevated overall risk profile [31]. Notably, refractory pain and refractory hypertension are regarded as criteria for complicated TBAD in some guidelines or studies, whereas in others they are considered markers of high-risk uTBAD. This classification overlap suggests that uTBAD and complicated TBAD are not strictly dichotomous, but rather exist along a continuous risk spectrum. Accordingly, clinical judgment should not be confined to the static classification made at admission, but should incorporate dynamic reassessment of changes in pain, blood pressure control, antihypertensive treatment intensity, readmission status, and early follow-up imaging findings [3].

3.2. Morphologic Features on Baseline CTA

Imaging findings constitute the domain with the strongest evidence base for risk stratification in patients with uTBAD. Morphologic high-risk features consistently identified in previous studies and guidelines include increased maximum descending aortic diameter, increased false-lumen diameter, a patent or persistently patent false lumen, a large primary entry tear, a primary entry tear located close to the left subclavian artery or on the lesser curvature of the aorta, true-lumen compression, extensive dissection length, and branch-vessel involvement [3, 4, 14, 31, 32]. Among these features, thresholds such as a maximum aortic diameter of >40 mm, false-lumen diameter of >22 mm, and primary entry tear diameter of >10 mm have been widely used for initial screening of high-risk patients because they are relatively easy to measure and reproduce [4, 14, 32]. From a pathophysiological perspective, these features collectively reflect, from different aspects, false-lumen perfusion pressure, aortic wall stress, and the risk of long-term aortic expansion.

However, no single imaging threshold is sufficient to fully capture the complex evolution of uTBAD. Differences across studies in CTA measurement planes, assessment time points, endpoint definitions, and follow-up intervals may lead to inconsistent predictive performance of the same parameter [32]. Therefore, identification of high-risk patients with uTBAD should not be equated simply with a single value exceeding a predefined threshold, but should instead rely on a multifactorial assessment. For instance, mild aortic dilation accompanied by a large proximal entry tear, a persistently patent false lumen, and early diameter growth may be far more clinically meaningful than a mildly increased baseline diameter alone. The 2026 ESVS guidelines are also consistent with this approach, recommending against routine TEVAR for uTBAD while supporting selective consideration of intervention in patients with early aortic expansion, a larger initial aortic diameter, and suitable anatomical conditions [4].

3.3. False Lumen Status and Flow-Related Phenotypes

False lumen status is one of the most closely examined yet carefully interpreted parameters in risk stratification. Overall, complete false lumen thrombosis generally indicates a favorable trend toward aortic remodeling, whereas a persistently patent false lumen may maintain elevated pressure within the false lumen and increase the long-term risk of aortic dilatation^[33]. By contrast, the clinical significance of partial false lumen thrombosis has long remained controversial. Earlier studies suggested that partial thrombosis might create a blind-sac-like false lumen because of restricted distal outflow, thereby increasing pressure within the false lumen and the risk of adverse events. However, recent systematic reviews and meta-analyses indicate that, compared with a fully patent false lumen, partial thrombosis has not been consistently associated with more rapid aortic growth, whereas complete false lumen thrombosis is associated with the lowest rate of aortic growth^[33]. Taken together, these findings suggest that partial false lumen thrombosis should not be simply equated with a high-risk state, nor should it serve as a standalone indication for preemptive TEVAR.

This controversy suggests that the conventional tripartite classification of false lumen status as patent, partially thrombosed, or completely thrombosed may lack the granularity needed for refined decision-making. The features that truly confer high-risk significance may not be the label of partial thrombosis itself, but rather the underlying morphologic and hemodynamic context, including saccular partial thrombosis, restricted distal outflow, few re-entry tears, limited branch-vessel communication, or progressive false lumen enlargement during follow-up^[31, 33, 34]. Accordingly, future studies should further characterize high-risk phenotypes related to the false lumen by incorporating the spatial distribution of thrombus within the false lumen, false lumen volume, the number and location of re-entry tears, branch-vessel communication, and longitudinal changes over time.

3.4. Longitudinal Imaging Assessment and Multimodal Risk Prediction Models

Beyond baseline clinical presentation and static CTA-derived morphologic features, longitudinal imaging assessment is emerging as an important approach for the more precise identification of high-risk uTBAD. Conventional two-dimensional measurement of maximum aortic diameter is easy to perform and widely applicable in clinical practice; however, it captures only local aortic morphology at a single time point and cannot fully characterize the extent of dissection, false lumen perfusion burden, true-false lumen interaction, or the overall trajectory of aortic remodeling. In contrast, parameters derived from serial CTA examinations—including the rate of aortic diameter expansion, changes in false lumen volume, the degree of true lumen expansion, changes in the true-to-false lumen ratio, and three-dimensional volumetric growth—may detect signals of adverse remodeling earlier than a single maximum-diameter measurement^[34]. Collectively, these advances suggest that the identification of high-risk uTBAD is gradually shifting from baseline single-threshold assessment toward longitudinal assessment of dynamic change.

This shift has important clinical implications. Some patients may not meet traditional high-risk diameter thresholds at presentation but may develop persistent false lumen expansion, progressive true lumen compression, or accelerated aortic growth during early follow-up. Conversely, some patients with mild baseline aortic dilatation may achieve morphologic stability with optimized BMT and therefore do not necessarily require early preemptive TEVAR. In this context, longitudinal imaging assessment not only helps identify high-risk patients who may be underestimated by traditional baseline risk stratification, but also helps reduce overtreatment in stable low-risk patients^[19]. This approach is consistent with the concepts of sequential imaging surveillance and individualized treatment decision-making emphasized in contemporary guidelines^[3].

Building on this concept, multimodal risk prediction models represent an important direction for future research. An ideal prediction model should integrate not only conventional two-dimensional CTA-derived parameters, such as maximum aortic diameter, false lumen diameter, and the size and location of the primary entry tear, but also clinical features and advanced imaging parameters, including persistent pain, refractory hypertension, the burden of antihypertensive therapy, hemorrhagic pleural effusion, false lumen thrombosis status, three-dimensional volumetric parameters, the number and location of re-entry tears, branch-vessel communication, hemodynamic information, and laboratory or inflammatory biomarkers^[15, 19, 32, 34]. More importantly, future models should not be limited to predicting which patients will develop aortic dilatation, but should further identify which patients are most likely to derive a net benefit from TEVAR in the subacute phase. This implies that risk stratification research should evolve from prediction of the natural disease course toward

comprehensive individualized decision-making models that simultaneously assess the risk associated with BMT, the potential benefit of TEVAR, and the risk of perioperative complications [19, 28, 29].

3.5. Summary and Limitations of Research on High-Risk uTBAD Identification

Overall, existing research has established a preliminary framework for identifying high-risk uTBAD. From a clinical perspective, clinical features such as persistent or recurrent chest or back pain, refractory hypertension, unplanned readmission, and hemorrhagic pleural effusion may indicate an unstable disease course [4]. From an imaging perspective, features including a maximum aortic diameter >40 mm, false lumen diameter >22 mm, primary entry tear size >10 mm, an entry tear located on the lesser curvature, persistently patent false lumen, true lumen compression, and early aortic growth have been repeatedly confirmed to be associated with long-term aortic dilatation, aorta-related adverse events, or the risk of reintervention [4, 14, 31-34]. From the perspective of longitudinal assessment, serial CTA follow-up, three-dimensional volumetric measurement, and multimodal prediction models may further improve the precision of high-risk patient identification and promote the transition of uTBAD management from “empirical judgment” to “individualized prediction” [19].

However, current research still has several notable limitations. First, the definition of high-risk uTBAD remains insufficiently standardized; differences across studies in the definition of clinical symptoms, imaging thresholds, and outcome endpoints during follow-up limit the comparability of findings [34]. Second, existing evidence is mainly derived from retrospective cohort studies, registry-based analyses, or meta-analyses of observational studies, with few high-quality prospective randomized controlled trials available [13, 20, 23-25, 28, 29]. Third, the prognostic interpretation of certain indicators remains controversial. As discussed previously in Section 3.3, partial thrombosis of the false lumen should not be automatically equated with a high-risk state, and its prognostic significance may depend on thrombus distribution, distal outflow, the number of re-entry tears, and false lumen pressure [33, 34]. Fourth, current models mainly focus on predicting aortic dilatation or adverse events, but rarely directly assess the net benefit of TEVAR compared with BMT. Stratified analyses according to age, comorbidity burden, life expectancy, anatomical suitability, and technical strategy also remain limited [3].

Therefore, future research on high-risk uTBAD should focus on three key issues: first, establishing standardized and reproducible definitions of high-risk status and criteria for imaging measurement; second, validating the combined predictive value of clinical features, two-dimensional CTA parameters, three-dimensional volumetric parameters, and hemodynamic indicators in prospective multicenter studies; and third, expanding predictive endpoints from “whether the disease will progress” to “whether the patient is likely to benefit from TEVAR in the subacute phase.” Only by completing this transition can the overuse of preemptive TEVAR in low-risk patients be avoided, while enabling more precise application of TEVAR to patients with high-risk uTBAD who have a demonstrable risk of aortic progression and are likely to derive long-term remodeling benefits.

The major clinical, CTA-derived, false lumen - related, and longitudinal imaging indicators for identifying high-risk uTBAD and their implications for preemptive TEVAR decision-making are summarized in Table 2.

Table 2: Indicators for Identifying High-Risk Uncomplicated Stanford Type B Aortic Dissection (uTBAD) and Their Implications for Preemptive TEVAR Decision-Making.

FL = false lumen TL = true lumen			
Domain	High-risk feature	Risk implication	Decision value
Clinical	Recurrent pain; refractory BP	Clinical instability	Reassess with imaging
Aortic morphology	Large aortic diameter	Late enlargement	Baseline risk marker
False lumen	Patent FL	Persistent FL pressure	Medical therapy may be insufficient
Entry tear	Large/unfavorable tear	Increased FL perfusion	Predicts TEVAR benefit
True lumen	TL compression	Ongoing pressurization	Interpret with other factors
Serial imaging	Early aortic growth	Active progression	Close follow-up

Note: This table summarizes the main-text discussion of clinical manifestations, CTA morphological features, false lumen status, and dynamic imaging changes associated with high-risk uTBAD. Partial thrombosis of the false lumen should not be used as an isolated criterion for high-risk status; rather, it should be interpreted in conjunction with entry tear features, re-entry tears, hemodynamic parameters, and serial imaging changes as part of a comprehensive assessment.

4. Conclusion

Preemptive TEVAR for uTBAD is not merely a technical option but a comprehensive clinical decision based on the natural history of the disease, patient heterogeneity, aortic remodeling potential, and the perioperative risk–benefit balance. Overall, current evidence does not support routine TEVAR in the hyperacute or acute phase for clinically stable patients with uTBAD. Although intervention in the acute phase may theoretically provide greater remodeling potential, the aortic wall and intimal flap are relatively fragile, and the risk of severe perioperative complications is higher. In the chronic phase, the operative setting is relatively stable; however, intimal flap fibrosis and a fixed false lumen reduce the potential for aortic remodeling. By contrast, the subacute phase may offer a more favorable balance between procedural safety and remodeling benefit, making it a preferable intervention window for patients who have stabilized after initial best medical therapy and who are confirmed, through comprehensive assessment, to have high-risk features and suitable anatomy.

Therefore, the core principle of uTBAD management should not simply be to perform TEVAR earlier, but rather to follow the approach of “stabilize first, stratify next, and intervene selectively.” Low-risk patients should continue to be managed with best medical therapy and regular imaging surveillance, whereas clinical attention should focus on the high-risk subgroup at increased risk of late aortic dilatation, adverse remodeling, or delayed aortic events. Manifestations of clinical instability, such as persistent or recurrent chest and back pain, refractory hypertension, and bloody pleural effusion, as well as CTA features including increased maximum aortic diameter, enlarged false lumen diameter, a large or unfavorably located primary entry tear, persistently patent false lumen, true lumen compression, and early aortic growth, may serve as important criteria for identifying high-risk patients. Meanwhile, the significance of partial thrombosis of the false lumen remains controversial; it should not be directly equated with high-risk status or used as an isolated indication for preemptive TEVAR, but should instead be interpreted in an integrated manner together with thrombus distribution, distal outflow, re-entry tears, and serial imaging changes.

5. Future Perspectives

Current research on preemptive TEVAR for uTBAD still has several important limitations. First, the definition of high-risk uTBAD remains inconsistent; heterogeneity across studies in clinical symptoms, CTA measurement methods, disease-phase classification, and follow-up endpoints limits the comparability of findings. Second, existing evidence is largely derived from retrospective cohorts, registry studies, and observational meta-analyses, whereas high-quality prospective randomized studies remain limited. Third, the interpretation of certain key indicators remains controversial. In particular, partial thrombosis of the false lumen should not be used as a stand-alone risk label, but instead requires integrated analysis in conjunction with the spatial distribution of thrombus, distal outflow status, the number and location of re-entry tears, and dynamic changes in the false lumen [33, 34]. In addition, existing risk models predominantly aim to predict aortic dilatation or adverse events and have not yet adequately addressed whether patients can derive a net clinical benefit from TEVAR compared with BMT alone.

Future research should prioritize the standardization of CTA measurement methods, aortic remodeling assessment indicators, and follow-up endpoints under a unified SVS/STS chronicity classification framework, thereby improving interstudy comparability and external generalizability. Second, prospective multicenter studies are needed to compare long-term aortic outcomes, survival, and reintervention risk among patients with different risk phenotypes who undergo TEVAR during different time windows or remain on BMT alone. Third, multimodal prediction models integrating clinical presentation, two-dimensional CTA-derived features, three-dimensional volumetric parameters, false lumen status, re-entry tear features, and hemodynamic parameters should be developed, so that the goal of risk stratification shifts from predicting “who will progress” to identifying “who will truly benefit.” Furthermore, older patients, patients with a substantial comorbidity burden, and special anatomical scenarios such as Zone 2 involvement require further stratified investigation to clarify the

true boundaries of applicability for preemptive TEVAR. Overall, the future management of uTBAD should gradually move beyond the traditional “complicated/uncomplicated” dichotomy toward a precise, individualized decision-making model based on high-risk identification, dynamic follow-up, and net-benefit assessment.

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