Original Article

Narrow true lumen favors future complication even in small diameter of type B aortic dissection

Ken Nakamura[1], Ri Sho[2], Kimihiro Kobayashi[3], Shingo Nakai[3], Ai Ishizawa[3], Daisuke Watanabe[3], Hideaki Uchino[3], Takao Shimanuki[1], Tetsuro Uchida[3]

[1]Division of Cardiovascular Surgery, Nihonkai General Hospital, Sakata, Japan; [2]Department of Public Health & Hygiene, Yamagata University Faculty of Medicine, Yamagata, Japan; [3]Second Department of Surgery, Yamagata University Faculty of Medicine, Yamagata, Japan

Contributions: (I) Conception and design: K Nakamura, T Uchida; (II) Administrative support: K Nakamura, A Ishizawa, D Watanabe, H Uchino; (III) Provision of study materials or patients: K Nakamura, A Ishizawa, D Watanabe; (IV) Collection and assembly of data: K Nakamura, K Kobayashi, S Nakai; (V) Data analysis and interpretation: K Nakamura, R Sho; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Ken Nakamura, MD, PhD. Division of Cardiovascular Surgery, Nihonkai General Hospital, 30 Akihochou, Sakata City, Yamagata, Japan. Email: ken.nakamura622@gmail.com.

Background: Uncomplicated Stanford type B aortic dissection (TBAD) is associated with aortic complications in the subacute or chronic phase, but it is still unclear in which patients these complications occur. The objective of this study was to identify the ideal imaging parameter predictive of the risk of aorta-related complications in patients with uncomplicated TBAD.

Methods: A retrospective study was conducted using prospectively collected data from patients with uncomplicated TBAD at two local hospitals in Japan. Computed tomography (CT) images were analyzed serially, and their association with "aorta-related complication" during follow-up was assessed.

Results: During a mean follow-up of 3.5 years, 53 out of 213 patients with uncomplicated TBAD experienced the aorta-related complications, among which 50 (23.5%) were aortic enlargement. Receiver operating characteristic curve analysis revealed that a low true lumen area ratio (TLAR) (<2.9%) at initial subacute phase was a significant prognostic factor for late aorta-related complications (P<0.001). The Cox regression analysis indicated that low TLAR [hazard ratio (HR), 6.32; 95% confidence interval (CI): 2.72–14.69] and an enlargement of the false lumen area (HR, 6.09: 95% CI: 2.22–16.7) were independent predictors of aorta-related complications. Subanalysis revealed a TLAR of 52.9% or less increased the risk of future aorta-related complications, even when the aortic diameter was smaller than 40 mm (P<0.001).

Conclusions: A narrow true lumen area at early subacute phase and an enlargement of the false lumen area are potentially good predictors to help us to identify a high-risk subgroup of patients who may benefit from earlier and more aggressive therapy. In particular, a narrow true lumen area is an independent risk factor for the future aorta-related complications, even when the aortic diameter is small.

Keywords: Uncomplicated Stanford type B aortic dissection (uncomplicated Stanford TBAD); conservative treatment; true lumen; false lumen; aorta-related complication

Submitted May 25, 2024. Accepted for publication Sep 12, 2024. Published online Oct 25, 2024.
doi: 10.21037/jtd-24-864
View this article at: https://dx.doi.org/10.21037/jtd-24-864

Introduction

The annual incidence of acute aortic dissection per 100,000 people is around 2.9–4.4 cases (1,2), and the number of cases reported from Japan ranges from 3 to 10 (3,4). Although surgical treatment has been established for acute Stanford type A aortic dissection, conservative treatment is the first choice for uncomplicated Stanford type B aortic dissection (TBAD). This is because the mortality rate at 14 days for antihypertensive treatment alone is about 2.4–6.3%, which is equivalent to the outcome of surgical treatment (5-7).

The survival rate of uncomplicated TBAD is acceptable (6), but the rate of invasive treatment in the chronic phase was 45% in 3 years, and 50% in 5 years (8). Recently, a treatment option called preemptive thoracic endovascular aortic repair (TEVAR) has shown a better outcome than optimal medical management, according to a 5-year randomized controlled trial, suggesting that it may become the preferred treatment for TBAD (9). However, there are still no ideal predicting factors for those patients who need surgical intervention.

In recent years, technological advances have made it possible to measure areas more accurately with three-dimensional computed tomography (3DCT), which can be performed in a shorter time, making it a useful diagnostic tool in clinical practice (10).

In this retrospective study, we aimed to verify the value of known predicting factors and to explore whether it is possible to identify the imaging parameters which were strongly associated with the factors involved in the development of late aorta-related complications during treatment of uncomplicated TBAD in the TEVAR era. The novelties of this study lie in its focus on changes in the true and false lumens, and its demonstration that quantitative evaluation can provide valid information to predict the need for preemptive TEVAR, ultimately improving the outcome of TBAD. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-864/rc).

Highlight box

Key findings

- A narrow true/full lumen area ratio on initial computed tomography (CT) and enlargement of the false lumen area on follow-up CT are potential clinical markers of late aortic adverse events in patients with uncomplicated Stanford type B aortic dissection.

What is known and what is new?

- It was known that narrow true lumen was a predictor of the development of aorta-related complications.
- Even if the aortic diameter is small, a narrow true lumen is predicted to cause future complications.

What is the implication, and what should change now?

- Patients with a true/full lumen area ratio less than 50% on CT short-axis images are likely to develop aortic aneurysms in the future, regardless of maximum aortic diameter.

Methods

Ethics statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Approval was granted from the Yamagata University Hospital Ethical Committee (No. 2018-245) and the ethical board of Nihonkai General Hospital (No. 006-3-5) and written consent were waived because of the retrospective nature of the study.

Study design and patients

A retrospective study was conducted using prospectively collected electronic medical records from Yamagata University Hospital between July 2004 and October 2019, and Nihonkai General Hospital between February 2016 and May 2019. Acute uncomplicated TBAD was defined as the absence of refractory pain, uncontrollable hypertension, malperfusion (both dynamic obstruction, which is improved by false lumen decompression, and static obstruction, which is not improved) or signs of early disease progression (11), such as retrograde type A dissection presenting within 14 days of symptom onset. The time course of aortic dissection was divided into acute (<14 days), sub-acute (15–90 days), and chronic (>90 days) phases (11).

Data collection and CT image re-analysis

Clinical data were extracted from the electronic medical record systems of two hospitals. These data included the following: demographic characteristics (such as age, sex, body mass index, etc.), medical conditions [diagnosis, in-hospital management, including intensive care unit (ICU) or high care unit (HCU) management, discharge medication, follow-up observation, etc.], and survival information. Survival was assessed through systematic follow-up outpatient clinics, electronic record vital status, or confirmation via a phone call. Information was collected by three people to prevent observer bias.

In-hospital management

Successful medical management in the acute phase was defined as control of hypertension and remission of general symptoms. That protocol was developed using Japanese guidelines as a reference (3). The outcome "aorta-related complication" includes enlargement of the aortic diameter (≥55 mm and/or ≥5 mm in 6 months), malperfusion and aortic rupture (3,11).

Imaging techniques

Contrast computed tomography (CT) scanning data at emergency admission, at the 1st and 7th days after admission, at hospital discharge, at 3, 6 and 12 months and annually thereafter, were recollected from hospital medical record systems (12). Image analysis was performed on a SYNAPSE VINCENT system (FUJIFILM Holding Corporation, Tokyo, Japan) with a dedicated 3D image analyzer. For CT angiography measurements, the midline of the aorta was first drawn, and multiplanar reconstruction (MPR) images in the axial plane perpendicular to it were created for measurement (Figure S1A). The aortic centerline was created by the VINCENT system software, which uses a 3D algorithm that performs MPR centered on the contrasted aortic lumen. The primary entry in the most proximal portion of the descending aorta was defined as an entry tear (12). This was measured using MPR on the cross section where the tear has the largest diameter. The location of entry tear in the descending aorta was examined and classified into distal arch, tracheal bifurcation level, diaphragm level, celiac artery level, and abdominal aorta.

The areas of the true and false lumens were measured, respectively. Measurements were taken in the orthogonal cross section at the location of maximum aortic diameter. (Figure S1B,S1C). The area with the largest aortic diameter with the primary entry was statistically treated as the "maximum aortic diameter". The maximum aortic diameter was compared between images obtained at the beginning of the subacute phase and images during the chronic phase. True lumen area ratio (TLAR: true lumen area to true and false lumen area) and false lumen area ratio (FLAR: false lumen area to true and false lumen area) were examined based on the findings of the CT scan at the time of initial diagnosis.

The status of the false lumen on imaging was classified as patent if flow was present in the absence of a thrombus (13). "Partial thrombosis" was evaluated at a later phase when an enhanced CT scan was performed.

Intramural hematomas and penetrating aortic ulcers were not included in this study. All thrombosed false lumen types have intimal tears confirmed by CT.

Statistical analysis

Clinical characteristics and CT imaging parameters of patients at emergency admission and during follow-up were summarized. Categorical measures were presented as percentages. Continuous measures were presented as medians and interquartile ranges. Outcomes were assessed with unadjusted and multivariable models. Aorta-related complication-free rates were calculated using Kaplan-Meier curves and tested by the log-rank test. Factors that are associated with aorta-related complication were investigated with the use of Cox proportional hazards regression model. All model-based results are presented with 95% confidence intervals (CIs). All statistical analyses were performed with R-4.2.0 software.

Results

A total of 296 patients were admitted to two hospitals with a diagnosis of TBAD. In all patients, the time of onset of acute TBAD could be identified. Patients were excluded if they developed acute complications in two weeks (58 patients) or if they had traumatic acute TBAD (21 patients). The remaining 213 patients that were treated medically for two weeks were enrolled in this study (Figure S2). All were Japanese, and 149 (70.0%) were male. The mean (range) age of all patients was 69.9 (62.0–79.0) years (*Table 1*). The mean observation period was 54±45 months. During follow-up, patients were divided into two groups: those with aorta-related complications [group A, n=53 (25%)] and those without [group U, n=160 (75%)].

The most common aorta-related complication was aortic enlargement [23.5% (n=50)]. The incidence of aortic rupture was 2.3% (n=5). Malperfusion was seen in only one patient (0.5%) and required surgical management (Figure S2). Five patients died from aorta-related complication (2.8%). During follow-up, patients who had an aorta-related complication, despite medical management, underwent an aortic intervention. An 84-year-old man died of aortobronchial fistulation 2 months after onset. He was unable to stand on his own due to dementia, and his family did not request surgical intervention. A 77-year-old man died of infection 3 months after onset of symptoms following TEVAR for aortoesophageal fistula followed by esophagectomy and planned reconstructive surgery with a graft replacement. Another three patients died of aortic rupture, two of whom died after graft replacement. Aortic

Table 1 Clinical profiles and outcomes of acute type B aortic dissection

Characteristics	All patients (n=213)	Aortic adverse event (n=53)	No occurrence (n=160)	P value†
At the onset				
Age (years)	69.9 (62.0–79.0)	73.0 (62.0–77.2)	71.0 (62.0–80.2)	0.44
Male (%)	70.0 (149 of 213)	71.7 (38 of 53)	69.4 (111 of 160)	0.86
BMI (kg/m^2)	23.4 (20.2–26.0)	22.2 (20.2–25.1)	22.5 (19.9–25.7)	0.86
COPD (%)	38.9 (82 of 211)	45.3 (24 of 53)	36.7 (58 of 158)	0.32
HTN (%)	51.6 (110 of 213)	58.5 (31 of 53)	49.4 (79 of 160)	0.27
Acute course of disease				
Delirium (%)	43.9 (90 of 205)	44.7 (21 of 47)	43.7 (69 of 158)	>0.99
NPPV required (%)	26.8 (55 of 205)	36.2 (17 of 47)	24.1 (38 of 158)	0.13
Tracheal intubation (%)	9.8 (20 of 205)	8.5 (4 of 47)	10.1 (16 of 158)	>0.99
Positive pressure ventilation required (NPPV or mechanical ventilation) (%)	31.7 (65 of 205)	34.0 (16 of 47)	31.0 (49 of 158)	0.72
ICU-HCU stay (days)	6.2 (4.0–7.25)	5.0 (4.0–6.5)	5.0 (3.0–7.8)	0.50
Medication at discharge from the hospital				
Beta blockers (%)	77.9 (162 of 208)	80.4 (41 of 51)	77.1 (121 of 157)	0.70
Angiotensin converting enzyme inhibitors (%)	19.2 (40 of 208)	19.6 (10 of 51)	19.1 (30 of 157)	>0.99
Angiotensin II receptor blockers (%)	65.4 (136 of 208)	56.9 (29 of 51)	68.2 (107 of 157)	0.18
Calcium channel blockers (%)	77.4 (161 of 208)	72.5 (37 of 51)	79.0 (124 of 157)	0.34
Statins (%)	30.8 (64 of 208)	35.3 (18 of 51)	2.9 (46 of 157)	0.49
Steroids (%)	3.8 (8 of 212)	3.8 (2 of 52)	3.8 (6 of 160)	0.63
Anticoagulants (%)	5.2 (11 of 213)	3.8 (2 of 53)	5.6 (9 of 160)	0.74

Continuous variables were presented as median (interquartile range). †, P value for the differences between patients with and without the aortic adverse event. BMI, body mass index; COPD, chronic obstructive pulmonary disease; HTN, hypertension; NPPV, noninvasive positive pressure ventilation; ICU, intensive care unit; HCU, high care unit.

interventions were needed in 39 patients (18%), and these included 13 with graft replacement, 27 with endovascular repair, 2 with hybrid (open repair and endovascular) repair and 1 with an extra-anatomical bypass. Two patients who developed Stanford type A aortic dissection during the follow-up period underwent graft replacement, and both survived. One case was after TEVAR, but the primary entry was in the ascending aorta, so the relationship to TEVAR was unclear. The survival rate after surgical intervention was 90% (35 of 39). None of the 27 cases of preemptive TEVAR performed in the subacute or early chronic phase were uncomplicated, and the 1- and 5-year aortic-related death-free rates for 100%/92%, respectively. Overall survival at 1 year after surgery was 96% *vs.* 97% (group A *vs.* group U) and at 5 years was 71% *vs.* 90% (group A *vs.* group U) (*Figure 1*). The 1-, 5-, and 10-year aorta-related complication-free rates for 213 patients were 76%, 72%, and 72%, respectively (Figure S3).

There were no differences in patient's characteristics between the two groups (*Table 1*). Marfan syndrome was present in 4 patients overall, and those patients were excluded from the analysis.

At the time of hospital discharge, no association of drug treatment with subsequent prognosis was observed (*Table 1*). From the CT findings of early subacute phase, significant differences between groups were found in the maximum aortic diameter (group A: 40±7 mm *vs.* group U: 37±6 mm, P=0.02), false lumen area (group A: 899±655 mm^2 *vs.* group

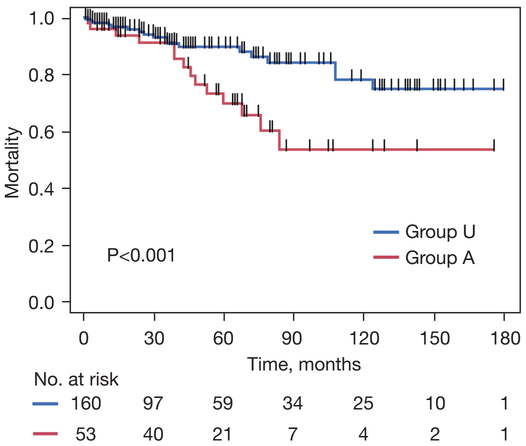

Figure 1 Freedom from all-cause death following conservative treatment for acute uncomplicated type B dissection. Survival rates are displayed in 30-month intervals. The group with aorta-related complications is group A, and those without is group U. The 95% CI is shown in color. CI, confidence interval.

U: 535±313 mm^2, P<0.001), and incidence of patent false lumen [group A: 64% (32 of 50) *vs.* group U: 34% (55 of 160), P<0.001].

Particularly in group A, the false lumen area (group A: 1,096±772 mm^2 *vs.* group U: 386±287 mm^2, P<0.001) tended to expand from the first visit (*Table 2*).

Aortic diameter at early subacute phase is a useful prognostic factor, and receiver operating characteristic (ROC) curve analysis showed that the incidence of aorta-related complications increased with a diameter greater than 39.100 mm (95% CI: 0.517–0.702, sensitivity: 0.745, specificity: 0.472) (*Figure 2*). As a new independent prognostic factor, the area under the curve of TLAR was generated (*Figure 3*). If the TLAR was 52.9% or less at the site where the dissected aorta was at its greatest diameter, aorta-related complications may have occurred in the long-term period, with a sensitivity of 0.775 and a specificity of 0.939. This tendency is the same for false lumens, and later aorta-related complications are more likely to occur with a sensitivity of 0.920 and specificity of 0.617 if the false lumen is greater than 814.000 mm (*Figure 4*). In our previous study, we found that an aneurysm diameter greater than 40 mm at initial presentation increased the likelihood of future aorta-related complications (14). A comparison of patients with an initial aortic diameter greater than 40 mm and those with an initial aortic diameter less than 40 mm showed that aorta-related complications were significantly more common in the former group when the TLAR was less than 52.9% (P<0.001). Interestingly, a TLAR of 52.9% or less increased the risk of future aorta-related complications, even when the aortic diameter was smaller than 40 mm (P<0.001) (*Figure 5*). The 1-, 3-, and 5-year aorta-related complications-free rates were 90%/54%/54% *vs.* 94/92/92%, respectively, for patients with a TLAR of less than 52.9% *vs.* 52.9% or greater with an aortic diameter of 40 mm or less.

A multivariate model was created to predict late aortic adverse events in patients with TBAD who were medically managed. Predictors of late aorta-related complications included TLAR of early subacute phase [hazard ratio (HR), 0.129; 95% CI: 0.044–0.377; P<0.001] and enlargement of false lumen area during follow-up (HR, 6.086; 95% CI: 2.223–16.660; P<0.001). The results of the Cox proportional hazards regression model are summarized in *Table 3*.

Discussion

Key findings of this study are summarized as follows: (I) aorta-related complication tended to occur, especially in cases with a low TLAR at the time of early subacute phase, and (II) an increase in the false lumen after the acute phase is a significant risk for the occurrence of aorta-related complication in the subacute or chronic phase. These new findings provide an important basis for determining whether preventive aortic intervention should be performed.

Although the short-term survival rate for acute TBAD with strict medical control is good (15), there might be a significant number of patients requiring surgical intervention during the chronic phase (8). The most common aorta-related complication is aortic enlargement, and a report from the International Registry of Acute Aortic Dissection showed aortic expansion in 73.3% of patients with TBAD who chose conservative treatment (16). The mechanism of aortic expansion in chronic aortic dissection remains unclear. Kelly *et al.* (17) explained that with aortic dissection, the aneurysm expanded during the chronic phase by losing the muscle layer barrier, which reduced the resistance of the wall to blood pressure and led to an increase in the diameter of the false lumen.

Predictors of aortic enlargement have been investigated in detail, including the number of vessels originating in the false lumen (18) and the number of intercostal arteries (19). Other well-known predictors of aortic events and mortality in patients with chronic TBAD include male (20), partial thrombosis of the false lumen (21), and aortic diameter

Table 2 Initial and follow-up computed tomography findings for all patients with or without an aortic adverse event

Computed tomography findings	All patients (n=213)	Aortic adverse event (n=53)	No occurrence (n=160)	P value†
Initial findings				
Aortic diameter on admission (mm)	38±6	40±7	37±6	0.02
Area of maximum aortic diameter (TLA + FLA) (mm^2)	1,235±490	1,461±668	1,163±419	<0.001
TLA (mm^2)	607±250	543±244	627±252	0.048
FLA (mm^2)	623±421	899±655	535±313	<0.001
Rate of true/false lumen area of maximum aortic diameter (TLA/FLA)	2.4±2.0	0.7±0.8	2.9±2.2	<0.001
TLAR	0.6±0.2	0.4±0.2	0.7±0.2	<0.001
FLAR	0.5±0.2	0.6±0.1	0.5±0.2	<0.001
Entry located distal arch (%)	78 (155 of 198)	76 (37 of 49)	79 (118 of 149)	0.69
Entry located tracheal bifurcation level (%)	3 (6 of 198)	4 (2 of 49)	3 (4 of 149)	0.64
Entry located diaphragm level (%)	10 (20 of 198)	10 (5 of 49)	10 (15 of 149)	0.63
Entry located celiac artery level (%)	6 (12 of 198)	12 (6 of 49)	4 (6 of 149)	0.08
Entry located abdominal aorta (%)	3 (6 of 198)	0 (0 of 49)	4 (6 of 149)	0.34
Number of intimal tears	1.7±1.1	2.1±1.4	1.6±0.9	0.01
Diameter of primary entry (mm)	12.3±6.0	14.5±7.2	10.9±5.1	0.02
Patent false lumen (%)	41 (87 of 210)	64 (32 of 50)	34 (55 of 160)	<0.001
Partial thrombosis (%)	10 (20 of 210)	14 (7 of 50)	8 (13 of 160)	0.27
Follow-up findings				
Aortic diameter during follow-up (max diameter) (mm)	40±7	46±9	38±7	<0.001
TLA (mm^2)	747±368	685±428	766±347	0.90
FLA (mm^2)	559±454	1,096±772	386±287	<0.001
Rate of true/false lumen area of maximum aortic diameter (TLA/FLA)	2.7±2.1	1.6±2.0	3.0±2.2	<0.001
TLAR	0.6±0.2	0.4±0.3	0.7±0.2	<0.001
FLAR	0.4±0.2	0.6±0.3	0.3±0.2	<0.001
Aortic growth rate (mm/month)	0.5±1.1	1.7±1.5	0.1±1.0	<0.001
Having narrowing true lumen area as compared to the initial (%)	24 (49 of 201)	49 (23 of 47)	17 (26 of 154)	<0.001
Having enlargement false lumen area as compared to the initial (%)	42 (75 of 180)	73 (32 of 44)	32 (43 of 136)	<0.001

Continuous variables were presented as mean ± SD. †, P value for the differences between patients with and without the aortic adverse event. SD, standard deviation; TLA, true lumen area; FLA, false lumen area; TLAR, true lumen area ratio; FLAR, false lumen area ratio.

>40 mm (14,22,23). However, these risk factors do not directly suggest indications for surgical intervention. Aortic diameter and future aneurysm occurrence at the onset of acute TBAD have been widely reported and are particularly important independent risk factors (24); it is highly likely that the diameter of the aneurysm will increase over the long term in patients with an aortic diameter >40 mm at the site of dissection at the initial examination (25). An aortic diameter of less than 40 mm is also a known factor that reduces future risk (3). In our study, a low TLAR at the time of initial presentation and an increased area of the false lumen after the acute phase appeared to be more significant prognostic factors than aortic diameter at early subacute phase. Although no clear answers have been obtained for

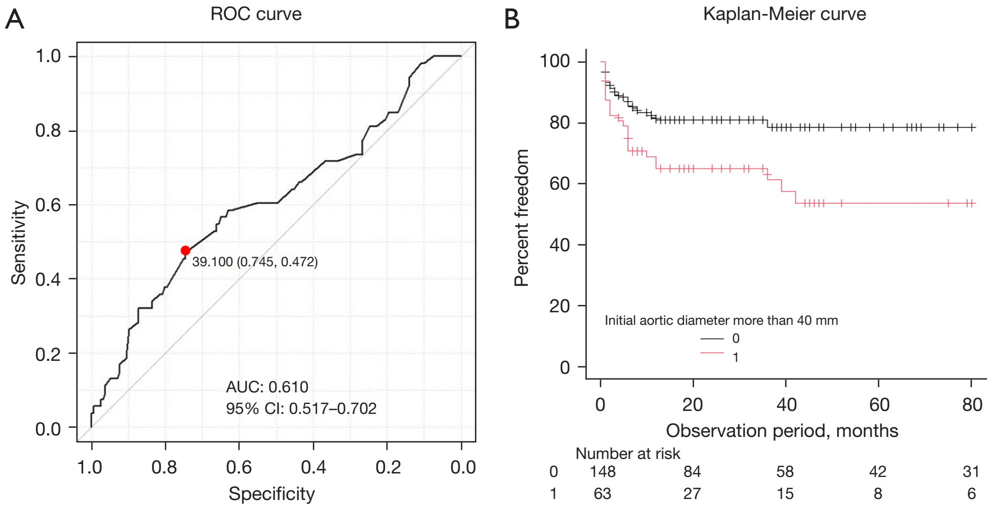

Figure 2 Patient of uncomplicated type B aortic dissection, aortic diameter in the early subacute phase. (A) ROC curve. Maximum aortic diameter of the early subacute CT findings. (B) Kaplan-Meier curve of the aorta-related complication-free rate. Patients with an initial aortic diameter of 40 mm or less (marked as 0) *vs.* more than 40 mm (marked as 1) were compared. AUC, area under the curve; CI, confidence interval; ROC, receiver operating characteristic; CT, computed tomography.

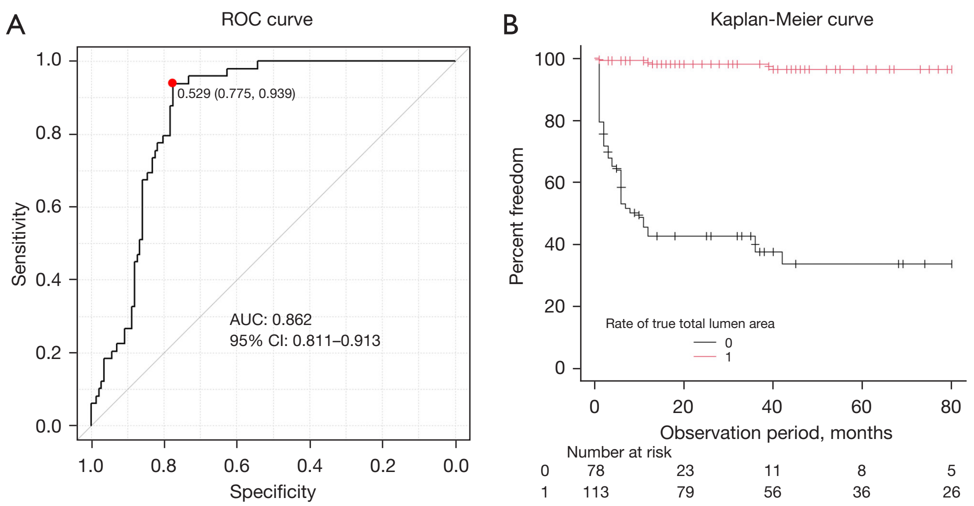

Figure 3 CT image finding. True lumen area ratio of maximum aortic diameter at the early subacute phase. (A) ROC curve. The true lumen area ratio was examined based on the CT findings of early subacute phase. The probability of an aorta-related complication occurring in the long-term period. (B) Kaplan-Meier curve of the aorta-related complication-free rate. Patients were divided into groups with true lumen ratio of 52.9% or less (marked as 0) and more than 52.9% (marked as 1). AUC, area under the curve; CI, confidence interval; CT, computer tomography; ROC, receiver operating characteristic.

risk factors and mechanisms, it has been reported that the diameter of the false lumen is associated with long-term prognosis (26,27); in addition, it has been reported that the prognosis is poor when the true lumen is elliptical in shape (20). Some previous reports suggested that a TLAR of less than 25–30% indicates a risk of aortic enlargement (12,28), but these reports were based on axial CT data, and 3DCT may be necessary to evaluate the aortic arch, which is the most susceptible to aneurysm formation. The result that aorta-related complications are more likely to occur

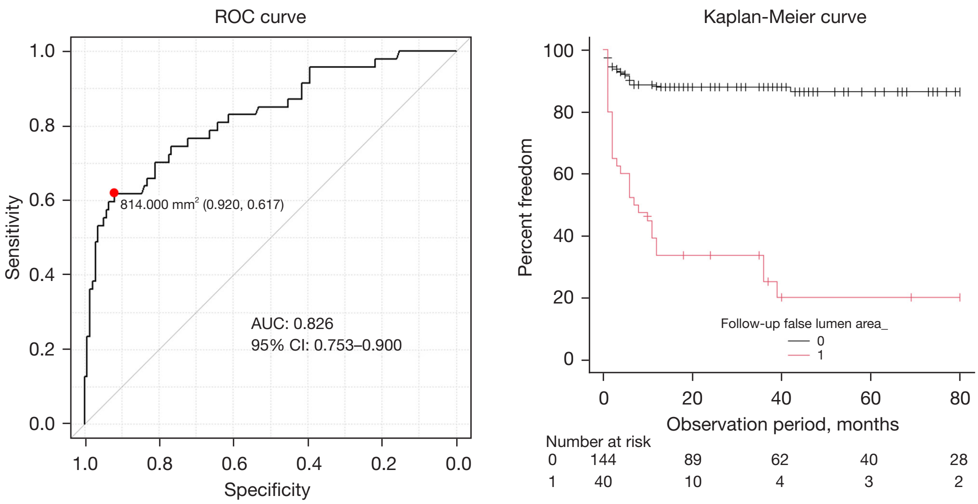

Figure 4 False lumen area (mm^2) of maximum aortic diameter during follow-up. ROC curve. During follow-up, the false lumen area was measured when the aortic diameter was at its maximum. The probability of occurrence of aorta-related complication was examined. Patients with a false lumen of equal to or less than 814 mm^2 (marked as 0) or greater than 814 mm^2 (marked as 1) were compared. AUC, area under the curve; CI, confidence interval; ROC, receiver operating characteristic.

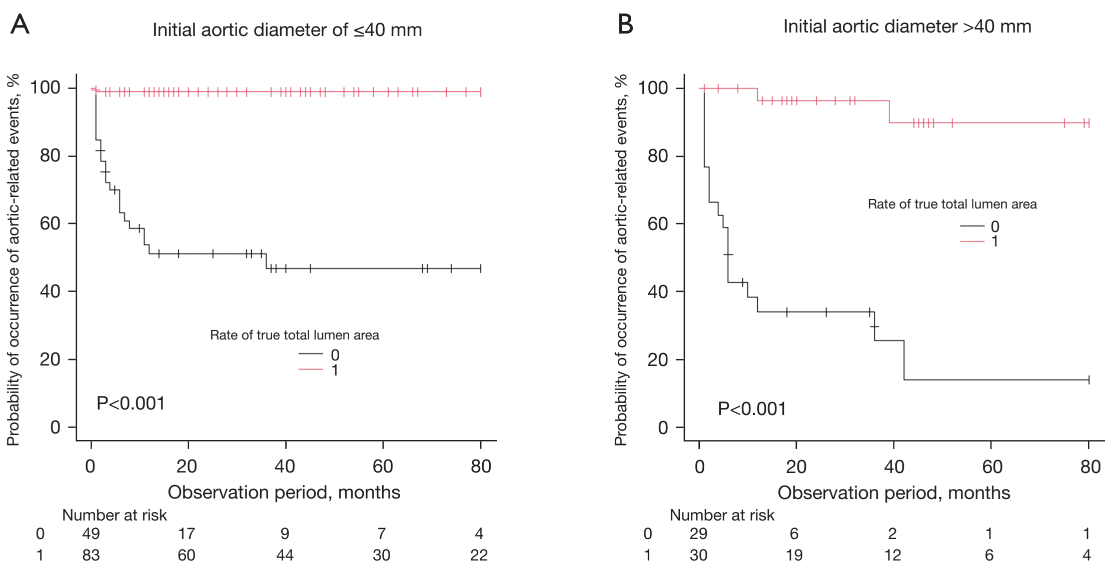

Figure 5 Survival curve was adjusted for age, gender and HT. (A) Patients with an initial aortic diameter of 40 mm or less than 40 mm were compared between groups with a TLAR of 52.9% or less (marked as 0) and more than 52.9% (marked as 1). (B) The probability of occurrence of aorta-related complication in the long-term period. Patients with an initial aortic diameter more than 40 mm were compared between groups with a TLAR of 52.9% or less (marked as 0) and more than 52.9% (marked as 1). HT, hypertension; TLAR, true lumen area ratio.

when TLAR is low even with small aortic diameters is clinically important and may be useful as a decision-making tool for aggressive intervention in the future.

Recently, an increasing number of reports support preemptive TEVAR for subacute uncomplicated TBAD as prophylaxis (29-31). However, there are still no clear criteria for what constitutes a decision to proceed with surgical intervention in patients who are still receiving conservative treatment with few symptoms. Based on our results, we inform patients with a narrow true lumen area of

Table 3 Independent factors for aortic enlargement: Cox proportional hazard regression model

Variables	Hazard ratio	95% CI
Clinical profile		
Age	0.984	0.940–1.031
Male	1.597	0.505–5.047
BMI	0.996	0.898–1.103
COPD	2.096	0.880–4.993
HT	2.499	1.116–5.595
Computed tomography findings		
Initial aortic diameter >40 mm	1.865	0.847–4.107
Number of intimal tears	1.543	0.948–2.512
Thrombosed false lumen	1.726	0.867–3.438
TLAR, early subacute	0.129	0.044–0.377
FLA, follow-up findings	6.086	2.223–16.660

BMI, body mass index; COPD, chronic obstructive pulmonary disease; HT, hypertension; TLAR, true lumen area ratio; FLA, false lumen area; CI, confidence interval.

the risk from the early subacute phase and share with them that preemptive TEVAR is a treatment option. The most important points to keep in mind are to prevent serious complications such as retrograde type A dissection and paraplegia, with special attention to (I) sufficient informed consent, (II) careful consideration of the indication for the procedure in the aortic arch, (III) avoiding oversizing, (IV) avoiding touch-up, (V) keeping a healthy landing on the proximal side, and so on. The mid-term outcome is good with no additional interventions, which will be reported separately in the future.

Our study is limited by its retrospective design, its relatively small number of patients, incomplete follow-up (9%), and varying number of CT scans among patients. Three cases of ulcer-like projection type were observed in the present study, all of which became patent false lumen type over time. Therefore, these three cases are classified as patent false lumen in this study.

In some cases, surgical intervention was performed when aneurysmal enlargement was observed at a rate equivalent to 5 mm/6 months before 6 months after onset, so we have included 0.83 mm/month as a criterion for aneurysmal enlargement.

Our findings highlight the potential role of the enlargement of the false lumen and a narrow true lumen as biomarkers for patients with TBAD who are at risk for late aorta-related complications. This work, however, is hypothesis generating and requires prospective validation in larger cohorts.

Conclusions

Enlargement of the false lumen area on follow-up may be related to the occurrence of aorta-related complications in the future. Narrow true lumen is associated with the occurrence of future aorta-related complications, even if the diameter of the aorta is small, further exploration of the relationship between the subacute and chronic outcomes after TBAD is warranted.

Acknowledgments

We thank JAM Post (www.jamp.com) for English language editing.
Funding: None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-864/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-864/dss

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-864/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-864/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Yamagata University Hospital Ethical Committee (#2018-245) and ethical board of Nihonkai General Hospital (#006-3-5), and written consent was waived because of the retrospective nature of the study.

References

1. Mészáros I, Mórocz J, Szlávi J, et al. Epidemiology and clinicopathology of aortic dissection. Chest 2000;117:1271-8.
2. Brooks M. Review of Studies Reporting the Incidence of Acute Type B Aortic Dissection. Hearts 2020;1:152-65.
3. Ogino H, Iida O, Akutsu K, et al. JCS/JSCVS/JATS/JSVS 2020 Guideline on Diagnosis and Treatment of Aortic Aneurysm and Aortic Dissection. Circ J 2023;87:1410-621.
4. Committee for Scientific Affairs, The Japanese Association for Thoracic Surgery, Shimizu H, Okada M, et al. Thoracic and cardiovascular surgeries in Japan during 2017 : Annual report by the Japanese Association for Thoracic Surgery. Gen Thorac Cardiovasc Surg 2020;68:414-49.
5. Iannuzzi JC, Stapleton SM, Bababekov YJ, et al. Favorable impact of thoracic endovascular aortic repair on survival of patients with acute uncomplicated type B aortic dissection. J Vasc Surg 2018;68:1649-55.
6. Moulakakis KG, Mylonas SN, Dalainas I, et al. Management of complicated and uncomplicated acute type B dissection. A systematic review and meta-analysis. Ann Cardiothorac Surg 2014;3:234-46.
7. Enezate TH, Omran J, Al-Dadah AS, et al. Thoracic endovascular repair versus medical management for acute uncomplicated type B aortic dissection. Catheter Cardiovasc Interv 2018;91:1138-43.
8. Durham CA, Cambria RP, Wang LJ, et al. The natural history of medically managed acute type B aortic dissection. J Vasc Surg 2015;61:1192-8.
9. Nienaber CA, Kische S, Rousseau H, et al. Endovascular repair of type B aortic dissection: long-term results of the randomized investigation of stent grafts in aortic dissection trial. Circ Cardiovasc Interv 2013;6:407-16.
10. Patterson BO, Vidal-Diez A, Karthikesalingam A, et al. Comparison of aortic diameter and area after endovascular treatment of aortic dissection. Ann Thorac Surg 2015;99:95-102.
11. Erbel R, Aboyans V, Boileau C, et al. 2014 ESC Guidelines on the diagnosis and treatment of aortic diseases. Kardiol Pol 2014;72:1169-252.
12. Evangelista A, Salas A, Ribera A, et al. Long-term outcome of aortic dissection with patent false lumen: predictive role of entry tear size and location. Circulation 2012;125:3133-41.
13. Hughes GC, Andersen ND, McCann RL. Management of acute type B aortic dissection. J Thorac Cardiovasc Surg 2013;145:S202-7.
14. Nakamura K, Uchida T, Sho R, et al. Analysis of Risk Factors for Aortic Enlargement in Patients with Chronic Type B Aortic Dissection. Ann Vasc Dis 2018;11:490-5.
15. Niino T, Hata M, Sezai A, et al. Optimal clinical pathway for the patient with type B acute aortic dissection. Circ J 2009;73:264-8.
16. Fattori R, Montgomery D, Lovato L, et al. Survival after endovascular therapy in patients with type B aortic dissection: a report from the International Registry of Acute Aortic Dissection (IRAD). JACC Cardiovasc Interv 2013;6:876-82.
17. Kelly AM, Quint LE, Nan B, et al. Aortic growth rates in chronic aortic dissection. Clin Radiol 2007;62:866-75.
18. Kamman AV, Brunkwall J, Verhoeven EL, et al. Predictors of aortic growth in uncomplicated type B aortic dissection from the Acute Dissection Stent Grafting or Best Medical Treatment (ADSORB) database. J Vasc Surg 2017;65:964-971.e3.
19. Sailer AM, van Kuijk SM, Nelemans PJ, et al. Computed Tomography Imaging Features in Acute Uncomplicated Stanford Type-B Aortic Dissection Predict Late Adverse Events. Circ Cardiovasc Imaging 2017;10:e005709.
20. Tolenaar JL, van Keulen JW, Jonker FH, et al. Morphologic predictors of aortic dilatation in type B aortic dissection. J Vasc Surg 2013;58:1220-5.
21. Tsai TT, Evangelista A, Nienaber CA, et al. Partial thrombosis of the false lumen in patients with acute type B aortic dissection. N Engl J Med 2007;357:349-59.
22. Onitsuka S, Akashi H, Tayama K, et al. Long-term outcome and prognostic predictors of medically treated acute type B aortic dissections. Ann Thorac Surg 2004;78:1268-73.
23. van Bogerijen GH, Tolenaar JL, Rampoldi V, et al. Predictors of aortic growth in uncomplicated type B aortic dissection. J Vasc Surg 2014;59:1134-43.
24. Geragotellis A, Al-Tawil M, Jubouri M, et al. Risk profile analysis of uncomplicated type B aortic dissection patients undergoing thoracic endovascular aortic repair: Laboratory

and radiographic predictors. J Card Surg 2022;37:2811-20.
25. Kato M, Bai H, Sato K, et al. Determining surgical indications for acute type B dissection based on enlargement of aortic diameter during the chronic phase. Circulation 1995;92:II107-12.
26. Matsushita A, Tabata M, Hattori T, et al. False lumen being larger than true lumen is associated with late aortic events in uncomplicated type B aortic dissection. Interact Cardiovasc Thorac Surg 2022;34:1132-40.
27. Weiss G, Wolner I, Folkmann S, et al. The location of the primary entry tear in acute type B aortic dissection affects early outcome. Eur J Cardiothorac Surg 2012;42:571-6.
28. Immer FF, Krähenbühl E, Hagen U, et al. Large area of the false lumen favors secondary dilatation of the aorta after acute type A aortic dissection. Circulation 2005;112:I249-52.
29. Sachs C, Vecchini F, Corniquet M, et al. Preemptive treatment in the acute and early subacute phase of uncomplicated type B aortic dissections with poor prognosis factors. Front Cardiovasc Med 2024;11:1362576.
30. Naito N, Takagi H. Optimal Timing of Pre-emptive Thoracic Endovascular Aortic Repair in Uncomplicated Type B Aortic Dissection: A Network Meta-Analysis. J Endovasc Ther 2024. [Epub ahead of print]. doi: 10.1177/15266028241245282.
31. Torrent DJ, McFarland GE, Wang G, et al. Timing of thoracic endovascular aortic repair for uncomplicated acute type B aortic dissection and the association with complications. J Vasc Surg 2021;73:826-35.

Cite this article as: Nakamura K, Sho R, Kobayashi K, Nakai S, Ishizawa A, Watanabe D, Uchino H, Shimanuki T, Uchida T. Narrow true lumen favors future complication even in small diameter of type B aortic dissection. J Thorac Dis 2024;16(10):6357-6367. doi: 10.21037/jtd-24-864