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The distance of the primary intimal tear from the left subclavian artery predicts aortic growth in uncomplicated type B aortic dissection

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Abstract

Objective: Controversy exists about the optimal treatment of acute uncomplicated type B aortic dissection (auTBAD). Optimal medical therapy (OMT) provides excellent short-term outcomes, but long-term results are poor. Ideally, auTBAD patients who will fail to respond to OMT in the chronic phase could be identified and undergo thoracic endovascular aortic repair.The purpose of this study was to identify radiographic predictors of auTBAD patients who will fail to respond to OMT.

Methods: A review of the Emory aortic database from 2000 to 2017 identified 320 auTBAD patients initially treated with OMT. From this cohort, 121 patients with two or more contrast-enhanced imaging scans were available for analysis. These patients were initially divided into groups based on growth of the thoracic aorta ≥10 mm or intervention due to aneurysmal growth: growth (n = 72) and no growth (n = 49). TeraRecon (Foster City, Calif) imaging software was used to analyze characteristics of the primary intimal tear (PIT), false lumen, and overall aortic size.

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Data collection: JC, XL, YD, EC, WJ, BL
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Finally, Cox proportional hazards models were constructed to estimate hazard ratios and to identify predictors of OMT failure.

Results: The mean age of all patients was 54 ± 11 years, and 67% were male. Thirty-eight patients (53%) in the growth group underwent intervention. There were no differences between groups in age, hypertension, diabetes mellitus, tobacco abuse, or chronic obstructive pulmonary disease. The distance of the PIT from the left subclavian artery in patients with auTBAD was significantly shorter in the growth group (growth, 27 mm [9–66 mm]; no growth, 77 mm [26–142 mm]; $P < .01$). Multivariable Cox regression analysis identified the distance of the PIT from the left subclavian artery and a thoracic aortic diameter >45 mm as independent predictors of failure of OMT. Partial false lumen thrombosis was not a predictor of aortic growth.

Conclusions: The distance of the PIT from the left subclavian artery is a predictor of aortic growth in auTBAD. Patients with a primary tear located in zone 3 of the proximal descending thoracic aorta should be monitored closely and may be considered for early thoracic endovascular aortic repair in the setting of auTBAD. (J Vasc Surg 2019;69:692–700.)

Keywords

Aortic dissection; Endovascular procedures

Evolving data regarding improved short-term and long-term outcomes of thoracic endovascular aortic repair (TEVAR) for complicated acute type B aortic dissection (TBAD) have raised the question of whether TEVAR should supplant optimal medical therapy (OMT) as the standard of care for acute uncomplicated TBAD (auTBAD). OMT provides excellent in-hospital and 1-year outcomes; however, the long-term outcomes are concerning. Mortality approaches 40% at 5 years, and the intervention-free survival rate is 50% at 5 years and 30% at 10 years.[1–3] TEVAR provides the ability to remodel the thoracic aorta and to reduce aorta-related mortality; however, it is not a risk-free procedure and carries periprocedural risks of stroke, retrograde type A aortic dissection, and spinal cord ischemia. Ideally, a strategy of selective TEVAR in the acute phase for patients who will ultimately fail to respond to OMT could be employed to optimize the long-term outcomes of patients with TBAD.

Previous studies in the literature have identified radiographic features in patients diagnosed with TBAD that place them at high risk for OMT failure, including thoracic aortic diameter >40 mm, false lumen size >22 mm, partial false lumen thrombosis, and primary intimal tear (PIT) >10 mm.[4–7] In a recent study from our institution of 318 patients who presented with auTBAD, we identified 146 (46%) patients who failed to respond to OMT in the chronic phase and required open or endo- vascular intervention.[3] The purpose of this study was to analyze and to compare this cohort of auTBAD patients (which contains both OMT "success" and "failure") to determine radiographic predictive risk factors for failure of OMT. Discovery of risk factors could provide a data- driven, selective approach to early TEVAR for auTBAD patients that may improve long-term outcomes of this lethal disease.

METHODS

This study was conducted with the approval of the Institutional Review Board at Emory University in compliance with Health Insurance Portability and Accountability Act regulation and the Declaration of Helsinki. The Institutional Review Board waived the need for consent of the patients. The Emory Data Warehouse was queried from 2000 to 2017 using the *International Classification of Diseases, Ninth Revision* and *Tenth Revision* codes for TBAD. After a detailed retrospective review of the electronic medical record, 400 patients with acute TBAD were identified; 320 patients were classified as acute uncomplicated TBAD (auTBAD) and were treated with OMT, defined as aggressive treatment of blood pressure and surveillance imaging. This cohort of patients was selected to be the study sample. Patients with complicated TBAD, residual distal dissections after proximal aortic repair for type A aortic dissection, and all other acute aortic syndromes involving the descending thoracic aorta were excluded from this analysis. From this cohort of 320 patients, 121 patients had two contrast-enhanced imaging studies that were available for analysis of aortic growth. The patients were divided into two groups for comparative analysis. The growth group (n = 72) consisted of patients who on surveillance imaging demonstrated thoracic aortic growth ≥10 mm during the study period or underwent surgical (open or endovascular) intervention for rapid aneurysmal growth. Those patients who did not demonstrate significant growth (<10 mm) between scans ≥6 months apart were placed in the no growth group (n = 49). The medical record was reviewed to collect demographics, date of diagnosis of auTBAD, and comorbidities.

Imaging analysis.

Patients underwent contrast- enhanced computed tomography or magnetic resonance angiography at presentation. TeraRecon (Foster City, Calif) imaging software was used to analyze each patient’s presenting and most recent computed tomography scans. All images were analyzed by the lead author (J.A.C.), and 30% of all images were checked by the senior author (B.G.L.). Interobserver differences were within 0.3 mm for all measurements. The index scan was analyzed for characteristics of the PIT, including the distance from the left subclavian artery, the width of the PIT, and the length of the PIT. The initial step in the analysis was to create an aortic centerline using the TeraRecon Aquarius iNtuition three-dimensional workstation. Straightened multiplanar reconstruction was then performed, and using the aortic centerline reconstruction, the first visible intimal tear was labeled as the PIT. The distance of the PIT from the left subclavian artery was measured by placing the first TeraRecon cross-sectional cursor at the distal edge of the left subclavian artery and the second cross-sectional cursor at the proximal edge of the PIT. The distance between the two cursors was defined as the distance of the PIT from the left subclavian artery (Fig 1). The cursors were subsequently moved to the proximal and distal edges of the PIT, and the distance between the two cursors was defined as the length of the PIT. The width of the PIT was evaluated using axial images. The axial slice with the largest visible space between edges of the dissection flap was measured and identified as the maximum width of the PIT (Fig 2).

Measurements of the cross-sectional diameter of the thoracic and abdominal aorta were performed orthogonal to the aortic centerline. Additional radiographic characteristics evaluated included the status of the false lumen (partial vs complete thrombosis), the location of the origin of the false lumen (greater vs lesser curve), and whether the false lumen spiraled around the aorta ≥180 degrees (Figs 3 and 4). The length of zone 3, defined as the distance from the distal edge of the left subclavian artery to the midpoint of the T4 vertebral body, was measured in all patients using the aortic centerline and the three-dimensional volume reconstructions.[8]

Statistics.

Descriptive statistics of the patients' demographics and clinical baseline characteristics were calculated. Continuous variables were reported as the mean ± standard deviation (or the median and the interquartile range, as appropriate); categorical variables werereported as frequency (percentage). For baseline comparison, Student *t*-test or Mann-Whitney test was used to compare group means, and χ^2 test or Fisher exact test was used to compare group proportions. The composite end point was intervention due to growth, growth >10 mm, or death. Single-predictor Cox models were initially built to identify univariable risk factors for the composite end point. Multivariable models were then constructed using the radiographic variables, and back-ward elimination was performed to identify the most parsimonious model. The proportional hazards assumption was verified using Schoenfeld residuals. All tests of hypotheses were two sided and conducted at a .05 level of significance. All statistical analyses were performed using SAS software version 9.4 (SAS Institute, Cary, NC).

RESULTS

Of the 121 patients who met the inclusion criteria for the study, 72 patients met criteria for the growth group and the remaining 49 patients met criteria for the no growth group. Table I lists the baseline demographics for all patients. The mean age of all patients was 54 ± 11 years, and 67% were male, with a higher incidence of men in the growth group. There were two patients in the no growth group and three patients in the growth group with connective tissue disorders with a combined mean age of 35 ± 8 years. A pre-existing history of hypertension was present in 99% of all patients. There were no differences between groups in age, tobacco abuse, chronic obstructive pulmonary disease, diabetes mellitus, history of myocardial infarction, dyslipidemia, and beta-blocker or statin use. The no growth group had a significantly higher incidence of congestive heart failure (no growth, 22%; growth, 6%; $P < .01$), stroke (no growth, 16%; growth, 0%; $P < .01$), and end-stage renal disease (no growth, 22%; growth, 8%; $P = .03$).

During the study period, the growth group contained 26 (36%) patients who underwent open descending or thoracoabdominal aortic replacement, 12 (17%) patients who underwent TEVAR, and 34 (47%) patients whoreceived definitive OMT. Of the 12 patients who underwent TEVAR, one patient developed postoperative paraplegia and one patient suffered a retrograde type A dissection. There were 19 total deaths in the study. In the growth group, there were 12 total deaths, and three were aorta-related deaths. One patient status post TEVAR developed a lethal aortoesophageal fistula, one patient undergoing open thoracoabdominal aortic aneurysm repair was unable to be separated from cardiopulmonary bypass, and one patient with Marfan syndrome had a lethal type A aortic dissection 10 days after open descending thoracic aortic replacement. In the no growth group, there were seven deaths, and none were aorta-related deaths.

The duration of follow-up between imaging scans was longer in the no growth group (no growth, 39 ± 34 months; growth, 27 ± 27 months; $P = .02$). Table II lists the radiographic characteristics analyzed between the two groups. At the time of initial diagnosis, the maximum diameter of the thoracic aorta was larger in the growth group (growth, 45 mm [38–52 mm]; no growth, 41 mm [36–46 mm]; $P < .01$), but there was no difference in the sizes of the abdominal aorta (growth, 34 mm [31–43 mm]; no growth, 35 mm [31–39 mm]; $P = .61$). Patients in the growth group demonstrated a greater expansion in the maximum thoracic aortic diameter between the first and last imaging studies (growth, 14 mm [10–22 mm]; no growth, 4 mm [1–6 mm]; $P < .01$). Approximately 40% of patients in each group had partial false lumen thrombosis. There was a significantly higher incidence of the false lumen arising from the greater curve of the aorta in patients in the growth group (growth, 91%; no growth, 64%; $P < .01$). There was no difference in the false lumen spiraling >180 degrees between the two groups.

The distance ofthe PIT from the leftsubclavian artery was significantly shorter in the growth group (27 mm [9–66 mm]) compared with the no growth group (77 mm [26–142 mm]; $P < .01$; Fig 5). The median length (growth, 6.5 mm [3.7–16 mm]; no growth, 7.8 mm [3.8–14 mm]; $P = .97$), width (growth, 10 mm [6.5–17 mm]; no growth, 8.9 mm [5.0–15 mm]; $P = .66$), and area (growth, 72 mm^2 [31–216 mm^2]; no growth, 65 mm^2 [21–212 mm^2]; $P = .98$) ofthe PIT were equivalent between groups. The PIT was located on the lesser curve in 67% of growth patients and in 53% of no growth patients (P = .2). The length of zone 3 was slightly longer in the growth group (growth, 50 mm [42–58 mm]; no growth, 44 mm [37–52 mm]; $P < .01$). In morphologic features, zone 3 correlated to the curved segment of the descending thoracic aorta in the majority of patients. Univariable Cox regression analysis identified male sex, tobacco use, preoperative statin use, distance of the PIT from the left subclavian artery, diameter of the descending thoracic aorta >4.5 cm, and origination of the false lumen from the greater curve on the initial diagnostic imaging study as risk factors for aortic growth, intervention, or death. In the multivariable model, the distance of the PIT from the left subclavian artery and a diameter of the descending thoracic aorta dichotomized at 45 mm on the initial diagnostic imaging study remained significant predictors of aortic growth, intervention, or death (Table III).

DISCUSSION

Efforts to improve the current treatment algorithm of patients who present with auTBAD are hindered by our inability to predict which patients will undergo aortic diameter progression in the chronic phase. Current management reserves open or endovascular intervention for patients who develop complications. However, the identification of patients in the acute phase who will ultimately fail to respond to OMT offers the potential for an early, selective TEVAR strategy that could improve long-term outcomes. TEVAR is highly efficacious in remodeling the aorta in the acute and subacute phases because of the compliant, elastic nature of a dissection flap that is easily reapproximated to the outer aortic wall by the endograft.[9] In the chronic phase, aorticremodeling is more challenging because of the fibrotic nature of the flap, which makes it relatively immobile. Hence, there is a need for early identification of anatomic risk factors that may predict which auTBAD patients will undergo significant aortic enlargement so that this process may be prevented with TEVAR.

Previous investigations into radiographic risk factors have focused on three characteristics of TBAD anatomy: aortic diameter, false lumen, and morphologic features of the PIT. Multiple studies have identified an aortic diameter >40 mm on presentation as a risk factor for subsequent aortic growth.[4,10] Our data differ from those of previous studies in that a descending thoracic aorta diameter of 40 mm in this study was not predictive of intervention as demonstrated by the median diameter of 41 mm in the no growth group. Instead, our data raise the threshold to a diameter of 45 mm, which was found to be an independent predictor of growth, intervention, or death. This increased aortic size threshold is consistent with the findings of the University of Texas-Houston group, who identified a size cutoff of 44 mm as a predictor of intervention and death in 294 patients with auTBAD.[11]

Our examination of the false lumen yielded two notable findings: the importance of the false lumen location and the irrelevance of partial false lumen thrombosis. In our analysis, we characterized the origin of the false lumen in relation to the greater or lesser curve of the aorta. In the growth group, the false lumen originated from the greater curve in 93% of patients. Furthermore, on univariable analysis, patients with a “greater curve” false lumen were three times more likely to demonstrate aortic expansion >10 mm or to require intervention compared with patients with a false lumen located on the lesser curve. Previous investigators have reported the importance of the greater curve or lesser curve location of the PIT.[12,13] In our analysis, we examined the aorta using axial, coronal, sagittal, and threedimensional volume reconstructed images. Despite these efforts, we found identifying the location of the PIT in relation to the greater or lesser curve to be extremely challenging and highly subjective, especially given that many of the primary tears were located in zone 4 of the straight mid-descending thoracic aorta and not in zone 3 of the curved proximal descending thoracic aorta. However, the identification of the origin of the false lumen in relation to the greater or lesser curve was objective and reproducible, especially with the assistance of three-dimensional volume renderings (Figs 3 and 4). Our findings suggest that a false lumen originating from the greater curve is associated with aortic growth.

The thrombosis status of the false lumen has become a controversial topic in the TBAD literature. In separate reports from the International Registry of Acute Aortic Dissection database, partial false lumen thrombosis has been determined to be an independent risk factor for aortic growth and mortality in auTBAD patients.[5,14] Sueyoshi et al[15] were unable to duplicate these findings; they did not find any association between partial falselumen thrombosis and aortic enlargement in a cohort of patients with a mean follow-up of 48 months. Moreover, in this study, we were unable to find an association between partial false lumen thrombosis and aortic growth as there were equal percentages of patients in both groups with partial false lumen thrombosis. Therefore, the impact of partial false lumen thrombosis on aortic growth and mortality remains unclear and requires further investigation.

The main finding of the study is that the location of the PIT in relation to the left subclavian artery is a significant predictor of aortic growth. Our data demonstrated that patients (growth) with a PIT beginning 27 mm distal to the left subclavian artery had a median overall growth of 14 mm, with 53% of patients requiring open or endo- vascular intervention. In contrast, patients (no growth) with a PIT beginning 77 mm distal to the left subclavian artery had a significantly lower overall median growth of 4 mm, with no patient requiring surgical intervention. These distances of the PIT from the left subclavian artery in each group correspond to two different morphologic segments and anatomic zones of the thoracic aorta. The PIT of the growth group was located primarily in zone 3 of the proximal descending thoracic aorta, which is a curved aortic segment that measured 50 mm in the growth group and 44 mm in the no growth group. The difference in lengths can primarily be accounted for by the aneurysm formation in zone 3 in the growth group. Zone 3 geometry differs from the straight, tubular morphology of zone 4 (descending thoracic aortic segment T4-T12), which was the primary location of the PIT in the no growth group. The morphologic differences of these two aortic segments may result in different hemodynamics and blood flow patterns that likely contribute to the differences in aortic growth observed in the two groups.

The current understanding of hemodynamics and blood flow patterns in normal and pathologic thoracic aortas has been described by the use of mathematical models and computational fluid dynamics (CFD). In an attempt to characterize the relative importance of anatomic, hemodynamic, and pharmacologic factors on the forces exerted on the aortic wall, Poullis et al[16] developed a steady-state one-dimensional flow model of the ascending aorta and proximal arch. These investigators concluded that the curvature of the aorta was more important than aortic diameter, patient size, blood pressure, and cardiac output in determining the forces acting on the aortic wall. In a blood flow analysis of the aortic arch using CFD, Numata et al[17] demonstrated an increase in wall shear stress and the oscillatory shear index in the proximal descending thoracic aorta compared with the mid-descending thoracic aorta. Wall shear stress is a mechanical force generated by blood flow that disrupts the endothelial cells of the intima, and the oscillatory shear index has been associated with medial degeneration. Based on these findings, we hypothesize that the shear stress and overall force on the aorta are greater when the PIT is located in the curved proximal descending thoracic aorta (zone 3) as opposed to the straight mid-descending thoracic aorta (zone 4). We are currently conducting CFD investigations of this hypothesis in patients from this study.

Major limitations of the study include the lack of complete imaging data, incomplete knowledge of the details and efficacy of the OMT, and longer term follow-up. The power of the study would be increased if we could have included all 320 auTBAD patients in our TBAD database. However, the lack of multiple contrast-enhanced images available for analysis limited the numbers included in this study. The bulk of the missing studies were the initial scans of patients in the early segment of the study period. The absence of blood pressure data limited our ability to assess the efficacy of the antihypertensive regimens prescribed in patients receiving OMT. Inadequate blood pressure control and anti-impulse therapy could have significantly affected the efficacy of OMT in preventing aortic expansion. Although the no growth group had a mean follow-up of >3 years, longer term follow-up would strengthen the findings of this study.

CONCLUSIONS

The main finding of this study is that the distance of the PIT from the left subclavian artery is a predictor of aortic enlargement in patients with auTBAD. This finding should be considered along with the growing list of malignant radiographic features (thoracic aortic diameter, false lumen size) that currently influence therapy for patients presenting with auTBAD. We hypothesize that patients with tears located closer to the left subclavian artery in zone 3, with the false lumen originating from the greater curve, experience increased false lumen wall stress resulting in significant false lumen growth compared with patients with tears located in zone 4. The reason for this increased wall stress is the inherent geometric differences, specifically curvature, between the proximal and mid-descending thoracic aorta. Based on these findings, we advocate an early TEVAR strategy for auTBAD patients with the PIT located in zone 3 of the proximal descending thoracic aorta.

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ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective cohort study
- **Key Findings:** In 120 patients with acute uncomplicated type B aortic dissection, distance of the primary aortic tear from the left subclavian artery and a thoracic aortic diameter of >45 mm were independent predictors of failure of best medical therapy.
- **Take Home Message:** Patients with a primary tear located in zone 3 (from left subclavian artery to mid T4 vertebra) of the proximal descending thoracic aorta should be monitored closely and may be considered for early thoracic endovascular aortic repair for acute uncomplicated type B aortic dissection.

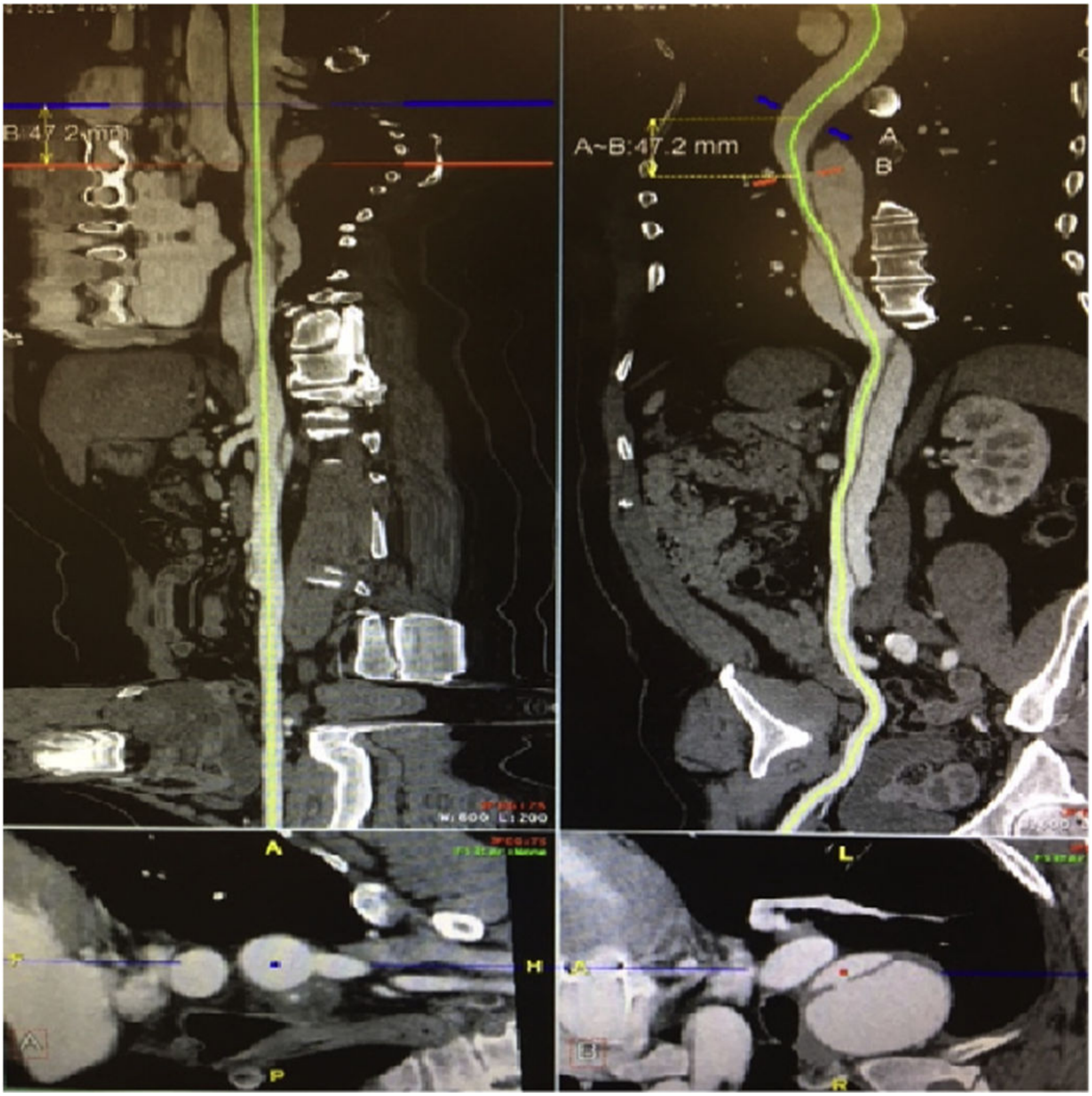

Fig 1.

Contrast-enhanced computed tomography TeraRecon Aquarius iNtuition straightened multiplanar reconstruction with aortic centerline. Example of technique used to measure distance of primary intimal tear (PIT) from the left subclavian artery

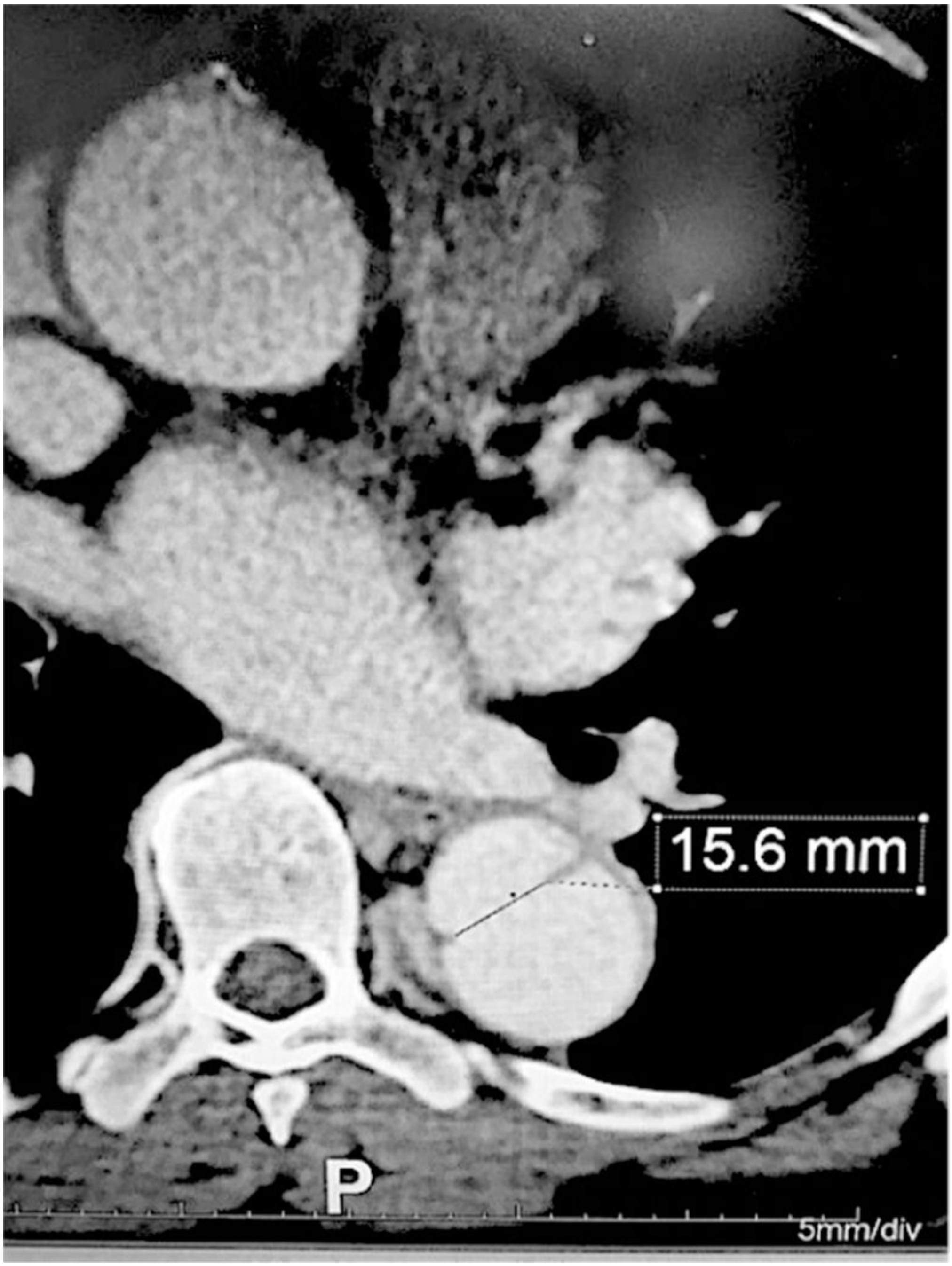

Fig 2.

Contrast-enhanced computed tomography Tera- Recon Aquarius iNtuition axial view. Example of technique used to measure maximum width of the primary intimal tear (PIT).

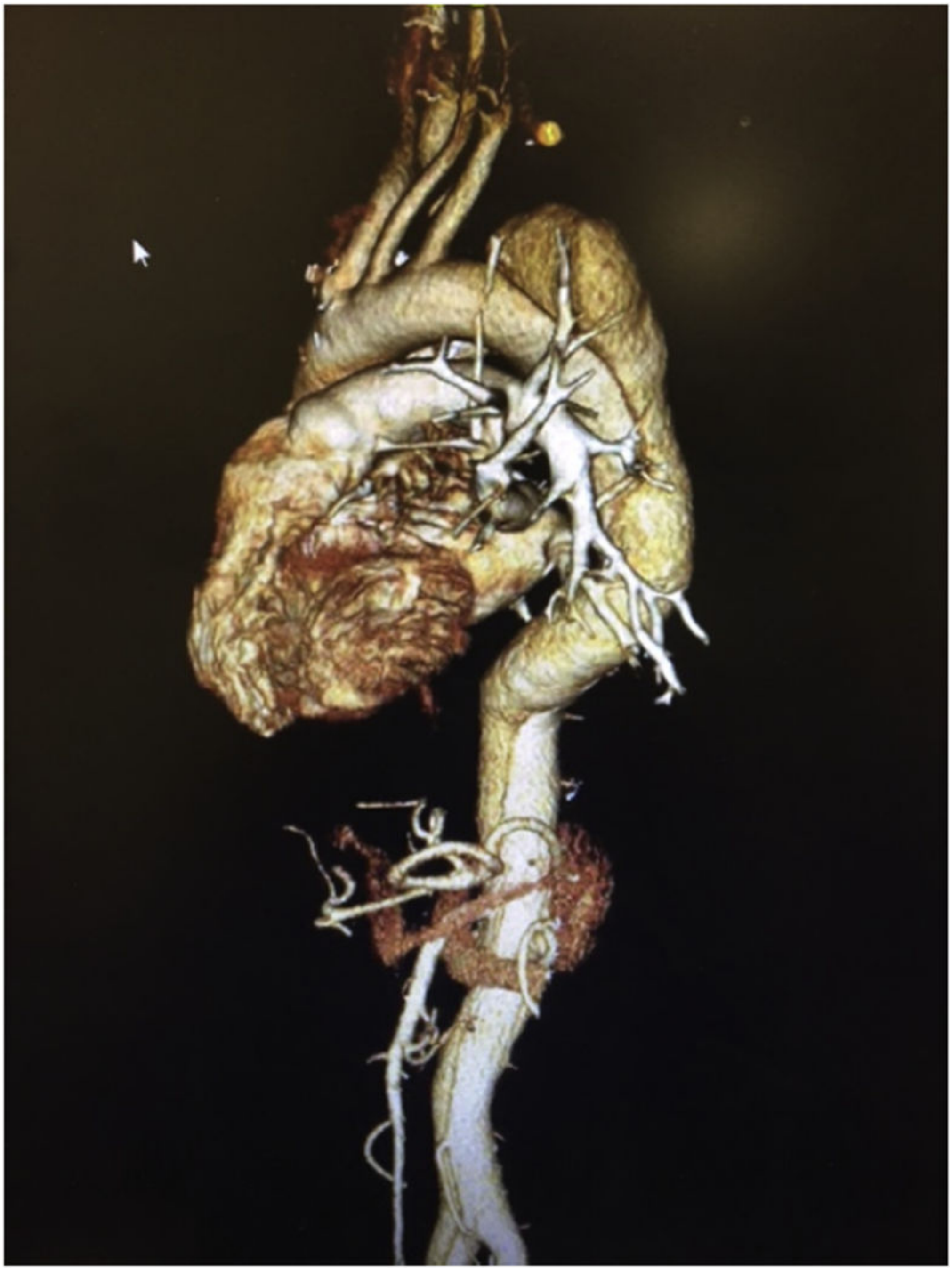

Fig 3.

Contrast-enhanced computed tomography Tera- Recon Aquarius iNtuition three-dimensional reconstruction. Example of a false lumen originiating from the greater curve of the proximal descending aorta and spiraling >180 degrees.

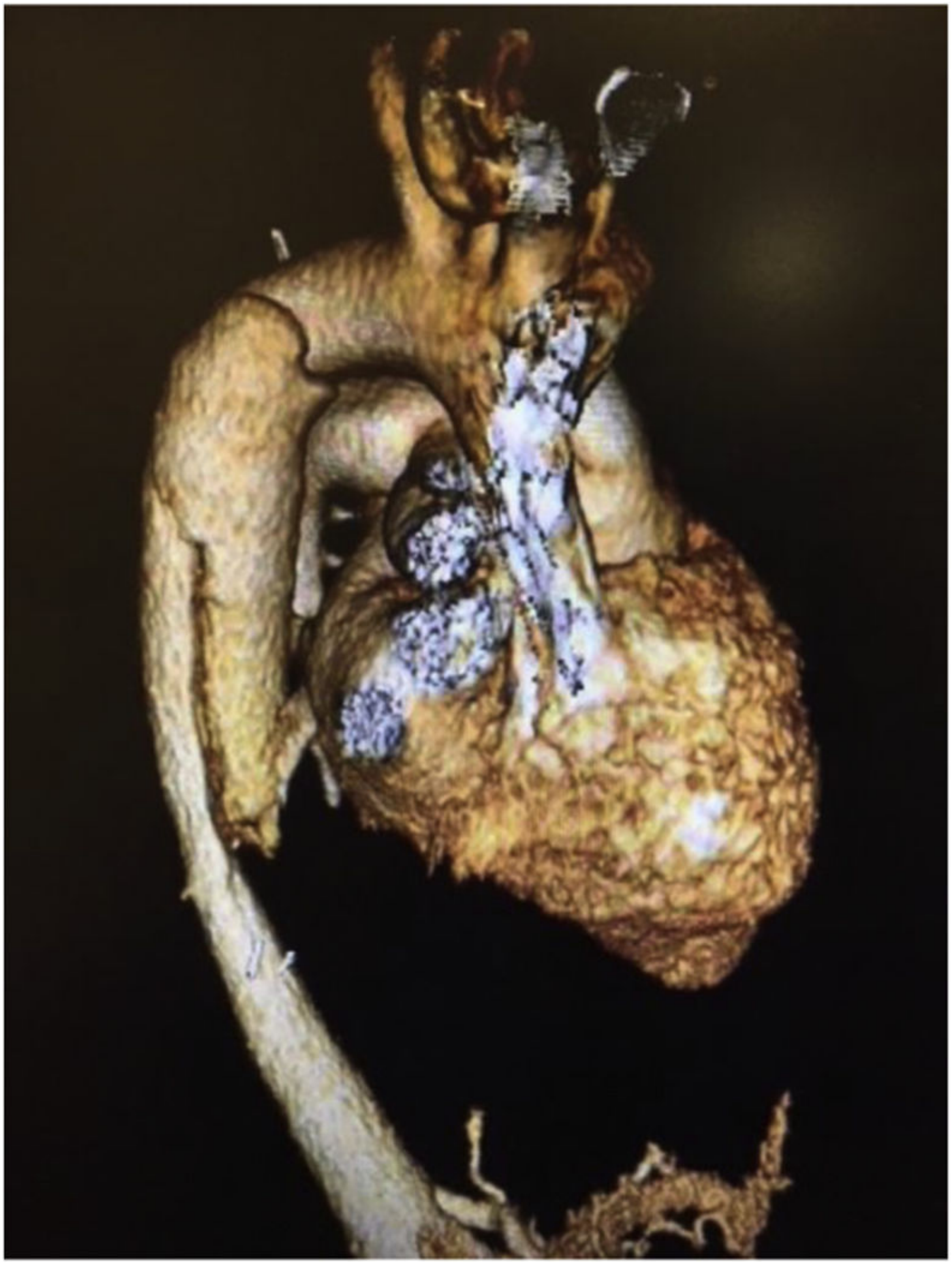

Fig 4.

Contrast-enhanced computed tomography TeraRecon Aquarius iNtuition three-dimensional reconstruction. Example of a false lumen originating from the lesser curve of the proximal descending aorta.

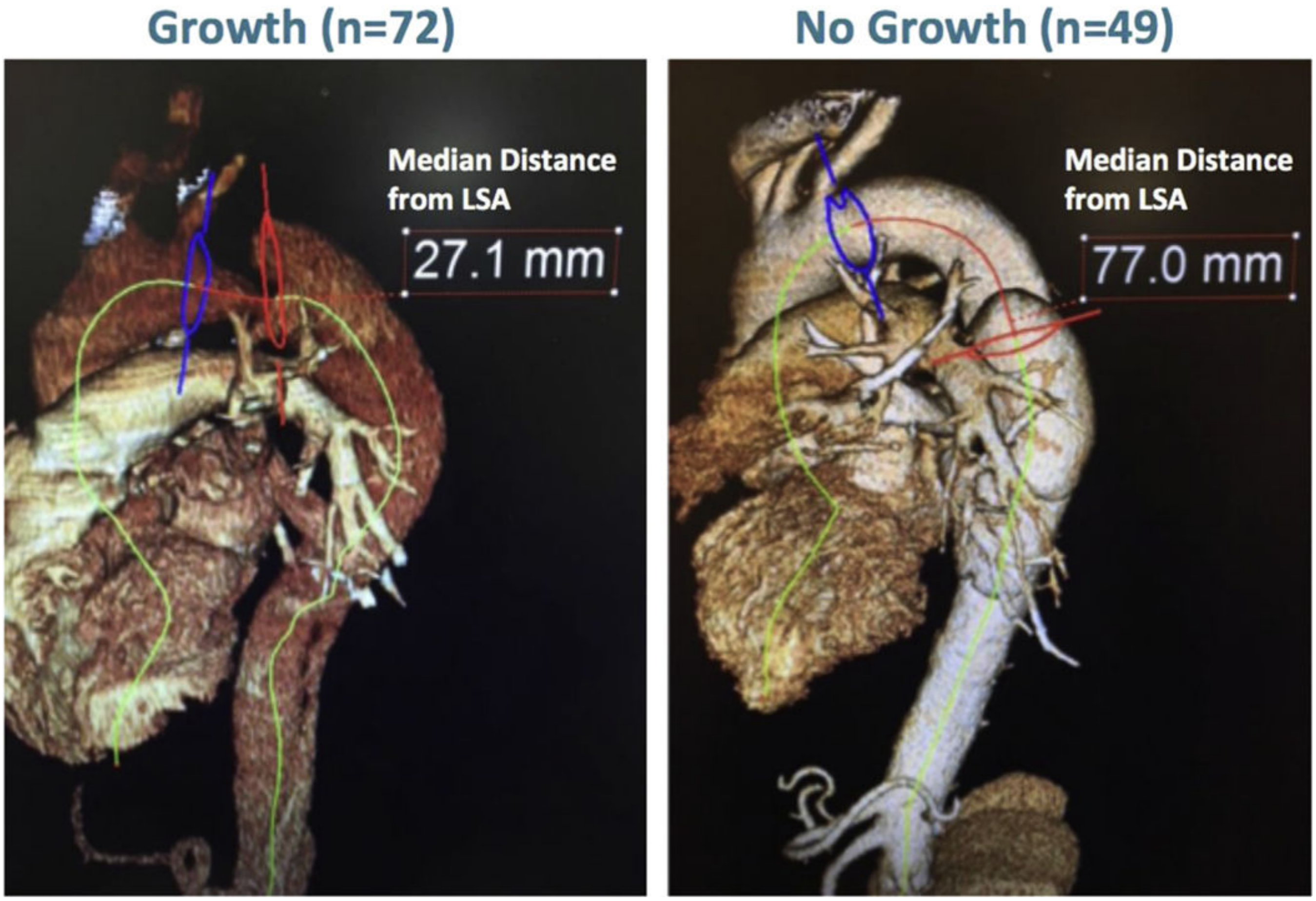

Fig 5.

Contrast-enhanced computed tomography TeraRecon Aquarius iNtuition three-dimensional reconstruction. Mean distance of primary intimal tear (PIT) from left subclavian artery (*LSA*) in growth and no growth groups.

Table I.

Baseline characteristics of acute uncomplicated type B aortic dissection (auTBAD) patients at the time of initial diagnosis

Variable	Growth (n = 72)	No growth (n = 49)	*P*
Age, years	52 ± 11	55 ± 11	.12
Male sex	55 (76)	26 (53)	.01[a]
Hypertension	72 (100)	48 (98)	.4
Smoker	19 (27)	13 (27)	.98
COPD	9 (13)	2 (4)	.2
Dyslipidemia	22 (31)	16 (33)	.89
Myocardial infarction	5 (7)	3 (6)	.99
CHF	4 (6)	12 (24)	<.01[a]
Stroke	0 (0)	8 (16)	<.01[a]
Diabetes mellitus	8 (11)	12 (24)	.05[a]
ESRD	6 (8)	11 (22)	.03
Beta blocker	40 (56)	20 (41)	.11
Statin	16 (31)	8 (22)	.31

CHF, Congestive heart failure; *COPD,* chronic obstructive pulmonary disease; *ESRD,* end-stage renal disease.

Descriptive summary statistics are either mean ± standard deviation or number (%).

[a] $P \leq .05$.

Table II.

Radiographic characteristics of acute uncomplicated type B aortic dissection (auTBAD) patients

Variable	Growth (n = 72)	No growth (n = 49)	*P*
Distance of PIT from LSA, mm	27 (9–66)	77 (26–142)	<.01[a]
PIT width, mm	10 (6.5–17)	8.9 (5.0–15)	.66
PIT length, mm	6.5 (3.7–16)	7.8 (3.8–14)	.97
PIT area, mm^2	72 (31–216)	65 (21–212)	.98
Zone 3 length, mm	50 (42–58)	44 (37–52)	<.01[a]
False lumen partial thrombosis	27 (40)	19 (42)	.79
False lumen spiraling ≥180 degrees	23 (33)	13 (28)	.52
False lumen originating on greater curve	64 (93)	30 (64)	<.01[a]
Maximum diameter of DTA, cm	4.5 (3.8–5.2)	4.1 (3.6–4.6)	<.01[a]
Maximum diameter of abdominal aorta, cm	3.4 (3.1–4.3)	3.5 (3.1–3.9)	.61
Growth of thoracic aorta, cm	1.4 (1.0–2.2)	0.4 (0.1–0.6)	<.01[a]

[a] $P \leq .05$.

Descriptive summary statistics are either median (interquartile range) or number (%).

DTA, Descending thoracic aorta; *LSA* left subclavian artery; *PIT,* primary intimal tear.

Table III.

Univariable and multivariable analyses of predictive risk factors for growth, intervention, or death in acute uncomplicated type B aortic dissection (auTBAD)

	Univariable analysis		Multivariable analysis	
Variable	**HR (95% CI)**	***P***	**HR (95% CI)**	***P***
Age	0.99 (0.97–1.02)	.61		
Male sex	1.90 (1.10–3.28)	.02[a]		
ESRD	0.61 (0.26–1.40)	.24		
Tobacco use	1.89 (1.10–3.26)	.02[a]		
COPD	1.26 (0.36–2.54)	.52		
Diabetes mellitus	0.50 (0.24–1.04)	.06		
Myocardial infarction	1.62 (0.65–4.06)	.3		
Congestive heart failure	0.39 (0.14–1.08)	.07		
Dyslipidemia	1.29 (0.78–2.14)	.33		
Beta blocker	1.29 (0.81–2.05)	.29		
Statin	2.23 (1.20–4.15)	.01[a]		
Distance of PIT from left subclavian artery	0.994 (0.989–0.999)	.01[a]	0.995 (0.990–0.999)	.03[a]
PIT width, mm	1.02 (0.99–1.05)	.17		
PIT length, mm	1.00 (0.98–1.02)	.73		
DTA diameter >4.5 cm	2.46 (1.54–3.95)	<.001[a]	2.36 (1.45–3.84)	<.01[a]
False lumen spiraling ≥180 degrees	1.01 (0.61–1.67)	.97		
False lumen originating on greater curve	3.31 (1.33–8.22)	.01[a]		
False lumen partial thrombosis	1.24 (0.76–2.02)	.38		

CI, Confidence interval; *COPD*, chronic obstructive pulmonary disease; *DTA*, descending thoracic aorta; *ESRD*, end-stage renal disease; *HR, hazard* ratio; *PIT*, primary intimal tear.

[a] $P \leq .05$.