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ORIGINAL RESEARCH

Sex-Related Differences in Clinical Features and In-Hospital Outcomes of Type B Acute Aortic Dissection: A Registry Study

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BACKGROUND: The association between female sex and poor outcomes following surgery for type A acute aortic dissection has been reported; however, sex-related differences in clinical features and in-hospital outcomes of type B acute aortic dissection, including classic aortic dissection and intramural hematoma, remain to be elucidated.

METHODS AND RESULTS: We studied 2372 patients with type B acute aortic dissection who were enrolled in the Tokyo Acute Aortic Super-Network Registry. There were fewer and older women than men (median age [interquartile range]: 76 years [66–84 years], n=695 versus 68 years [57–77 years], n=1677; $P<0.001$). Women presented to the aortic centers later than men. Women had a higher proportion of intramural hematoma (63.7% versus 53.7%, $P<0.001$), were medically managed more frequently (90.9% versus 86.3%, $P=0.002$), and had less end-organ malperfusion (2.4% versus 5.7%, $P<0.001$) and higher in-hospital mortality (5.3% versus 2.7%, $P=0.002$) than men. In multivariable analysis, age (per year, odds ratio [OR], 1.06 [95% CI, 1.03–1.08]; $P<0.001$), hyperlipidemia (OR, 2.09 [95% CI, 1.13–3.88]; $P=0.019$), painlessness (OR, 2.59 [95% CI, 1.14–5.89]; $P=0.023$), shock/hypotension (OR, 2.93 [95% CI, 1.21–7.11]; $P=0.017$), non–intramural hematoma (OR, 2.31 [95% CI, 1.32–4.05]; $P=0.004$), aortic rupture (OR, 26.6 [95% CI, 14.1–50.0]; $P<0.001$), and end-organ malperfusion (OR, 4.61 [95% CI, 2.11–10.1]; $P<0.001$) were associated with higher in-hospital mortality, but was not female sex (OR, 1.67 [95% CI, 0.96–2.91]; $P=0.072$).

CONCLUSIONS: Women affected with type B acute aortic dissection were older and had more intramural hematoma, a lower incidence of end-organ malperfusion, and higher in-hospital mortality than men. However, female sex was not associated with in-hospital mortality after multivariable adjustment.

Key Words: female sex ■ intramural hematoma ■ mortality ■ sex difference ■ type B acute aortic dissection

Acute aortic dissection (AAD) is a life-threatening medical condition associated with high morbidity and mortality rates.[1] In a prior study from the IRAD (International Registry of Acute Aortic Dissection), the association between female sex and poor outcomes following surgery for type A AAD was reported; however, no significant difference in in-hospital mortality between the sexes was found in those with type B AAD.[2] More recent studies have shown conflicting results on the association between female sex and outcomes of AAD; some did not show a mortality difference between the sexes in patients with AAD, whereas others showed a higher short-term mortality rate after acute surgical repair in women than in men.[3–10] In addition, few studies have reported on sex differences in outcomes for intramural hematoma (IMH), which

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CLINICAL PERSPECTIVE

What Is New?

- Women with type B acute aortic dissection (AAD) tended to be older, presented to the aortic centers later, had more intramural hematomas and less extension of dissection, and were less likely to experience end-organ malperfusion than men (2.4% versus 5.7%, *P*<0.001).
- In type B AAD, women were medically managed more frequently (90.9% versus 86.3%, *P*=0.002) and had a higher in-hospital mortality rate (5.3% versus 2.7%, *P*=0.002) than men.
- Multivariable analysis revealed that age, hyperlipidemia, painlessness, shock/hypotension, non–intramural hematoma, aortic rupture, and end-organ malperfusion were independent predictors of in-hospital mortality; however, female sex was not associated with in-hospital mortality (odds ratio, 1.67 [95% CI, 0.96–2.91]; *P*=0.072).

What Are the Clinical Implications?

- We clarified sex-related differences in clinical features, management, and in-hospital outcomes in patients with type B AAD, including classic aortic dissection and intramural hematoma.
- Our real-world data of type B AAD from a large Japanese AAD registry provide useful clinical information on the management of patients with type B AAD and insightful perspectives on sex-related differences in AAD.
- Further research is warranted to determine sex-specific risk assessment and therapeutic strategies for patients with type B AAD.

Nonstandard Abbreviations and Acronyms

AAD	acute aortic dissection
IMH	intramural hematoma
TEVAR	thoracic endovascular aortic repair

was traditionally regarded as a disease entity different from classic aortic dissection.[11–13] Although there is no clear distinction between classic aortic dissection and IMH in terms of clinical presentation, IMH is associated with more favorable outcomes than classic aortic dissection.[14–18]

During the past 2 decades, more patients have been managed with interventional procedures such as surgery for type A AAD and endovascular therapy for type B AAD. With these changes, a significant decrease has been noted in the overall in-hospital mortality for patients with type A AAD, but not for those with type B AAD.[1] Such temporal changes in diagnostic and therapeutic approaches for AAD may affect sex-specific effects on clinical features, management, and outcomes. It remains poorly understood whether sex-related differences in clinical features and in-hospital outcomes for type B AAD exist and how they are influenced by in-hospital management.

Therefore, the present study aimed to assess sex-related differences in clinical features, management, and in-hospital outcomes in patients with type B AAD, including classic aortic dissection and IMH, using a large Japanese multicenter registry database, representing the current real-world clinical practice of AAD in Japan. We also investigated whether female sex per se is independently associated with in-hospital outcomes of patients with type B AAD using multivariable analysis.

METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Aortic Network System and Database

The Tokyo Cardiovascular Care Unit Network is an emergent transfer system for patients with all types of cardiovascular diseases that covers the entire Tokyo metropolitan region except the island areas.[19] Since November 2010, we inaugurated a regional aortic network system called the Tokyo Acute Aortic Super-Network, which was established on the basis of the Tokyo Cardiovascular Care Unit Network,[14] with the aim to develop a safe and effective transfer system for patients with AAD and ruptured aortic aneurysm with the help of ambulance units through the control room of the Tokyo Fire Department. The Tokyo Acute Aortic Super-Network currently consists of 39 participating hospitals with specialized care for AAD and ruptured aortic aneurysm; patients with suspected or confirmed AAD are first referred to such hospitals, as reported elsewhere.[20,21] Detailed data on all patients treated in their emergency departments, cardiovascular surgery departments, and cardiovascular care units were routinely recorded and submitted to the data management center on specific survey forms.

Ethical Statements

The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki and the Ethical Guidelines for Epidemiological Research by the Japanese government. The study was approved by the institutional review board of the Tokyo Cardiovascular Care Unit Network Scientific Committee. According to the guidelines, the study satisfied the conditions for waiving the requirement for informed consent from individual participants.

Study Population and Design

We used the data from 2674 consecutive patients with type B AAD who were hospitalized from January 2013 to December 2017 and enrolled in the Tokyo Acute Aortic Super-Network registry database. The exclusion criteria were as follows: patients who were admitted >14 days from the symptom onset (n=35); patients who had cardiopulmonary arrest on arrival (n=8); and patients with no available data on the symptom onset date (n=28), in-hospital outcomes (n=16), false lumen status based on computed tomography (CT) findings (n=151), DeBakey classification or those with types other than DeBakey IIIa/IIIb (n=37), and blood pressure measurement at presentation (n=27). Finally, a total of 2372 patients with type B AAD were included in this study (Figure 1). Clinical features, management, and in-hospital outcomes were compared between the sexes in patients with type B AAD.

We classified AAD with nonthrombosed or partially thrombosed false lumen as classic aortic dissection, whereas AAD with a completely thrombosed false lumen was classified as an IMH according to the CT findings. Aortic dissections with ulcer-like projection in the thrombosed false lumen on CT imaging were included in the IMH group as previously reported.[14] AAD was categorized as types I, II, or III according to the DeBakey classification. Type III AADs were further subclassified, depending on whether the dissection was limited to the descending thoracic aorta (IIIa) or extended below the diaphragm to involve the abdominal aorta (IIIb).

Complicated type B AAD was defined by the presence of at least 1 of the following: aortic rupture or extra-aortic blood collection (impending rupture), intractable pain, uncontrolled hypertension despite full medications, early aortic expansion, progressive dissection, and malperfusion in the cerebral, spinal, renal, visceral, or peripheral vasculature. The best medical treatment was chosen as the initial management strategy for uncomplicated type B AAD. Interventional procedures such as endovascular or surgical treatment were indicated only for complicated aortic dissection, although operative procedures were selected at the discretion of surgeons and aortic teams in charge.

Statistical Analysis

We performed a power calculation to estimate the sample size required to detect a sex difference in the in-hospital mortality of patients with type B AAD, assuming the ratio of men to women was 2.5, and the in-hospital mortality was 3.5% in men and 6.5% in women, based on the results of our previous study[14] and the annual survey data of the Tokyo Cardiovascular Care Unit Network. The sample size needed to detect a prespecified difference in outcome with 80% power and an α level of 0.05 (2-sided) was calculated to be 1869 using the software package GPower (version 3.1.9.7; Kiel, Germany). The actual power calculated by a post hoc power analysis with an α level of 0.05 (2-sided) was 86.3%.

Categorical variables are expressed as the number of patients (%). Continuous data are presented

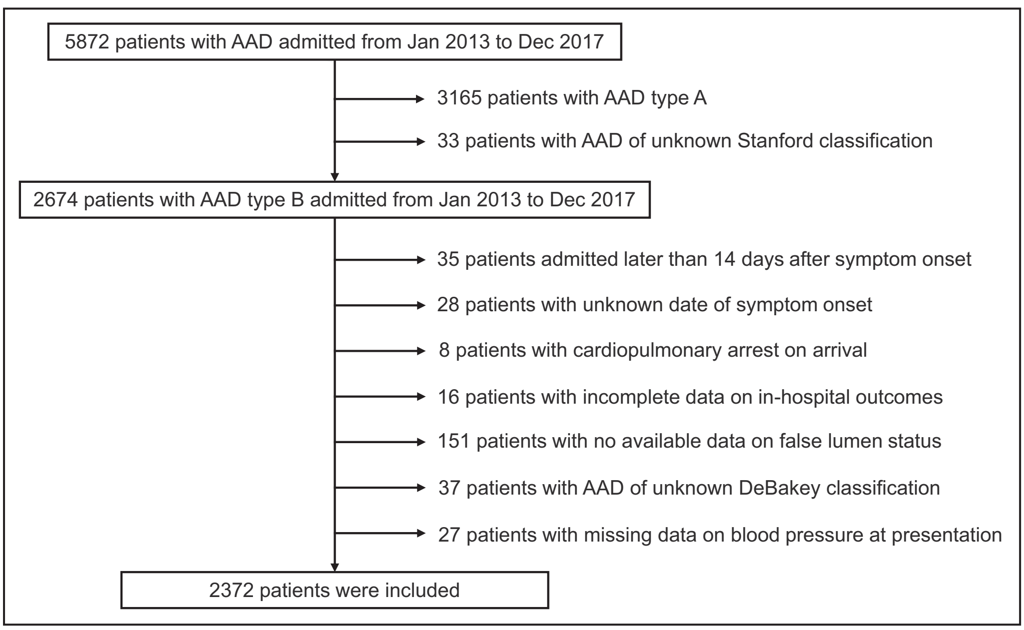

Figure 1. Flowchart of patient selection.
AAD indicates acute aortic dissection.

as mean±SD if the data followed a normal distribution. Otherwise, data are shown as median (interquartile range). The χ^2 test or Fisher exact test was used to compare categorical variables, and the unpaired Student *t* test or Mann–Whitney *U* test was used to compare continuous variables. Multivariable logistic regression analyses were performed to determine the effects of female sex on aortic rupture, end-organ malperfusion, and in-hospital mortality in patients with type B AAD. Age, sex, and clinically relevant variables including shock/hypotension and classic aortic dissection, which had a *P* value <0.05 on univariate analysis, were entered in a multivariable model. Hyperlipidemia and DeBakey classification were also included because women tended to be hyperlipidemic and had DeBakey type IIIb less frequently than men. Cigarette smoking was excluded because of multicollinearity (strong correlation with younger age and male sex). Additionally, aortic rupture, end-organ malperfusion, and medical management were entered into a different model to determine independent predictors of in-hospital mortality. Subgroup analyses were conducted in patients with complicated type B AAD or in the elderly group (patients aged ≥70 years).

Statistical significance was defined as a *P* value of <0.05 (2-sided). All statistical analyses were performed using SPSS version 24 (IBM, Armonk, NY).

RESULTS

Baseline Characteristics

As presented in Table 1, the median (interquartile range) age of the patients was 70 years (60–79 years), and 695 (29.3%) patients were women. There were fewer and older women than men (76 years [66–84 years], n=695 versus 68 years [57–77 years], n=1677; *P*<0.001). The proportion of men and women by decade of age is shown in Figure 2. More women from the older age groups were admitted than were women from the younger age groups. Hyperlipidemia was more prevalent in women than in men (20.3% versus 16.4%, *P*=0.025). The rate of cigarette smoking was lower in women than in men (16.2% versus 35.5%, *P*<0.001). Women had back pain more frequently and lower systolic blood pressures and heart rates on admission and were more likely to have IMH (63.7% versus 53.7%, *P*<0.001) and DeBakey type IIIa AAD (27.5% versus 21.5%, *P*=0.002) than men. Among patients with IMH, ulcer-like projection was observed more frequently in men than in women (29.2% versus 20.8%, *P*=0.001).

In both the subgroups of patients with complicated type B AAD and elderly patients aged ≥70 years, women were significantly older, less likely to be cigarette smokers, and had back pain more frequently than men (Tables S1 and S2).

Among patients who were admitted within 24 hours of symptom onset with available data on the exact times of symptom onset and hospital arrival, women presented to the aortic centers later than men (180 minutes [95–305 minutes], n=544 versus 159 minutes [80–280 minutes], n=1311; *P*=0.006). In addition, later presentation in women compared with men was also observed in patients with complicated type B AAD (216 minutes [134–355 minutes], n=98 versus 180 minutes [90–313 minutes], n=281; *P*=0.029) or in the elderly group (196 minutes [105–340 minutes], n=355 versus 165 minutes [83–283 minutes], n=562; *P*=0.006).

In-Hospital Management and Outcomes

As shown in Table 2, 2079 (87.6%) out of 2372 patients received medical treatment alone during hospitalization. Women were medically managed more frequently than men (90.9% versus 86.3%, *P*=0.002). The remaining 293 (12.4%) patients underwent interventional procedures including endovascular and open surgical therapies. Endovascular treatment and open surgery were performed in the acute phase (<14 days from the onset of AAD) in 17 (63.0%) women and 68 (64.8%) men and in 25 (69.4%) women and 80 (64.5%) men, respectively. In a subset of patients who underwent interventional procedures within 24 hours after admission, the time from hospital arrival to emergency operation did not differ between sexes (women: 186 minutes [88–520 minutes], n=29 versus men: 160 minutes [88–305 minutes], n=72; *P*=0.473). As for medications after admission, men were more likely to receive β-blockers, angiotensin-converting enzyme inhibitors and/or angiotensin receptor blockers, diuretics, and nitrates than women (Table 2).

The overall in-hospital mortality was higher in women than in men (5.3% versus 2.7%, *P*=0.002). In addition, the in-hospital mortality of the medically managed patients was higher among women than men (4.1% versus 1.8%, *P*=0.002). The in-hospital mortality of the endovascularly or surgically treated patients was also higher in women than in men (17.5% versus 8.7%, *P*=0.045). The most common cause of death was aortic rupture, which occurred in 38 (22 men and 16 women) out of 83 patients who were deceased. No significant difference was observed in aortic rupture between the sexes. In contrast, women were less likely to experience end-organ malperfusion than men (2.4% versus 5.7%, *P*<0.001), including renal ischemia (0.7% versus 2.0%, *P*=0.028) and mesenteric ischemia (0.7% versus 2.2%, *P*=0.012). In a subset of patients with classic aortic dissection, women had a higher incidence of aortic rupture than men (8.3% [21/252] versus 4.0% [31/777], *P*=0.006),

Table 1. Baseline Characteristics

	Total n=2372	Men n=1677	Women n=695	*P* value
Age, y	70 (60–79)	68 (57–77)	76 (66–84)	<0.001
Hypertension	1768 (74.5%)	1263 (75.3%)	505 (72.7%)	0.175
Hyperlipidemia	417 (17.5%)	276 (16.4%)	141 (20.3%)	0.025
Diabetes	187 (7.9%)	135 (8.0%)	52 (7.5%)	0.643
Cigarette smoking*	700 (29.9%)	589 (35.5%)	111 (16.2%)	<0.001
Previous coronary artery disease	89 (3.8%)	62 (3.7%)	27 (3.9%)	0.827
Previous stroke	163 (6.9%)	118 (7.1%)	45 (6.5%)	0.651
Previous peripheral artery disease	26 (1.1%)	20 (1.2%)	6 (0.9%)	0.486
Previous cardiac surgery	36 (1.5%)	28 (1.7%)	8 (1.2%)	0.347
End-stage renal disease on hemodialysis	42 (1.6%)	33 (2.0%)	9 (1.3%)	0.260
Time from onset to admission				0.548
<24 h	2111 (89.0%)	1497 (89.3%)	614 (88.3%)	
1–6 d	199 (8.4%)	140 (8.3%)	59 (8.5%)	
7–14 d	62 (2.6%)	40 (2.4%)	22 (3.2%)	
Back pain	1689 (71.2%)	1165 (69.5%)	524 (75.4%)	0.004
Chest pain	938 (39.5%)	675 (40.3%)	263 (37.8%)	0.275
Abdominal pain	287 (12.1%)	209 (12.5%)	78 (11.2%)	0.399
Lumbago	183 (7.7%)	126 (7.5%)	57 (8.2%)	0.568
Leg pain	22 (1.2%)	18 (1.3%)	4 (0.7%)	0.253
Painlessness	115 (4.8%)	74 (4.4%)	41 (5.9%)	0.125
Shock/hypotension	63 (2.7%)	43 (2.6%)	20 (2.9%)	0.666
Aortic rupture on admission	48 (2.0%)	32 (1.9%)	16 (2.3%)	0.525
Malperfusion on admission	71 (3.0%)	57 (3.4%)	14 (2.0%)	0.085
Systolic blood pressure, mm Hg	161 (137–189)	162 (139–190)	159 (133–186)	0.011
Heart rate, beats per min	76 (66–88)	77 (67–82)	74 (65–86)	0.012
Status of false lumen				<0.001
Classic aortic dissection	1029 (43.4%)	777 (46.3%)	252 (36.3%)	
IMH	1343 (56.6%)	900 (53.7%)	443 (63.7%)	
DeBakey classification				0.002
Type IIIa	551 (23.2%)	360 (21.5%)	191 (27.5%)	
Type IIIb	1821 (76.8%)	1317 (78.5%)	504 (72.5%)	

Values are median (interquartile range) or n (percent). The χ^2 test or Fisher exact test was used to compare categorical variables, and the Mann-Whitney *U* test was used to compare continuous variables. IMH indicates intramural hematoma.
*Data on history of cigarette smoking are available on 1658 men and 684 women.

whereas no significant difference was found in end-organ malperfusion between the sexes (women: 4.4% [11/252] versus men: 7.5% [58/777], *P*=0.087). In a subset of patients with IMH, no significant difference was observed in aortic rupture between the sexes (women: 2.0% [9/443] versus men: 2.1% [19/900], *P*=0.924), whereas women had a lower incidence of end-organ malperfusion than men (1.4% [6/443] versus 4.1% [37/900], *P*=0.007).

Among patients with complicated type B AAD, women were medically managed more frequently than men (49.2% versus 37.5%, *P*=0.022; Table S3). The in-hospital mortality of this subgroup was higher in women than in men (25.0% versus 10.9%, *P*<0.001). Women had aortic rupture and acute ischemic stroke more frequently than men, whereas women were less likely to experience end-organ malperfusion than men (Table S3).

In the elderly group, women had higher in-hospital mortality than men (7.3% versus 3.8%, *P*=0.007; Table S4). There were no significant differences in in-hospital complications including aortic rupture

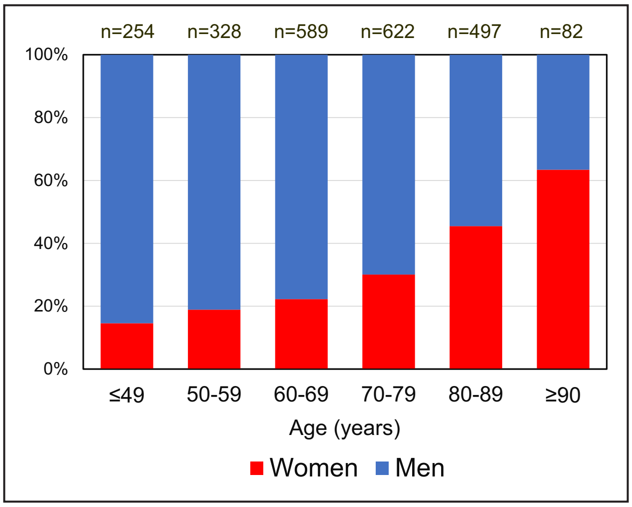

Figure 2. Proportions of men and women by decade of age.

and end-organ malperfusion between the sexes (Table S4).

Effects of Female Sex on Aortic Rupture, End-Organ Malperfusion, and In-Hospital Mortality in Type B AAD

Results of univariate analyses for aortic rupture, end-organ malperfusion, and in-hospital mortality are shown in Table S5. In multivariable analysis, age, shock/hypotension, and classic aortic dissection were significant predictors of aortic rupture. Female sex was not associated with aortic rupture after multivariable adjustment (Table 3). Additionally, shock/hypotension and classic aortic dissection were independent predictors of end-organ malperfusion. Female sex was inversely associated with end-organ malperfusion (odds ratio [OR], 0.47 [95% CI, 0.28–0.81]; *P*=0.006).

In the multivariable analysis for in-hospital mortality, age, hyperlipidemia, painlessness, shock/hypotension, classic aortic dissection, aortic rupture, and end-organ malperfusion were independent predictors of mortality, whereas female sex was not predictive of mortality after multivariable adjustment (OR, 1.67 [95% CI, 0.96–2.91]; *P*=0.072; Model 2 in Table 3). The subgroup analysis of complicated type B AAD showed that age, classic aortic dissection, and aortic rupture were independent predictors of mortality; female sex was not significantly associated with mortality (Model 2 in Table S6). In addition, multivariable analysis, which was performed only for patients who underwent an interventional procedure (endovascular/surgical), showed that only aortic rupture was an independent predictor of mortality (Model 2 in Table S7). Female sex was a significant predictor of mortality, when multivariable analysis was conducted only in the elderly group (Table S8).

DISCUSSION

The main findings of our study were as follows: (1) Women were older, presented to the aortic centers later, and had IMH and DeBakey type IIIa AAD more frequently than men. (2) Women were less likely to experience end-organ malperfusion including visceral and limb ischemia than men. (3) Women were medically managed more frequently and had higher in-hospital mortality (unadjusted) than men. (4) Female sex per se was not associated with in-hospital mortality after multivariable adjustment.

As reported previously,[4] women with type B AAD presented at an older age than men. The sex difference in age has also been reported to be observed in type A aortic dissections and ruptured aortic aneurysms.[2,10,22,23] The pathogenic process of aortic disease may differ between the sexes through hormonal, molecular, and hemodynamic differences, although the pathophysiologic mechanisms remain unknown. Notably, women had IMH more frequently than men in the present study, where IMH was defined as aortic dissection with a completely thrombosed false lumen. The prevalence of IMH was as high as 57% in patients with type B AAD, which was consistent with the results from our previous report.[14] The pathophysiology of IMH is thought to originate from a contained hemorrhage within the medial layer of the aorta because of either rupture of the vasa vasorum or an atherosclerotic plaque. The difference in the prevalence of IMH between our study and others may be explained by the different definitions of IMH, racial variance, and different availability of diagnostic image modalities, such as CT. In our study, aortic dissections with ulcer-like projection in the false lumen were included in the IMH group. Because ulcer-like projection is a sign of intimal tear on CT imaging, some studies may differentiate them as communicating dissections from IMH. As compared with those with classic aortic dissection, patients with IMH have been reported to be older,[14,18,24,25] have a greater intima-media thickness,[26] experience dissection with limited extension to the supraceliac aorta more frequently, and exhibit lower incidences of leg ischemia and renal failure.[16,24] The development of IMH may be associated with increased stiffness of the aortic wall, leading to limited extension of the dissection, particularly in older women than in older men. Previous reports focusing on sex differences in type B AAD[4,8,9] did not provide detailed data on false lumen patency because their databases were created based on the coding system, which did not differentiate IMH from classic aortic dissection accurately; therefore, our data would provide additional information on the sex difference in IMH.

In the present study, women were medically managed more frequently than men, whereas men were

Table 2. In-Hospital Management and Outcomes

	Total	Men	Women	
	n=2372	n=1677	n=695	*P* value
Management				
Medical therapy	2079 (87.6%)	1447 (86.3%)	632 (90.9%)	0.002
Interventional therapy	293 (12.4%)	230 (13.7%)	63 (9.1%)	0.002
Endovascular therapy	132 (5.6%)	105 (6.3%)	27 (3.9%)	0.022
Open surgical therapy	148 (6.2%)	116 (6.9%)	32 (4.6%)	0.034
Hybrid therapy	13 (0.5%)	9 (0.5%)	4 (0.6%)	0.907
In-hospital death				
Overall	83 (3.5%)	46 (2.7%)	37 (5.3%)	0.002
Medically managed	52 (2.5%)	26 (1.8%)	26 (4.1%)	0.002
Interventionally treated	31 (10.6%)	20 (8.7%)	11 (17.5%)	0.045
Endovascularly treated	12 (9.1%)	8 (7.6%)	4 (14.8%)	0.265
Surgically treated*	19 (11.8%)	12 (9.6%)	7 (19.4%)	0.107
In-hospital complications				
Aortic rupture	80 (3.2%)	50 (3.0%)	30 (4.3%)	0.130
Hemothorax	29 (1.2%)	18 (1.1%)	11 (1.6%)	0.304
Acute ischemic stroke	38 (1.6%)	23 (1.4%)	15 (2.2%)	0.165
Acute coronary event	29 (1.2%)	21 (1.3%)	8 (1.2%)	>0.999
End-organ malperfusion	112 (4.7%)	95 (5.7%)	17 (2.4%)	<0.001
Renal ischemia	38 (1.6%)	33 (2.0%)	5 (0.7%)	0.028
Mesenteric ischemia	42 (1.8%)	37 (2.2%)	5 (0.7%)	0.012
Spinal cord ischemia	16 (0.7%)	14 (0.8%)	2 (0.3%)	0.109
Limb ischemia	38 (1.6%)	32 (1.9%)	6 (0.9%)	0.065
Redissection/extension	92 (3.9%)	70 (4.2%)	22 (3.2%)	0.248
Medications after admission				
β-Blocker	1884 (79.4%)	1375 (82.0%)	509 (73.2%)	<0.001
ACEI/ARB	1558 (65.7%)	1129 (67.3%)	429 (61.7%)	0.009
Calcium channel blocker	1920 (80.9%)	1362 (81.2%)	558 (80.3%)	0.600
Nitrate	940 (39.6%)	687 (41.0%)	253 (36.4%)	0.039
Diuretic	487 (20.5%)	366 (21.8%)	121 (17.4%)	0.015
Statin	536 (22.6%)	368 (21.9%)	168 (24.2%)	0.237
Antiplatelet	250 (10.5%)	188 (11.2%)	62 (8.9%)	0.098

Values are n (percent). The χ^2 test or Fisher exact test was used. ACEI indicates angiotensin-converting enzyme inhibitor; and ARB, angiotensin receptor blocker.

*The patients treated with hybrid therapy are included.

more likely to undergo interventional procedures than women. The sex difference in treatment could be explained by the higher incidence of end-organ malperfusion in men than in women. We also found an inverse association of female sex with end-organ malperfusion after multivariable adjustment. These results were in line with those of previous reports, which showed that men had a higher incidence of renal failure and mesenteric or limb ischemia than women.[4] Although the exact mechanism underlying the sex difference in the incidence of end-organ malperfusion is unclear, it could be explained by the anatomical difference in the aorta involved with dissection between the sexes. Compared with women, men were more likely to have classic aortic dissection, which was also associated with the incidence of end-organ malperfusion. Because the proportion of DeBakey type IIIb dissections and the rate of end-organ malperfusion at initial presentation were comparable between the sexes, it is possible that men could be more susceptible to end-organ malperfusion during the hospital course. The development of malperfusion may be caused by distal extension of the aortic dissection, coexisting stenosis or dissection of the branch arteries, or progressive stenosis of the true lumen.

In the unadjusted analysis, we found that women had a higher in-hospital mortality rate than men. A difference in mortality was not only observed in the

Table 3. Multivariable Analyses for Aortic Rupture, End-Organ Malperfusion, and In-Hospital Mortality

Variables	Aortic rupture			End-organ malperfusion		
	OR	95% CI	*P* value	OR	95% CI	*P* value
Age, per y	1.05	1.03–1.07	<0.001	0.99	0.97–1.00	0.111
Female sex	1.24	0.75–2.04	0.400	0.47	0.28–0.81	0.006
Hyperlipidemia	0.99	0.54–1.84	0.974	0.74	0.42–1.32	0.306
Shock/hypotension	12.3	6.54–23.3	<0.001	5.92	3.06–11.4	<0.001
DeBakey type IIIb*	1.11	0.63–1.96	0.729	0.98	0.60–1.61	0.933
Classic aortic dissection†	3.44	2.08–5.68	<0.001	1.81	1.19–2.75	0.006
	In-hospital mortality (model 1)			In-hospital mortality (model 2)		
Age, per y	1.06	1.04–1.09	<0.001	1.06	1.03–1.08	<0.001
Female sex	1.55	0.96–2.51	0.075	1.67	0.96–2.91	0.072
Hyperlipidemia	1.69	0.99–2.90	0.056	2.09	1.13–3.88	0.019
Painlessness	1.60	0.76–3.38	0.217	2.59	1.14–5.89	0.023
Shock/hypotension	11.0	5.64–21.3	<0.001	2.93	1.21–7.11	0.017
DeBakey type IIIb*	1.40	0.78–2.50	0.260	1.44	0.75–2.76	0.274
Classic aortic dissection†	3.76	2.29–6.16	<0.001	2.31	1.32–4.05	0.004
Aortic rupture				26.6	14.1–50.0	<0.001
End-organ malperfusion				4.61	2.11–10.1	<0.001
Medical management				0.52	0.27–0.99	0.046

OR indicates odds ratio.
*DeBakey type IIIa as a reference.
†Intramural hematoma as a reference.

medically managed patients (88%) but also in the patients who underwent an interventional procedure, including endovascular and open surgical therapies. Table 4 shows a list of prior studies on sex differences in mortality of patients with type B AAD. The study from the IRAD showed a significant mortality difference between the sexes in those with type A AAD but not in those with type B AAD.[2] Moreover, the study by Liang et al,[4] which had the largest sample size, did not show a mortality difference between the sexes. Tolenaar et al[7] showed a risk score calculation formula for mortality in type B AAD, in which age, shock/hypotension, malperfusion, and periaortic hematoma were positive independent risk factors for in-hospital mortality, whereas female sex was not significant. Only 0.3% was contributed by the female sex in such a risk calculation model for mortality. Therefore, we constructed a multivariable logistic regression model to assess the effect of female sex on mortality in the present study. As anticipated from the previous report by Tolenaar et al,[7] age, shock/hypotension, malperfusion, and aortic rupture were independent predictors of in-hospital mortality, whereas female sex was not associated with mortality in the total cohort. Female sex was a significant predictor of mortality when multivariable analysis was performed only in the elderly group. This suggests that older women are at higher risk of in-hospital death than older men. Women were less likely to experience malperfusion, which was not associated with mortality in the setting of invasively treated AAD. Therefore, the management of older women with type B AAD, compared with older men, should focus more on the prevention

Table 4. Prior Studies With Available Data on Sex Differences in Mortality Among Patients With Type B Acute Aortic Dissection

Author, year	No.	% Women	Treatment			In-hospital mortality		
			Medical	Surgical	Endovascular	Men	Women	*P* value
Nienaber et al, 2004[2]	403	29%	72%	18%	10%	12.3%	14.4%	0.56
Tolenaar et al, 2014[7]	1034	35%	65%	10%	23%	10.4%	11.0%	0.77
Maitusong et al, 2016[5]	246	26%	30%	2%	68%	3.8%	7.9%	0.19
Liang et al, 2017[4]	9855	43%	84%	9%	7%	10.7%	11.6%	0.2
McClure et al, 2018[8]	3632	39%	83%	10%	7%	6.9%	9.9%	NA

NA indicates not available.

and treatment of sex-related comorbid conditions and complications other than malperfusion, such as aortic rupture, during hospitalization.

In the present study, multivariable analyses showed that aortic rupture was one of the most life-threatening complications associated with increased in-hospital mortality, even in patients treated with interventional procedures. It would be reasonable that an initial therapeutic goal is to prevent the incidence of aortic rupture, the most common cause of death, in the setting of type B AAD regardless of male or female sex. Although female sex was not associated with aortic rupture after multivariable adjustment, age, shock/hypotension, and classic aortic dissection were independent risk factors for aortic rupture. Early interventional procedures such as thoracic endovascular aortic repair (TEVAR) may be optimal therapies for type B AAD with high-risk profiles of aortic rupture.

Study Limitations

There were some limitations to our study. First, this study was observational in nature; therefore, unmeasured confounders that affect mortality might be present. Second, responses to the treatment might be different between men and women. However, we did not directly compare these responses between the sexes. Third, patients with interventional procedures for type B AAD were included in only 12% of the total cohort. Although endovascular treatment such as TEVAR has been the first-line therapy for complicated type B AAD recently,[27] the risks of operation and comorbid conditions were considered when decisions for interventional therapies were made at each institution. A significant sex difference in in-hospital outcomes for such a high-risk patient group may not be detected because of the relatively small sample size. Fourth, long-term outcomes were not assessed in the present study. Further investigation is warranted to confirm sex differences in long-term outcomes, including aortic events in patients with type B AAD. Finally, pre-emptive TEVAR has now been increasingly used in patients with high-risk features to prevent late aorta-related complications.[28] However, the use of TEVAR was not indicated for uncomplicated type B AAD with high-risk features during the study period in Japan. The beneficial effect of preemptive TEVAR in the acute phase has not yet been established. It is uncertain whether our results are generalizable to other regions of the world where TEVAR is performed for different indications. Further study is needed to clarify the sex difference in the therapeutic effect of such intervention in patients with high-risk features.

Despite these limitations, we believe that our data from the large Japanese AAD registry will provide useful information on the management of patients with type B AAD and insightful perspectives on sex differences in AAD.

CONCLUSIONS

In type B AAD, women were older, presented later, had more IMH and less extension of dissection, and were less likely to experience end-organ malperfusion than men. The overall in-hospital mortality was higher in women than in men; however, female sex per se was not associated with in-hospital mortality after multivariable adjustment. Further research is warranted to determine sex-specific risk assessment and therapeutic strategies for type B AAD.

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Disclosures

None.

Supplemental Material

Table S1–S8

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SUPPLEMENTAL MATERIAL

Table S1. Baseline characteristics of patients with complicated type B AAD.

	Total (n = 492)	Men (n = 368)	Women (n = 124)	*P* value
Age (years)	69 (58–78)	66 (55–75)	78 (70–84)	<0.001
Hypertension	371 (75.4%)	278 (74.7%)	93 (75.0%)	0.903
Hyperlipidemia	75 (15.2%)	50 (13.6%)	25 (20.2%)	0.078
Diabetes mellitus	40 (8.1%)	28 (7.6%)	12 (9.7%)	0.466
Cigarette smoking*	130 (26.7%)	112 (30.9%)	18 (14.8%)	0.001
Previous coronary artery disease	18 (3.7%)	12 (3.3%)	6 (4.8%)	0.414
Previous stroke	28 (5.7%)	22 (6.0%)	6 (4.8%)	0.636
Previous peripheral artery disease	9 (1.8%)	7 (1.9%)	2 (1.6%)	1.000
Previous cardiac surgery	7 (1.4%)	6 (1.6%)	1 (0.8%)	0.685
End-stage renal disease on HD	6 (1.2%)	3 (0.8%)	3 (2.4%)	0.171
Time from onset to admission				0.054
< 24 h	436 (88.6%)	328 (89.1%)	108 (87.1%)	
1–6 days	40 (8.1%)	32 (8.7%)	8 (6.5%)	
7–14 days	16 (3.3%)	8 (2.2%)	8 (6.5%)	
Back pain	324 (65.8%)	230 (62.5%)	94 (75.8%)	0.007
Chest pain	195 (39.6%)	146 (39.7%)	49 (39.5%)	0.975
Abdominal pain	66 (13.4%)	52 (14.1%)	14 (11.3%)	0.422
Lumbago	42 (8.5%)	35 (9.5%)	7 (5.6%)	0.183
Leg pain	14 (2.8%)	12 (3.3%)	2 (1.6%)	0.367
Painlessness	30 (6.1%)	23 (6.3%)	7 (5.6%)	0.808
Shock/hypotension	34 (6.9%)	22 (6.0%)	12 (9.7%)	0.160
Aortic rupture on admission	48 (9.8%)	32 (8.7%)	16 (12.9%)	0.172
Malperfusion on admission	71 (14.4%)	57 (15.4%)	14 (11.3%)	0.250
Systolic blood pressure (mmHg)	150 (128–178)	152 (131–180)	142 (121–170)	0.009
Heart rate (beats per min)	79 (68–91)	80 (68–92)	77 (66–89)	0.249
Status of false lumen				0.283
Classic aortic dissection	290 (58.9%)	222 (60.3%)	68 (54.8%)	
IMH	202 (41.1%)	146 (39.7%)	56 (45.2%)	
DeBakey classification				0.089
Type IIIa	119 (24.2%)	82 (22.3%)	37 (29.8%)	
Type IIIb	373 (75.8%)	286 (77.7%)	87 (70.2%)	

Values are median (interquartile) or n (%). AAD = acute aortic dissection; HD = hemodialysis; IMH = intramural hematoma. The Chi-square test or Fisher's exact test was used to compare categorical variables, and the Mann–Whitney U test was used to compare continuous variables.
* Data on history of cigarette smoking are available in 365 men and 122 women.

Table S2. Baseline characteristics of the elderly group.

	Total (n = 1201)	Men (n = 736)	Women (n = 465)	*P* value
Age (years)	79 (74–84)	78 (74–82)	81 (74–86)	<0.001
Hypertension	915 (76.2%)	561 (76.2%)	354 (76.1%)	0.970
Hyperlipidemia	226 (18.8%)	130 (17.7%)	96 (20.6%)	0.198
Diabetes mellitus	122 (10.2%)	84 (11.4%)	38 (8.2%)	0.070
Cigarette smoking*	222 (18.7%)	169 (23.2%)	53 (11.6%)	<0.001
Previous coronary artery disease	64 (5.3%)	41 (5.6%)	23 (4.9%)	0.639
Previous stroke	117 (9.7%)	76 (10.3%)	41 (8.8%)	0.390
Previous peripheral artery disease	20 (1.7%)	15 (2.0%)	5 (1.1%)	0.204
Previous cardiac surgery	24 (2.0%)	19 (2.6%)	5 (1.1%)	0.069
End-stage renal disease on HD	27 (2.2%)	19 (2.6%)	8 (1.7%)	0.327
Time from onset to admission				0.878
< 24 h	1062 (88.4%)	653 (88.7%)	409 (88.0%)	
1–6 days	111 (9.2%)	67 (9.1%)	44 (9.5%)	
7–14 days	28 (2.3%)	16 (2.2%)	12 (2.6%)	
Back pain	826 (68.8%)	490 (66.6%)	336 (72.3%)	0.038
Chest pain	468 (39.0%)	294 (39.9%)	174 (37.4%)	0.382
Abdominal pain	125 (10.4%)	76 (10.3%)	49 (10.5%)	0.907
Lumbago	80 (6.7%)	50 (6.8%)	30 (6.5%)	0.817
Leg pain	4 (0.3%)	2 (0.3%)	2 (0.4%)	0.643
Painlessness	81 (6.7%)	49 (6.7%)	32 (6.9%)	0.880
Shock/hypotension	22 (1.8%)	14 (1.9%)	8 (1.7%)	0.819
Aortic rupture on admission	32 (2.7%)	19 (2.6%)	13 (2.8%)	0.822
Malperfusion on admission	25 (2.1%)	14 (1.9%)	11 (2.4%)	0.584
Systolic blood pressure (mmHg)	160 (136–189)	160 (138–188)	159 (132–189)	0.346
Heart rate (beats per min)	76 (66–87)	76 (66–88)	77 (65–86)	0.467
Status of false lumen				0.145
Classic aortic dissection	394 (32.8%)	253 (34.4%)	141 (30.3%)	
IMH	807 (67.2%)	483 (65.6%)	324 (69.7%)	
DeBakey classification				0.204
Type IIIa	362 (30.1%)	212 (28.8%)	150 (32.3%)	
Type IIIb	839 (69.9%)	524 (71.2%)	315 (67.7%)	

Values are median (interquartile) or n (%). HD = hemodialysis; IMH = intramural hematoma. The Chi-square test or Fisher's exact test was used to compare categorical variables, and the Mann–Whitney U test was used to compare continuous variables.

* Data on history of cigarette smoking are available in 727 men and 458 women.

Table S3. In-hospital management and outcomes of patients with complicated type B AAD.

	Total (n = 492)	Men (n = 368)	Women (n = 124)	*P* value
Management				
Medical therapy	199 (40.4%)	138 (37.5%)	61 (49.2%)	0.022
Interventional therapy	293 (59.6%)	230 (62.5%)	63 (50.8%)	0.022
Endovascular therapy	132 (26.8%)	105 (28.5%)	27 (21.8%)	0.140
Open surgical therapy	148 (30.1%)	116 (31.5%)	32 (25.8%)	0.230
Hybrid therapy	13 (2.6%)	9 (2.4%)	4 (3.2%)	0.746
In-hospital death				
Overall	71 (14.4%)	40 (10.9%)	31 (25.0%)	<0.001
Medically managed	40 (20.1%)	20 (14.5%)	20 (32.8%)	0.003
Interventionally treated	31 (10.6%)	20 (8.7%)	11 (17.5%)	0.045
Endovascularly treated	12 (9.1%)	8 (7.6%)	4 (14.8%)	0.246
Surgically treated*	19 (11.8%)	12 (9.6%)	7 (17.5%)	0.140
In-hospital complications				
Aortic rupture	80 (16.3%)	50 (13.6%)	30 (24.2%)	0.006
Hemothorax	29 (5.9%)	18 (4.9%)	11 (8.9%)	0.104
Acute ischemic stroke	38 (7.7%)	23 (6.3%)	15 (12.1%)	0.035
Acute coronary event	11 (2.2%)	10 (2.7%)	1 (0.8%)	0.305
End-organ malperfusion	112 (22.8%)	95 (25.8%)	17 (13.7%)	0.005
Renal ischemia	38 (7.7%)	33 (9.0%)	5 (4.0%)	0.082
Mesenteric ischemia	42 (8.5%)	37 (10.1%)	5 (4.0%)	0.038
Spinal cord ischemia	16 (3.2%)	14 (3.8%)	2 (1.6%)	0.379
Limb ischemia	38 (7.7%)	32 (8.7%)	6 (4.8%)	0.164
Re-dissection/extension	92 (18.7%)	70 (19.0%)	22 (17.7%)	0.752
Medications after admission				
Beta-blocker	362 (73.6%)	280 (76.1%)	82 (66.1%)	0.030
ACEI/ARB	254 (51.6%)	191 (51.9%)	63 (50.8%)	0.833
Calcium channel blocker	360 (73.2%)	269 (73.1%)	91 (73.4%)	0.950
Nitrate	168 (34.1%)	125 (34.0%)	43 (34.7%)	0.885
Diuretic	146 (29.7%)	111 (30.2%)	35 (28.2%)	0.683
Statin	95 (19.3%)	68 (18.5%)	27 (21.8%)	0.421
Antiplatelet	65 (13.2%)	53 (14.4%)	12 (9.7%)	0.179

Values are n (%). AAD = acute aortic dissection; ACEI = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker. The Chi-square test or Fisher's exact test was used. * The patients treated with hybrid therapy are included.

Table S4. In-hospital management and outcomes in the elderly group.

	Total (n = 1201)	Men (n = 736)	Women (n = 465)	*P* value
Management				
Medical therapy	1077 (89.7%)	657 (89.3%)	420 (90.3%)	0.558
Interventional therapy	124 (10.3%)	79 (10.7%)	45 (9.7%)	0.558
Endovascular therapy	72 (6.0%)	49 (6.7%)	23 (4.9%)	0.224
Open surgical therapy	61 (5.1%)	36 (4.9%)	25 (5.4%)	0.709
Hybrid therapy	9 (0.7%)	6 (0.8%)	3 (0.6%)	1.000
In-hospital death				
Overall	62 (5.2%)	28 (3.8%)	34 (7.3%)	0.007
Medically managed	46 (4.3%)	20 (3.0%)	26 (6.2%)	0.013
Interventionally treated	16 (10.6%)	8 (10.1%)	8 (17.8%)	0.222
Endovascularly treated	5 (7.9%)	2 (4.7%)	3 (15.0%)	0.315
Surgically treated*	11 (18.0%)	6 (16.7%)	5 (20.0%)	0.747
In-hospital complications				
Aortic rupture	56 (4.7%)	30 (4.1%)	26 (5.6%)	0.225
Hemothorax	18 (1.5%)	10 (1.4%)	8 (1.7%)	0.615
Acute ischemic stroke	18 (1.5%)	8 (1.1%)	10 (2.2%)	0.139
Acute coronary event	14 (1.2%)	9 (1.2%)	5 (1.1%)	0.816
End-organ malperfusion	40 (3.3%)	28 (3.8%)	12 (2.6%)	0.250
Renal ischemia	13 (1.1%)	11 (1.5%)	2 (0.4%)	0.082
Mesenteric ischemia	10 (8.3%)	7 (1.0%)	3 (0.6%)	0.749
Spinal cord ischemia	8 (0.7%)	6 (0.8%)	2 (0.4%)	0.718
Limb ischemia	14 (1.2%)	9 (1.2%)	5 (1.1%)	0.816
Re-dissection/extension	43 (3.6%)	26 (3.5%)	17 (3.7%)	0.911
Medications after admission				
Beta-blocker	891 (74.2%)	567 (77.0%)	324 (69.7%)	0.005
ACEi/ARB	728 (60.6%)	462 (62.8%)	266 (57.2%)	0.054
Calcium channel blocker	949 (79.0%)	579 (78.7%)	370 (79.6%)	0.709
Nitrate	429 (35.7%)	272 (37.0%)	157 (33.8%)	0.261
Diuretic	224 (18.7%)	141 (19.2%)	83 (17.8%)	0.571
Statin	277 (23.1%)	168 (22.8%)	109 (23.4%)	0.805
Antiplatelet	153 (12.7%)	101 (13.7%)	52 (11.2%)	0.198

Values are n (%). ACEI = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker. The Chi-square test or Fisher's exact test was used.
* The patients treated with hybrid therapy are included.

Table S5. Univariate analyses for aortic rupture, end-organ malperfusion, and in-hospital mortality.

	Aortic rupture			End-organ malperfusion			In-hospital mortality		
Variables	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value
Age (per year)	1.04	1.02–1.06	<0.001	0.98	0.97–0.99	0.001	1.05	1.03–1.07	<0.001
Female sex	1.47	0.93–2.33	0.103	0.42	0.25–0.71	0.001	1.99	1.28–3.10	0.002
Hypertension	1.03	0.62–1.72	0.923	1.14	0.73–1.78	0.576	0.79	0.49–1.27	0.322
Hyperlipidemia	0.99	0.55–1.79	0.985	0.66	0.37–1.16	0.151	1.62	0.98–2.69	0.062
Diabetes mellitus	0.77	0.31–1.94	0.582	1.29	0.68–2.45	0.437	1.83	0.96–3.52	0.069
Cigarette smoking	0.69	0.40–1.17	0.164	0.95	0.62–1.45	0.807	0.36	0.19–0.69	0.002
Previous coronary artery disease	0.79	0.28–2.19	0.645	0.72	0.31–1.69	0.457	0.52	0.22–1.22	0.134
Previous stroke	0.71	0.26–1.96	0.503	1.12	0.59–2.41	0.618	1.06	0.45–2.47	0.896
Previous peripheral artery disease	1.15	0.15–8.58	0.893	1.69	0.40–7.26	0.478	-	-	-
Previous cardiac surgery	-	-	-	1.86	0.56–6.15	0.311	1.64	0.39–6.93	0.503
End-stage renal disease on hemodialysis	0.70	0.09–5.12	0.721	-	-	-	0.70	0.09–4.92	0.693
Time from onset to admission <24 hours	1.03	0.51–2.08	0.943	0.70	0.35–1.39	0.306	1.25	0.65–2.38	0.506
Painlessness	1.32	0.52–3.34	0.554	1.33	0.60–2.92	0.481	2.85	1.43–5.68	0.003
Shock/hypotension	23.6	12.0–46.6	<0.001	5.36	2.41–11.9	<0.001	22.5	11.4–44.4	<0.001
DeBakey type IIIb*	1.04	0.61–1.78	0.875	1.25	0.78–2.01	0.358	1.18	0.69–2.03	0.547
Classic aortic dissection†	2.50	1.57–3.99	<0.001	2.17	1.47–3.21	<0.001	2.51	1.59–3.97	<0.001
Aortic rupture							52.3	30.7–89.0	<0.001
End-organ malperfusion							5.46	3.05–9.77	<0.001
Medical management							0.22	0.14–0.34	<0.001

OR = odds ratio; CI = confidence interval.
* DeBakey type IIIa as a reference. † Intramural hematoma as a reference.

Table S6. Multivariable analysis for in-hospital mortality in patients with complicated type B AAD.

	Model 1			Model 2		
Variables	OR	95% CI	*P* value	OR	95% CI	*P* value
Age (per year)	1.06	1.03–1.08	<0.001	1.04	1.01–1.07	0.004
Female sex	1.76	0.97–3.17	0.062	1.78	0.93–3.43	0.083
Hyperlipidemia	1.55	0.77–3.10	0.219	1.62	0.75–3.46	0.218
Painlessness	1.61	0.59–4.41	0.352	1.98	0.65–6.07	0.233
Shock/hypotension	3.86	1.76–8.47	<0.001	2.00	0.81–4.93	0.134
DeBakey type IIIb[*]	1.75	0.88–3.49	0.113	1.69	0.80–3.59	0.169
Classic aortic dissection[†]	2.35	1.29–4.26	0.005	2.19	1.13–4.24	0.021
Aortic rupture				8.79	4.65–16.6	<0.001
End-organ malperfusion				1.36	0.65–2.86	0.416
Medical management				1.73	0.92–3.25	0.087

AAD = acute aortic dissection; OR = odds ratio; CI = confidence interval.
[*] DeBakey type IIIa as a reference. [†] Intramural hematoma (IMH) as a reference.

Table S7. Multivariable analysis for in-hospital mortality in patients treated with interventional procedures.

	Model 1			Model 2		
Variables	OR	95% CI	*P* value	OR	95% CI	*P* value
Age (per year)	1.02	0.99–1.06	0.198	1.01	0.98–1.05	0.587
Female sex	2.10	0.87–5.07	0.100	1.87	0.71–4.97	0.210
Hyperlipidemia	0.98	0.33–2.86	0.965	1.03	0.33–3.24	0.965
Painlessness	0.38	0.04–3.39	0.384	0.55	0.06–5.22	0.603
Shock/hypotension	6.62	2.12–20.6	0.001	2.64	0.72–9.68	0.143
DeBakey type IIIb*	1.09	0.42–2.87	0.859	1.16	0.42–3.22	0.773
Classic aortic dissection†	2.60	0.98–6.92	0.055	2.11	0.76–5.89	0.153
Aortic rupture				7.09	2.85–17.6	<0.001
End-organ malperfusion				1.97	0.67–5.76	0.216

OR = odds ratio; CI = confidence interval.

* DeBakey type IIIa as a reference. † Intramural hematoma (IMH) as a reference.

Table S8. Multivariable analyses for aortic rupture, end-organ malperfusion, and in-hospital mortality in the elderly group.

	Aortic rupture			End-organ malperfusion		
Variables	OR	95% CI	*P* value	OR	95% CI	*P* value
Age (per year)	1.05	1.00–1.10	0.033	1.01	0.95–1.06	0.862
Female sex	1.34	0.74–2.42	0.334	0.68	0.34–1.38	0.285
Hyperlipidemia	1.03	0.49–2.14	0.943	0.78	0.32–1.90	0.586
Shock/hypotension	24.0	9.48–60.9	<0.001	5.92	3.06–11.4	0.001
DeBakey type IIIb*	1.00	0.53–1.90	0.729	1.09	0.53–2.23	0.821
Classic aortic dissection†	3.62	2.01–6.52	<0.001	1.28	0.66–2.48	0.459

	In-hospital mortality (model 1)			In-hospital mortality (model 2)		
Variables	OR	95% CI	*P* value	OR	95% CI	*P* value
Age (per year)	1.07	1.02–1.12	0.004	1.06	1.01–1.11	0.028
Female sex	1.94	1.11–3.40	0.020	1.95	1.05–3.63	0.036
Hyperlipidemia	1.60	0.85–3.00	0.144	1.89	0.94–3.81	0.073
Painlessness	1.46	0.62–3.40	0.387	2.25	0.88–5.75	0.090
Shock/hypotension	11.3	5.09–25.1	<0.001	3.33	1.18–9.44	0.024
DeBakey type IIIb*	1.23	0.66–2.29	0.518	1.23	0.62–2.45	0.554
Classic aortic dissection†	3.74	2.14–6.53	<0.001	2.56	1.37–4.79	0.003
Aortic rupture				24.4	11.5–51.5	<0.001
End-organ malperfusion				3.84	1.32–11.7	0.013
Medical management				0.95	0.41–2.22	0.910

OR = odds ratio; CI = confidence interval.
* DeBakey type IIIa as a reference. † Intramural hematoma (IMH) as a reference.