Published in final edited form as:

Ann Thorac Surg. 2022 February ; 113(2): 498–505. doi:10.1016/j.athoracsur.2021.03.100.

Sex-Based Aortic Dissection Outcomes From the International Registry of Acute Aortic Dissection

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Abstract

BACKGROUND—Worse outcomes have been reported for women with type A acute aortic dissection (TAAD). We sought to determine sex-specific operative approaches and outcomes for TAAD in the current era.

METHODS—The Interventional Cohort (IVC) of the International Registry of Acute Aortic Dissection (IRAD) database was queried to explore sex differences in presentation, operative approach, and outcomes. Multivariable logistic regression was performed to identify adjusted outcomes in relation to sex.

RESULTS—Women constituted approximately one-third (34.3%) of the 2823 patients and were significantly older than men (65.4 vs 58.6 years, $P < .001$). Women were more likely to present with intramural hematoma, periaortic hematoma, or complete or partial false lumen thrombosis (all $P < .05$) and more commonly had hypotension or coma ($P = .001$). Men underwent a greater proportion of Bentall, complete arch, and elephant trunk procedures (all $P < .01$). In-hospital mortality during the study period was higher in women (16.7% vs 13.8%, $P = .039$). After adjustment, female sex trended towards higher in-hospital mortality overall (odds ratio, 1.40; $P =$

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Dr Trimarchi discloses a financial relationship with W.L. Gore & Associates and Medtronic; Dr Coselli with Terumo Aortic, Medtronic, W.L. Gore & Associates, CytoSorbents, Edwards Lifesciences, and Abbott; Drs Eagle and Patel with W.L. Gore & Associates, Medtronic, and Terumo; and Dr Gleason with Abbott.

The Supplemental Tables can be viewed in the online version of this article [https://doi.org/10.1016/j.athoracsur.2021.03.100] https://www.annalsthoracicsurgery.org.

Presented at the Scientific Sessions of the American Heart Association, Philadelphia, PA, Nov 16-18, 2019.

.053) but not in the last decade of enrollment (odds ratio, 0.93; $P = .807$). Five-year mortality and reintervention rates were not significantly different between the sexes.

CONCLUSIONS—In-hospital mortality remains higher among women with TAAD but demonstrates improvement in the last decade. Significant differences in presentation were noted in women, including older age, distinct imaging findings, and greater evidence of malperfusion. Although no distinctions in 5-year mortality or reintervention were observed, a tailored surgical approach should be considered to reduce sex disparities in early mortality rates for TAAD.

Type A acute aortic dissection (TAAD), which occurs approximately twice as frequently in men, carries a high surgical mortality, historically ranging from 17% to 40%.[1-4] Prior reports have detailed worse postoperative outcomes in women,[1,4,5] whereas others have refuted these findings with evidence of comparable mortality rates.[6-8] Nevertheless, sex-specific distinctions in TAAD have been described, raising the question of whether distinct considerations for management based on sex are warranted. Sex differences in cardiovascular disease have received considerable attention owing to the lower prevalence of atherosclerotic coronary artery disease in premenopausal women compared with age-matched men.[9] Despite these findings, the influence of sex on thoracic aortic disease is incompletely characterized.

Multiple groups have explored sex differences in TAAD, with recent studies finding no sex differences in operative mortality or long-term outcomes.[6-8] In contrast, a 2016 study described higher in-hospital surgical mortality among women (40.0% vs 11.8%), a pattern that echoes the findings of an International Registry of Acute Aortic Dissection (IRAD) study from 2004 (31.9% mortality in women vs 21.9% in men).[1,4] Unique symptoms and a later age of presentation in women have been suggested as possible contributors to worse outcomes.

A recent IRAD publication highlighted advances in operative strategy for TAAD, including increased use of aortic valve-sparing root replacement and broader use of antegrade cerebral perfusion strategies during arch reconstruction.[10] These surgical advances have resulted in a significant decrease in in-hospital mortality from 17.5% to 12.2%.[10] Now, we sought to investigate sex-specific contributors to TAAD morbidity and mortality and elucidate contemporary sex-specific risk factors that may give rise to poorer outcomes.

PATIENTS AND METHODS

STUDY POPULATION AND DATA COLLECTION.

The IRAD is a multinational registry collecting data from 55 institutions in 12 countries. The IRAD Interventional Cohort (IRAD-IVC) consists of more than 2800 patients undergoing surgical, endovascular, or hybrid procedures for aortic dissection. Patients were identified prospectively at presentation or retrospectively by discharge diagnoses, imaging, and surgical databases. Details from the procedures performed at baseline are recorded on a separate, standardized form and entered into an online database managed by the coordinating center at the University of Michigan. Data are reviewed for face validity and completeness. Institutional Review Board approval was obtained at each participating institution.

The study included IRAD-IVC patients with TAAD, defined as any nontraumatic dissection involving the ascending aorta presenting within 14 days of symptom onset, who were enrolled from 1996 to 2018 and who underwent operative repair or a surgical approach as part of a hybrid repair. The study period was divided into quartiles for analysis. Patients with a type B aortic dissection and those with only endovascular or medical management were excluded.

STATISTICAL ANALYSIS.

Differences between groups for categorical variables were compared using χ^2 analysis or Fisher exact tests. Continuous variables were compared using the Student *t* test for variables with normal distributions or Mann-Whitney *U* tests for variables with skewed distributions. Because the difference in mean age between the sexes was so great, univariate comparisons were adjusted for age using binary logistic regression for categorical variables and general linear models for continuous variables, in all cases testing for interaction. Trends across time groups were analyzed using Mantel-Haenszel tests of trend for categorical variables or Kruskal-Wallis tests for continuous variables.

Binary logistic regression was performed to determine the independent effects of variables associated with in-hospital mortality. Candidate variables considered to be clinically relevant were first subjected to univariate analysis, and those with *P* of less than .20 were introduced into the model. A backward step-wise method was used to create the final model.

Kaplan-Meier analysis was used to assess 5-year freedom from death and reintervention. We used Cox proportional hazards models to determine independent predictors of 5-year mortality in the entire cohort. Multivariable logistic regression and Cox proportional hazards analyses were both applied to patients presenting in the last decade. For all analyses, *P* of less than .05 was considered significant. IBM SPSS Statistics 25 (IBM, Armonk, NY) was used for analysis.

RESULTS

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS AND DIAGNOSTIC IMAGING.

The study included 2823 patients, with men comprising 65.7% of the cohort (Table 1). Women were significantly older (65.4 vs 58.6 years; $P < .001$). A bicuspid aortic valve was more common in men (4.4%) than in women (2.8%, $P = .003$). There were no differences in Marfan syndrome (2.4% of men vs 2.8% of women, $P = .510$). Few patients carried a previous diagnosis of an aortic aneurysm (14.9% of women and 13.7% of men, $P = .404$).

Women were significantly more likely to present with intramural hematoma (IMH, 19.4% vs 13.2%, $P < .001$) or complete (17.2% vs 10.2%, $P = .001$) or partial (24.8% vs 19.4%, $P = .039$) false lumen thrombosis (Table 2). Arch vessel and coronary artery involvement were similar; however, aortic insufficiency was more likely in men (64.9% vs 53.5%, $P = .016$). Women more commonly presented with pericardial (49.6% vs 39.8%, $P < .001$) and pleural effusion (15.3% vs 9.2%, $P = .007$). Male patients demonstrated significantly greater median aortic diameters at the annulus (2.5 vs 2.3 cm), root (4.3 vs 3.8 cm), and sinotubular junction (4.0 vs 3.7 cm; all $P < .001$) (Table 2). Tubular ascending aorta and arch dimensions were similar. The distal extent of dissection was similar in both sexes at the ascending aorta, arch, and descending aorta.

CLINICAL PRESENTATION.

Greater evidence of malperfusion was noted among women, with a higher prevalence of shock (31.3% vs 22.2%, $P < .001$) and altered consciousness (11.5% vs 7.5%, $P = .001$) (Supplemental Table 1). Despite this, preoperative gross neurologic findings were similar. Involvement of the myocardial, mesenteric, and renal vasculature was equivalent.

SURGICAL APPROACH.

Complete arch replacement was performed more frequently in men (20.6% vs 15.2%, $P = .002$) (Table 3). Men were more likely to undergo a Bentall procedure (32.4% vs 22.8%, $P < .001$), and the rate of aortic valve replacement was higher (34.5% vs 26.6%, $P < .001$). Median cerebral perfusion time (34 vs 32 minutes, $P = .036$) and total cardiopulmonary bypass time (201 vs 182 minutes, $P < .001$) were both longer in men.

OUTCOMES.

In-hospital mortality occurred in 162 women (16.7%) and 256 men (13.8%, $P = .039$) (Supplemental Table 2). Postoperative complication rates were not significantly different between the sexes, except for acute renal failure, which was lower in women (17.7% vs 21.2%, $P = .029$). The 5-year Kaplan-Meier estimates of survival (82.6% in women vs 85.9% in men) (Figure 1A) and freedom from reintervention (87.8% in women vs 87.6% in men) (Figure 1B) were comparable.

TEMPORAL TRENDS IN OPERATIVE APPROACH AND OUTCOMES.

During the study period, ascending aortic cross-clamping, aortic valve-sparing root replacement, and hemiarch replacement increased significantly, although these trends were comparable in both sexes (Supplemental Table 3). Use of antegrade cerebral perfusion increased, whereas use of retrograde cerebral perfusion decreased.

INDEPENDENT PREDICTORS OF MORTALITY

Female sex trended towards being a significant predictor of in-hospital mortality for the entire study period (odds ratio [OR], 1.40; $P = .053$); however, it was clearly equivalent when only the last decade of enrollment was considered (OR, 0.93; $P = .807$) (Table 4). Additional predictors of mortality included age (OR, 1.04; $P < .001$), complete arch replacement (OR, 7.30; $P = .002$), renal failure (OR, 2.68; $P < .001$), coma (OR, 13.38; $P < .001$), limb ischemia (OR, 1.87; $P = .003$), and cardiopulmonary bypass time (OR, 1.01; $P < .001$). For the last decade of enrollment, age, coma, and cardiopulmonary bypass time remained as independent predictors. Dissection extending to the descending aorta (OR, 2.27; $P = .006$), mesenteric ischemia/infarction (OR, 7.28; $P < .001$), and hypotension (OR, 3.93; $P < .001$) emerged as new predictors. When stratified by sex, the variables of age, postoperative hypotension, postoperative renal failure, and total cardiopulmonary bypass time independently predicted in-hospital mortality for both sexes (Supplemental Table 4).

After a Cox proportional hazards model was performed for 5-year mortality, age was associated with an increased hazard for death (hazard ratio [HR], 1.05; $P < .001$); however, female sex (HR, 3.02; $P = .318$) and the interaction term for age-sex (HR, 0.99; $P = .352$) were not statistically significant (Supplemental Table 5). Similarly, when only patients enrolled in the last decade were examined, age was again associated with an elevated hazard for death (HR, 1.03; $P = .033$); however, female sex (HR, 0.34; $P = .491$) and the interaction term age-sex (HR, 1.02; $P = .508$) were not significant (Supplemental Table 6).

COMMENT

TAAD carries a high risk of death. Importantly, advances in management have resulted in decreased mortality during the last 2 decades from 31.4% to 21.7%.[3] Whereas some reports have found equivalent TAAD outcomes between the sexes, others have suggested worse outcomes in women. In this current study, we examined the IRAD-IVC database to explore sex-specific variations in clinical presentation, operative approach, and outcomes with a specific focus on temporal trends. We found that women had increased mortality overall, although mortality in the last few years was comparable between the sexes, suggesting significant improvements in care. Additionally, distinct differences in imaging findings (eg, IMH, false lumen thrombosis, and pericardial and pleural effusions) and operative approaches (eg, root replacement and arch replacement) were noted between men and women.

Aside from the approximately 2-fold higher prevalence among men enrolled in IRAD, the most striking finding is the age distribution, with women presenting approximately 7 years later. This mirrors data linking sex, age, and aortic aneurysm presentation, with women commonly being a decade older than men.[11] Hormonal and mechanical influences have both been proposed as possible explanations for the sex differences in aortic pathology, although the pathophysiologic mechanisms remain unknown.[12,13] Prior IRAD reports have specifically examined characteristics of young (<40 years) and elderly (≥70 years) dissection patients.[14,15] In addition to higher mortality among the elderly, differences in clinical presentation, imaging, and operative approach have also been noted.[15]

Some of the sex differences in this study, such as IMH or false lumen thrombosis, may be partially attributable to age.[16,17] False lumen thrombosis and IMH rates are higher, as are rates of malperfusion, shock at presentation, and altered consciousness, which suggest that women present later in the cascade of dissection events after an inciting aortic tear than men. Given the long-standing recognition that morbidity and mortality of type A dissection increases steadily with every hour of delay in intervention, this may explain the noted differences among women. Further study will be necessary to determine the interplay between age and sex in TAAD.

While age alone may explain some of the differences, the absence of an established relationship between age and certain pathologic findings suggests an independent role of sex in TAAD presentation. We observed a greater prevalence of malperfusion among women, which had not been found to vary between those patients aged younger than 70 vs 70 years and older.[15]

Cerebral malperfusion has been associated with worse in-hospital mortality, which is consistent with our finding of an increased odds of death with coma or hypotension.[18] In our multivariable analysis, coma was associated with an increased hazard for death in women, whereas hypotension was predictive in both sexes. Alternatively, there were no sex differences in postoperative coma or hypotension, suggesting that preoperative rather than postoperative neurologic status is a key predictor of TAAD outcomes in women.

Because arch vessel involvement was similar in both sexes, it is possible that a global low-flow state has a differential effect in women. Improved understanding of preoperative predictors of adverse outcomes in each sex may help better predict prognosis of TAAD and direct specific therapeutic strategies.

Another study of dissection patients that explored the role of sex on postoperative mortality rates by Rylski and colleagues[19] described comparable 30-day mortality between men and women, with rates of 16.6% and 16.3%, respectively. Although we did not explicitly examine 30-day mortality, these rates are similar to our overall observed in-hospital mortality rates. However, we detected a significant downward trend in in-hospital mortality among men, resulting in a lower overall in-hospital mortality rate of 13.8%, which was significantly different from the 16.7% in-hospital mortality of women. Another potentially relevant finding of the study by Rylski and colleagues[19] was a noted difference in dissection extent by sex; namely, the overall involvement of the descending and abdominal aorta was higher among men. The IRAD database more granularly captured the location of distal extent of dissection, and thus, our results are not directly comparable, but another previously executed propensity-matched analysis found no difference in the extent of the dissection between sexes.[7]

Interestingly, we found that operative approaches were distinct between the sexes, with men being more likely to undergo aortic valve replacement, aortic root replacement, and/or complete arch replacement. Aortic root replacement may be used more widely in men as a result of increased aortic diameters at presentation.[20] This finding of a higher rate of root replacement among men is consistent with a German registry study of dissection patients. Their investigators attributed this finding to the younger age of male patients.[19] These diameters, however, were not indexed to body size; therefore, proportionate dilatation within the 2 sexes may confound these apparent distinctions in aortic dimensions.[21]

Similarly, the greater use of complete arch replacement in men (20.6% vs 15.2%) is notable, particularly given that aortic arch diameters were comparable and the extent of dissection did not differ at the level of the arch and descending aorta between the sexes. Complete arch replacement was a significant predictor of in-hospital mortality. Worse outcomes after complete arch replacement have historically been demonstrated; thus, it is plausible that a more aggressive approach was avoided in the older, female population due to a concern for worse outcomes.[22] These outcome data, however, have since been challenged by multiple subsequent studies showing no difference in mortality after complete arch surgery.[23-25]

Our current study has several limitations. The IRAD-IVC cohort focuses on patients undergoing endovascular, hybrid, or surgical procedures and therefore cannot assess outcomes for patients undergoing medical management. Nevertheless, multiple prior IRAD reports have demonstrated this same sex distribution in TAAD, suggesting that the proportion of men and women in this study of surgically managed patients is representative of overall TAAD epidemiology.

We cannot fully account for all factors contributing to decision making for management approach, operative procedure, and perioperative management. Thus, variables including but not limited to frailty, advance directives, and clinical impression may have influenced any of the aforementioned factors. These enrolling centers represent institutions with a high volume of aortic cases and thus may not reflect outcomes or approaches at all centers.

Finally, we were not able to obtain the cause of death, thus the relative impact of preoperative and post-operative complications on adverse events, and consequently, the rate of dissection-related death is unknown.

In summary, we report an improvement in in-hospital mortality for surgical management of TAAD in both sexes, with comparable 5-year survival and reintervention rates in men and women. In particular, female sex does not appear to be a predictor of perioperative mortality in the modern era, suggesting that progress in TAAD management has resulted in narrowing the previous mortality gap between the sexes. Nevertheless, sex-specific differences in TAAD presentation should prompt an individualized approach to make further strides in reducing perioperative mortality, which remains high. Further study will be necessary to better understand the pathophysiologic mechanisms driving the development of acute aortic syndromes in each sex to more accurately stratify dissection risk and inform the decision for prophylactic aortic replacement.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This work was supported in part by NIH R01HL109132 (TGG), NIH T32HL098036 (LVH), and the Thoracic Surgery Foundation (LVH).

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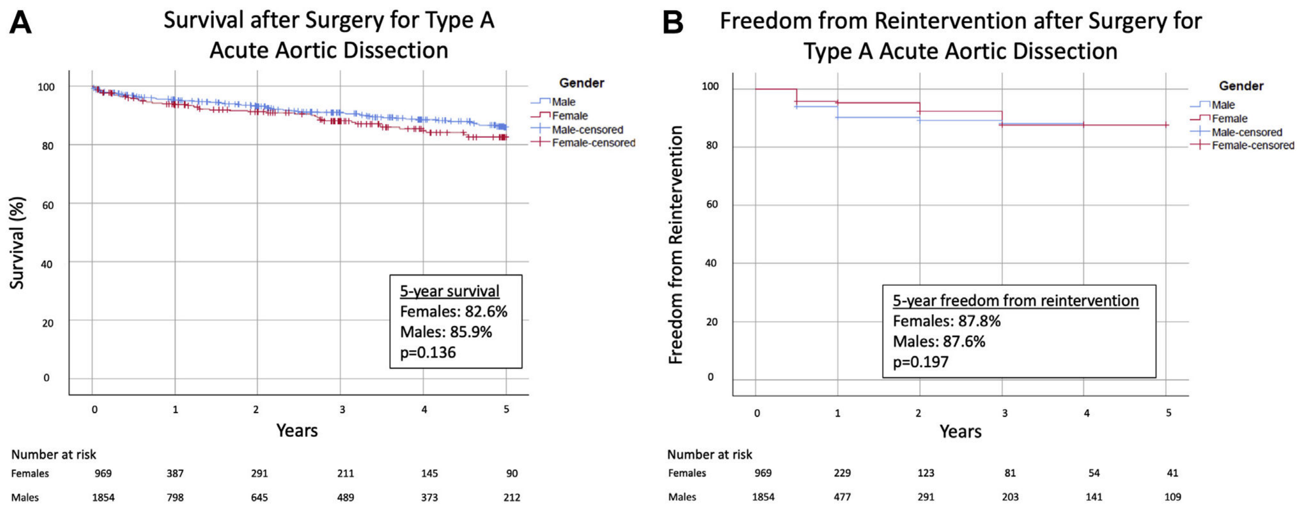

FIGURE 1.

Kaplan-Meier analysis of (A) survival after operative intervention and (B) freedom from reintervention for type A acute aortic dissection, stratified by sex.

TABLE 1

Baseline Characteristics Among Patients Undergoing Surgery for Type A Acute Aortic Dissection

Variable	Overall (N = 2823)	Female (n = 969)	Male (n = 1854)	*P* Value	Age-Adjusted Odds Ratio	Age-Adjusted *P* Value
Demographics						
Age, mean (SD), y	60.9 (13.7)	65.4 (13.4)	58.6 (13.3)	<.001	…	…
Age ≥70 y	775 (27.5)	399 (41.2)	376 (20.3)	<.001	…	…
Body mass index, median (IQR), kg/m^2		27 (24.1-31.7)	27.8 (24.9-32.3)	<.001	…	.348
White	1900 (75.6)	642 (75.2)	1258 (75.9)	.699	0.73	.003
Transferred	2095 (74.2)	711 (73.4)	1384 (74.6)	.462	0.95	.608
Medical history						
Hypertension	2011 (76.5)	725 (80.5)	1286 (74.4)	<.001	1.11	.325
Atherosclerosis	369 (14.8)	115(13.6)	254 (15.5)	.198	0.59	<.001
Diabetes	260 (10.3)	113(13.1)	147 (8.9)	.001	1.29	.064
Chronic renal insufficiency	148 (6.8)	47 (6.2)	101 (7.1)	.447	0.82	.289
Current smoker	602 (31.7)	177 (28.1)	425 (33.4)	.017	0.94	.569
Ever smoked	1009 (53.0)	303 (48.0)	706 (55.5)	.002	2.05	.125
Cocaine abuse	61 (2.5)	14(1.7)	47 (2.9)	.060	0.77	.406
Marfan syndrome	63 (2.5)	24 (2.8)	39 (2.4)	.512	2.12	.008
Bicuspid aortic valve	89 (3.6)	17 (2.0)	72 (4.4)	.003	0.59	.058
Peripartum state	…	5 (0.6)	…	…	…	…
Known aortic aneurysm	354 (14.1)	128 (14.9)	226 (13.7)	.404	8.17	.001
Previous aortic dissection	117 (4.7)	33 (3.9)	84 (5.1)	.161	7.66	.032
Aortic valve disease	249 (10.0)	85 (10.0)	164 (10.0)	.990	5.90	.009
Previous cardiac surgery	295 (11.8)	85 (10.0)	210 (12.7)	.042	0.66	.003
Aortic valve replacement	94 (3.8)	32 (3.8)	62 (3.8)	.987	0.99	.958
Aortic aneurysm/dissection repair	124 (5.0)	34 (4.0)	90 (5.5)	.116	10.78	.011
Coronary artery bypass grafting	108 (4.3)	21 (2.5)	87 (5.3)	.001	0.31	<.001
Iatrogenic dissection	80 (2.9)	35 (3.6)	45 (2.5)	.074	1.13	.599

Categorical data are presented as n (%) and continuous data as indicated. IQR, interquartile range.

TABLE 2

Diagnostic Imaging Findings in Patients Undergoing Surgery for Type A Acute Aortic Dissection, Stratified by Sex

Variable	Overall (N = 2823)	Female (n = 969)	Male (n = 1854)	*P* Value	Age-Adjusted Odds Ratio	Age-Adjusted *P* Value
Diagnostic imaging findings						
Arch vessel involvement	790 (51.1)	247 (48.6)	543 (52.3)	.173	0.88	.258
Intramural hematoma	432 (15.3)	188 (19.4)	244 (13.2)	<.001	1.32	.011
Periaortic hematoma	289 (20.7)	115 (24.8)	174 (18.6)	.007	1.33	.044
Complete false lumen thrombosis	138 (12.4)	61 (17.2)	77 (10.2)	.001	1.51	.032
Partial false lumen thrombosis	234 (21.1)	88 (24.8)	146 (19.4)	.039	1.31	.092
Patent false lumen	737 (66.5)	206 (58.0)	531 (70.4)	<.001	0.66	.002
Coronary artery compromise	143 (11.6)	51 (12.3)	92 (11.3)	.584	1.12	.543
Pericardial effusion	758 (43.0)	290 (49.6)	468 (39.8)	<.001	1.34	.005
Aortic regurgitation more than mild	300 (61.2)	84 (53.5)	216 (64.9)	.016	0.78	.220
Distal extent of dissection						
Ascending	210 (10.8)	76 (12.0)	134 (10.3)	.258	1.09	.605
Arch	347 (17.9)	124 (19.6)	223 (17.1)	.188	1.09	.496
Left subclavian artery	68 (3.5)	20 (3.2)	48 (3.7)	.553	0.02	.012
Descending	352 (18.2)	124 (19.6)	228 (17.5)	.270	1.17	.213
Abdominal or distal	960 (49.6)	290 (45.7)	670 (51.4)	.019	0.85	.173
Abdominal (not specified)	500 (25.8)	152 (24.0)	348 (26.7)	.197	0.85	.173
Suprarenal	56 (2.9)	23 (3.6)	33 (2.5)	.177	1.50	.156
Infrarenal	104 (5.4)	35 (5.5)	69 (5.3)	.837	1.06	.787
Iliofemoral	300 (15.5)	80 (12.6)	220 (16.9)	.015	0.81	.145
Chest roentgenogram						
Normal	520 (37.4)	149 (34.9)	371 (38.4)	.207	0.98	.867
Pleural effusion	98 (11.2)	44 (15.3)	54 (9.2)	.007	1.74	.014
Widened mediastinum	461 (51.6)	138 (47.9)	323 (53.3)	.132	0.79	.106
Absence of widened mediastinum or abnormal aortic contour	648 (75.7)	212 (76.0)	436 (75.6)	.893	1.06	.738
Displacement/calcification of aorta	38 (4.5)	12 (4.3)	26 (4.6)	.884	0.71	.349
Electrocardiogram						

Variable	Overall (N = 2823)	Female (n = 969)	Male (n = 1854)	*P* Value	Age-Adjusted Odds Ratio	Age-Adjusted *P* Value
Normal	731 (38.2)	221 (35.6)	510 (39.4)	.115	0.92	.396
New Q wave or ST elevations	143 (11.3)	48 (11.1)	95 (11.4)	.910	1.03	.877
Ischemia	207 (16.6)	68 (16.0)	139 (16.9)	.670	1.01	.955
Nonspecific ST-T changes	560 (43.2)	187 (43.0)	373 (43.4)	.895	1.02	.900
Widest aortic diameter by any method						
Aortic annulus, cm	2.5 (2.3-2.7)	2.3 (2.1-2.6)	2.5 (2.3-2.8)	<.001	…	.710
Aortic root, cm	4.2 (3.7-4.8)	3.8 (3.4-4.4)	4.3 (3.9-5.0)	<.001	…	.129
Sinotubular junction, cm	3.9 (3.4-4.6)	3.7 (3.1-4.3)	4.0 (3.5-4.7)	<.001	…	.007
Tubular ascending aorta, cm	5.0 (4.4-5.6)	4.8 (4.4-5.5)	5.0 (4.4-5.6)	.121	…	.131
Aortic arch, cm	3.6 (3.1-4.1)	3.6 (3.2-4.0)	3.6 (3.1-4.1)	.814	…	.966

Data are presented as n (%) or as median (interquartile range).

TABLE 3

Operative Approach for Patients Undergoing Surgery for Type A Acute Aortic Dissection

Variable	Overall (N = 2823)	Female (n = 969)	Male (n = 854)	*P* Value
Ascending aortic cross-clamp	1471 (56.6)	518(58.1)	953 (55.9)	.267
Aortic valve sparing	427 (19.7)	135 (19.1)	292 (20.1)	.588
Commissural resuspension	813 (37.4)	280 (38.4)	533 (36.9)	.496
Bentall	520 (29.3)	129 (22.8)	391 (32.4)	<.001
Hemiarch replacement	1314 (54.2)	466 (56.1)	848 (53.2)	.182
Partial arch replacement	194 (8.9)	61 (8.3)	133 (9.2)	.480
Complete arch replacement	434 (18.8)	119 (15.2)	315 (20.6)	.002
Elephant trunk	116 (5.4)	24 (3.3)	92 (6.5)	.002
Concomitant CABG	303 (13.0)	112 (14.3)	191 (12.4)	.186
Aortic valve replacement	707 (31.8)	200 (26.6)	507 (34.5)	<.001
Mechanical	292 (45.9)	65 (37.1)	227 (49.2)	.010
Biological	329 (51.7)	103 (58.9)	226 (49.0)	
Arterial line (cooling)				
Axillary	918 (42.9)	266 (38.1)	652 (45.2)	.002
Femoral	927 (43.3)	306 (43.8)	621 (43.0)	.725
Direct aortic	280 (13.1)	116 (16.6)	164 (11.4)	.001
Minimum temperature, °C	21.5 (18-26)	22 (18-26)	21 (18-26)	.205
Cerebral perfusion	1981 (80.7)	663 (80.3)	1318 (81.0)	.681
Antegrade	1207 (64.8)	394 (63.3)	813 (65.6)	.344
Retrograde	655 (35.2)	228 (36.7)	427 (34.4)	.344
Cerebral perfusion time, min	33 (22-46)	32 (22-44)	34 (22-48)	.036
Total cardiopulmonary bypass time,	195 (151-243)	182 (145-234)	201 (157-248)	<.001

Categorical data are presented as n (%) and continuous data as median (interquartile range). CABG, coronary artery bypass grafting

TABLE 4

Multivariable Logistic Regression for In-Hospital Mortality Among Patients With Acute Aortic Dissection in the Overall Cohort and in the Last Decade of Enrollment

Variable	Odds Ratio	95% CI	*P* Value
Overall cohort[a]			
Female sex	1.40	1.00-1.98	.053
Age	1.04	1.03-1.05	<.001
Complete arch replacement	7.30	2.07-25.71	.002
Preoperative or postoperative			
Renal failure	2.68	1.91-3.74	<.001
Coma	13.38	7.87-22.73	<.001
Limb ischemia	1.87	1.23-2.86	.003
Total CPB time	1.01	1.01-1.01	<.001
Interaction between complete arch and total CPB time	0.99	0.99-1.00	.010
Last decade of enrollment[b]			
Female sex	0.93	0.54-1.62	.807
Age	1.05	1.03-1.07	<.001
Postoperative coma	30.34	13.82-66.61	<.001
Dissection extends to descending aorta	2.27	1.26-4.10	.006
Preoperative or postoperative			
Mesenteric ischemia/infarction	7.28	3.54-14.98	<.001
Hypotension	3.93	2.36-6.56	<.001
Total CPB time	1.01	1.01-1.01	<.001

[a]Overall: Hosmer-Lemeshow test $P = .491$; C statistic, 0.825

[b]Last decade: Hosmer-Lemeshow test $P = .845$; C statistic, 0.887. CI, confidence interval; CPB, cardiopulmonary bypass.