Endovascular Versus Open Repair of Intact Descending Thoracic Aortic Aneurysms

Supplementary Appendix

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METHODS

Author Contributions

Peter Chiu, Andrew B. Goldstone, Justin Schaffer, and Michael D. Dake designed the study. Bharathi Lingala output the data into an analyzable format. Peter Chiu analyzed the data. All authors vouch for the validity of the data and analysis. Peter Chiu and Justin M. Schaffer prepared the first draft of the manuscript. All authors contributed to interpreting the data, performing critical edits, and approving the final version of the manuscript prior to submission.

Funding Sources

This work was conducted with support from a KL2 Mentored Career Development Award of the Stanford Clinical and Translational Science Award to Spectrum and from a TL1 Clinical Research Training Program grant (PC - NIH KL2 TR 001083; ABG - NIH TL1 TR 001084).

Statistical Analysis

In this supplementary statistical analysis section, we will discuss: 1) use of administrative databases in patients with thoracic aortic disease, 2) pitfalls of using ICD-9 procedure codes in the evaluation of thoracic aortic diseases; 3) our use of a regression discontinuity design; 4) use of optimal matching to account for observed confounders; 5) methodology for survival analyses – time partitioning and RMST; 6) sensitivity analyses; and 7) list the statistical packages used during the data analysis.

Use of Administrative Databases in Patients with Thoracic Aortic Disease

Prior attempts to use administrative data from the Medicare database to evaluate the treatment of thoracic aortic disease employed ICD-9 codes and reported outcomes for open surgical repair of descending thoracic aortic aneurysms that were superior to outcomes reported by high-volume centers of excellence; this was despite being limited to a high risk population of Medicare beneficiaries.[1-3] This

introduced the possibility of misclassification. ICD-9 procedure and diagnosis codes fail to differentiate between ascending and descending thoracic aortic aneurysms. These operations have fundamentally different risk profiles, and a comparison relying purely on these codes may lead to inaccurate and biased conclusions. For example, the perioperative mortality for elective ascending aortic replacement in the Society of Thoracic Surgeons database has been reported to be 3.4%, while the operative risk associated with open descending thoracic aortic replacement has been reported by centers of excellence to be as high as 8-12%.[4-6]

Pitfalls of using ICD-9 procedure codes

We first attempted to replicate prior studies of open vs. endovascular repair of descending thoracic aortic aneurysms by using ICD-9 diagnosis and procedure codes to identify appropriate Medicare Beneficiaries. An underutilized feature of the Medicare database is the ability to link individual surgeon-billed procedure claims (Current Procedural Terminology [CPT] codes) to particular hospital stays. CPT codes contain more anatomic information than ICD-9 codes and thus help to clarify the exact operation performed. We then linked these patients' ICD-9 data to these billed CPT codes to identify more accurately the actual surgical procedure performed. We have previously demonstrated that this could be performed for patients who underwent TEVAR[7] and open descending thoracic aortic aneurysm repair.[8] We found that using ICD-9 codes alone to identify patients undergoing open surgical repair of a thoracic aortic aneurysm was associated with a high risk (up to 70%) of including patients who had an ascending or thoracoabdominal aortic repair (as determined by CPT code). As such, we believe it is critically important that future studies evaluating the management of descending thoracic aortic aneurysms in Medicare beneficiaries link CPT codes to Medicare beneficiary hospitalizations to capture accurate and homogeneous cohorts of patients. Given the idiosyncratic nature of ICD-9 codes, this may not be necessary for other procedures.

Regression Discontinuity Method

Observational studies frequently employ propensity score methods to account for treatment selection bias. However, we have previously suggested that anatomy influences treatment selection, and this information was not available in the Medicare data.[9] As such, we decided against using standard propensity score and g-estimation methods.

Food and Drug Administration (FDA) approval of TEVAR in September of 2005 resulted in an immediate and substantial change in treatment selection. Following the introduction of TEVAR, 94.4% of cases were treated endovascularly (Figure S1). In this way, time appeared to be positively correlated with the treatment received in an almost dichotomous fashion. We took advantage of this feature by using a regression discontinuity design. Patients who had repair of a descending thoracic aortic aneurysm prior to September of 2005 were encouraged toward open surgical repair as TEVAR was not an option outside of clinical trials or physician-sponsored investigational device exemptions. Patients who had a repair of descending thoracic aortic aneurysm after September of 2005 were encouraged toward TEVAR as almost all patients treated after FDA approval of the device were treated endovascularly. This may be viewed as a form of pseudo-randomization as patients treated on either side of the discontinuity will be similar with the exception of increasing clinical eligibility for intervention. This is observable in the data as an imbalance in baseline covariates.

Due to the lack of anatomical data, we were unable to discover the patients from the open surgical repair era (pre-FDA approval of TEVAR) who would have been anatomically unsuitable for TEVAR. As such, we avoided excluding such patients from the TEVAR era. This group was most likely represented by the group of patients who were encouraged toward TEVAR but still underwent open surgical repair similar to treatment non-compliance in a randomized trial. Presumably, the number of patients undergoing open surgical repair with anatomy unsuitable for TEVAR would not change over time, as the clinical eligibility criteria for surgery would not change significantly. We then used an intention-to-treat encouragement design: patients who were encouraged to receive open surgical repair (treated prior to FDA approval of TEVAR) were analyzed together in the open surgical repair group; patients who were encouraged to receive TEVAR (treated after FDA approval of TEVAR) were analyzed altogether as the

TEVAR group. This allowed us to account for anatomical features that may have precluded endovascular repair; attempts to address this potential issue have been scarce in the literature.

2:1 Optimal Pair Matching

To account for the differences in observed covariates between the two groups, we used a non-parsimonious logistic regression to estimate the likelihood of being encouraged to open surgical repair conditional on observed baseline covariates. We then used optimal matching to create matched sets that minimized the distance between matched sets. We employed 2:1 matching in order to improve the generalizability of the analysis while excluding a subset of patients who were very unlikely to receive open surgical repair as evidenced by the very low propensity scores among these patients (Figures S3A and S3B). These patients represented a large proportion of the additional patients observed after the introduction of TEVAR. Due to their greater comorbidity burden (Table S2), patients who went unmatched experienced substantially worse unadjusted survival than patients who were able to be matched, $p < 0.001$ (Figure S6), and this mirrored an analysis of Stanford's early institutional experience by Demers et al.[10] After matching, balance was assessed using standardized mean differences.[11]

Survival Analysis: Time partitioning and RMST

We used Cox proportional hazards regression to evaluate the effect of TEVAR vs. open surgical repair on mid-term outcomes. Two distinct hazard phases were present: an early-hazard phase in which open surgical repair appeared to be associated with greater risk of mortality, and a late-hazard phase in which open surgical repair appeared to be associated with a lower risk of mortality. We used time-partitioning to account for the non-proportionality of hazards, i.e. changing hazard over time.

In the early hazard phase, the proportionality of hazards assumption was again violated. As a result, we assessed the odds of mortality using logistic regression. Operation at a high-volume open surgical center was a significant effect modifier for perioperative mortality,[8] and standard errors for stratum specific effect estimates were estimated with 500 bootstrap replicates, high-volume open surgical

center: OR 1.97 (95% confidence interval [CI]: 1.53 to 2.61) and for low-volume open surgical centers: OR 3.62 (95% CI 2.88 to 4.51), p-value for interaction = 0.002 (Table 2). As previously reported, TEVAR at a high-volume center did not affect perioperative survival.[7]

The proportionality of hazards assumption was met for contingent 180-day survival in our landmark analysis. Late hazard of death was reduced in the open surgical repair group, HR 0.86 (95% CI 0.77 to 0.95; p = 0.004), Figure S4. This suggested that provided patients were able to survive the first 6 months after the operation, the patients had a lower likelihood of death with open surgical repair than with TEVAR. This may speak to the improved durability of open surgical repair, but whether this improved durability makes a difference for the typical patient is uncertain with this form of analysis.

Restricted Mean Survival Time (RMST) is a model-free approach to addressing non-proportionality of hazards that is based on the area under the survival curve.[12] This value is the population average event-free survival at a certain follow-up point allowing for comparisons of mean survival times between two groups. At 9 years follow-up, the difference in RMST was -209.2 days (95% CI -298.7 to -119.7 days; p <0.001) for open surgical repair thus favoring TEVAR, Table 2 and Figure S5. On average, patients receiving TEVAR lived 209.2 days longer than patients receiving open surgical repair. This analysis would suggest that the early penalty of open surgical repair outweighs the late benefit amongst Medicare beneficiaries. Whether this would hold for patients who are younger is uncertain, as those patients have lower predicted risk of mortality,[13] and this age difference may in part explain the difference observed between our analysis and the meta-analysis by Cheng et al.[14] Among younger patients, the improved long term durability of open surgical repair may be an important consideration.

Sensitivity Analyses

The regression discontinuity design assumes homogeneity of treatments. This is complicated in its application as not only do practice patterns vary between hospitals, but technical capabilities also vary. Whereas a volume-outcome relationship has been shown to exist for open surgical repair of descending thoracic aortic aneurysms, the same has not been shown for TEVAR.[7,8] Reasons for this include

differences in the technical and technological demands of the two operations. Whereas open surgical repair requires the coordinated efforts of the surgeon, anesthesiologist, operating room staff, intensivist, intensive care nurses, and allied health professionals, TEVAR has a much smaller footprint as it were. This may explain the portability of this technology to the 362 hospitals that had not treated descending thoracic aortic aneurysms in Medicare beneficiaries in the first half of our study period (prior to FDA approval of TEVAR).

A challenge introduced by the change in practice pattern was the potential for differences in hospital-level characteristics to influence outcome. We performed a sensitivity analysis restricted to the 349 hospitals that were observed both in the early and the late period in order to control for hospital-level differences. Data analysis was performed in the same manner with an intention-to-treat design based on encouragement to open surgical repair or TEVAR. Due to reduced ability to construct appropriate balance, 1:1 matching was used to address observed differences in covariates, and appropriate balance was achieved (Tables S3 and S4). With the evolution of referral patterns and the explosion of centers treating descending thoracic aortic aneurysms in the Medicare population, the population under study in this sensitivity analysis was more likely to be selected than in the main analysis as the least complicated patients were the most likely to undergo an operation at centers with the least overall experience treating descending thoracic aortic aneurysms. Despite the reduction in hospital-level variation, this may have resulted in a more complicated group of TEVAR patients (as compared to the main analysis) included in this sensitivity analysis. Despite this, there was no significant change in inference (Figure S7). There was no difference in the survival curves according to the log-rank test, but the difference in RMST at 9-years attributable to open surgical repair still favored TEVAR: -153.8 days (95% CI -261.7 to -45.9; p = 0.005). The odds of mortality was increased among patients undergoing open surgical repair compared with TEVAR in univariate matched analysis, OR 3.11 (95% CI 2.34 to 4.21) for a low-volume open surgical center and OR 1.87 (95% CI 1.32 to 2.62) for a high-volume open surgical center, but the hazard of death contingent on 180-day survival was again reduced among open surgical patients, HR 0.83 (95% CI 0.73 to 0.94; p = 0.004). The results of this sensitivity analysis match that of our main analysis.

Separately, we evaluated for the possibility that a secular trend might have introduced bias into our regression discontinuity design. We did this by performing a sensitivity analysis on the open surgical repair cohort comparing the 1,235 patients treated in the early period with the 257 patients treated in the late period using a g-estimation method (inverse probability of treatment weighting, IPTW). Using a non-parsimonious logistic regression, probability of undergoing open surgical repair in the early vs. the late period was estimated, and inverse probability weighting with stabilized weights was used to achieve appropriate balance between the groups (Tables S5 and S6).[15] The proportionality of hazards assumption was satisfied, and Cox regression revealed that there was no difference in the hazard of death attributable to undergoing open surgical repair in the early period, HR 1.21 (95% CI 0.97 to 1.51; p = 0.1) (Figure S8).

Given the significant interaction between hospital volume and outcome of open surgical repair, we performed a sensitivity analysis to evaluate whether hospital volume would affect our inference. We performed this analysis by selecting only the patients undergoing open surgical repair at high-volume open surgical centers and matching these to TEVAR patients. We then performed the remainder of the analysis as previously described and found appropriate balance after matching (Tables S7 and S8). The odds of early mortality was increased among patients undergoing open surgical repair, OR 2.14 (95% CI 1.62 to 2.83; p <0.001). Mid-term survival was no different using the log-rank test, p = 0.2 (Figure S9). However, RMST at 9-years revealed a difference in mean survival of -136.7 days (-260.5 to -13.0 days; p = 0.03) favoring TEVAR.

We separately performed the analysis after matching patients undergoing open operations at low-volume open surgical centers, and found appropriate balance after matching (Tables S9 and S10). The odds of early mortality was increased among patients undergoing open surgical repair, OR 3.58 (95% CI 2.78 to 4.60; p <0.001). Mid-term survival was reduced for open surgical repair patients by the log-rank test, p <0.001 (Figures S9). RMST at 9-years revealed a difference in mean survival of -330.6 days (-458.4 to -202.8 days; p <0.001) favoring TEVAR once again.

Finally, we narrowed the population under investigation to the years immediately surrounding the discontinuity, i.e. 2004 to 2006. This allowed us to assess the possibility that greater distance from the discontinuity resulted in loss of the pseudo-randomization. Matching created adequate balance (Tables S11 and S12). There was no difference in mid-term survival by the log-rank test, p = 0.2. However, the difference in RMST remained significant, RMST difference -231.7 days (95% CI -427.8 to -35.6), p = 0.02 (Figure S11).

Data Analysis

Data were prepared using SAS (SAS Institute Inc., *Cary, NC*); statistical analyses were performed using R version 3.4.1 (R Foundation, *Vienna, Austria*). Matching was performed using the *optmatch* package. We used the *survey* package to evaluate differences in covariates at baseline and in both the matched and weighted populations.[16] Survival and competing risks analyses were performed with the *survival* package.[17]

Figure S1

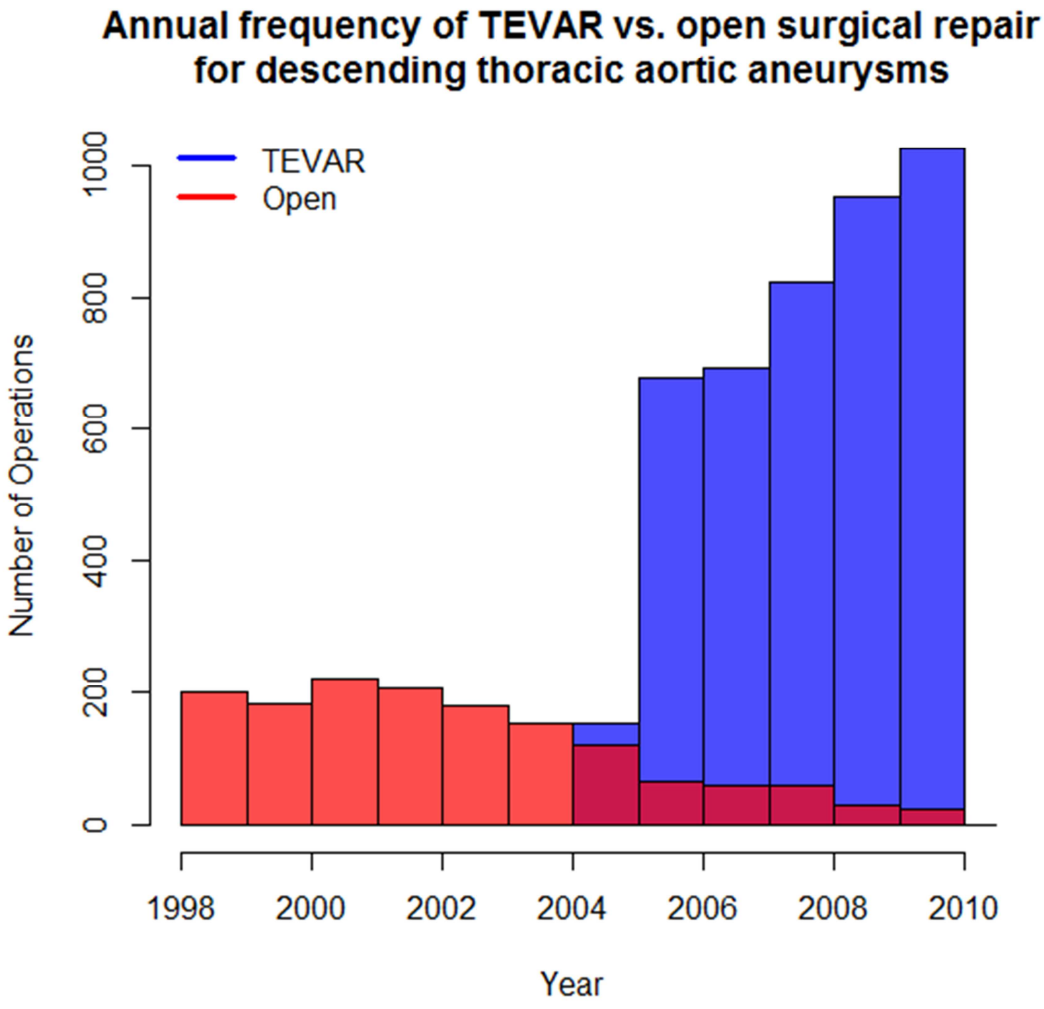
Annual frequency of TEVAR vs. open surgical repair for descending thoracic aortic aneurysms
TEVAR
Open
Number of Operations
0
200
400
600
800
1000
1998
2000
2002
2004
2006
2008
2010
Year

Figure S2

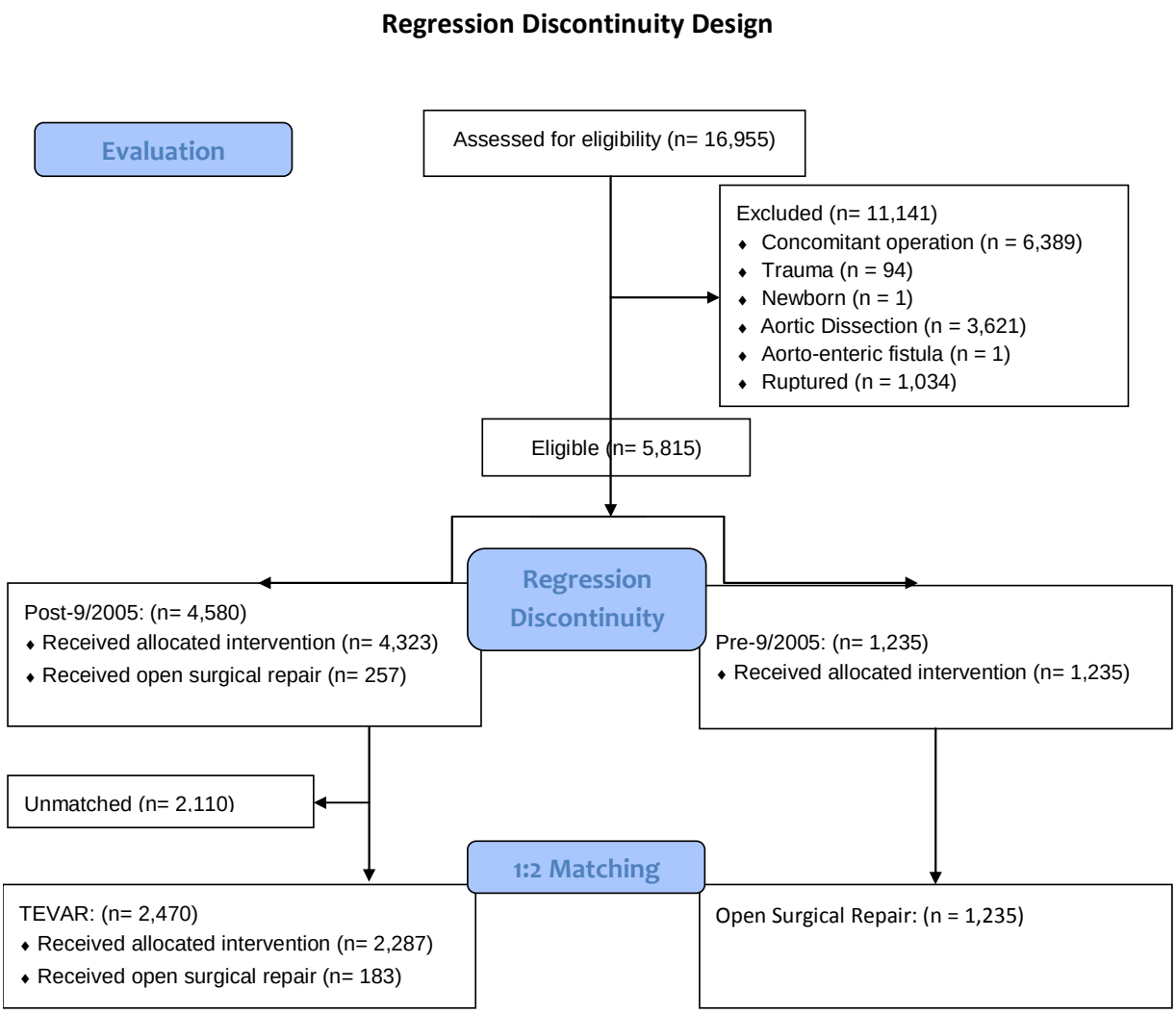
Regression Discontinuity Design
Evaluation
Assessed for eligibility (n= 16,955)
Excluded (n= 11,141)
Concomitant operation (n = 6,389)
Trauma (n = 94)
Newborn (n = 1)
Aortic Dissection (n = 3,621)
Aorto-enteric fistula (n = 1)
Ruptured (n = 1,034)
Eligible (n= 5,815)
Regression Discontinuity
Post-9/2005: (n= 4,580)
Received allocated intervention (n= 4,323)
Received open surgical repair (n= 257)
Pre-9/2005: (n= 1,235)
Received allocated intervention (n= 1,235)
Unmatched (n= 2,110)
1:2 Matching
TEVAR: (n= 2,470)
Received allocated intervention (n= 2,287)
Received open surgical repair (n= 183)
Open Surgical Repair: (n = 1,235)

Figure S3A.

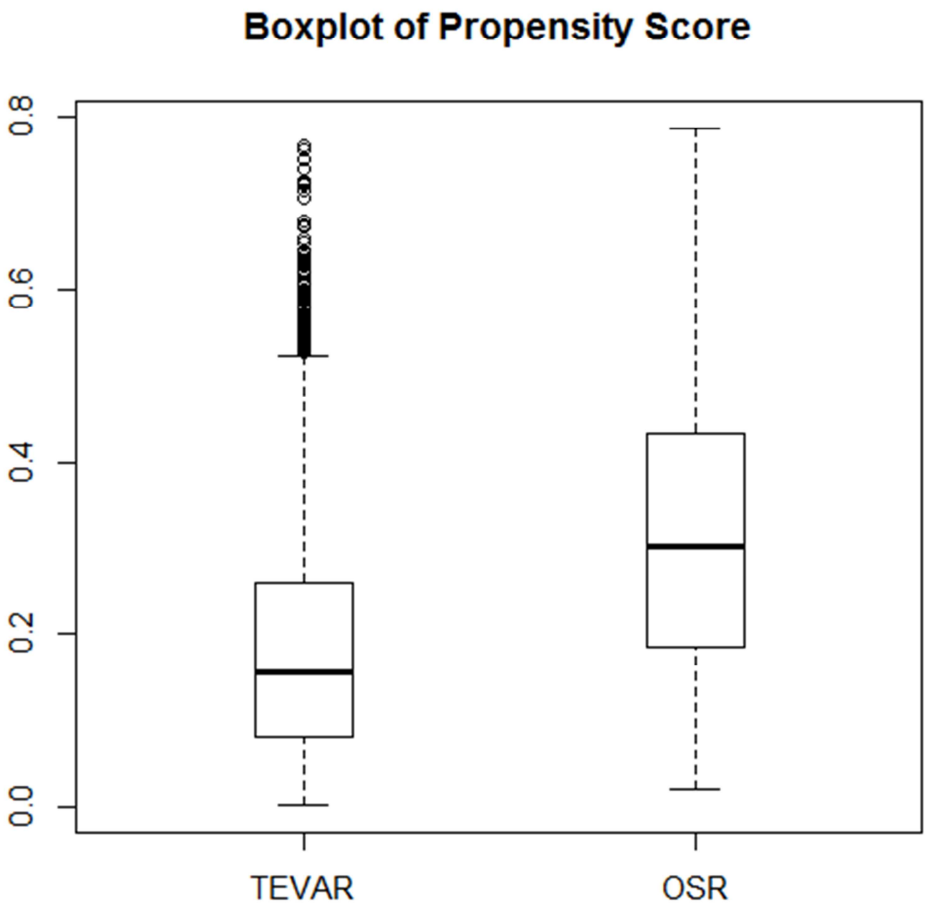

Figure S3B. The unmatched group, n = 2,110, had very low likelihood of undergoing open surgical repair conditional on baseline covariates.

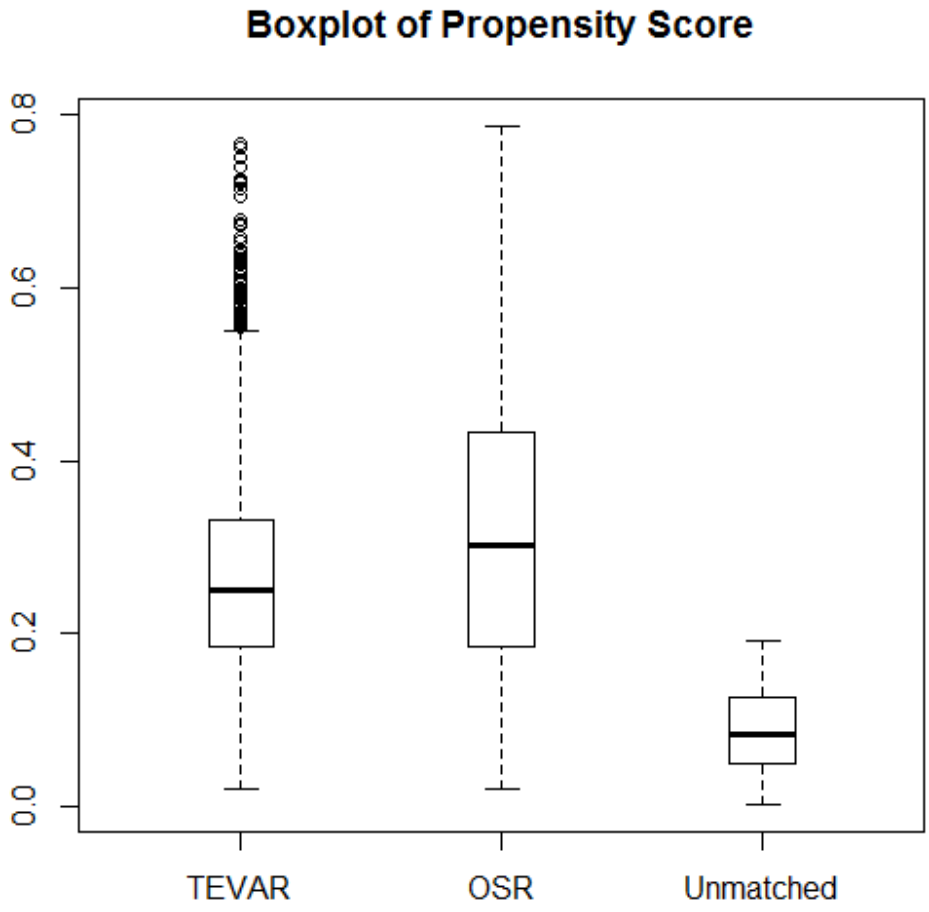

Figure S4. Landmark analysis. Contingent on 180-day survival, patients undergoing open surgical repair had superior mid-term survival.

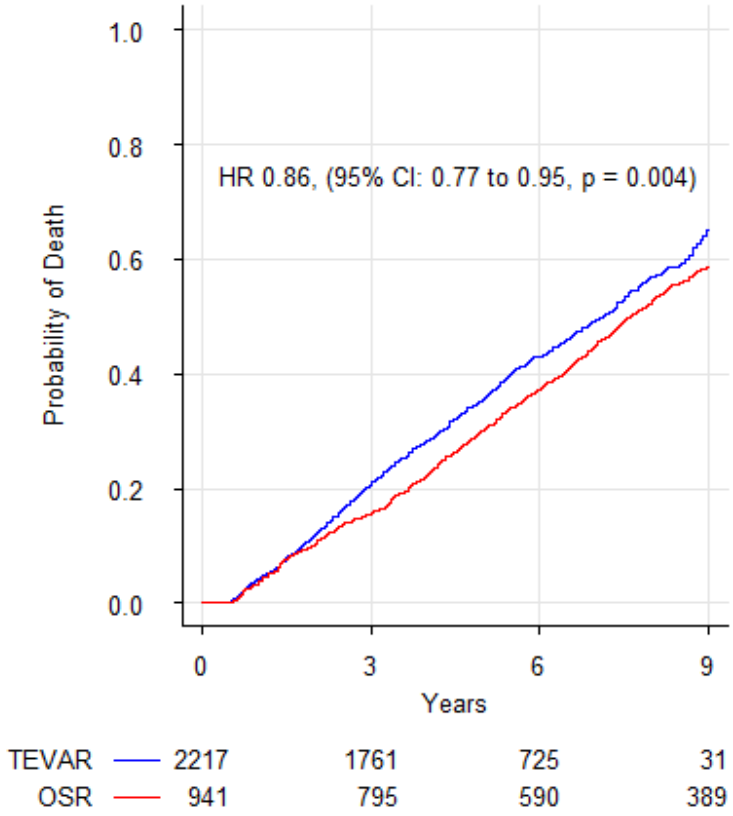

Figure S5. Plot of Restricted Mean Survival Time over time. The initial survival benefit of TEVAR is never overcome by open surgical repair despite the superior survival of open surgical repair in the landmark analysis.

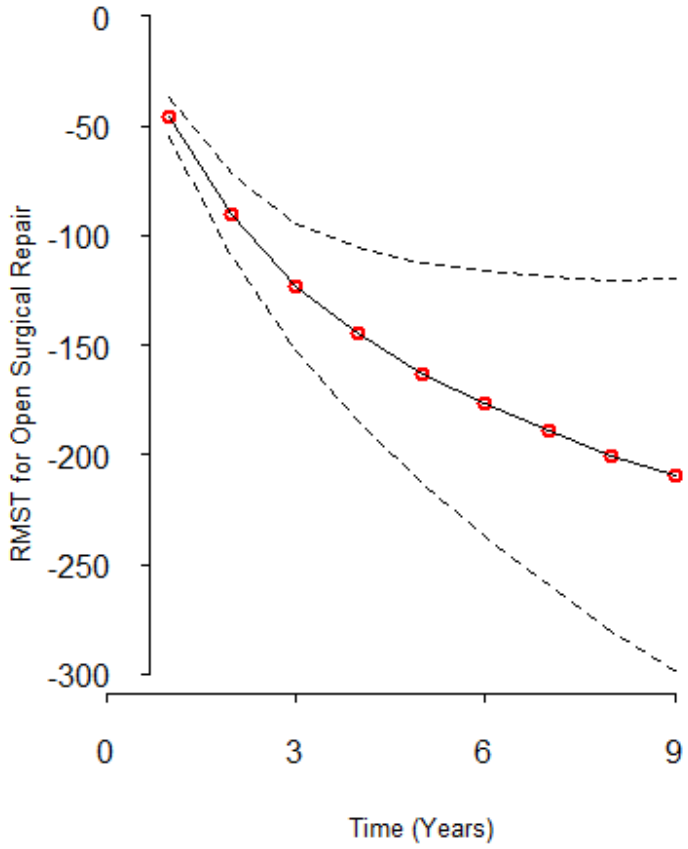

Figure S6. Unadjusted survival comparing matched and unmatched patients from the TEVAR group (post-9/2005).

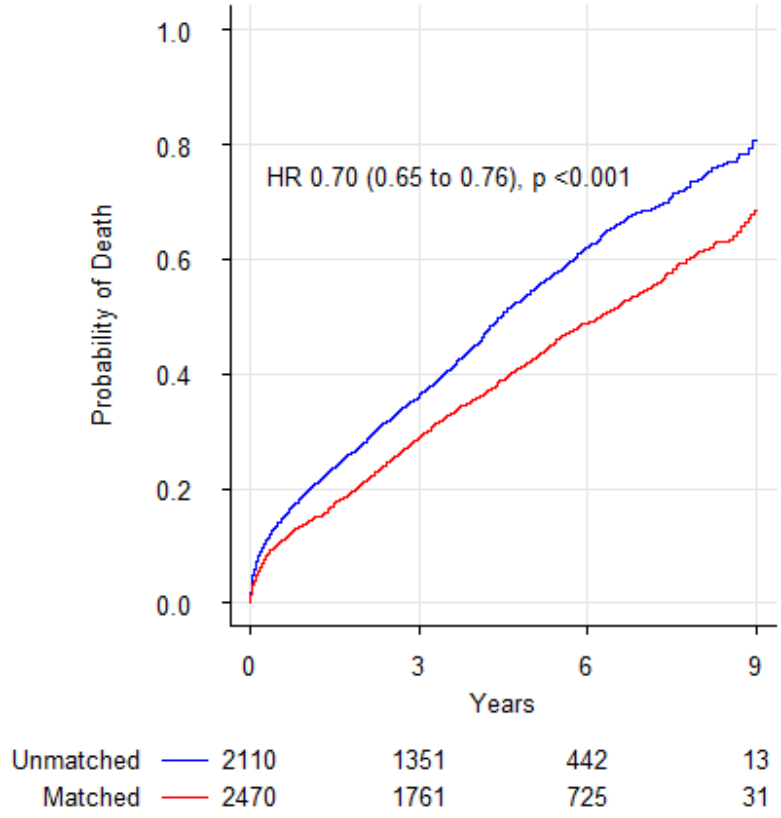

Figure S7. Sensitivity Analysis (Institutional Effects): Cumulative incidence of mortality restricting the dataset to the 349 hospitals present before and after the introduction of TEVAR RMST difference for open surgical repair was -153.8 days (95% CI -261.7 to -45.9), p = 0.005. This suggests that while restricting the analysis to only hospitals present in both the early and late periods reduced the effect size, open surgical repair continued to be associated with increased risk of death and reduced survival time during follow-up.

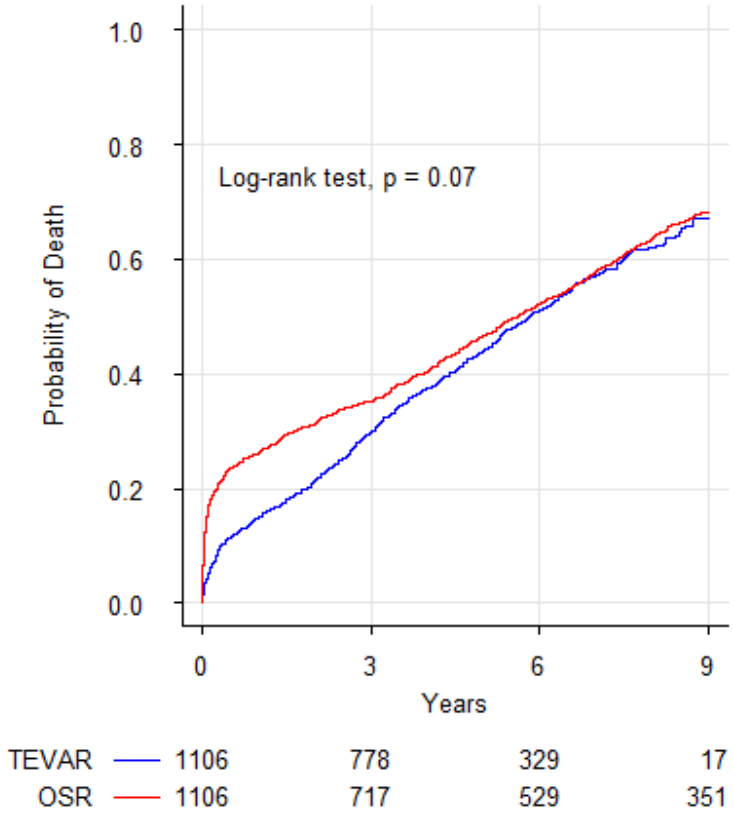

Figure S8. Sensitivity Analysis (Secular Trend): Adjusted survival curves constructed with inverse probability weighting with stabilized weights comparing survival following open surgical repair in patients from the early period and late period. There was no difference in mid-term survival, though there was decreased odds of early mortality in the second half of the study period with open surgical repair, OR 0.70 (95% CI 0.49 to 0.99), p = 0.04.

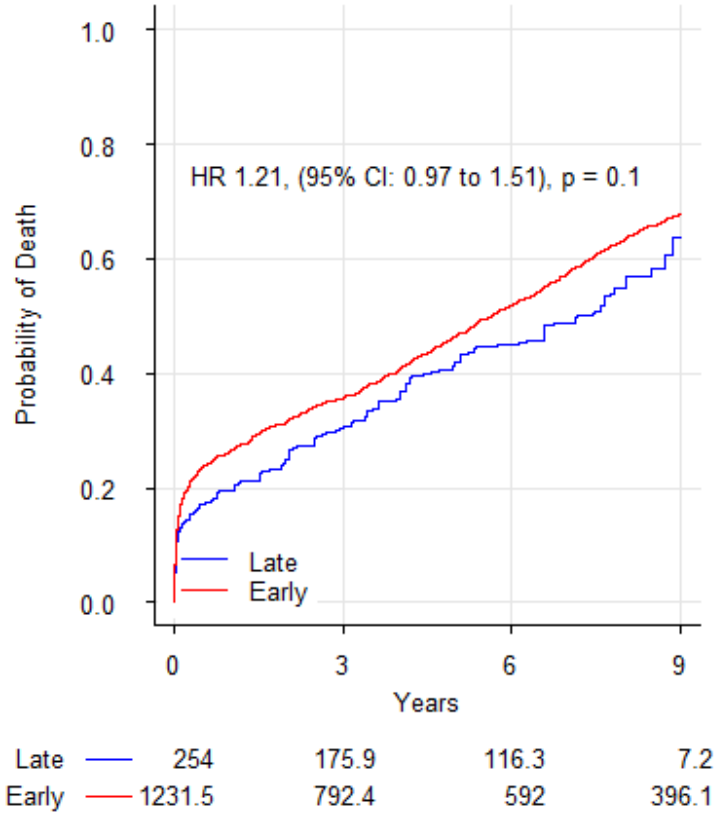

Figure S9. Sensitivity Analysis (Hospital Volume): Mid-term survival after accounting for open surgical volume. Patients undergoing open surgical repair at high-volume open surgical centers were matched with TEVAR patients. Despite reducing the difference in cumulative incidence of mortality, restricting the OSR population to only high-volume open surgical centers still resulted in reduced survival in the open surgical repair arm, RMST difference -136.7 days (95% CI -260.5 to -13.0), p = 0.03.

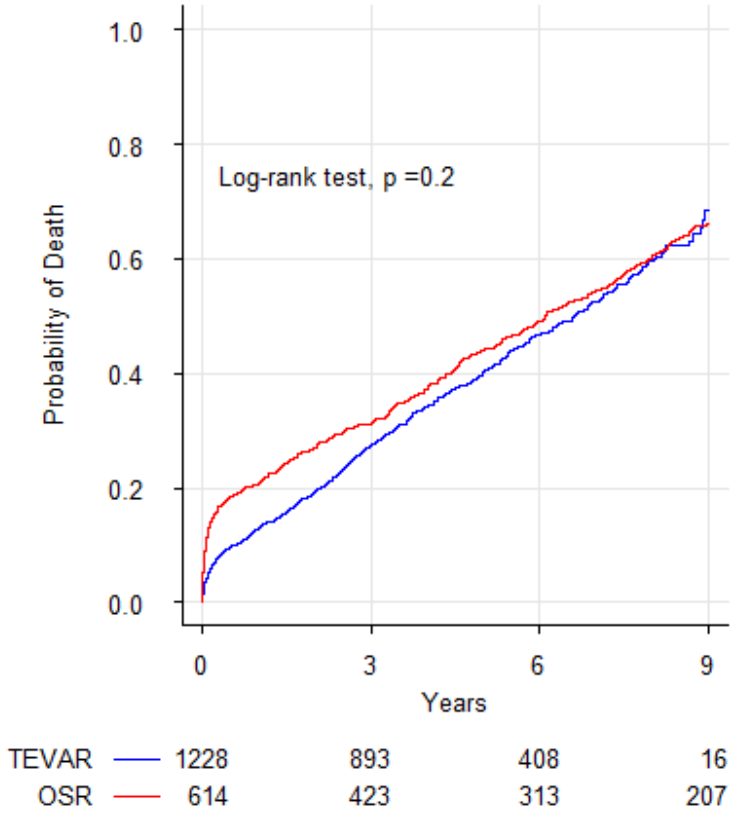

Figure S10. Sensitivity Analysis (Hospital Volume): Mid-term survival after accounting for open surgical volume. Patients undergoing open surgical repair at low-volume open surgical centers were matched with TEVAR patients. Restricting the OSR population to only low-volume open surgical centers resulted in reduced survival in the open surgical repair arm, RMST difference -330.6 days (95% CI -458.4 to -202.8), p <0.001.

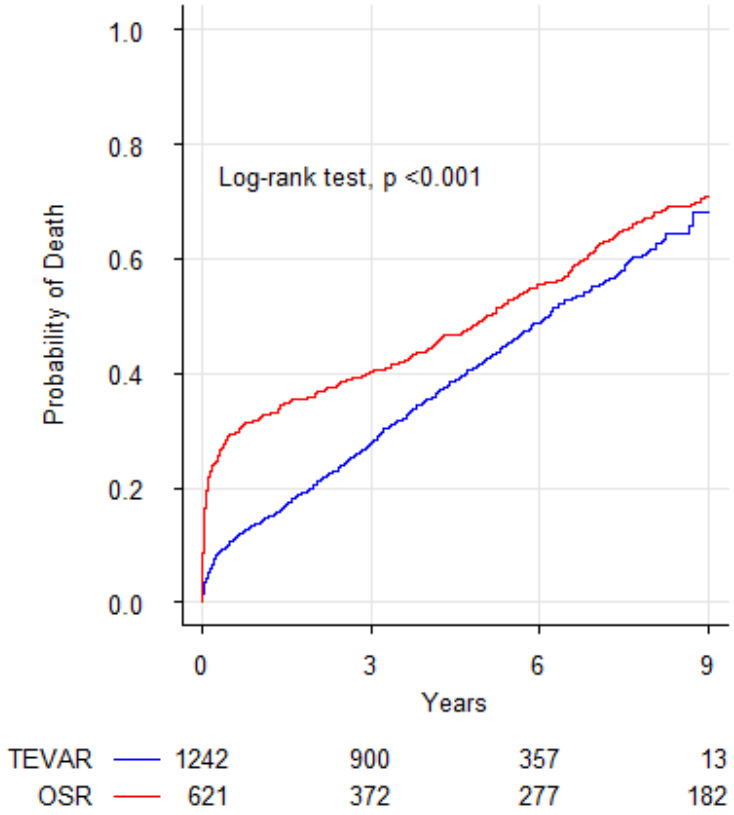

Figure S11. Sensitivity Analysis (Discontinuity): Mid-term survival after narrowing the population under investigation to the years immediately surrounding the discontinuity, i.e. 2004 to 2006. Despite not reaching statistical significance with the log-rank test, narrowing the population under investigation still resulted in reduced survival in the open surgical repair arm, RMST difference -231.7 days (95% CI -427.8 to -35.6), p = 0.02.

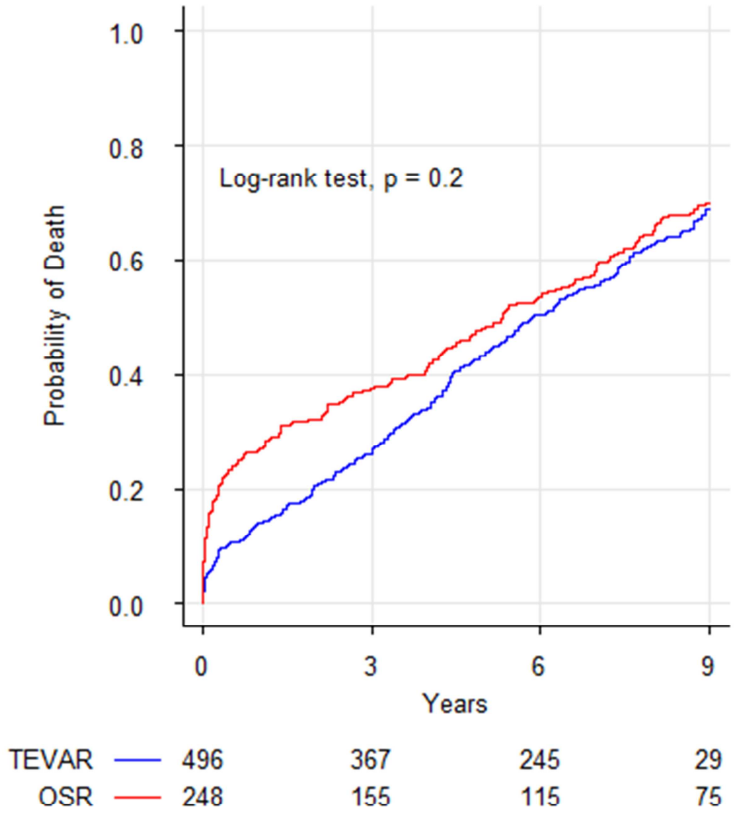

Table S1. Propensity Score Model.

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.328	0.559	0.586	0.558
Age	-0.017	0.008	-2.182	0.029
Male	-0.103	0.083	-1.236	0.216
Age (categorical), ≥70, <80	0.514	0.114	4.501	0.000
Age (categorical), ≥80	-0.131	0.184	-0.709	0.478
Race, Black	-0.299	0.268	-1.115	0.265
Ethnicity, Hispanic	0.194	0.366	0.529	0.597
Race, North American Native	0.475	0.557	0.853	0.394
Race, Other	-1.858	0.646	-2.875	0.004
Race, Unknown	-0.741	1.163	-0.638	0.524
Race, White	0.122	0.243	0.502	0.616
Alzheimer Dementia	-0.089	0.174	-0.515	0.606
Myocardial Infarction	-0.534	0.192	-2.785	0.005
Anemia	-0.216	0.081	-2.679	0.007
Asthma	-0.123	0.120	-1.017	0.309
Atrial Fibrillation	-0.114	0.107	-1.068	0.286
Breast Cancer	-0.056	0.221	-0.254	0.799
Colorectal Cancer	-0.433	0.243	-1.786	0.074
Endometrial Cancer	-0.119	0.568	-0.209	0.835
Lung Cancer	-0.135	0.209	-0.648	0.517
Prostate Cancer	0.114	0.150	0.759	0.448
Cataract	-0.332	0.080	-4.149	0.000
Congestive Heart Failure	-0.016	0.086	-0.184	0.854
Chronic Kidney Disease	-0.791	0.102	-7.719	0.000
End Stage Renal Disease	0.098	0.236	0.417	0.677
Chronic Obstructive Pulmonary Disease	-0.116	0.077	-1.498	0.134
Depression	-0.490	0.102	-4.8	<0.001
Diabetes	-0.163	0.089	-1.838	0.066
Glaucoma	-0.052	0.108	-0.484	0.628
Hip Fracture	0.487	0.263	1.847	0.065
Hyperlipidemia	-0.980	0.085	-11.593	<0.001
Hypertension	0.582	0.106	5.503	<0.001
Benign Prostatic Hyperplasia	-0.246	0.109	-2.251	0.024
Hypothyroidism	-0.230	0.119	-1.931	0.053
Ischemic Heart Disease	0.995	0.092	10.847	< 2e-16
Osteoporosis	-0.329	0.133	-2.465	0.014
Arthritis	-0.342	0.084	-4.08	<0.001
Stroke	-0.251	0.109	-2.314	0.021
Urgency (Urgent)	-0.109	0.131	-0.837	0.402

Urgency (Elective)	-0.404	0.101	-4.018	<0.001
Urgency (Unknown)	-0.727	0.832	-0.874	0.382
Prior Aortic Arch Replacement	0.060	0.262	0.228	0.819

Table S2. Baseline Characteristics of TEVAR patients who were able to be matched and those who were not matched.

	Unmatched	Matched	SMD
	n = 2110	n = 2470	
Operative Year, median [IQR]	2008 [2007, 2009]	2008 [2007, 2009]	0.050
Age, mean (sd)	77.35 (7.63)	72.97 (8.36)	0.546
Age (categorical)			
Age <70	392 (18.6)	763 (30.9)	0.642
Age >= 70 and <80	805 (38.2)	1322 (53.5)	
Age >= 80	913 (43.3)	385 (15.6)	
Male Gender	1148 (54.4)	1423 (57.6)	0.065
Race			
Asian	41 (1.9)	49 (2.0)	0.254
Black	242 (11.5)	211 (8.5)	
Hispanic	31 (1.5)	38 (1.5)	
North American Native	7 (0.3)	12 (0.5)	
Other	64 (3.0)	6 (0.2)	
Unknown	7 (0.3)	2 (0.1)	
White	1718 (81.4)	2152 (87.1)	
Alzheimer Dementia	236 (11.2)	105 (4.3)	0.262
Stroke or TIA	554 (26.3)	298 (12.1)	0.367
Depression	723 (34.3)	378 (15.3)	0.450
Myocardial Infarction	189 (9.0)	91 (3.7)	0.218
Atrial Fibrillation	460 (21.8)	354 (14.3)	0.195
Congestive Heart Failure	1019 (48.3)	746 (30.2)	0.377
Ischemic Heart Disease	1495 (70.9)	1705 (69.0)	0.040
Hypertension	1911 (90.6)	1948 (78.9)	0.330
Hyperlipidemia	1887 (89.4)	1484 (60.1)	0.718
Chronic Obstructive Pulmonary Disease	1149 (54.5)	1047 (42.4)	0.243
Asthma	371 (17.6)	244 (9.9)	0.225
Chronic Kidney Disease	1040 (49.3)	385 (15.6)	0.772
Benign Prostatic Hyperplasia	600 (28.4)	374 (15.1)	0.326
End-stage Renal Disease	93 (4.4)	61 (2.5)	0.107
Diabetes	827 (39.2)	531 (21.5)	0.392
Hypothyroidism	428 (20.3)	248 (10.0)	0.289
Glaucoma	443 (21.0)	291 (11.8)	0.251
Cataract	1503 (71.2)	1054 (42.7)	0.602
Hip Fracture	56 (2.7)	49 (2.0)	0.045
Osteoporosis	467 (22.1)	198 (8.0)	0.402
Arthritis	1222 (57.9)	704 (28.5)	0.622

Anemia	1462 (69.3)	983 (39.8)	0.620
Breast Cancer	96 (4.5)	66 (2.7)	0.101
Colorectal Cancer	120 (5.7)	58 (2.3)	0.171
Prostate Cancer	167 (7.9)	152 (6.2)	0.069
Lung Cancer	99 (4.7)	66 (2.7)	0.107
Endometrial Cancer	21 (1.0)	7 (0.3)	0.089
Prior Aortic Valve Replacement	38 (1.8)	55 (2.2)	0.030
Prior Aortic Root Replacement	13 (0.6)	25 (1.0)	0.044
Prior Ascending Aortic Replacement	40 (1.9)	48 (1.9)	0.003
Prior Aortic Arch Replacement	28 (1.3)	49 (2.0)	0.051
Prior Mitral Valve Surgery	8 (0.4)	5 (0.2)	0.033
Prior Tricuspid Valve Surgery	2 (0.1)	0 (0.0)	0.044
Prior Coronary Artery Bypass Grafting	183 (8.7)	184 (7.4)	0.045
Prior Ventricular Assist Device	3 (0.1)	0 (0.0)	0.053
Prior Transplant	0 (0.0)	1 (0.0)	0.028
Subclavian Bypass	82 (3.9)	89 (3.6)	0.015
High-Volume Open Surgical Center	756 (35.8)	894 (36.2)	0.008
Urgency			0.163
Emergency	223 (10.6)	369 (14.9)	
Urgent	226 (10.7)	325 (13.2)	
Elective	1658 (78.6)	1771 (71.7)	
Unknown	3 (0.1)	5 (0.2)	

Table S3. Sensitivity Analysis (Institutional Effects): Propensity score model restricting the dataset to the 349 hospitals present before and after the introduction of TEVAR

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.831	0.626	1.328	0.184
Male	-0.112	0.091	-1.224	0.221
Age	-0.017	0.008	-2.048	0.041
Age (categorical), ≥70, <80	0.501	0.126	3.992	<0.001
Age (categorical), ≥80	-0.082	0.201	-0.410	0.682
Race, Black	-0.330	0.303	-1.089	0.276
Ethnicity, Hispanic	0.229	0.411	0.557	0.577
Race, North American Native	0.321	0.631	0.508	0.611
Race, Other	-1.924	0.783	-2.458	0.014
Race, Unknown	-12.186	193.644	-0.063	0.950
Race, White	0.093	0.277	0.337	0.736
Alzheimer Dementia	-0.135	0.192	-0.704	0.481
Myocardial Infarction	-0.586	0.216	-2.713	0.007
Anemia	-0.204	0.087	-2.333	0.020
Asthma	-0.159	0.133	-1.197	0.231
Atrial Fibrillation	-0.114	0.115	-0.988	0.323
Breast Cancer	-0.251	0.253	-0.994	0.320
Colorectal Cancer	-0.495	0.259	-1.909	0.056
Endometrial Cancer	0.010	0.600	0.017	0.987
Lung Cancer	-0.342	0.241	-1.423	0.155
Prostate Cancer	0.059	0.162	0.365	0.715
Cataract	-0.424	0.086	-4.917	<0.001
Congestive Heart Failure	-0.007	0.094	-0.077	0.938
Chronic Kidney Disease	-0.776	0.111	-7.001	<0.001
Chronic Obstructive Pulmonary Disease	-0.080	0.084	-0.955	0.339
Depression	-0.495	0.109	-4.530	<0.001
Diabetes	-0.160	0.098	-1.638	0.101
Glaucoma	-0.064	0.117	-0.548	0.583
Hip Fracture	0.231	0.308	0.752	0.452
Hyperlipidemia	-1.001	0.092	-10.888	<0.001
Benign Prostatic Hyperplasia	-0.196	0.120	-1.638	0.101
Hypertension	0.471	0.116	4.058	<0.001
Hypothyroidism	-0.236	0.129	-1.836	0.066
Ischemic Heart Disease	0.908	0.100	9.085	<0.001
Osteoporosis	-0.402	0.147	-2.740	0.006
Arthritis	-0.286	0.091	-3.145	0.002
Stroke	-0.198	0.117	-1.693	0.090

End Stage Renal Disease	0.210	0.250	0.841	0.401
Urgency (Urgent)	-0.122	0.143	-0.853	0.394
Urgency (Elective)	-0.423	0.110	-3.843	<0.001
Urgency (Unknown)	-0.391	0.912	-0.429	0.668
Prior Aortic Arch Replacement	-0.014	0.281	-0.050	0.960

Table S4. Sensitivity Analysis (Institutional Effects): Baseline characteristics restricting the dataset to the 349 hospitals present before and after the introduction of TEVAR

	Before Matching			After Matching		
	TEVAR	Open Surgical Repair	SMD	TEVAR	Open Surgical Repair	SMD
	n = 3310	n = 1106		n = 1106	n = 1106	
Operative Year, median [IQR]	2008 [2007, 2009]	2002 [2000, 2003]	3.732	2008 [2007, 2009]	2002 [2000, 2003]	3.701
Age, mean (sd)	75.09 (8.25)	72.87 (7.55)	0.281	73.10 (8.68)	72.87 (7.55)	0.029
Age (categorical)			0.351			0.037
Age <70	817 (24.7)	327 (29.6)		314 (28.4)	327 (29.6)	
Age ≥ 70 and <80	1543 (46.6)	619 (56.0)		619 (56.0)	619 (56.0)	
Age ≥ 80	950 (28.7)	160 (14.5)		173 (15.6)	160 (14.5)	
Male Gender	1840 (55.6)	634 (57.3)	0.035	638 (57.7)	634 (57.3)	0.007
Race			0.153			0.041
Asian	60 (1.8)	21 (1.9)		17 (1.5)	21 (1.9)	
Black	325 (9.8)	95 (8.6)		92 (8.3)	95 (8.6)	
Hispanic	45 (1.4)	18 (1.6)		19 (1.7)	18 (1.6)	
North American Native	15 (0.5)	5 (0.5)		6 (0.5)	5 (0.5)	
Other	43 (1.3)	2 (0.2)		1 (0.1)	2 (0.2)	
Unknown	6 (0.2)	0 (0.0)		0 (0.0)	0 (0.0)	
White	2816 (85.1)	965 (87.3)		971 (87.8)	965 (87.3)	
Alzheimer Dementia	237 (7.2)	42 (3.8)	0.148	52 (4.7)	42 (3.8)	0.045
Stroke or TIA	619 (18.7)	125 (11.3)	0.208	131 (11.8)	125 (11.3)	0.017
Depression	812 (24.5)	149 (13.5)	0.285	158 (14.3)	149 (13.5)	0.024
Myocardial Infarction	197 (6.0)	29 (2.6)	0.165	20 (1.8)	29 (2.6)	0.055
Atrial Fibrillation	623 (18.8)	146 (13.2)	0.154	147 (13.3)	146 (13.2)	0.003
Congestive Heart Failure	1278 (38.6)	301 (27.2)	0.244	297 (26.9)	301 (27.2)	0.008
Ischemic Heart Disease	2376 (71.8)	805 (72.8)	0.022	762 (68.9)	805 (72.8)	0.086
Hypertension	2850 (86.1)	880 (79.6)	0.174	852 (77.0)	880 (79.6)	0.061

Hyperlipidemia	2500 (75.5)	560 (50.6)	0.534	598 (54.1)	560 (50.6)	0.069
Chronic Obstructive Pulmonary Disease	1619 (48.9)	435 (39.3)	0.194	434 (39.2)	435 (39.3)	0.002
Asthma	439 (13.3)	95 (8.6)	0.15	93 (8.4)	95 (8.6)	0.006
Chronic Kidney Disease	1038 (31.4)	154 (13.9)	0.426	155 (14.0)	154 (13.9)	0.003
Benign Prostatic Hyperplasia	687 (20.8)	143 (12.9)	0.21	140 (12.7)	143 (12.9)	0.008
End-stage Renal Disease	108 (3.3)	26 (2.4)	0.055	24 (2.2)	26 (2.4)	0.012
Diabetes	984 (29.7)	209 (18.9)	0.255	206 (18.6)	209 (18.9)	0.007
Hypothyroidism	506 (15.3)	98 (8.9)	0.198	105 (9.5)	98 (8.9)	0.022
Glaucoma	537 (16.2)	128 (11.6)	0.135	123 (11.1)	128 (11.6)	0.014
Cataract	1918 (57.9)	423 (38.2)	0.402	425 (38.4)	423 (38.2)	0.004
Hip Fracture	77 (2.3)	16 (1.4)	0.065	14 (1.3)	16 (1.4)	0.016
Osteoporosis	496 (15.0)	78 (7.1)	0.255	91 (8.2)	78 (7.1)	0.044
Arthritis	1403 (42.4)	280 (25.3)	0.367	291 (26.3)	280 (25.3)	0.023
Anemia	1783 (53.9)	399 (36.1)	0.363	395 (35.7)	399 (36.1)	0.008
Breast Cancer	121 (3.7)	23 (2.1)	0.095	24 (2.2)	23 (2.1)	0.006
Colorectal Cancer	141 (4.3)	20 (1.8)	0.143	18 (1.6)	20 (1.8)	0.014
Prostate Cancer	237 (7.2)	64 (5.8)	0.056	62 (5.6)	64 (5.8)	0.008
Lung Cancer	121 (3.7)	26 (2.4)	0.077	29 (2.6)	26 (2.4)	0.017
Endometrial Cancer	20 (0.6)	4 (0.4)	0.035	2 (0.2)	4 (0.4)	0.035
Prior Aortic Valve Replacement	75 (2.3)	24 (2.2)	0.007	27 (2.4)	24 (2.2)	0.018
Prior Aortic Root Replacement	28 (0.8)	5 (0.5)	0.049	10 (0.9)	5 (0.5)	0.055
Prior Ascending Aortic Replacement	76 (2.3)	40 (3.6)	0.078	22 (2.0)	40 (3.6)	0.099
Prior Aortic Arch Replacement	65 (2.0)	21 (1.9)	0.005	25 (2.3)	21 (1.9)	0.025
Prior Mitral Valve Surgery	9 (0.3)	6 (0.5)	0.043	3 (0.3)	6 (0.5)	0.043
Prior Tricuspid Valve Surgery	1 (0.0)	0 (0.0)	0.025	0 (0.0)	0 (0.0)	<0.001
Prior Coronary Artery Bypass Grafting	280 (8.5)	97 (8.8)	0.011	74 (6.7)	97 (8.8)	0.078
Prior Ventricular Assist Device	2 (0.1)	0 (0.0)	0.035	1 (0.1)	0 (0.0)	0.043
Prior Transplant	1 (0.0)	0 (0.0)	0.025	0 (0.0)	0 (0.0)	<0.001

Subclavian Bypass	134 (4.0)	8 (0.7)	0.219	39 (3.5)	8 (0.7)	0.195
High-Volume Open Surgical Center	1602 (48.4)	605 (54.7)	0.126	522 (47.2)	605 (54.7)	0.151
Urgency			0.128			0.043
Emergency	422 (12.7)	177 (16.0)		191 (17.3)	177 (16.0)	
Urgent	402 (12.1)	161 (14.6)		154 (13.9)	161 (14.6)	
Elective	2481 (75.0)	766 (69.3)		760 (68.7)	766 (69.3)	
Unknown	5 (0.2)	2 (0.2)		1 (0.1)	2 (0.2)	

Table S5. Sensitivity Analysis (Secular Trend): Propensity score model for comparison of open surgical repair patients from the early period of the study with those from the late period

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-1.265	1.019	-1.241	0.215
Male	-0.065	0.180	-0.359	0.720
Age	0.049	0.014	3.629	<0.001
Age (categorical), ≥70, <80	0.386	0.231	1.671	0.095
Age (categorical), ≥80	-0.091	0.358	-0.255	0.799
Race, Black	-0.161	0.547	-0.294	0.769
Ethnicity, Hispanic	0.292	0.767	0.380	0.704
Race, North American Native	13.570	589.587	0.023	0.982
Race, Other	-2.361	0.890	-2.654	0.008
Race, Unknown	13.768	1455.398	0.009	0.992
Race, White	0.368	0.498	0.738	0.460
Alzheimer Dementia	0.362	0.390	0.927	0.354
Myocardial Infarction	-0.321	0.372	-0.862	0.388
Anemia	-0.032	0.169	-0.187	0.851
Asthma	-0.305	0.238	-1.280	0.200
Atrial Fibrillation	-0.166	0.210	-0.792	0.428
Breast Cancer	-0.617	0.398	-1.548	0.122
Colorectal Cancer	-0.995	0.449	-2.216	0.027
Endometrial Cancer	-0.675	0.850	-0.794	0.427
Lung Cancer	1.342	0.656	2.044	0.041
Prostate Cancer	0.379	0.368	1.030	0.303
Cataract	-0.712	0.169	-4.224	<0.001
Congestive Heart Failure	-0.176	0.172	-1.021	0.307
Chronic Kidney Disease	-0.300	0.207	-1.455	0.146
Chronic Obstructive Pulmonary Disease	0.101	0.163	0.620	0.535
Depression	-0.360	0.196	-1.836	0.066
Diabetes	0.221	0.188	1.174	0.240
Glaucoma	-0.323	0.216	-1.492	0.136
Hip Fracture	0.257	0.556	0.461	0.644
Hyperlipidemia	-0.945	0.179	-5.273	<0.001
Benign Prostatic Hyperplasia	0.231	0.248	0.930	0.352
Hypertension	-0.161	0.236	-0.682	0.495
Hypothyroidism	-0.363	0.232	-1.567	0.117
Ischemic Heart Disease	0.170	0.194	0.872	0.383
Osteoporosis	-0.175	0.265	-0.661	0.509
Arthritis	-0.072	0.172	-0.418	0.676

Stroke	-0.410	0.205	-1.998	0.046
End Stage Renal Disease	0.314	0.467	0.673	0.501
Urgency (Urgent)	-0.220	0.254	-0.868	0.386
Urgency (Elective)	0.115	0.207	0.557	0.577
Urgency (Unknown)	13.524	1020.685	0.013	0.989
High-Volume Hospital	0.131	0.149	0.880	0.379
Prior Aortic Arch Replacement	-0.371	0.459	-0.809	0.419

Table S6. Sensitivity Analysis (Secular Trend): Baseline characteristics comparing open surgical repair patients from the early period of the study with those from the late period.

	Before IPTW			After IPTW		
	early	late	SMD	early	late	SMD
	n = 1235	n = 257		n = 1231.54	n = 254.02	
Operative Year, median [IQR]	2002 [2000, 2003]	2007 [2006, 2008]	3.366	2002 [2000, 2003]	2007 [2006, 2008]	3.300
Age, mean (sd)	72.88 (7.52)	70.71 (10.11)	0.244	72.44 (8.11)	72.12 (8.20)	0.040
Age (categorical)						
Age <70	362 (29.3)	100 (38.9)	0.213	384.7 (31.2)	77.8 (30.6)	0.060
Age ≥ 70 and <80	700 (56.7)	121 (47.1)		676.3 (54.9)	145.5 (57.3)	
Age ≥ 80	173 (14.0)	36 (14.0)		170.6 (13.8)	30.6 (12.1)	
Male Gender	710 (57.5)	134 (52.1)	0.108	702.8 (57.1)	157.3 (61.9)	0.099
Race						
Asian	25 (2.0)	6 (2.3)	0.256	25.5 (2.1)	5.9 (2.3)	0.118
Black	105 (8.5)	32 (12.5)		112.5 (9.1)	22 (8.7)	
Hispanic	20 (1.6)	4 (1.6)		19.4 (1.6)	2.3 (0.9)	
North American Native	6 (0.5)	0 (0.0)		5 (0.4)	0 (0.0)	
Other	3 (0.2)	6 (2.3)		5.5 (0.4)	1.4 (0.6)	
Unknown	1 (0.1)	0 (0.0)		0.8 (0.1)	0 (0.0)	
White	1075 (87.0)	209 (81.3)		1062.9 (86.3)	222.3 (87.5)	
Alzheimer Dementia	49 (4.0)	10 (3.9)	0.004	50 (4.1)	15.1 (5.9)	0.086
Stroke or TIA	136 (11.0)	46 (17.9)	0.197	149.4 (12.1)	32.7 (12.9)	0.023
Depression	163 (13.2)	61 (23.7)	0.274	181 (14.7)	33.2 (13.1)	0.047
Myocardial Infarction	36 (2.9)	12 (4.7)	0.092	39.2 (3.2)	6.9 (2.7)	0.027
Atrial Fibrillation	159 (12.9)	45 (17.5)	0.129	167.2 (13.6)	38.3 (15.1)	0.043
Congestive Heart Failure	343 (27.8)	96 (37.4)	0.206	362.3 (29.4)	82.7 (32.6)	0.068
Ischemic Heart Disease	895 (72.5)	194 (75.5)	0.069	897.8 (72.9)	195.2 (76.8)	0.091
Hypertension	982 (79.5)	225 (87.5)	0.218	995.3 (80.8)	209.6 (82.5)	0.044

Hyperlipidemia	624 (50.5)	185 (72.0)	0.452	664.7 (54.0)	148.4 (58.4)	0.090
Chronic Obstructive Pulmonary Disease	482 (39.0)	110 (42.8)	0.077	486.8 (39.5)	101.9 (40.1)	0.012
Asthma	113 (9.1)	33 (12.8)	0.118	119.1 (9.7)	25.8 (10.1)	0.016
Chronic Kidney Disease	170 (13.8)	59 (23.0)	0.239	186.1 (15.1)	39.3 (15.5)	0.010
Benign Prostatic Hyperplasia	163 (13.2)	32 (12.5)	0.022	162.5 (13.2)	39.2 (15.4)	0.064
End-stage Renal Disease	27 (2.2)	9 (3.5)	0.079	29.9 (2.4)	5.4 (2.1)	0.021
Diabetes	240 (19.4)	58 (22.6)	0.077	246.8 (20.0)	58.9 (23.2)	0.077
Hypothyroidism	110 (8.9)	35 (13.6)	0.149	118.2 (9.6)	22.2 (8.7)	0.030
Glaucoma	144 (11.7)	39 (15.2)	0.103	147.4 (12.0)	26.1 (10.3)	0.054
Cataract	481 (38.9)	133 (51.8)	0.259	502.5 (40.8)	106.8 (42.0)	0.025
Hip Fracture	22 (1.8)	5 (1.9)	0.012	22.3 (1.8)	4 (1.6)	0.017
Osteoporosis	93 (7.5)	30 (11.7)	0.141	100.3 (8.1)	19 (7.5)	0.024
Arthritis	313 (25.3)	83 (32.3)	0.154	325.6 (26.4)	72.3 (28.5)	0.045
Anemia	448 (36.3)	117 (45.5)	0.189	463.1 (37.6)	105.4 (41.5)	0.080
Breast Cancer	30 (2.4)	11 (4.3)	0.103	33.3 (2.7)	7 (2.8)	0.004
Colorectal Cancer	22 (1.8)	9 (3.5)	0.107	26.2 (2.1)	7.1 (2.8)	0.043
Prostate Cancer	72 (5.8)	11 (4.3)	0.071	68.2 (5.5)	14 (5.5)	0.002
Lung Cancer	34 (2.8)	3 (1.2)	0.115	30.7 (2.5)	4.9 (1.9)	0.037
Endometrial Cancer	4 (0.3)	3 (1.2)	0.098	5 (0.4)	1 (0.4)	0.003
Prior Aortic Valve Replacement	27 (2.2)	8 (3.1)	0.058	27.2 (2.2)	5.1 (2.0)	0.014
Prior Aortic Root Replacement	6 (0.5)	3 (1.2)	0.075	6.5 (0.5)	2.5 (1.0)	0.054
Prior Ascending Aortic Replacement	44 (3.6)	9 (3.5)	0.003	45.2 (3.7)	9 (3.5)	0.007
Prior Aortic Arch Replacement	23 (1.9)	8 (3.1)	0.080	26.4 (2.1)	9.6 (3.8)	0.096
Prior Mitral Valve Surgery	6 (0.5)	1 (0.4)	0.015	5.8 (0.5)	1 (0.4)	0.012
Prior Tricuspid Valve Surgery	0 (0.0)	0 (0.0)	<0.001	0 (0.0)	0 (0.0)	<0.001
Prior Coronary Artery Bypass Grafting	103 (8.3)	23 (8.9)	0.022	107.1 (8.7)	22.3 (8.8)	0.002
Prior Ventricular Assist Device	0 (0.0)	0 (0.0)	<0.001	0 (0.0)	0 (0.0)	<0.001
Prior Transplant	0 (0.0)	0 (0.0)	<0.001	0 (0.0)	0 (0.0)	<0.001
Subclavian Bypass	8 (0.6)	3 (1.2)	0.055	7.8 (0.6)	1.7 (0.7)	0.005
High-Volume Open Surgical Center	614 (49.7)	124 (48.2)	0.029	611.1 (49.6)	130.9 (51.5)	0.038

Urgency						
Emergency	193 (15.6)	45 (17.5)		198 (16.1)	46.7 (18.4)	
Urgent	177 (14.3)	49 (19.1)	0.159	188.5 (15.3)	33.6 (13.2)	0.094
Elective	863 (69.9)	163 (63.4)		843.4 (68.5)	173.7 (68.4)	
Unknown	2 (0.2)	0 (0.0)		1.7 (0.1)	0 (0.0)	

Table S7. Sensitivity Analysis (Hospital Volume): Propensity score model for comparison of high-volume open surgical centers with TEVAR.

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.858	0.735	-1.167	0.243
Age	-0.015	0.010	-1.492	0.136
Male	-0.090	0.109	-0.832	0.405
Age (categorical), ≥70, <80	0.455	0.148	3.064	0.002
Age (categorical), ≥80	-0.048	0.240	-0.199	0.842
Race, Black	-0.199	0.368	-0.539	0.590
Ethnicity, Hispanic	0.019	0.534	0.035	0.972
Race, North American Native	-12.740	310.712	-0.041	0.967
Race, Other	-2.053	1.065	-1.929	0.054
Race, Unknown	-13.226	437.088	-0.030	0.976
Race, White	0.249	0.336	0.740	0.459
Alzheimer Dementia	-0.494	0.274	-1.801	0.072
Myocardial Infarction	-0.502	0.252	-1.990	0.047
Anemia	-0.231	0.106	-2.187	0.029
Asthma	0.000	0.157	-0.002	0.998
Atrial Fibrillation	-0.078	0.139	-0.557	0.577
Breast Cancer	-0.278	0.325	-0.855	0.392
Colorectal Cancer	-0.107	0.288	-0.373	0.709
Endometrial Cancer	-0.126	0.768	-0.164	0.869
Lung Cancer	-0.226	0.284	-0.798	0.425
Prostate Cancer	0.095	0.192	0.494	0.621
Cataract	-0.288	0.106	-2.720	0.007
Congestive Heart Failure	-0.008	0.113	-0.069	0.945
Chronic Kidney Disease	-0.758	0.136	-5.571	0.000
End Stage Renal Disease	-0.035	0.329	-0.106	0.916
Chronic Obstructive Pulmonary Disease	-0.213	0.103	-2.070	0.038
Depression	-0.362	0.133	-2.711	0.007
Diabetes	-0.323	0.121	-2.675	0.007
Glaucoma	-0.127	0.147	-0.865	0.387
Hip Fracture	-0.309	0.483	-0.639	0.523
Hyperlipidemia	-0.900	0.110	-8.164	<0.001
Hypertension	0.687	0.143	4.796	<0.001
Benign Prostatic Hyperplasia	-0.219	0.141	-1.548	0.122
Hypothyroidism	-0.395	0.169	-2.338	0.019
Ischemic Heart Disease	1.174	0.125	9.409	<0.001
Osteoporosis	-0.581	0.194	-2.989	0.003
Arthritis	-0.385	0.111	-3.479	0.001

Stroke	-0.355	0.148	-2.389	0.017
Urgency (Urgent)	-0.117	0.178	-0.654	0.513
Urgency (Elective)	-0.286	0.137	-2.098	0.036
Urgency (Unknown)	-13.891	489.410	-0.028	0.977
Prior Aortic Arch Replacement	0.445	0.293	1.521	0.128

Table S8. Sensitivity Analysis (Hospital Volume): Baseline characteristics comparing high-volume open surgical centers with TEVAR.

	Before Matching			After Matching		
	TEVAR	Open Surgical Repair	SMD	TEVAR	Open Surgical Repair	SMD
	n = 4580	n = 614		n = 1228	n = 614	
Operative Year, median [IQR]	2008 [2007, 2009]	2001 [2000, 2003]	3.784	2008 [2007, 2009]	2001 [2000, 2003]	3.687
Age, mean (sd)	74.99 (8.32)	72.96 (7.38)	0.258	73.03 (8.24)	72.96 (7.38)	0.010
Age (categorical)						
Age <70	1155 (25.2)	182 (29.6)	0.324	369 (30.0)	182 (29.6)	0.013
Age ≥ 70 and <80	2127 (46.4)	339 (55.2)		678 (55.2)	339 (55.2)	
Age ≥ 80	1298 (28.3)	93 (15.1)		181 (14.7)	93 (15.1)	
Male Gender	2571 (56.1)	364 (59.3)	0.064	741 (60.3)	364 (59.3)	0.022
Race						
Asian	90 (2.0)	11 (1.8)	0.201	16 (1.3)	11 (1.8)	0.055
Black	453 (9.9)	51 (8.3)		104 (8.5)	51 (8.3)	
Hispanic	69 (1.5)	7 (1.1)		10 (0.8)	7 (1.1)	
North American Native	19 (0.4)	0 (0.0)		0 (0.0)	0 (0.0)	
Other	70 (1.5)	1 (0.2)		3 (0.2)	1 (0.2)	
Unknown	9 (0.2)	0 (0.0)		0 (0.0)	0 (0.0)	
White	3870 (84.5)	544 (88.6)		1095 (89.2)	544 (88.6)	
Alzheimer Dementia	341 (7.4)	16 (2.6)	0.223	32 (2.6)	16 (2.6)	<0.001
Stroke or TIA	852 (18.6)	63 (10.3)	0.239	144 (11.7)	63 (10.3)	0.047
Depression	1101 (24.0)	87 (14.2)	0.253	188 (15.3)	87 (14.2)	0.032
Myocardial Infarction	280 (6.1)	19 (3.1)	0.144	30 (2.4)	19 (3.1)	0.040
Atrial Fibrillation	814 (17.8)	85 (13.8)	0.108	200 (16.3)	85 (13.8)	0.068
Congestive Heart Failure	1765 (38.5)	175 (28.5)	0.214	368 (30.0)	175 (28.5)	0.032
Ischemic Heart Disease	3200 (69.9)	469 (76.4)	0.147	969 (78.9)	469 (76.4)	0.061
Hypertension	3859 (84.3)	501 (81.6)	0.071	1046 (85.2)	501 (81.6)	0.096
Hyperlipidemia	3371 (73.6)	328 (53.4)	0.429	738 (60.1)	328 (53.4)	0.135
Chronic Obstructive Pulmonary	2196 (47.9)	232 (37.8)	0.206	497 (40.5)	232 (37.8)	0.055

Disease						
Asthma	615 (13.4)	61 (9.9)	0.109	121 (9.9)	61 (9.9)	0.003
Chronic Kidney Disease	1425 (31.1)	87 (14.2)	0.413	204 (16.6)	87 (14.2)	0.068
Benign Prostatic Hyperplasia	974 (21.3)	89 (14.5)	0.177	189 (15.4)	89 (14.5)	0.025
End-stage Renal Disease	154 (3.4)	12 (2.0)	0.088	19 (1.5)	12 (2.0)	0.031
Diabetes	1358 (29.7)	110 (17.9)	0.278	234 (19.1)	110 (17.9)	0.029
Hypothyroidism	676 (14.8)	47 (7.7)	0.227	103 (8.4)	47 (7.7)	0.027
Glaucoma	734 (16.0)	67 (10.9)	0.150	144 (11.7)	67 (10.9)	0.026
Cataract	2557 (55.8)	245 (39.9)	0.323	514 (41.9)	245 (39.9)	0.040
Hip Fracture	105 (2.3)	5 (0.8)	0.120	9 (0.7)	5 (0.8)	0.009
Osteoporosis	665 (14.5)	36 (5.9)	0.289	80 (6.5)	36 (5.9)	0.027
Arthritis	1926 (42.1)	154 (25.1)	0.365	331 (27.0)	154 (25.1)	0.043
Anemia	2445 (53.4)	225 (36.6)	0.341	469 (38.2)	225 (36.6)	0.032
Breast Cancer	162 (3.5)	12 (2.0)	0.097	22 (1.8)	12 (2.0)	0.012
Colorectal Cancer	178 (3.9)	15 (2.4)	0.083	27 (2.2)	15 (2.4)	0.016
Prostate Cancer	319 (7.0)	39 (6.4)	0.025	83 (6.8)	39 (6.4)	0.016
Lung Cancer	165 (3.6)	16 (2.6)	0.057	40 (3.3)	16 (2.6)	0.039
Endometrial Cancer	28 (0.6)	2 (0.3)	0.042	4 (0.3)	2 (0.3)	<0.001
Prior Aortic Valve Replacement	93 (2.0)	11 (1.8)	0.017	28 (2.3)	11 (1.8)	0.035
Prior Aortic Root Replacement	38 (0.8)	3 (0.5)	0.042	12 (1.0)	3 (0.5)	0.057
Prior Ascending Aortic Replacement	88 (1.9)	33 (5.4)	0.185	30 (2.4)	33 (5.4)	0.152
Prior Aortic Arch Replacement	77 (1.7)	18 (2.9)	0.083	38 (3.1)	18 (2.9)	0.010
Prior Mitral Valve Surgery	13 (0.3)	3 (0.5)	0.033	6 (0.5)	3 (0.5)	<0.001
Prior Tricuspid Valve Surgery	2 (0.0)	0 (0.0)	0.030	0 (0.0)	0 (0.0)	<0.001
Prior Coronary Artery Bypass Grafting	367 (8.0)	56 (9.1)	0.040	93 (7.6)	56 (9.1)	0.056
Prior Ventricular Assist Device	3 (0.1)	0 (0.0)	0.036	0 (0.0)	0 (0.0)	<0.001
Prior Transplant	1 (0.0)	0 (0.0)	0.021	0 (0.0)	0 (0.0)	<0.001
Subclavian Bypass	171 (3.7)	4 (0.7)	0.212	44 (3.6)	4 (0.7)	0.205
High-Volume Open Surgical Center	1650 (36.0)	614 (100.0)	1.885	461 (37.5)	614 (100.0)	1.824

Urgency						
Emergency	592 (12.9)	85 (13.8)		160 (13.0)	85 (13.8)	
Urgent	551 (12.0)	80 (13.0)	0.073	170 (13.8)	80 (13.0)	0.031
Elective	3429 (74.9)	449 (73.1)		898 (73.1)	449 (73.1)	
Unknown	8 (0.2)	0 (0.0)		0 (0.0)	0 (0.0)	

Table S9. Sensitivity Analysis (Hospital Volume): Propensity score model for comparison of low-volume open surgical centers with TEVAR

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.116	0.707	-0.164	0.870
Age	-0.016	0.010	-1.690	0.091
Male	-0.133	0.108	-1.228	0.219
Age (categorical), ≥70, <80	0.579	0.149	3.877	<0.001
Age (categorical), ≥80	-0.233	0.244	-0.953	0.340
Race, Black	-0.371	0.340	-1.092	0.275
Ethnicity, Hispanic	0.318	0.445	0.714	0.475
Race, North American Native	1.024	0.588	1.741	0.082
Race, Other	-1.697	0.789	-2.151	0.032
Race, Unknown	-0.239	1.191	-0.201	0.841
Race, White	0.016	0.306	0.051	0.959
Alzheimer Dementia	0.221	0.208	1.064	0.287
Myocardial Infarction	-0.562	0.266	-2.113	0.035
Anemia	-0.232	0.108	-2.150	0.032
Asthma	-0.227	0.166	-1.371	0.170
Atrial Fibrillation	-0.164	0.146	-1.124	0.261
Breast Cancer	0.143	0.275	0.522	0.602
Colorectal Cancer	-0.907	0.399	-2.270	0.023
Endometrial Cancer	-0.050	0.762	-0.065	0.948
Lung Cancer	-0.081	0.270	-0.298	0.766
Prostate Cancer	0.157	0.206	0.765	0.445
Cataract	-0.371	0.107	-3.480	0.001
Congestive Heart Failure	-0.026	0.115	-0.224	0.823
Chronic Kidney Disease	-0.851	0.140	-6.080	<0.001
End Stage Renal Disease	0.227	0.303	0.748	0.455
Chronic Obstructive Pulmonary Disease	-0.032	0.102	-0.309	0.758
Depression	-0.635	0.142	-4.481	<0.001
Diabetes	-0.030	0.116	-0.255	0.799
Glaucoma	0.077	0.141	0.551	0.582
Hip Fracture	0.895	0.297	3.017	0.003
Hyperlipidemia	-1.092	0.111	-9.871	<0.001
Hypertension	0.511	0.135	3.770	<0.001
Benign Prostatic Hyperplasia	-0.284	0.150	-1.893	0.058
Hypothyroidism	-0.056	0.152	-0.371	0.711
Ischemic Heart Disease	0.882	0.118	7.444	<0.001
Osteoporosis	-0.121	0.170	-0.712	0.476
Arthritis	-0.312	0.113	-2.768	0.006
Stroke	-0.154	0.143	-1.075	0.282

Urgency (Urgent)	-0.098	0.163	-0.602	0.547
Urgency (Elective)	-0.496	0.127	-3.901	<0.001
Urgency (Unknown)	-0.215	0.847	-0.254	0.800
Prior Aortic Arch Replacement	-0.822	0.483	-1.700	0.089

Table S10. Sensitivity Analysis (Hospital Volume): Baseline characteristics comparing low-volume open surgical centers with TEVAR.

	Before Matching			After Matching		
	TEVAR	Open Surgical Repair	SMD	TEVAR	Open Surgical Repair	SMD
	n = 4580	n = 621		n = 1242	n = 621	
Operative Year, median [IQR]	2008 [2007, 2009]	2002 [2000, 2003]	3.781	2008 [2007, 2009]	2002 [2000, 2003]	3.809
Age, mean (sd)	74.99 (8.32)	72.81 (7.66)	0.272	73.09 (8.31)	72.81 (7.66)	0.036
Age (categorical)			0.391			0.031
Age <70	1155 (25.2)	180 (29.0)		347 (27.9)	180 (29.0)	
Age ≥ 70 and <80	2127 (46.4)	361 (58.1)		724 (58.3)	361 (58.1)	
Age ≥ 80	1298 (28.3)	80 (12.9)		171 (13.8)	80 (12.9)	
Male Gender	2571 (56.1)	346 (55.7)	0.008	653 (52.6)	346 (55.7)	0.063
Race			0.156			0.059
Asian	90 (2.0)	14 (2.3)		31 (2.5)	14 (2.3)	
Black	453 (9.9)	54 (8.7)		109 (8.8)	54 (8.7)	
Hispanic	69 (1.5)	13 (2.1)		20 (1.6)	13 (2.1)	
North American Native	19 (0.4)	6 (1.0)		8 (0.6)	6 (1.0)	
Other	70 (1.5)	2 (0.3)		6 (0.5)	2 (0.3)	
Unknown	9 (0.2)	1 (0.2)		2 (0.2)	1 (0.2)	
White	3870 (84.5)	531 (85.5)		1066 (85.8)	531 (85.5)	
Alzheimer Dementia	341 (7.4)	33 (5.3)	0.087	65 (5.2)	33 (5.3)	0.004
Stroke or TIA	852 (18.6)	73 (11.8)	0.192	143 (11.5)	73 (11.8)	0.008
Depression	1101 (24.0)	76 (12.2)	0.310	164 (13.2)	76 (12.2)	0.029
Myocardial Infarction	280 (6.1)	17 (2.7)	0.165	37 (3.0)	17 (2.7)	0.014
Atrial Fibrillation	814 (17.8)	74 (11.9)	0.165	162 (13.0)	74 (11.9)	0.034
Congestive Heart Failure	1765 (38.5)	168 (27.1)	0.246	338 (27.2)	168 (27.1)	0.004
Ischemic Heart Disease	3200 (69.9)	426 (68.6)	0.028	844 (68.0)	426 (68.6)	0.014
Hypertension	3859 (84.3)	481 (77.5)	0.174	978 (78.7)	481 (77.5)	0.031
Hyperlipidemia	3371 (73.6)	296 (47.7)	0.551	624 (50.2)	296 (47.7)	0.052

Chronic Obstructive Pulmonary Disease	2196 (47.9)	250 (40.3)	0.155	512 (41.2)	250 (40.3)	0.020
Asthma	615 (13.4)	52 (8.4)	0.163	116 (9.3)	52 (8.4)	0.034
Chronic Kidney Disease	1425 (31.1)	83 (13.4)	0.437	166 (13.4)	83 (13.4)	<0.001
Benign Prostatic Hyperplasia	974 (21.3)	74 (11.9)	0.253	155 (12.5)	74 (11.9)	0.017
End-stage Renal Disease	154 (3.4)	15 (2.4)	0.057	27 (2.2)	15 (2.4)	0.016
Diabetes	1358 (29.7)	130 (20.9)	0.202	266 (21.4)	130 (20.9)	0.012
Hypothyroidism	676 (14.8)	63 (10.1)	0.140	129 (10.4)	63 (10.1)	0.008
Glaucoma	734 (16.0)	77 (12.4)	0.104	136 (11.0)	77 (12.4)	0.045
Cataract	2557 (55.8)	236 (38.0)	0.363	511 (41.1)	236 (38.0)	0.064
Hip Fracture	105 (2.3)	17 (2.7)	0.028	33 (2.7)	17 (2.7)	0.005
Osteoporosis	665 (14.5)	57 (9.2)	0.166	123 (9.9)	57 (9.2)	0.025
Arthritis	1926 (42.1)	159 (25.6)	0.353	342 (27.5)	159 (25.6)	0.044
Anemia	2445 (53.4)	223 (35.9)	0.357	458 (36.9)	223 (35.9)	0.020
Breast Cancer	162 (3.5)	18 (2.9)	0.036	40 (3.2)	18 (2.9)	0.019
Colorectal Cancer	178 (3.9)	7 (1.1)	0.177	11 (0.9)	7 (1.1)	0.024
Prostate Cancer	319 (7.0)	33 (5.3)	0.069	61 (4.9)	33 (5.3)	0.018
Lung Cancer	165 (3.6)	18 (2.9)	0.040	37 (3.0)	18 (2.9)	0.005
Endometrial Cancer	28 (0.6)	2 (0.3)	0.042	7 (0.6)	2 (0.3)	0.036
Prior Aortic Valve Replacement	93 (2.0)	16 (2.6)	0.036	23 (1.9)	16 (2.6)	0.049
Prior Aortic Root Replacement	38 (0.8)	3 (0.5)	0.043	8 (0.6)	3 (0.5)	0.022
Prior Ascending Aortic Replacement	88 (1.9)	11 (1.8)	0.011	20 (1.6)	11 (1.8)	0.012
Prior Aortic Arch Replacement	77 (1.7)	5 (0.8)	0.079	14 (1.1)	5 (0.8)	0.033
Prior Mitral Valve Surgery	13 (0.3)	3 (0.5)	0.032	2 (0.2)	3 (0.5)	0.057
Prior Tricuspid Valve Surgery	2 (0.0)	0 (0.0)	0.030	0 (0.0)	0 (0.0)	<0.001
Prior Coronary Artery Bypass Grafting	367 (8.0)	47 (7.6)	0.017	74 (6.0)	47 (7.6)	0.064
Prior Ventricular Assist Device	3 (0.1)	0 (0.0)	0.036	0 (0.0)	0 (0.0)	<0.001
Prior Transplant	1 (0.0)	0 (0.0)	0.021	0 (0.0)	0 (0.0)	<0.001
Subclavian Bypass	171 (3.7)	4 (0.6)	0.212	46 (3.7)	4 (0.6)	0.211

High-Volume Open Surgical Center	1650 (36.0)	0 (0.0)	1.061	426 (34.3)	0 (0.0)	1.022
Urgency			0.182			0.045
Emergency	592 (12.9)	108 (17.4)		196 (15.8)	108 (17.4)	
Urgent	551 (12.0)	97 (15.6)		196 (15.8)	97 (15.6)	
Elective	3429 (74.9)	414 (66.7)		845 (68.0)	414 (66.7)	
Unknown	8 (0.2)	2 (0.3)		5 (0.4)	2 (0.3)	

Table S11. Sensitivity Analysis (Discontinuity): Propensity score model for the comparison after narrowing the population under investigation to the years immediately surrounding the discontinuity, i.e. 2004 to 2006.

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.573	1.345	0.426	0.670
Age	-0.019	0.018	-1.062	0.288
Male	0.057	0.190	0.299	0.765
Age (categorical), ≥70, <80	0.327	0.256	1.274	0.203
Age (categorical), ≥80	-0.129	0.414	-0.310	0.756
Race, Black	0.026	0.598	0.044	0.965
Ethnicity, Hispanic	-0.993	1.196	-0.830	0.406
Race, North American Native	0.300	1.363	0.220	0.826
Race, Other	-14.270	589.100	-0.024	0.981
Race, Unknown	-12.840	926.400	-0.014	0.989
Race, White	0.174	0.542	0.322	0.748
Alzheimer Dementia	0.580	0.320	1.813	0.070
Myocardial Infarction	-0.265	0.363	-0.730	0.466
Anemia	0.216	0.170	1.272	0.203
Asthma	0.006	0.243	0.026	0.980
Atrial Fibrillation	0.046	0.206	0.223	0.824
Breast Cancer	-0.892	0.562	-1.587	0.112
Colorectal Cancer	-0.449	0.463	-0.969	0.332
Endometrial Cancer	-13.620	689.000	-0.020	0.984
Lung Cancer	-0.478	0.469	-1.020	0.308
Prostate Cancer	0.227	0.304	0.747	0.455
Cataract	-0.285	0.170	-1.673	0.094
Congestive Heart Failure	-0.112	0.173	-0.648	0.517
Chronic Kidney Disease	-0.729	0.207	-3.520	0.000
End Stage Renal Disease	0.070	0.561	0.125	0.900
Chronic Obstructive Pulmonary Disease	-0.203	0.164	-1.234	0.217
Depression	-0.338	0.199	-1.698	0.090
Diabetes	0.239	0.173	1.384	0.166
Glaucoma	-0.341	0.231	-1.475	0.140
Hip Fracture	0.669	0.456	1.466	0.143
Hyperlipidemia	-0.478	0.186	-2.568	0.010
Hypertension	0.269	0.272	0.988	0.323
Benign Prostatic Hyperplasia	-0.356	0.221	-1.609	0.108
Hypothyroidism	-0.003	0.226	-0.012	0.990
Ischemic Heart Disease	0.450	0.211	2.138	0.033
Osteoporosis	-0.165	0.270	-0.611	0.541
Arthritis	-0.324	0.168	-1.930	0.054

Stroke	-0.071	0.209	-0.341	0.733
Urgency (Urgent)	-0.342	0.278	-1.230	0.219
Urgency (Elective)	-0.492	0.215	-2.292	0.022
Urgency (Unknown)	-14.520	1024.000	-0.014	0.989
Prior Aortic Arch Replacement	0.606	0.454	1.336	0.181

Table S12. Sensitivity Analysis (Discontinuity): Baseline characteristics for the comparison after narrowing the population under investigation to the years immediately surrounding the discontinuity, i.e. 2004 to 2006.

	Before Matching			After Matching		
	TEVAR	Open Surgical Repair	SMD	TEVAR	Open Surgical Repair	SMD
	n = 919	n = 248		n = 496	n = 248	
Operative Year, median [IQR]	2006 [2006, 2006]	2004 [2004, 2005]	3.216	2006 [2006, 2006]	2004 [2004, 2005]	3.202
Age, mean (sd)	75.28 (7.69)	73.26 (7.73)	0.261	73.69 (7.72)	73.26 (7.73)	0.055
Age (categorical)			0.284			0.023
Age <70	226.0 (24.6)	74.0 (29.8)		143.0 (28.8)	74.0 (29.8)	
Age ≥ 70 and <80	434.0 (47.2)	133.0 (53.6)		269.0 (54.2)	133.0 (53.6)	
Age ≥ 80	259.0 (28.2)	41.0 (16.5)		84.0 (16.9)	41.0 (16.5)	
Male Gender	534.0 (58.1)	149.0 (60.1)	0.040	295.0 (59.5)	149.0 (60.1)	0.012
Race			0.163			0.068
Asian	18.0 (2.0)	5.0 (2.0)		11.0 (2.2)	5.0 (2.0)	
Black	77.0 (8.4)	23.0 (9.3)		40.0 (8.1)	23.0 (9.3)	
Hispanic	11.0 (1.2)	1.0 (0.4)		4.0 (0.8)	1.0 (0.4)	
North American Native	3.0 (0.3)	1.0 (0.4)		2.0 (0.4)	1.0 (0.4)	
Other	6.0 (0.7)	0.0 (0.0)		0.0 (0.0)	0.0 (0.0)	
Unknown	2.0 (0.2)	0.0 (0.0)		0.0 (0.0)	0.0 (0.0)	
White	802.0 (87.3)	218.0 (87.9)		439.0 (88.5)	218.0 (87.9)	
Alzheimer Dementia	55.0 (6.0)	17.0 (6.9)	0.036	31.0 (6.2)	17.0 (6.9)	0.024
Stroke or TIA	185.0 (20.1)	41.0 (16.5)	0.093	76.0 (15.3)	41.0 (16.5)	0.033
Depression	225.0 (24.5)	46.0 (18.5)	0.145	91.0 (18.3)	46.0 (18.5)	0.005
Myocardial Infarction	52.0 (5.7)	11.0 (4.4)	0.056	26.0 (5.2)	11.0 (4.4)	0.038
Atrial Fibrillation	193.0 (21.0)	48.0 (19.4)	0.041	100.0 (20.2)	48.0 (19.4)	0.020
Congestive Heart Failure	408.0 (44.4)	94.0 (37.9)	0.132	198.0 (39.9)	94.0 (37.9)	0.041
Ischemic Heart Disease	720.0 (78.3)	199.0 (80.2)	0.047	398.0 (80.2)	199.0 (80.2)	<0.001
Hypertension	833.0 (90.6)	218.0 (87.9)	0.089	445.0 (89.7)	218.0 (87.9)	0.058
Hyperlipidemia	703.0 (76.5)	165.0 (66.5)	0.222	345.0 (69.6)	165.0 (66.5)	0.065

Chronic Obstructive Pulmonary Disease	490.0 (53.3)	116.0 (46.8)	0.131	233.0 (47.0)	116.0 (46.8)	0.004
Asthma	123.0 (13.4)	30.0 (12.1)	0.039	63.0 (12.7)	30.0 (12.1)	0.018
Chronic Kidney Disease	272.0 (29.6)	44.0 (17.7)	0.282	95.0 (19.2)	44.0 (17.7)	0.036
Benign Prostatic Hyperplasia	214.0 (23.3)	41.0 (16.5)	0.170	90.0 (18.1)	41.0 (16.5)	0.043
End-stage Renal Disease	23.0 (2.5)	5.0 (2.0)	0.033	6.0 (1.2)	5.0 (2.0)	0.064
Diabetes	266.0 (28.9)	75.0 (30.2)	0.028	152.0 (30.6)	75.0 (30.2)	0.009
Hypothyroidism	147.0 (16.0)	33.0 (13.3)	0.076	64.0 (12.9)	33.0 (13.3)	0.012
Glaucoma	158.0 (17.2)	28.0 (11.3)	0.169	53.0 (10.7)	28.0 (11.3)	0.019
Cataract	569.0 (61.9)	122.0 (49.2)	0.258	261.0 (52.6)	122.0 (49.2)	0.069
Hip Fracture	24.0 (2.6)	8.0 (3.2)	0.036	14.0 (2.8)	8.0 (3.2)	0.024
Osteoporosis	132.0 (14.4)	25.0 (10.1)	0.131	50.0 (10.1)	25.0 (10.1)	<0.001
Arthritis	394.0 (42.9)	81.0 (32.7)	0.212	171.0 (34.5)	81.0 (32.7)	0.038
Anemia	506.0 (55.1)	129.0 (52.0)	0.061	261.0 (52.6)	129.0 (52.0)	0.012
Breast Cancer	38.0 (4.1)	4.0 (1.6)	0.151	6.0 (1.2)	4.0 (1.6)	0.034
Colorectal Cancer	39.0 (4.2)	6.0 (2.4)	0.102	14.0 (2.8)	6.0 (2.4)	0.025
Prostate Cancer	66.0 (7.2)	19.0 (7.7)	0.018	34.0 (6.9)	19.0 (7.7)	0.031
Lung Cancer	38.0 (4.1)	6.0 (2.4)	0.096	19.0 (3.8)	6.0 (2.4)	0.081
Endometrial Cancer	4.0 (0.4)	0.0 (0.0)	0.094	0.0 (0.0)	0.0 (0.0)	<0.001
Prior Aortic Valve Replacement	28.0 (3.0)	9.0 (3.6)	0.032	19.0 (3.8)	9.0 (3.6)	0.011
Prior Aortic Root Replacement	14.0 (1.5)	4.0 (1.6)	0.007	10.0 (2.0)	4.0 (1.6)	0.030
Prior Ascending Aortic Replacement	15.0 (1.6)	14.0 (5.6)	0.216	12.0 (2.4)	14.0 (5.6)	0.165
Prior Aortic Arch Replacement	17.0 (1.8)	9.0 (3.6)	0.109	14.0 (2.8)	9.0 (3.6)	0.046
Prior Mitral Valve Surgery	3.0 (0.3)	2.0 (0.8)	0.064	1.0 (0.2)	2.0 (0.8)	0.085
Prior Tricuspid Valve Surgery	0.0 (0.0)	0.0 (0.0)	<0.001	0.0 (0.0)	0.0 (0.0)	<0.001
Prior Coronary Artery Bypass Grafting	76.0 (8.3)	24.0 (9.7)	0.049	38.0 (7.7)	24.0 (9.7)	0.072
Prior Ventricular Assist Device	0.0 (0.0)	0.0 (0.0)	<0.001	0.0 (0.0)	0.0 (0.0)	<0.001
Prior Transplant	0.0 (0.0)	0.0 (0.0)	<0.001	0.0 (0.0)	0.0 (0.0)	<0.001
Subclavian Bypass	33.0 (3.6)	1.0 (0.4)	0.229	20.0 (4.0)	1.0 (0.4)	0.248

High-Volume Open Surgical Center	379.0 (41.2)	120.0 (48.4)	0.144	208.0 (41.9)	120.0 (48.4)	0.130
Urgency			0.175			0.069
Emergency	111.0 (12.1)	44.0 (17.7)		76.0 (15.3)	44.0 (17.7)	
Urgent	131.0 (14.3)	36.0 (14.5)		70.0 (14.1)	36.0 (14.5)	
Elective	675.0 (73.4)	168.0 (67.7)		350.0 (70.6)	168.0 (67.7)	
Unknown	2.0 (0.2)	0.0 (0.0)		0.0 (0.0)	0.0 (0.0)	

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