Clinical Outcomes of Atrial Fibrillation in Aortic Aneurysm Patients: Insights from the National Inpatient Sample

Analysis for RCOP NIS Cardio13

Ali Salman

## Preamble:

* **Reference Papers:**
  + [Kumi et al. 2024](https://doi.org/10.1136/bmjopen-2023-077839)
  + [Shrestha et al. 2023](https://onlinelibrary.wiley.com/doi/full/10.1002/joa3.12831)
* **Study Objective**: Examine the impact of atrial fibrillation on in-hospital mortality and length of stay among inpatient admissions with a principal diagnosis of aortic aneurysm (AA).
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection**: Included all inpatient admissions with a principal diagnosis of AA.
* **Aortic Aneurysm + Atrial Fibrillation Categories**:
  + Aortic Aneurysm with Atrial Fibrillation
  + Aortic Aneurysm without Atrial Fibrillation
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* **Secondary Outcomes**:
  + Ischemic Stroke
  + Acute Myocardial Infarction
  + Major Bleeding
  + Bleeding Requiring Transfusion
  + Arterial Embolism
* **Statistical Analysis**: Multiple logistic and linear regression to determine the independent association of atrial fibrillation with in-hospital mortality and length of stay, respectively, adjusted for:
  + Demographics: Age, sex, race, residential income, insurance, hospital region, hospital bedsize, hospital location, and teaching status.
  + Medical History: Aneurysm type, Ruptured/Unruptured, Hypertension, cerebrovascular disease, heart failure, diabetes mellitus, chronic kidney disease, chronic obstructive pulmonary disease, and HIV/AIDS.
  + CHA₂DS₂-VASc score
  + Long-term (current) anticoagulant use
* **Software:** All analyses were performed using R Version 4.4.1 (R Foundation for Statistical Computing, Vienna, Austria)

## Baseline Table:

| **Characteristic** | **Aortic Aneurysm without Atrial Fibrillation** N = 120,045 | **Aortic Aneurysm with Atrial Fibrillation** N = 27,375 | **p-value***1* | **Overall** N = 147,420 |
| --- | --- | --- | --- | --- |
| Age, y, Mean (SD) | 71 (11) | 74 (10) | <0.001 | 71 (11) |
| Sex, n (%) |  |  | 0.84 |  |
| Female | 33,055 (28) | 7,500 (27) |  | 40,555 (28) |
| Male | 86,990 (72) | 19,875 (73) |  | 106,865 (72) |
| Race, n (%) |  |  | <0.001 |  |
| White | 95,945 (82) | 22,835 (86) |  | 118,780 (83) |
| Asian or Pacific Islander | 2,575 (2.2) | 670 (2.5) |  | 3,245 (2.3) |
| Black | 9,465 (8.1) | 1,330 (5.0) |  | 10,795 (7.5) |
| Hispanic | 5,695 (4.9) | 1,135 (4.3) |  | 6,830 (4.8) |
| Other | 3,165 (2.7) | 665 (2.5) |  | 3,830 (2.7) |
| Residential income, n (%) |  |  | <0.001 |  |
| $1 - $51,999 | 32,410 (27) | 6,270 (23) |  | 38,680 (27) |
| $52,000 - $65,999 | 32,815 (28) | 7,090 (26) |  | 39,905 (28) |
| $66,000 - $87,999 | 29,230 (25) | 7,275 (27) |  | 36,505 (25) |
| $88,000 or more | 23,620 (20) | 6,290 (23) |  | 29,910 (21) |
| Expected primary payer, n (%) |  |  | <0.001 |  |
| Private | 26,255 (22) | 5,035 (18) |  | 31,290 (21) |
| Medicaid | 5,655 (4.7) | 905 (3.3) |  | 6,560 (4.4) |
| Medicare | 88,135 (73) | 21,435 (78) |  | 109,570 (74) |
| Hospital region, n (%) |  |  | <0.001 |  |
| Midwest | 30,130 (25) | 7,140 (26) |  | 37,270 (25) |
| Northeast | 21,630 (18) | 5,010 (18) |  | 26,640 (18) |
| South | 47,790 (40) | 10,060 (37) |  | 57,850 (39) |
| West | 20,495 (17) | 5,165 (19) |  | 25,660 (17) |
| Hospital bedsize, n (%) |  |  | 0.001 |  |
| Large | 75,230 (63) | 17,970 (66) |  | 93,200 (63) |
| Medium | 29,815 (25) | 6,395 (23) |  | 36,210 (25) |
| Small | 15,000 (12) | 3,010 (11) |  | 18,010 (12) |
| Hospital location and teaching status, n (%) |  |  | <0.001 |  |
| Rural | 4,375 (3.6) | 705 (2.6) |  | 5,080 (3.4) |
| Urban, non-teaching | 15,500 (13) | 2,975 (11) |  | 18,475 (13) |
| Urban, teaching | 100,170 (83) | 23,695 (87) |  | 123,865 (84) |
| Aneurysm location, n (%) |  |  | <0.001 |  |
| Abdominal | 92,705 (78) | 16,045 (59) |  | 108,750 (74) |
| Thoracic | 21,820 (18) | 9,925 (36) |  | 31,745 (22) |
| Thoracoabdominal | 5,010 (4.2) | 1,310 (4.8) |  | 6,320 (4.3) |
| Ruptured aortic aneurysm, n (%) |  |  | <0.001 |  |
| Unruptured | 109,120 (91) | 24,405 (89) |  | 133,525 (91) |
| Ruptured | 10,925 (9.1) | 2,970 (11) |  | 13,895 (9.4) |
| Hypertension, n (%) |  |  | <0.001 |  |
| 0 | 23,035 (19) | 3,725 (14) |  | 26,760 (18) |
| 1 | 97,010 (81) | 23,650 (86) |  | 120,660 (82) |
| Diabetes mellitus, n (%) |  |  | 0.12 |  |
| 0 | 97,550 (81) | 21,990 (80) |  | 119,540 (81) |
| 1 | 22,495 (19) | 5,385 (20) |  | 27,880 (19) |
| Heart Failure, n (%) | 16,350 (14) | 8,990 (33) | <0.001 | 25,340 (17) |
| Peripheral vascular disease, n (%) | 15,620 (13) | 3,120 (11) | 0.002 | 18,740 (13) |
| Chronic obstructive pulmonary disease, n (%) | 38,915 (32) | 9,435 (34) | 0.004 | 48,350 (33) |
| Dementia, n (%) | 3,735 (3.1) | 1,155 (4.2) | <0.001 | 4,890 (3.3) |
| Liver disease, n (%) | 2,870 (2.4) | 695 (2.5) | 0.53 | 3,565 (2.4) |
| Cancer, n (%) | 4,055 (3.4) | 990 (3.6) | 0.38 | 5,045 (3.4) |
| HIV/AIDS, n (%) | 775 (0.6) | 205 (0.7) | 0.39 | 980 (0.7) |
| Chronic kidney disease, n (%) | 22,720 (19) | 7,030 (26) | <0.001 | 29,750 (20) |
| Long-term (current) anticoagulant use, n (%) | 7,145 (6.0) | 8,750 (32) | <0.001 | 15,895 (11) |
| Prior stroke or thromboembolism, n (%) | 8,210 (6.8) | 2,535 (9.3) | <0.001 | 10,745 (7.3) |
| Vascular disease, n (%) | 68,770 (57) | 18,110 (66) | <0.001 | 86,880 (59) |
| CHA₂DS₂-VASc score, Mean (SD) | 3.28 (1.49) | 3.85 (1.48) | <0.001 | 3.39 (1.50) |
| *1*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Outcomes Table:

| **Characteristic** | **Aortic Aneurysm without Atrial Fibrillation** N = 120,045 | **Aortic Aneurysm with Atrial Fibrillation** N = 27,375 | **p-value***1* | **Overall** N = 147,420 |
| --- | --- | --- | --- | --- |
| Died during hospitalization, n (%) | 5,195 (4.3) | 1,555 (5.7) | <0.001 | 6,750 (4.6) |
| Length of stay (days), Median (IQR) | 2.0 (1.0 – 5.0) | 5.0 (1.0 – 8.0) | <0.001 | 2.0 (1.0 – 6.0) |
| Inflation-adjusted total charge ($), Median (IQR) | 129,647 (83,430 – 202,671) | 160,363 (97,994 – 262,751) | <0.001 | 134,672 (85,310 – 213,062) |
| Ischemic stroke, n (%) | 1,255 (1.0) | 675 (2.5) | <0.001 | 1,930 (1.3) |
| Transient ischemic attack, n (%) | 180 (0.1) | 100 (0.4) | 0.002 | 280 (0.2) |
| Acute myocardial infarction, n (%) | 1,585 (1.3) | 630 (2.3) | <0.001 | 2,215 (1.5) |
| Arterial embolism, n (%) | 7,060 (5.9) | 1,455 (5.3) | 0.11 | 8,515 (5.8) |
| Major Bleeding, n (%) | 3,215 (2.7) | 960 (3.5) | <0.001 | 4,175 (2.8) |
| Bleeding Requiring Transfusion, n (%) | 245 (0.2) | 115 (0.4) | 0.003 | 360 (0.2) |
| *1*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | |

## Multivariable Logistic Regression:

### All-Cause Mortality:

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.07 (0.90 to 1.27) | 0.46 |
| Age, y | 1.02 (1.01 to 1.03) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 0.74 (0.62 to 0.87) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.96 (0.61 to 1.49) | 0.84 |
| Black | 0.87 (0.67 to 1.15) | 0.33 |
| Hispanic | 0.97 (0.72 to 1.31) | 0.85 |
| Other | 1.18 (0.84 to 1.66) | 0.34 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.92 (0.76 to 1.10) | 0.35 |
| $66,000 - $87,999 | 1.04 (0.87 to 1.24) | 0.70 |
| $88,000 or more | 0.82 (0.67 to 1.01) | 0.068 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.14 (0.78 to 1.67) | 0.49 |
| Medicare | 0.86 (0.70 to 1.05) | 0.14 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.23 (0.99 to 1.51) | 0.059 |
| South | 1.10 (0.91 to 1.31) | 0.32 |
| West | 1.08 (0.86 to 1.35) | 0.51 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 1.19 (1.02 to 1.39) | 0.027 |
| Small | 1.16 (0.94 to 1.43) | 0.18 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.97 (0.67 to 1.40) | 0.87 |
| Urban, teaching | 0.86 (0.62 to 1.20) | 0.37 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 1.27 (1.06 to 1.52) | 0.010 |
| Thoracoabdominal | 3.25 (2.44 to 4.32) | <0.001 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 24.2 (21.2 to 27.6) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | 0.41 (0.34 to 0.49) | <0.001 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | 0.78 (0.64 to 0.95) | 0.012 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 1.48 (1.24 to 1.77) | <0.001 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.94 (0.76 to 1.17) | 0.57 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.89 (0.77 to 1.03) | 0.13 |
| Dementia |  |  |
| No | — |  |
| Yes | 1.34 (1.03 to 1.74) | 0.029 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.30 (0.86 to 1.96) | 0.22 |
| Cancer |  |  |
| No | — |  |
| Yes | 0.89 (0.61 to 1.29) | 0.54 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 0.88 (0.45 to 1.72) | 0.71 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.10 (0.93 to 1.30) | 0.25 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | 0.65 (0.52 to 0.82) | <0.001 |
| CHA₂DS₂-VASc score | 1.21 (1.11 to 1.31) | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |

### Ischemic Stroke

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.85 (1.36 to 2.51) | <0.001 |
| Age, y | 0.90 (0.89 to 0.91) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 5.82 (4.36 to 7.76) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.10 (0.50 to 2.44) | 0.81 |
| Black | 1.44 (0.89 to 2.33) | 0.13 |
| Hispanic | 1.54 (0.90 to 2.61) | 0.11 |
| Other | 0.66 (0.33 to 1.32) | 0.24 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 1.26 (0.87 to 1.81) | 0.22 |
| $66,000 - $87,999 | 1.27 (0.85 to 1.89) | 0.24 |
| $88,000 or more | 1.10 (0.73 to 1.64) | 0.65 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.17 (0.66 to 2.10) | 0.59 |
| Medicare | 0.43 (0.30 to 0.61) | <0.001 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.35 (0.90 to 2.01) | 0.14 |
| South | 1.12 (0.79 to 1.58) | 0.52 |
| West | 1.04 (0.67 to 1.62) | 0.85 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.89 (0.64 to 1.25) | 0.50 |
| Small | 0.79 (0.48 to 1.28) | 0.34 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 3.45 (0.89 to 13.3) | 0.072 |
| Urban, teaching | 3.16 (0.86 to 11.6) | 0.083 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 6.11 (4.53 to 8.25) | <0.001 |
| Thoracoabdominal | 6.68 (4.16 to 10.7) | <0.001 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 3.81 (2.70 to 5.39) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | 0.06 (0.04 to 0.08) | <0.001 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | 0.12 (0.09 to 0.18) | <0.001 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 0.14 (0.10 to 0.19) | <0.001 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.47 (0.32 to 0.68) | <0.001 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.79 (0.59 to 1.06) | 0.11 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.38 (0.16 to 0.92) | 0.033 |
| Liver disease |  |  |
| No | — |  |
| Yes | 0.70 (0.27 to 1.80) | 0.46 |
| Cancer |  |  |
| No | — |  |
| Yes | 0.54 (0.21 to 1.38) | 0.20 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 2.53 (1.00 to 6.43) | 0.051 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.94 (0.68 to 1.29) | 0.69 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | 0.38 (0.23 to 0.61) | <0.001 |
| CHA₂DS₂-VASc score | 7.91 (7.11 to 8.79) | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |

### Transient Ischemic Attack

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.96 (1.01 to 3.80) | 0.047 |
| Age, y | 0.90 (0.88 to 0.92) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 7.20 (3.62 to 14.3) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.00 (0.00 to 0.00) | <0.001 |
| Black | 1.16 (0.39 to 3.39) | 0.79 |
| Hispanic | 0.73 (0.20 to 2.69) | 0.63 |
| Other | 1.04 (0.23 to 4.77) | 0.95 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.85 (0.38 to 1.92) | 0.70 |
| $66,000 - $87,999 | 1.02 (0.45 to 2.31) | 0.96 |
| $88,000 or more | 0.79 (0.32 to 1.92) | 0.60 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.89 (0.19 to 4.14) | 0.88 |
| Medicare | 0.54 (0.26 to 1.14) | 0.11 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.74 (0.25 to 2.17) | 0.58 |
| South | 1.32 (0.62 to 2.83) | 0.47 |
| West | 1.46 (0.58 to 3.66) | 0.42 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 1.07 (0.51 to 2.21) | 0.86 |
| Small | 0.78 (0.27 to 2.22) | 0.64 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.28 (0.25 to 6.50) | 0.76 |
| Urban, teaching | 0.56 (0.12 to 2.55) | 0.46 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 3.32 (1.86 to 5.96) | <0.001 |
| Thoracoabdominal | 1.25 (0.27 to 5.77) | 0.77 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 0.35 (0.09 to 1.39) | 0.13 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | 0.09 (0.04 to 0.20) | <0.001 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | 0.17 (0.08 to 0.35) | <0.001 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 0.13 (0.06 to 0.27) | <0.001 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 1.14 (0.58 to 2.25) | 0.70 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.91 (0.48 to 1.73) | 0.77 |
| Dementia |  |  |
| No | — |  |
| Yes | 2.21 (0.72 to 6.76) | 0.16 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.72 (0.34 to 8.58) | 0.51 |
| Cancer |  |  |
| No | — |  |
| Yes | 0.35 (0.03 to 4.04) | 0.40 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 6.81 (0.74 to 63.0) | 0.091 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.64 (0.86 to 3.10) | 0.13 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | 0.63 (0.26 to 1.48) | 0.29 |
| CHA₂DS₂-VASc score | 6.37 (5.34 to 7.59) | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |

### Acute Myocardial Infarction

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.58 (1.23 to 2.04) | <0.001 |
| Age, y | 0.96 (0.95 to 0.97) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.98 (1.54 to 2.54) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.54 (0.86 to 2.76) | 0.15 |
| Black | 0.96 (0.66 to 1.41) | 0.85 |
| Hispanic | 1.32 (0.87 to 2.00) | 0.19 |
| Other | 1.21 (0.72 to 2.04) | 0.47 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.85 (0.64 to 1.13) | 0.26 |
| $66,000 - $87,999 | 0.92 (0.70 to 1.21) | 0.56 |
| $88,000 or more | 0.87 (0.64 to 1.20) | 0.40 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.86 (0.52 to 1.43) | 0.57 |
| Medicare | 0.67 (0.51 to 0.89) | 0.006 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.00 (0.73 to 1.37) | 0.99 |
| South | 0.94 (0.73 to 1.23) | 0.67 |
| West | 1.06 (0.77 to 1.44) | 0.73 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.95 (0.74 to 1.23) | 0.72 |
| Small | 0.99 (0.72 to 1.37) | 0.97 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.21 (0.57 to 2.54) | 0.62 |
| Urban, teaching | 1.64 (0.83 to 3.24) | 0.15 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 0.80 (0.60 to 1.05) | 0.10 |
| Thoracoabdominal | 1.15 (0.74 to 1.79) | 0.53 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 4.90 (3.94 to 6.09) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | 0.35 (0.27 to 0.47) | <0.001 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | 0.42 (0.32 to 0.56) | <0.001 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 1.40 (1.09 to 1.79) | 0.008 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.98 (0.72 to 1.34) | 0.92 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.97 (0.78 to 1.20) | 0.77 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.92 (0.55 to 1.55) | 0.77 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.28 (0.72 to 2.26) | 0.39 |
| Cancer |  |  |
| No | — |  |
| Yes | 0.93 (0.54 to 1.62) | 0.81 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 1.12 (0.35 to 3.58) | 0.84 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.35 (1.07 to 1.70) | 0.012 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | 0.39 (0.26 to 0.59) | <0.001 |
| CHA₂DS₂-VASc score | 1.99 (1.83 to 2.16) | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |

### Major Bleeding

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.21 (1.01 to 1.45) | 0.035 |
| Age, y | 1.00 (0.99 to 1.01) | 0.46 |
| Sex |  |  |
| Female | — |  |
| Male | 1.15 (0.96 to 1.38) | 0.13 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.68 (0.39 to 1.20) | 0.19 |
| Black | 1.42 (1.10 to 1.82) | 0.006 |
| Hispanic | 1.51 (1.13 to 2.02) | 0.006 |
| Other | 0.70 (0.41 to 1.20) | 0.19 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.94 (0.78 to 1.14) | 0.55 |
| $66,000 - $87,999 | 0.96 (0.78 to 1.17) | 0.67 |
| $88,000 or more | 1.04 (0.84 to 1.30) | 0.71 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.76 (0.47 to 1.23) | 0.27 |
| Medicare | 1.00 (0.80 to 1.25) | 0.98 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.70 (0.55 to 0.89) | 0.004 |
| South | 0.98 (0.81 to 1.19) | 0.87 |
| West | 1.12 (0.89 to 1.41) | 0.33 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.94 (0.78 to 1.13) | 0.51 |
| Small | 1.08 (0.87 to 1.34) | 0.48 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.01 (0.64 to 1.59) | 0.97 |
| Urban, teaching | 1.07 (0.70 to 1.63) | 0.75 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 0.83 (0.69 to 1.02) | 0.071 |
| Thoracoabdominal | 1.29 (0.96 to 1.72) | 0.089 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 2.09 (1.71 to 2.55) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | 0.67 (0.54 to 0.84) | <0.001 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | 0.61 (0.49 to 0.75) | <0.001 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 0.77 (0.63 to 0.94) | 0.011 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 1.0 (0.81 to 1.22) | 0.96 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 1.26 (1.08 to 1.47) | 0.003 |
| Dementia |  |  |
| No | — |  |
| Yes | 1.32 (0.97 to 1.81) | 0.078 |
| Liver disease |  |  |
| No | — |  |
| Yes | 2.69 (1.94 to 3.73) | <0.001 |
| Cancer |  |  |
| No | — |  |
| Yes | 0.95 (0.65 to 1.39) | 0.77 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 1.12 (0.49 to 2.56) | 0.79 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.31 (1.10 to 1.55) | 0.002 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | 0.80 (0.62 to 1.03) | 0.079 |
| CHA₂DS₂-VASc score | 1.45 (1.34 to 1.57) | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |

### Bleeding Requiring Transfusion

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.90 (1.04 to 3.47) | 0.035 |
| Age, y | 1.05 (1.01 to 1.09) | 0.015 |
| Sex |  |  |
| Female | — |  |
| Male | 0.70 (0.38 to 1.28) | 0.25 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.69 (0.57 to 5.08) | 0.35 |
| Black | 2.04 (0.95 to 4.38) | 0.068 |
| Hispanic | 1.60 (0.62 to 4.08) | 0.33 |
| Other | 1.70 (0.50 to 5.83) | 0.40 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.95 (0.47 to 1.94) | 0.89 |
| $66,000 - $87,999 | 0.87 (0.41 to 1.84) | 0.71 |
| $88,000 or more | 1.14 (0.58 to 2.25) | 0.70 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.03 (0.22 to 4.79) | 0.96 |
| Medicare | 0.71 (0.32 to 1.60) | 0.41 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 2.57 (1.08 to 6.12) | 0.032 |
| South | 2.35 (0.98 to 5.64) | 0.056 |
| West | 2.20 (0.84 to 5.79) | 0.11 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 1.73 (0.98 to 3.04) | 0.058 |
| Small | 2.40 (1.24 to 4.62) | 0.009 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.53 (0.18 to 1.54) | 0.24 |
| Urban, teaching | 0.30 (0.11 to 0.80) | 0.016 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 0.87 (0.41 to 1.83) | 0.72 |
| Thoracoabdominal | 0.93 (0.29 to 3.02) | 0.91 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 6.54 (3.87 to 11.0) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | 0.93 (0.47 to 1.83) | 0.83 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | 1.08 (0.53 to 2.21) | 0.83 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 0.91 (0.48 to 1.74) | 0.78 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.42 (0.15 to 1.21) | 0.11 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 1.41 (0.88 to 2.25) | 0.15 |
| Dementia |  |  |
| No | — |  |
| Yes | 1.86 (0.93 to 3.72) | 0.079 |
| Liver disease |  |  |
| No | — |  |
| Yes | 0.58 (0.07 to 4.52) | 0.60 |
| Cancer |  |  |
| No | — |  |
| Yes | 2.74 (1.12 to 6.69) | 0.027 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 2.01 (0.28 to 14.2) | 0.49 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.73 (1.05 to 2.83) | 0.030 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | 0.52 (0.21 to 1.26) | 0.15 |
| CHA₂DS₂-VASc score | 1.10 (0.82 to 1.49) | 0.52 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |

### Arterial Embolism

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.10 (0.94 to 1.29) | 0.22 |
| Age, y | 0.98 (0.97 to 0.99) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 0.69 (0.61 to 0.79) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.88 (0.60 to 1.31) | 0.54 |
| Black | 1.00 (0.81 to 1.22) | 0.97 |
| Hispanic | 1.33 (1.07 to 1.64) | 0.009 |
| Other | 1.18 (0.87 to 1.58) | 0.29 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.92 (0.80 to 1.05) | 0.21 |
| $66,000 - $87,999 | 1.02 (0.89 to 1.18) | 0.76 |
| $88,000 or more | 0.85 (0.72 to 1.00) | 0.051 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.09 (0.84 to 1.43) | 0.50 |
| Medicare | 1.04 (0.89 to 1.21) | 0.65 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.02 (0.86 to 1.21) | 0.79 |
| South | 1.01 (0.88 to 1.16) | 0.88 |
| West | 1.12 (0.95 to 1.32) | 0.19 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.94 (0.83 to 1.07) | 0.35 |
| Small | 0.82 (0.69 to 0.97) | 0.022 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.84 (0.60 to 1.19) | 0.33 |
| Urban, teaching | 1.12 (0.82 to 1.53) | 0.46 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 0.31 (0.26 to 0.38) | <0.001 |
| Thoracoabdominal | 1.22 (0.99 to 1.52) | 0.067 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 1.99 (1.72 to 2.31) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | 0.80 (0.68 to 0.93) | 0.005 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | 0.78 (0.67 to 0.91) | 0.002 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 1.03 (0.87 to 1.21) | 0.74 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 2.67 (2.36 to 3.03) | <0.001 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 1.12 (1.00 to 1.24) | 0.046 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.92 (0.68 to 1.25) | 0.60 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.29 (0.96 to 1.74) | 0.10 |
| Cancer |  |  |
| No | — |  |
| Yes | 0.94 (0.71 to 1.24) | 0.66 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 0.93 (0.48 to 1.77) | 0.81 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.23 (1.08 to 1.41) | 0.002 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | 0.81 (0.67 to 0.99) | 0.041 |
| CHA₂DS₂-VASc score | 1.08 (1.01 to 1.15) | 0.027 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 1.7 (1.4 to 1.9) | <0.001 |
| Age, y | -0.08 (-0.10 to -0.07) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 0.10 (-0.11 to 0.32) | 0.35 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.0 (0.40 to 1.7) | 0.001 |
| Black | 0.98 (0.59 to 1.4) | <0.001 |
| Hispanic | 0.98 (0.57 to 1.4) | <0.001 |
| Other | -0.09 (-0.49 to 0.31) | 0.65 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | -0.05 (-0.24 to 0.15) | 0.63 |
| $66,000 - $87,999 | 0.04 (-0.17 to 0.26) | 0.69 |
| $88,000 or more | -0.13 (-0.35 to 0.10) | 0.26 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.3 (0.74 to 1.9) | <0.001 |
| Medicare | 0.09 (-0.14 to 0.32) | 0.43 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.65 (0.36 to 0.94) | <0.001 |
| South | 0.35 (0.14 to 0.56) | 0.001 |
| West | 0.17 (-0.07 to 0.41) | 0.17 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | -0.60 (-0.78 to -0.42) | <0.001 |
| Small | -0.84 (-1.0 to -0.64) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.38 (0.04 to 0.72) | 0.031 |
| Urban, teaching | 1.2 (0.92 to 1.6) | <0.001 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 2.8 (2.6 to 3.0) | <0.001 |
| Thoracoabdominal | 4.4 (3.8 to 5.1) | <0.001 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 3.7 (3.3 to 4.1) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | -1.3 (-1.5 to -0.98) | <0.001 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | -0.71 (-0.93 to -0.48) | <0.001 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 1.1 (0.80 to 1.5) | <0.001 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.22 (0.02 to 0.43) | 0.031 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.30 (0.14 to 0.46) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.61 (0.11 to 1.1) | 0.017 |
| Liver disease |  |  |
| No | — |  |
| Yes | 0.69 (0.18 to 1.2) | 0.008 |
| Cancer |  |  |
| No | — |  |
| Yes | 0.83 (0.29 to 1.4) | 0.003 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | 0.32 (-0.69 to 1.3) | 0.54 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.2 (1.0 to 1.5) | <0.001 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | -0.94 (-1.2 to -0.71) | <0.001 |
| CHA₂DS₂-VASc score | 0.60 (0.48 to 0.71) | <0.001 |
| Abbreviation: CI = Confidence Interval | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Aortic Aneurysm without Atrial Fibrillation | — |  |
| Aortic Aneurysm with Atrial Fibrillation | 29,924 (22,839 to 37,009) | <0.001 |
| Age, y | -2,127 (-2,540 to -1,715) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 20,648 (12,696 to 28,599) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 20,747 (1,968 to 39,527) | 0.030 |
| Black | 14,971 (3,438 to 26,504) | 0.011 |
| Hispanic | 36,626 (23,024 to 50,228) | <0.001 |
| Other | 15,915 (-3,249 to 35,080) | 0.10 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 6,143 (533 to 11,754) | 0.032 |
| $66,000 - $87,999 | 7,371 (128 to 14,615) | 0.046 |
| $88,000 or more | 12,199 (3,636 to 20,761) | 0.005 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 14,890 (-107 to 29,888) | 0.052 |
| Medicare | 7,997 (708 to 15,286) | 0.032 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 25,520 (13,214 to 37,826) | <0.001 |
| South | 28,841 (22,126 to 35,556) | <0.001 |
| West | 82,672 (64,444 to 100,901) | <0.001 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | -15,433 (-23,535 to -7,332) | <0.001 |
| Small | -21,765 (-31,708 to -11,822) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 41,274 (31,156 to 51,393) | <0.001 |
| Urban, teaching | 53,906 (45,439 to 62,374) | <0.001 |
| Aneurysm location |  |  |
| Abdominal | — |  |
| Thoracic | 51,460 (42,469 to 60,451) | <0.001 |
| Thoracoabdominal | 113,157 (91,755 to 134,559) | <0.001 |
| Ruptured aortic aneurysm |  |  |
| Unruptured | — |  |
| Ruptured | 75,828 (65,292 to 86,364) | <0.001 |
| Hypertension |  |  |
| 0 | — |  |
| 1 | -33,090 (-41,318 to -24,863) | <0.001 |
| Diabetes mellitus |  |  |
| 0 | — |  |
| 1 | -11,144 (-18,485 to -3,802) | 0.003 |
| Heart Failure |  |  |
| No | — |  |
| Yes | 28,435 (16,288 to 40,582) | <0.001 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 6,988 (1,206 to 12,770) | 0.018 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | -542 (-5,801 to 4,717) | 0.84 |
| Dementia |  |  |
| No | — |  |
| Yes | -32,056 (-42,461 to -21,651) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1,160 (-12,457 to 14,777) | 0.87 |
| Cancer |  |  |
| No | — |  |
| Yes | 12,019 (-26 to 24,064) | 0.050 |
| HIV/AIDS |  |  |
| No | — |  |
| Yes | -12,971 (-43,172 to 17,230) | 0.40 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 19,464 (11,463 to 27,464) | <0.001 |
| Long-term (current) anticoagulant use |  |  |
| No | — |  |
| Yes | -24,774 (-31,380 to -18,167) | <0.001 |
| CHA₂DS₂-VASc score | 12,884 (9,184 to 16,583) | <0.001 |
| Abbreviation: CI = Confidence Interval | | |