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Insurance Status is Associated with Acuity of Presentation and Outcomes for Thoracic Aortic Operations

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Abstract

Background—Non-elective procedure status is the greatest risk factor for postoperative morbidity and mortality in patients undergoing thoracic aortic operations. We hypothesized that uninsured patients were more likely to require non-elective thoracic aortic operation due to decreased access to preventative care and elective surgical services.

Methods and Results—An observational study of the Society of Thoracic Surgeons Database identified 51,282 patients who underwent thoracic aortic surgery between 2007–2011 at 940 North American centers. Patients were stratified by insurance status (private insurance, Medicare, Medicaid, other insurance, or uninsured) as well as age < 65 years or age ≥ 65 years to account for differences in Medicare eligibility. The need for non-elective thoracic aortic operation was highest for uninsured patients (71.7%) and lowest for privately insured patients (36.6%). The adjusted risks of non-elective operation were increased for uninsured patients (adjusted risk ratio [ARR], 1.77; 95% confidence interval [CI], 1.70–1.83 for age < 65 years; ARR, 1.46; 95% CI, 1.29–1.62 for age ≥ 65 years) as well as Medicaid patients age < 65 years (ARR, 1.18; 95% CI, 1.10–1.26) when compared to patients with private insurance. The adjusted odds of major morbidity and/or mortality were further increased for all patients age < 65 years without private insurance (ARRs between 1.13 and 1.27).

Conclusions—Insurance status was associated with acuity of presentation and major morbidity and mortality for thoracic aortic operations. Efforts to reduce insurance-based disparities in the care of patients with thoracic aortic disease appear warranted and may reduce the incidence of aortic emergencies and improve outcomes after thoracic aortic surgery.

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DISCLOSURES
None

Keywords

Surgery; aorta; outcomes

Aortic aneurysm and dissection account for 30–60,000 deaths per year in the United States, and surgical repair of the thoracic aorta represents a formidable and increasingly common challenge in cardiovascular medicine.[1–4] Advances in surgical technique and perioperative management have resulted in expected operative mortality rates of less than 5% for patients who undergo elective replacement of a diseased thoracic aortic segment.[1, 3] Conversely, emergency repair of thoracic aortic dissection or ruptured aneurysm portends a much poorer outcome, with up to 50% of such patients dying in the perioperative period.[3, 5, 6] Because approximately 40% of thoracic aortic procedures are performed in the non-elective setting, any strategy that can effectively reduce the need for emergency surgical intervention for thoracic aortic disease can be expected to result in a dramatic improvement in the overall outcomes associated with these conditions.[3]

Indirect evidence suggests that health insurance status might influence the need for and timing of operative intervention for thoracic aortic disease. Insured patients are not only more likely than those without insurance to reap the benefits of preventative cardiovascular services, but may also be more likely to receive appropriate surveillance for disease progression and more timely referral for elective surgical repair when indicated.[7–12] Although an association between insurance status and timing of surgery has been documented for patients with abdominal aortic aneurysmal disease, to date no published study has described such a relationship for patients with thoracic aortic disease.[13, 14] Because it includes approximately 94% of all cardiothoracic surgical procedures performed in the United States each year, the Society of Thoracic Surgeons Adult Cardiac Surgery Database provides a unique opportunity to determine whether patient insurance status impacts the timing of thoracic aortic surgery.[15] The objective of the current study was to use this data source to test the hypothesis that uninsured patients undergoing thoracic aortic procedures are more likely to require non-elective intervention when compared to patients with health insurance.

METHODS

Data Source

The STS Adult Cardiac Surgery Database (ACSD) is the largest specialty-specific clinical data registry in the world. The database currently houses more than 4.5 million surgical records from 1,091 participating centers, representing an estimated 94 percent of all adult cardiac surgery centers across the United States.[15] Participating centers report more than 300 data elements for each episode of cardiac surgery using a standardized data collection form. The quality of the STS ACSD data has been assessed in a regional independent chart abstraction study, which documented a 96% correlation between submitted and abstracted data elements.[16] The present study was approved by the Access and Publications Committee of the STS Workforce for National Databases as well as by the Duke University Institutional Review Board.

Study Population

The study population consisted of a final cohort of 51,282 patients who underwent aortic root, ascending aorta, arch, descending aorta, and /or thoracoabdominal aorta repair between 2007 and 2011 (STS data collection form version 2.61). Cases were excluded if they (1) indicated aortic dissection as a post-operative complication of cardiac surgery (n=163), (2) indicated cardiac trauma as the indication for non-elective operation (n=104), or (3) had incomplete data for insurance status (n=928) or procedure status (n=29).

Variable Definitions

Medicare is a national health insurance program administered by the U.S. federal government that provides health insurance for people age 65 or older, people under age 65 with certain disabilities, and people of all ages with end-stage renal disease (ESRD) requiring dialysis or a kidney transplant. Patients with Medicare also commonly enroll in supplemental insurance programs offered through private vendors (employer-sponsored, Medicare Advantage, or Medigap plans) to cover costs not covered by Medicare.[17] Medicaid is jointly funded by state and federal governments and is a health insurance program that provides health insurance for lower-income people, families and children, the elderly, and people with disabilities.[18] Medicaid reimburses practitioners at lower rates than other forms of insurance, and patients with Medicaid are generally considered underinsured.[19–21]

Patients were assigned to one of five exclusive, hierarchical insurance status categories, and patients possessing more than one type of insurance were placed in the category of highest ranking: (1) private insurance (commercial health insurance or health maintenance organization), (2) Medicare, (3) Medicaid, (4) other insurance (military health care, state-specific plan, Indian Health Service, non-U.S. insurance), or (5) none / self-pay. All other study variables were defined using standard STS definitions, including race/ethnicity which was assessed using open-ended patient designation.[22]

Study Outcomes

The primary outcome of interest was non-elective procedure status, defined as patients undergoing urgent or emergent operation. The decision to combine urgent and emergent patients into one category for comparison was made *a priori* and was based on the presumption that differences between elective and non-elective operations were most likely to be partially influenced by health system-level factors such as insurance status, as well as the recognition that patients requiring non-elective thoracic aortic operation (either urgent or emergent) are all at a significantly increased risk of operative mortality and/or major morbidity.[3] The secondary outcome was a composite endpoint of operative mortality and/or major morbidity, where operative mortality was defined as death from any cause either in-hospital or within 30 days of the index procedure, and major morbidity was defined using the standard STS database composite of stroke, renal failure, prolonged ventilation, deep sternal wound infection, and reoperation.[22]

Statistical Analysis

A decision was made *a priori* to stratify the analyses by patient age (age < 65 years vs. age ≥ 65 years) in recognition of the fact that a majority of younger patients in the United States are insured through private insurance programs, while older patients are universally eligible for Medicare. Baseline patient characteristics, operative parameters, and outcomes were summarized by percentages or mean (standard deviation). Logistic regression modeling with generalized estimating equations was used to estimate the association between insurance status category (private insurance, referent) and outcome. The association between insurance status and non-elective procedure status was risk-adjusted for the following preoperative patient characteristics: age, left ventricular ejection fraction, time trend, female sex, race/ethnicity, body mass index, current or recent smoker, dyslipidemia, hypertension, peripheral vascular disease, immunosuppressive treatment, left main coronary artery disease, mitral stenosis, aortic stenosis, mitral insufficiency, aortic insufficiency, preoperative arrhythmia, active endocarditis, prior cardiac surgery, prior percutaneous coronary intervention, glomerular filtration rate, dialysis use, angina, unstable angina, acute myocardial infarction, distant myocardial infarction, chronic lung disease, cerebrovascular disease, diabetes, number of diseased coronary vessels, and congestive heart failure. The association between insurance status and major morbidity and/or mortality was further adjusted for procedural variables including procedure status, preoperative shock, segments of aorta involved, concomitant coronary artery bypass grafting (CABG), concomitant aortic valve procedure, and concomitant mitral valve procedure. Robust sandwich variance estimates were used to obtain 95% confidence intervals to account for statistical dependence of patients within sites. Odds ratios were corrected for outcome incidence to obtain estimated risk ratios, as previously described.[23]

RESULTS

Patient Characteristics

A total of 28,549 patients < 65 years of age and 22,733 patients ≥ 65 years of age met study inclusion criteria. Of those patients < 65 years of age, 20,854 (73.0%) had private insurance, 1,837 (6.4%) had Medicare, 1,822 (6.4%) had Medicaid, 1,085 (3.8%) had other insurance, and 2,951 (10.3%) had no insurance. Of those patients ≥ 65 years of age, 14,568 (64.1%) had private insurance, 7,455 (32.8%) had Medicare, 155 (0.7%) had Medicaid, 212 (0.9%) had other insurance, and 343 (1.5%) had no insurance. Of the privately insured elderly patients, 3,143 (21.6%) had private insurance alone whereas 11,425 (78.4%) had private insurance in addition to Medicare. Thus, a total of 18,880 (83.1%) patients ≥ 65 years of age were covered by Medicare, of which 11,425 (60.5%) had supplemental private insurance and were placed in the private insurance group due to the hierarchical classification system.

Table 1 depicts baseline characteristics for patients < 65 years of age. In general, Medicaid and uninsured patients were more likely to be non-Caucasian than patients in other insurance groups. Uninsured patients also were generally younger, more likely to smoke, less likely to carry an established diagnosis of dyslipidemia, less likely to be taking anti-hypertensive and lipid-lowering medications, and less likely to have undergone previous cardiac surgery than patients with private insurance. Uninsured patients also appeared more likely to carry a

preoperative diagnosis of shock than patients in other insurance groups. Medicare patients tended to be older and have higher rates of comorbidities and preoperative dialysis when compared to the other insurance groups, consistent with the use of Medicare only for individuals with disabilities or ESRD in this age cohort.

Table 2 depicts baseline characteristics for patients ≥ 65 years of age. Similar to the younger cohort, uninsured elderly patients were more likely to be non-Caucasian, less likely to carry a preoperative diagnosis of dyslipidemia, less likely to be taking anti-hypertensive and lipid-lowering medications, and more likely to present in preoperative shock than privately insured elderly patients. Otherwise, the elderly patients in the different insurance groups appeared to be more homogenous in their preoperative characteristics than patients from the younger cohort.

Clinical Presentations and Operative Parameters

Tables 3 and 4 report the clinical presentations and operative parameters of patients undergoing thoracic aortic operation, stratified by insurance status and age group. For patients < 65 years of age, the need for non-elective operation was highest for uninsured patients (73.2%) and lowest for privately insured patients (35.6%). Non-elective operation was most commonly required for aortic dissection (59.2%), valve dysfunction (17.5%), or anatomy (12.0%), the latter likely indicating symptomatic or unstable aneurysm disease. For patients ≥ 65 years of age, the need for non-elective operation was similarly highest for uninsured patients (58.9%) and lowest for privately insured patients (38.0%). In this cohort the major indications for non-elective operation were aortic dissection (49.6%), anatomy (18.1%), and valve dysfunction (16.3%). Compared to the younger cohort, the incidence of surgical intervention for distal (descending, thoracoabdominal) versus proximal (root, ascending, arch) aortic disease was increased in the age ≥ 65 cohort, consistent with these latter aortic diseases being more common in the elderly,[24] and also likely accounting for the finding of more frequent anatomy and less frequent dissection indications for non-elective operation as compared to the age < 65 group.

Table 5 depicts the association between insurance status and non-elective operation stratified by age. After adjustment for patient-related variables, uninsured patients (adjusted risk ratio [ARR], 1.77; 95% confidence interval [CI], 1.70–1.83) and patients with Medicaid (ARR, 1.18; 95% CI, 1.10–1.26) were significantly more likely to require non-elective surgery when compared to patients with private insurance (reference group). Lack of health insurance was also associated with a significantly greater incidence of non-elective operation for patients ≥ 65 years of age after adjustment for patient-related factors (ARR, 1.46; 95% CI, 1.29–1.62).

Operative Outcomes

Table 6 depicts postoperative outcomes for patients undergoing thoracic aortic operation, stratified by insurance status and age group. For patients < 65 years of age, the most common complications were prolonged mechanical ventilation and reoperation, both of which occurred with more frequency in uninsured patients compared to privately insured patients. Renal failure, stroke, and operative mortality rates were also higher in uninsured

patients. Similar findings were demonstrated for patients ≥ 65 years of age with regards to the incidence of specific complications after thoracic aortic operation, although the differences between uninsured and privately insured patients appeared to be less pronounced due largely to a greater incidence of complications in elderly privately insured patients relative to non-elderly privately insured patients.

Table 7 depicts the composite of mortality/major morbidity for patients undergoing thoracic aortic operation, stratified by insurance status and age group. For patients < 65 years of age, the risks of mortality/major morbidity were increased for all insurance status groups in reference to private insurance patients after adjustment for patient and procedural factors including procedure status, with ARRs ranging from 1.13 (95% CI, 1.06–1.21) for uninsured patients to 1.27 (95% CI, 1.18–1.37) for Medicare patients. Conversely, the adjusted risks of mortality/major morbidity did not differ significantly between insurance status groups in patients ≥ 65 years of age after risk adjustment.

DISCUSSION

The current analysis of 51,282 patients undergoing surgery for thoracic aortic disease demonstrates a clear association between patient insurance status and need for non-elective operation, with 73.8% of non-elderly and 58.9% of elderly patients without health insurance requiring urgent or emergent surgical intervention. After adjustment for patient-related factors, uninsured patients displayed a 77% (for non-elderly patients) and 46% (for elderly patients) increased risk of requiring non-elective operation compared to privately insured patients. Given the profound impact that timing of thoracic aortic surgery has on expected postoperative mortality, any significant reduction in the overall incidence of non-elective interventions that might result from increased health insurance coverage of patients with thoracic aortic disease could result in a reduction in the mortality associated with these conditions.[3, 5, 6] Further, given that aneurysm and dissection rank among the 15 leading causes of death for middle-aged and elderly Americans, as well as the fact that the incidence of these diseases appears to be increasing, the overall impact on the health care system of any intervention aimed at reducing the incidence of non-elective thoracic aortic intervention is likely to be significant.[1, 4]

Foremost among the potential explanations for the association between patient insurance status and timing of thoracic aortic surgery is that uninsured patients often lack access to cardiovascular services known to be important in preventing progression of thoracic aortic disease.[2, 24–28] Prior studies have demonstrated that uninsured patients are not only less likely than insured patients to receive adequate screening for hypertension or hypercholesterolemia, but are also less likely to receive adequate medical therapy when such conditions are diagnosed.[8–12] In addition, despite having a much greater prevalence of tobacco use, uninsured patients are less likely to participate in smoking cessation programs.[7, 8] Compounding this reduced access to preventative care is the strong likelihood that uninsured patients with known thoracic aortic disease will be less likely than insured patients to undergo screening for disease progression or to receive timely referral for elective surgery when indicated.[11] As suggested by the findings of the current study, these insurance-based disparities in prevention and management of thoracic aortic disease appear

to culminate in an increased risk of catastrophic aortic events and subsequent emergency operation for patients without health insurance. Furthermore, the gap between insured and uninsured patients may only be predicted to increase, as future efforts directed at reducing the 40% incidence of non-elective thoracic aortic operation amongst the general population, such as increased aortic screening, improved medical therapy, and lowering of size thresholds for elective aortic replacement,[3] will preferentially benefit those with stable access to the health care system.

This study also demonstrates a relationship between insurance status and outcomes after thoracic aortic surgery, which is independent of the timing of operative intervention. Adjusting for this variable, as well as a number of patient- and procedure-related factors, we found that non-elderly patients without private insurance were significantly more likely than those with private insurance to suffer mortality and/or major morbidity after thoracic aortic procedures. The association between insurance status and postoperative outcomes has been widely described for both cardiac and non-cardiac surgery and is likely multifactorial in etiology.[19–21, 29] Interestingly, a significant association between insurance status and postoperative outcomes could not be documented for the elderly patients in our study sample. Possible reasons for this finding include the relatively low number of elderly patients in the sample without health insurance, which would make potentially significant insurance-based outcomes disparities more difficult to detect, and the greater incidence of mortality/major morbidity in the elderly compared to non-elderly reference group (42% vs. 29%). Alternatively, it may also be possible that insurance status has a less pronounced effect on the outcomes of elderly surgical patients compared to non-elderly patients after adjustment for timing of operation.

The Congressional Budget Office estimates a reduction in the number of uninsured Americans by as many as 32 million if the provisions of the 2010 Affordable Care Act (ACA) are fully implemented.[30, 31] However, whether the ACA will ultimately result in a decreased need for emergency operation for thoracic aortic disease remains to be seen and will likely depend on the degree to which the ACA is implemented coupled with the larger changes to the health system that occur as a result of the legislation. Temporal reassessment of national rates of insurance enrollment and non-elective thoracic aortic operations will ultimately determine the impact of the ACA on this disease process.

Limitations

This study has several important limitations. First, the study sample does not include patients with catastrophic surgical thoracic aortic disease who either died before hospital presentation or in whom operation was deferred. As a result, the study is likely to understate the impact of insurance status on timing of thoracic aortic surgery since we have found that uninsured patients are more likely to present with acute aortic events necessitating non-elective operation. Second, the retrospective nature of the study makes it likely that potentially important factors that might confound the relationship between insurance status and the outcome variables were not included in the multivariable regression models. Other patient-related factors that have been found to influence surgical outcomes include patient education level, employment status, and socioeconomic status.[11, 30, 31] While it is therefore

possible that insurance status serves only as a marker for some other more explanatory socioeconomic factor(s), the inclusivity of the STS ACSD and the breadth of clinical variables that it records make it the most comprehensive source of risk adjustment currently available for analyses of cardiothoracic surgical outcomes. Finally, the precise mechanism explaining how/why uninsured thoracic aortic patients perform poorly in the health system is not directly addressed and could be the topic of further study.

Conclusion

Patients without health insurance, and to a lesser degree patients who are insured through Medicaid, are more likely than privately insured patients to require non-elective surgery for thoracic aortic disease and to experience postoperative mortality and/or major morbidity. Given the marked discrepancy in outcomes after elective versus non-elective thoracic aortic operations, any significant reduction in the number of uninsured patients with thoracic aortic disease may result in improved survival for patients with these conditions, an outcome with potential wide-reaching effects on the health care system at large given the lethality and increasing incidence of thoracic aortic disease.

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What is Known

- Nearly 40% of thoracic aortic operations are performed to treat acute aortic catastrophes, such as aneurysm rupture or aortic dissection, and non-elective surgery represents the greatest risk factor for postoperative morbidity and mortality following thoracic aortic operation.
- Lack of private health insurance has been associated with greater disease severity at presentation and worse postoperative outcomes in other realms of cardiovascular surgery.

What this Article Adds

- In the Society of Thoracic Surgeons database, the rates of non-elective thoracic aortic operation were highest for uninsured patients (71.7%) and lowest for privately insured patients (36.6%).
- After controlling for patient and procedural factors, insurance status was associated with acuity of presentation and major morbidity and mortality for thoracic aortic operations.
- Efforts to reduce insurance-based disparities in the care of patients with thoracic aortic disease appear warranted and may reduce the incidence of aortic emergencies and improve outcomes after thoracic aortic surgery.

Table 1

Baseline Characteristics of Patients Age < 65 Years Undergoing Thoracic Aortic Operation Stratified by Insurance Status[a]

Variable	Private Insurance (n = 20 854; 73.0%)	Medicare (n = 1 837; 6.4%)	Medicaid (n = 1 822; 6.4%)	Other Insurance (n = 1 085; 3.8%)	None/ Self-Pay (n = 2 951; 10.3%)
Age, y	51.5 (9.96)	52.4 (9.58)	46.8 (11.67)	50.3 (11.28)	48.2 (10.78)
Female	24.4	30.4	33.2	21.0	24.5
Race/ethnicity - White	86.3	72.5	64.0	73.0	67.3
- Black	7.7	22.0	24.9	16.3	22.4
- Asian	2.2	1.6	3.0	2.5	2.9
- Native American	0.2	0.2	0.7	1.3	0.4
- Other	2.5	2.0	4.3	5.1	4.9
Body mass index (kg/m^2)	29.5 (6.2)	29.2 (7.1)	29.2 (7.8)	29.1 (6.6)	29.0 (6.7)
Hypertension	65.4	80.1	68.6	68.9	68.0
Dyslipidemia	45.4	48.8	36.0	41.8	27.6
Preoperative medications - Beta blockers	58.6	65.7	63.0	58.1	58.0
- ACE-I or ARB	28.7	33.7	29.9	27.5	21.5
- Lipid-lowering	31.9	37.0	25.8	30.1	17.3
Diabetes mellitus - Non-insulin-dependent	7.8	11.6	9.1	9.0	6.6
- Insulin-dependent	2.2	7.4	4.2	3.0	2.2
Preoperative dialysis	1.3	11.4	2.6	1.3	1.1
Current or recent smoker	22.8	40.9	48.0	34.9	47.4
Chronic lung disease	12.8	27.7	21.8	16.5	13.2
History of - Stroke or TIA	7.0	18.2	12.5	6.9	7.5
- Congestive heart failure	18.7	28.9	27.2	23.4	20.4
Previous cardiac surgery	19.8	32.2	26.4	18.4	14.2
Preoperative shock	2.7	4.0	4.0	4.4	7.4

Abbreviations: ACE-I, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; TIA, transient ischemic attack.

[a]Data are presented as mean (standard deviation) or %.

Table 2

Baseline Characteristics of Patients Age ≥ 65 Years Undergoing Thoracic Aortic Operation Stratified by Insurance Status[a]

Variable	Private Insurance (n = 14 568; 64.1%)	Medicare (n = 7 455; 32.8%)	Medicaid (n = 155; 0.7%)	Other Insurance (n = 212; 0.9%)	None/ Self-Pay (n = 343; 1.5%)
Age, y	**73.4 (5.96)**	**73.7 (5.87)**	**72.1 (5.77)**	**72.1 (6.02)**	**73.2 (5.89)**
Female	40.3	44.1	55.5	27.4	40.8
Race/ethnicity - White	90.8	85.2	51.6	80.7	73.5
- Black	4.5	7.7	12.9	7.1	9.6
- Asian	1.7	3.0	14.2	6.1	8.2
- Native American	0.1	0.2	0.7	0.9	0
- Other	2.0	2.8	13.6	3.8	6.7
Body mass index (kg/m^2)	27.9 (5.4)	27.7 (5.7)	27.7 (6.3)	27.9 (4.9)	26.7 (4.9)
Hypertension	84.0	85.4	90.3	89.2	83.7
Dyslipidemia	66.2	63.9	59.4	69.8	49.0
Preoperative medications - Beta blockers	65.6	65.5	69.7	66.5	58.6
- ACE-I or ARB	36.6	35.8	39.4	36.8	31.2
- Lipid-lowering	50.5	48.7	37.4	55.7	35.0
Diabetes mellitus - Non-insulin-dependent	13.3	14.5	16.9	19.3	13.4
- Insulin-dependent	2.8	3.9	1.9	4.3	2.3
Preoperative dialysis	1.2	1.7	1.3	1.4	0.9
Current or recent smoker	15.4	19.1	20.7	28.9	15.5
Chronic lung disease	23.1	26.1	21.3	26.4	15.5
History of - Stroke or TIA	12.9	14.0	12.3	14.6	9.0
- Congestive heart failure	24.3	25.4	29.7	23.1	29.2
Previous cardiac surgery	19.5	19.4	12.3	23.6	13.7
Preoperative shock	3.2	3.9	0	6.1	7.0

Abbreviations: ACE-I, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; TIA, transient ischemic attack.

[a]Data are presented as mean (standard deviation) or %.

Table 3

Clinical Presentations and Operative Parameters of Patients Age < 65 Years Undergoing Thoracic Aortic Operation Stratified by Insurance Status[a]

Variable	Private Insurance (n = 20 854; 73.0%)	Medicare (n = 1 837; 6.4%)	Medicaid (n = 1 822; 6.4%)	Other Insurance (n = 1 085; 3.8%)	None/ Self-Pay (n = 2 951; 10.3%)
Procedure Status - Elective	64.4	50.3	47.2	55.1	26.8
- Urgent	18.6	29.9	30.0	23.7	28.2
- Emergent	17.0	19.8	22.8	21.2	45.0
Urgent Reason - Valve dysfunction	32.9	34.6	31.4	28.0	35.6
- Aortic dissection	23.2	27.5	31.3	31.5	35.5
- Anatomy	25.1	17.5	21.6	21.0	20.7
- Congestive heart failure	11.1	11.8	11.2	11.3	10.8
Emergent Reason - Aortic dissection	94.5	90.3	92.1	95.4	95.2
- Shock	1.5	2.3	1.7	2.3	1.5
- Valve dysfunction	2.2	4.0	4.4	1.8	1.4
Segments of aorta involved - Root	50.3	44.9	42.6	46.9	38.9
- Ascending aorta	77.7	65.9	68.8	71.2	75.7
- Arch	20.4	20.2	19.9	21.7	24.9
- Descending aorta	6.2	9.7	11.1	9.6	11.0
- Thoracoabdominal aorta	2.9	7.0	5.4	2.9	4.3
Concomitant CABG	15.5	18.8	12.4	15.1	13.2
Concomitant aortic valve procedure	26.1	22.4	23.9	24.3	25.7
Concomitant mitral valve procedure	4.1	6.9	5.4	4.6	3.3
Cardiopulmonary bypass time	179.0 (80.1)	193.6 (85.0)	190.8 (84.0)	192.0 (92.3)	189.6 (85.4)
Cross-clamp time	126.3 (59.4)	131.2 (64.0)	129.3 (64.3)	131.0 (66.4)	122.7 (62.5)

Abbreviations: CABG, coronary artery bypass grafting.

[a]Data are presented as mean (standard deviation) or %.

Table 4

Clinical Presentations and Operative Parameters of Patients Age ≥ 65 Years Undergoing Thoracic Aortic Operation Stratified by Insurance Status[a]

Variable	Private Insurance (n = 14 568; 64.1%)	Medicare (n = 7 455; 32.8%)	Medicaid (n = 155; 0.7%)	Other Insurance (n = 212; 0.9%)	None/ Self-Pay (n = 343; 1.5%)
Procedure Status - Elective	62.0	57.7	49.7	55.2	41.1
- Urgent	22.8	25.4	31.6	24.1	28.6
- Emergent	15.2	16.9	18.7	20.8	30.3
Urgent Reason - Valve dysfunction	26.5	23.9	22.5	23.5	23.5
- Aortic dissection	21.1	22.3	28.6	23.5	25.5
- Anatomy	30.0	30.1	26.5	21.6	22.5
- Congestive heart failure	11.9	12.4	12.2	15.7	23.5
Emergent Reason - Aortic dissection	93.6	92.2	100	95.1	89.4
- Shock	2.2	2.3	0	0	4.3
- Valve dysfunction	1.6	2.4	0	2.4	4.3
Segments of aorta involved - Root	35.8	34.2	29.7	33.5	31.5
- Ascending aorta	76.6	72.7	71.6	67.9	79.9
- Arch	22.2	20.9	18.1	23.1	23.9
- Descending aorta	8.1	9.0	13.6	11.8	9.9
- Thoracoabdominal aorta	5.0	6.6	5.8	9.4	6.7
Concomitant CABG	30.4	32.1	22.6	33.0	23.6
Concomitant aortic valve procedure	28.6	27.4	27.1	19.8	28.6
Concomitant mitral valve procedure	6.1	5.8	7.1	6.6	8.5
Cardiopulmonary bypass time	176.3 (79.9)	180.8 (80.2)	178.8 (84.1)	203.2 (93.4)	184.5 (77.8)
Cross-clamp time	119.2 (58.4)	121.3 (58.5)	118.5 (61.2)	133.7 (68.3)	116.9 (54.5)

Abbreviations: CABG, coronary artery bypass grafting.

[a]Data are presented as mean (standard deviation) or %.

Table 5

Procedure Status of Patients Undergoing Thoracic Aortic Operation Stratified by Insurance Status and Age

Patient Age < 65 Years					
Variable	**Private Insurance (n = 20 854; 73.0%)**	**Medicare (n = 1 837; 6.4%)**	**Medicaid (n = 1 822; 6.4%)**	**Other Insurance (n = 1 085; 3.8%)**	**None/ Self-Pay (n = 2 951; 10.3%)**
Non-Elective Operation	35.6%	49.7%	52.8%	44.9%	73.2%
Unadjusted analysis - Risk ratio (95% confidence interval)	Ref	1.40 (1.33–1.46)	1.48 (1.42–1.55)	1.26 (1.17–1.34)	2.06 (2.01–2.10)
Adjusted analysis - Adjusted risk ratio (95% confidence interval)	Ref	1.06 (0.98–1.14)	1.18 (1.10–1.26)	1.10 (1.01–1.21)	1.77 (1.70–1.83)
Patient Age ≥ 65 Years					
Variable	**Private Insurance (n = 14 568; 64.1%)**	**Medicare (n = 7 455; 32.8%)**	**Medicaid (n = 155; 0.7%)**	**Other Insurance (n = 212; 0.9%)**	**None/ Self-Pay (n = 343; 1.5%)**
Non-Elective Operation	38.0%	42.3%	50.3%	44.9%	58.9%
Unadjusted analysis - Risk ratio (95% confidence interval)	Ref	1.12 (1.08–1.15)	1.33 (1.12–1.53)	1.18 (1.01–1.36)	1.55 (1.41–1.69)
Adjusted analysis - Adjusted risk ratio (95% confidence interval)	Ref	1.02 (0.99–1.07)	1.19 (0.96–1.42)	1.07 (0.87–1.28)	1.46 (1.29–1.62)

Table 6

Postoperative Outcomes for Patients Undergoing Thoracic Aortic Operation Stratified by Insurance Status and Age[a]

Patient Age < 65 Years					
Outcome	**Private Insurance (n = 20 854; 73.0%)**	**Medicare (n = 1 837; 6.4%)**	**Medicaid (n = 1 822; 6.4%)**	**Other Insurance (n = 1 085; 3.8%)**	**None/ Self-Pay (n = 2 951; 10.3%)**
Stroke	3.3	4.2	5.4	4.2	6.7
Renal failure	6.7	10.8	9.9	9.4	12.5
Prolonged ventilation	21.7	38.2	35.1	28.8	36.6
Deep sternal wound infection	0.4	0.6	0.6	0.2	0.5
Reoperation	11.6	19.9	16.9	13.1	17.3
Operative mortality	5.3	12.7	8.8	5.8	12.5
Patient Age ≥ 65 Years					
Outcome	**Private Insurance (n = 14 568; 64.1%)**	**Medicare (n = 7 455; 32.8%)**	**Medicaid (n = 155; 0.7%)**	**Other Insurance (n = 212; 0.9%)**	**None/ Self-Pay (n = 343; 1.5%)**
Stroke	5.7	5.8	3.9	5.7	5.0
Renal failure	9.2	10.7	7.1	9.9	14.0
Prolonged ventilation	31.6	34.1	35.5	34.9	35.0
Deep sternal wound infection	0.5	0.5	0	0.5	0.9
Reoperation	14.9	16.0	14.2	17.5	13.1
Operative mortality	10.8	13.1	11.0	13.2	15.2

[a]Data are presented as %.

Table 7

Composite Major Morbidity and/or Mortality for Patients Undergoing Thoracic Aortic Operation Stratified by Insurance Status and Age

Patient Age < 65 Years					
Outcome	**Private Insurance (n = 20 854; 73.0%)**	**Medicare (n = 1 837; 6.4%)**	**Medicaid (n = 1 822; 6.4%)**	**Other Insurance (n = 1 085; 3.8%)**	**None/ Self-Pay (n = 2 951; 10.3%)**
Major Morbidity and/or Mortality	29.0%	49.1%	44.1%	38.0%	48.9%
Unadjusted analysis - Risk ratio (95% confidence interval)	Ref	1.69 (1.61–1.77)	1.52 (1.44–1.60)	1.31 (1.21–1.41)	1.69 (1.62–1.75)
Adjusted analysis - Adjusted risk ratio (95% confidence interval)	Ref	1.27 (1.18–1.37)	1.24 (1.15–1.34)	1.19 (1.08–1.31)	1.13 (1.06–1.21)
Patient Age ≥ 65 Years					
Outcome	**Private Insurance (n = 14 568; 64.1%)**	**Medicare (n = 7 455; 32.8%)**	**Medicaid (n = 155; 0.7%)**	**Other Insurance (n = 212; 0.9%)**	**None/ Self-Pay (n = 343; 1.5%)**
Major Morbidity and/or Mortality	42.0%	44.8%	46.5%	46.2%	46.4%
Unadjusted analysis - Risk ratio (95% confidence interval)	Ref	1.07 (1.03–1.10)	1.11 (0.92–1.30)	1.10 (0.94–1.26)	1.10 (0.98–1.23)
Adjusted analysis - Adjusted risk ratio (95% confidence interval)	Ref	1.00 (0.96–1.04)	1.07 (0.87–1.28)	0.99 (0.82–1.17)	0.90 (0.77–1.04)