Patients with Ascending Thoracic Aortic Aneurysm: How Do They Die?

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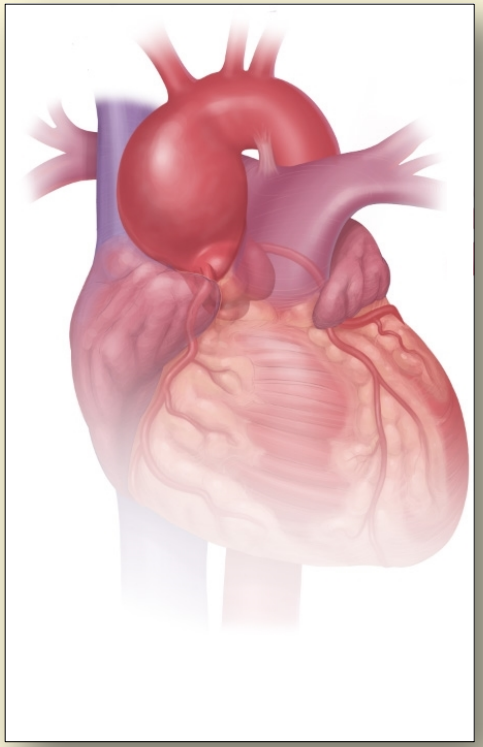
Liege, Belgium

Disclosures

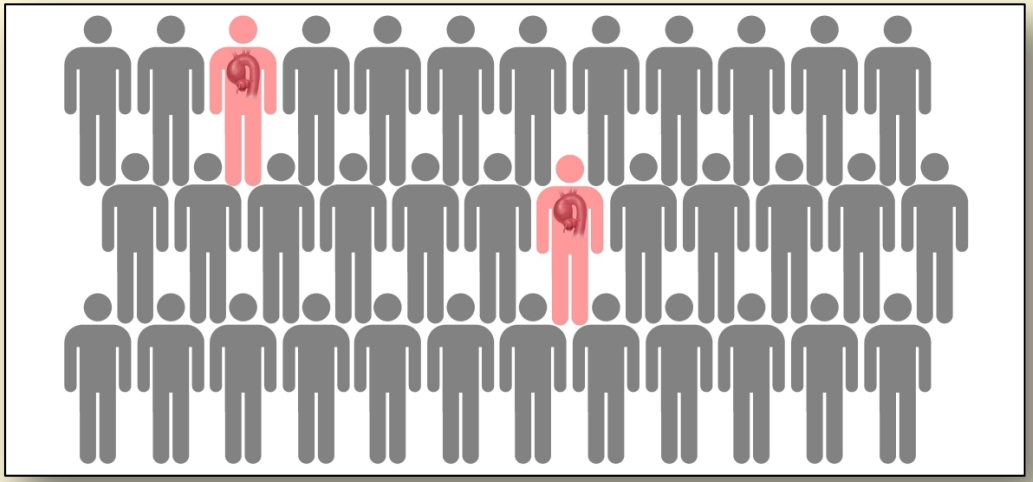
- Nothing to disclose

Ascending aortic aneurysm – an indolent, but virulent disease



Patients succumb due disease of the aorta, unless detected in time and managed surgically

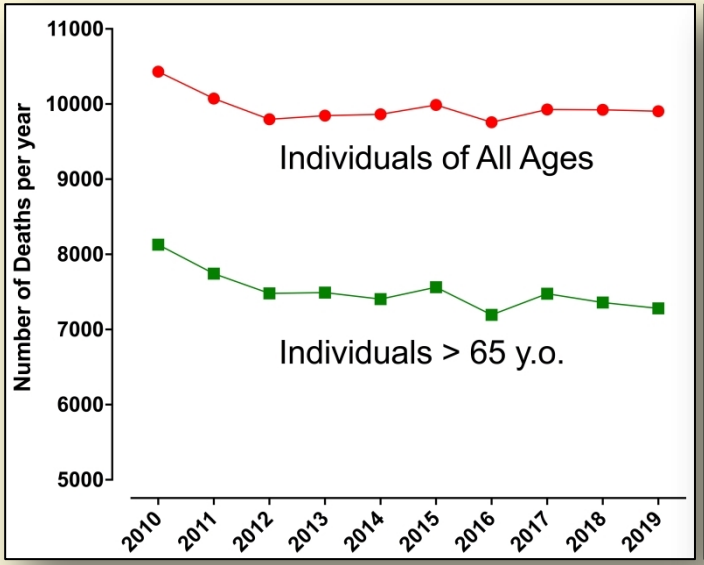
Identification of Asymptomatic Disease Carriers – Most Significant Challenge in TAA Management

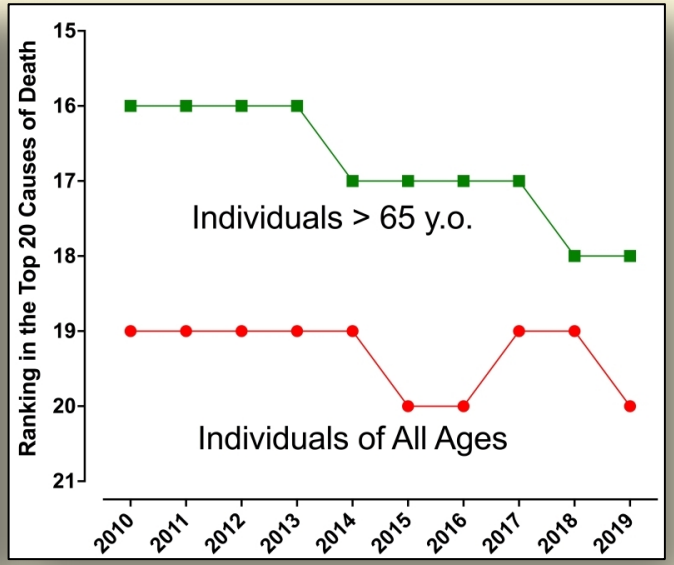


Currently > 65% of patients with TAAD are detected incidentally

No Mass Screening of Population for TAAD via Imaging

Epidemiology – CDC data for 2020





- 99,511 people have died in the US of aortic aneurysms during 2010-2019
- More than 75% of these deaths – people 65 years and older

Aortic aneurysms:

- the 20th leading cause of death in all individuals
- the 18th most common in individuals older than age 65 years

Centers for Disease Control and Prevention. National Center for Injury Prevention and Control. WISQARS leading causes of death reports, 1999–2020. https://webappa.cdc.gov/sasweb/ncipc/leadcause.html. Accessed May 14, 2022.

Prevalence of Type A aortic dissection in cardiac death

Prevalence of Type A Acute Aortic Dissection in Patients With Out-Of-Hospital Cardiopulmonary Arrest

Yoshihiro Tanaka, MD[a], Kenji Sakata, MD[a], Yasuo Sakurai, MD[b], Tsuyoshi Yoshimuta, MD[a], Yuka Morishita, MD[c], Satoshi Nara, MD[c], Isao Takahashi, MD[c], Mitsugu Hirokami, MD[d], and Masakazu Yamagishi, MD[a,e]

Postmortem computed tomography (PMCT) has been recently reported to be useful for detecting causes of death in the emergency department. In this study, the incidence and causes of death of type A acute aortic dissection (AAD) were investigated in patients who experienced out-of-hospital cardiopulmonary arrest (OHCPA) using PMCT. PMCT or enhanced computed tomography was performed in 311 of 528 consecutive patients experiencing OHCPA. A total of 23 (7%) of 311 patients were diagnosed with type A AAD based on clinical courses and CT findings. Eighteen consecutive patients who did not experience OHCPA were diagnosed with type A AAD during the same period. Pre-hospital death was observed in 21 (51%) of 41 patients with type A AAD. Bloody pericardial effusion was observed more frequently in patients who experienced OHCPA with type A AAD than in those who did not experience OHCPA with type A AAD (91% vs 28%, respectively; p <0.05). In conclusion, the incidence of type A AAD was common (7%) in patients who experienced OHCPA, with a high rate of pre-hospital death. Aortic rupture to the intrapericardial space was considered the major cause of death in patients who experienced OHCPA with type A AAD. © 2016 Elsevier Inc. All rights reserved. (Am J Cardiol 2016;117:1826–1830)

Etiology of out-of-hospital cardiac arrest diagnosed via detailed examinations including perimortem computed tomography

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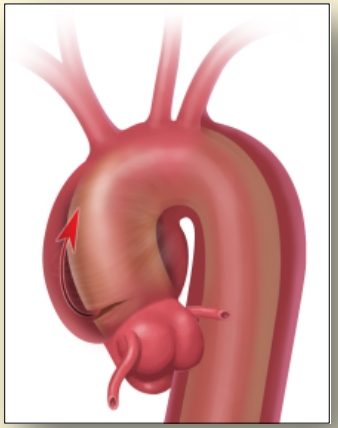
ABSTRACT

Context: The spectrum of the etiology of out-of-hospital cardiopulmonary arrest (OHCPA) has not been established. We have performed perimortem computed tomography (CT) during cardiopulmonary resuscitation. **Aims:** To clarify the incidence of non-cardiac etiology (NCE), actual distribution of the causes of OHCPA via perimortem CT and its usefulness. **Settings and Design:** Population-based observational case series study. **Materials and Methods:** We reviewed the medical records of 1846 consecutive OHCPA cases and divided them into two groups: 370 showing an obvious cause of OHCPA with NCE (trauma, neck hanging, terminal stage of malignancy, and gastrointestinal bleeding) and others. **Results:** Of a total OHCPA, perimortem CT was performed in 57.5% and 62.5% were finally diagnosed as NCE: Acute aortic dissection (AAD) 8.07%, pulmonary thrombo-embolization (PTE) 1.46%, hypoxia due to pneumonia 5.25%, asthma and acute worsening of chronic obstructive pulmonary disease 2.06%, cerebrovascular disorder (CVD) 4.48%, airway obstruction 7.64%, and submersion 5.63%. The rates of patients who survived to hospital discharge were 6-14% in patients with NCE. Out of the 1476 cases excluding obvious NCE of OHCPA, 66.3% underwent perimortem CT, 14.6% of cases without obvious NCE and 22.1% of cases with perimortem CT were confirmed as having some NCE. **Conclusions:** Of the total OHCPA the incidences of NCE was 62.5%; the leading etiologies were AAD, airway obstruction, submersion, hypoxia and CVD. The rates of cases converted from cardiac etiology to NCE using perimortem CT were 14.6% of cases without an obvious NCE.

Postmortem CT Scans

7-8%



Type A (ascending) aortic dissection

Natural History of Ascending Aortic Aneurysm Disease

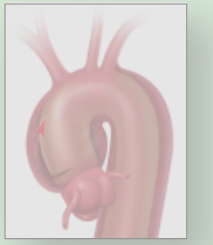
Normal ascending aorta

Time (decades)

Genetic factors and/or other pathologic mechanisms

Ascending aortic aneurysm, often silent and undiagnosed

+ Hypertensive episode



Ascending aortic dissection or rupture

Sudden Death

Not well studied

Well-studied, multiple reports in the literature

Normal ascending aorta

Time (decades)

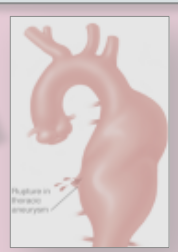
Genetic factors and/or other pathologic mechanisms

Ascending aortic aneurysm, often silent and undiagnosed

Elective, low-risk surgical replacement of ascending aorta

Restoration of near-normal life expectancy

Death from other causes



Aortic Rupture

Sudden Death

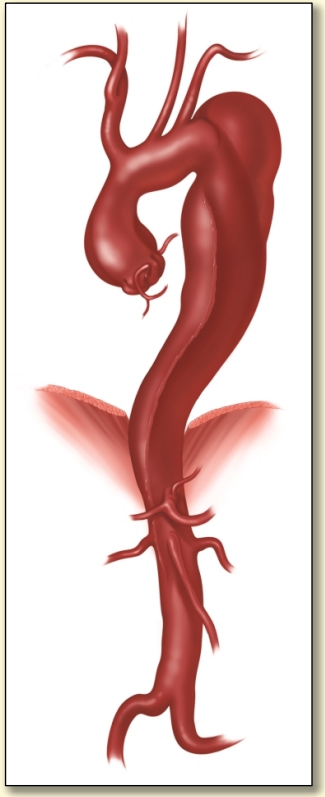
Aim of the Study

- To leverage the extensive longitudinal data collected prospectively on patients with ascending aortic pathology at the Yale Aortic Institute over a 30-year period (1990-2020) in order to understand the incidence and causes of death of these patients.

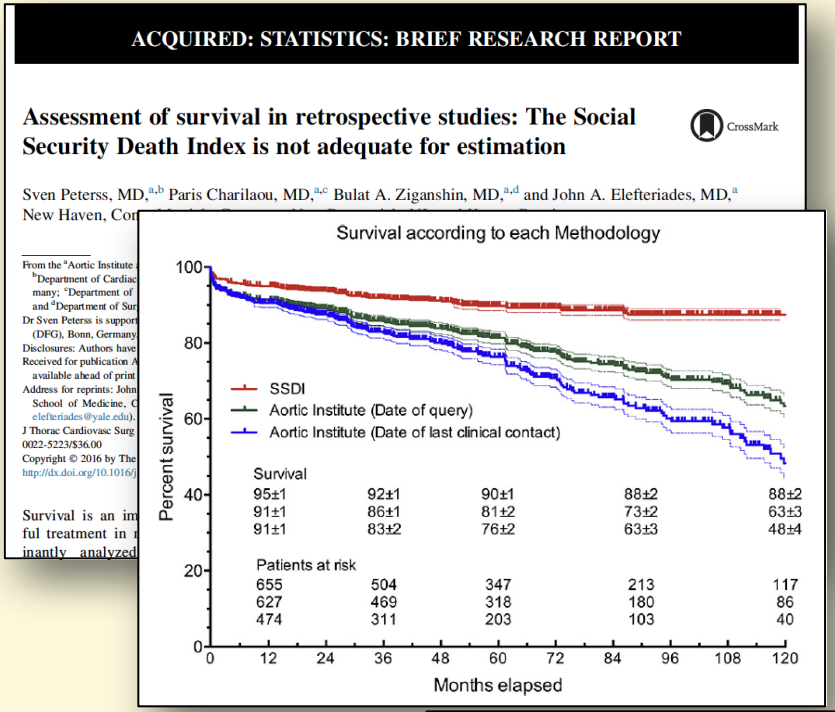
Patients and Methods

- Yale Aortic Institute Database: 4114 patients
- 2501 patients included in this study

- [x] At least one verified ascending aortic size measurement
- [x] Verified clinical data
- [x] 1990-2020



Methods of Survival Analysis



ACQUIRED: STATISTICS: BRIEF RESEARCH REPORT

Assessment of survival in retrospective studies: The Social Security Death Index is not adequate for estimation

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Survival is an im
ful treatment in
inantly analyzed

Online database mortality query (SSDI)

Electronic Medical Record (EPIC) clinical and mortality query

Referring doctor/family follow-up

Online obituary search

State-issued death certificates

Benefits and Limitations of Using Death Certificates

Benefits:

- Publicly available information
- Ability to determine the cause of death for every patient
- Issued by every state

Limitations:

- Completed by patient's GP, who may not be fully aware of circumstances of death
- Out-of-hospital death causes not as accurate

Classifying Aortic Deaths

- **“Definite” aortic death:**
  - Attributed to aortic dissection or rupture
  - Confirmed radiographically, surgically, via autopsy or stated in death certificate

- **“Possible” aortic death:**
  - Patients presenting with symptoms of dissection or impending rupture, but without objective confirmation
  - Sudden cardiac deaths not attributable to other causes (such as CAD)

Baseline Patient Characteristics

Variable	Value	Percentage
Total number of patients	2501	100%
Male	1728	69.1%
Age at first presentation (mean (SD))	62.23 ± 14.47 years	
Bicuspid	554	22.2%
Height (mean (SD))	173.48 ± 11.58 cm	
Weight (mean (SD))	86.32 ± 23.95 kg	
Family History:		
None	1188	47.5%
Proven	462	18.5%
Likely	135	5.4%
Possible	193	7.7%
Unknown	523	20.9%

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Risk Factors and Comorbidities

Variable	Value	Percentage
Smoking status:		
Unknown	910	36.5%
Never Smoked	695	27.9%
Former Smoker	503	20.2%
Current Smoker	385	15.4%
Hypertension	1617	64.8%
Dyslipidemia	1038	41.6%
Chronic Obstructive Pulmonary Disease	261	10.5%
Diabetes mellitus	210	8.4%
Myocardial Infarction	125	5.0%
Coronary Artery Disease	547	21.9%
Active malignancy	127	5.1%
Stroke	158	6.4%
Aortic Valve Replacement	173	6.9%
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Prior CABG	126	5.0%
Marfan Syndrome	77	3.1%

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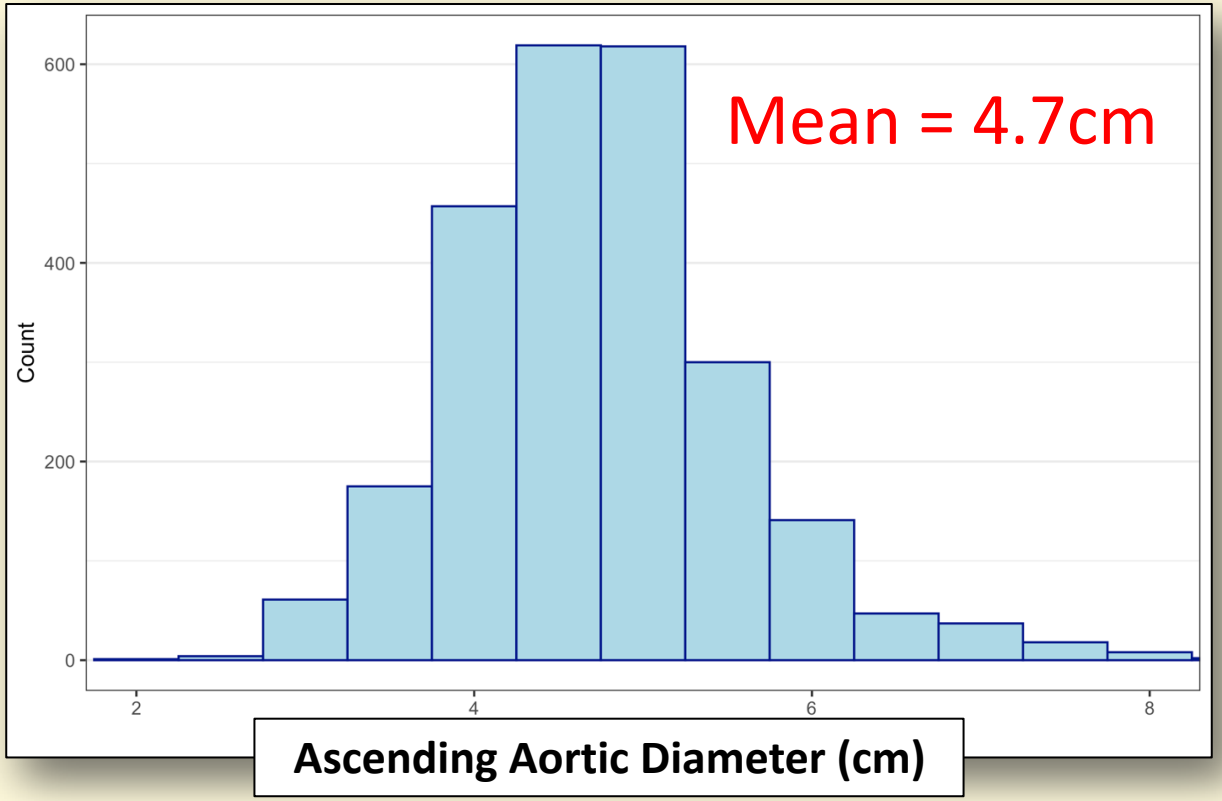
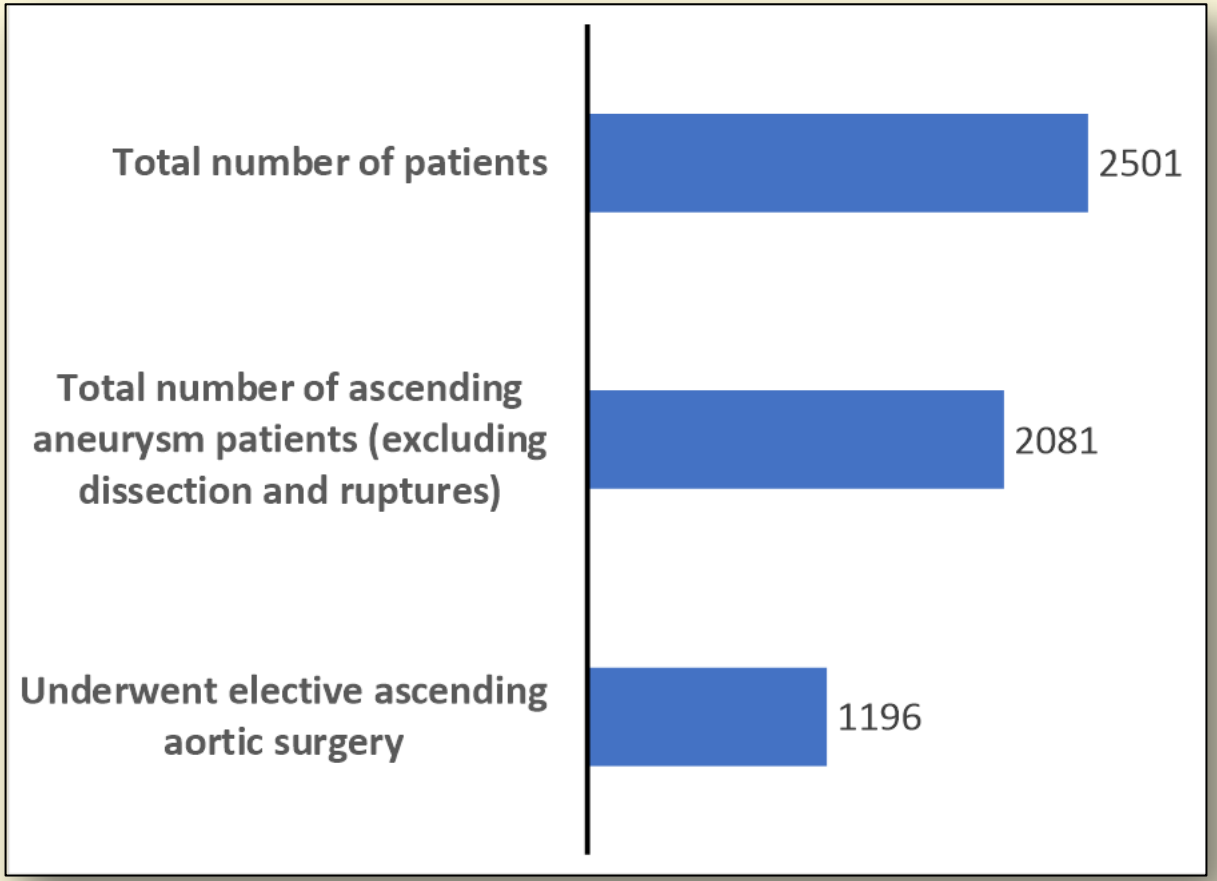
Frequency Distribution of Ascending Aortic Size

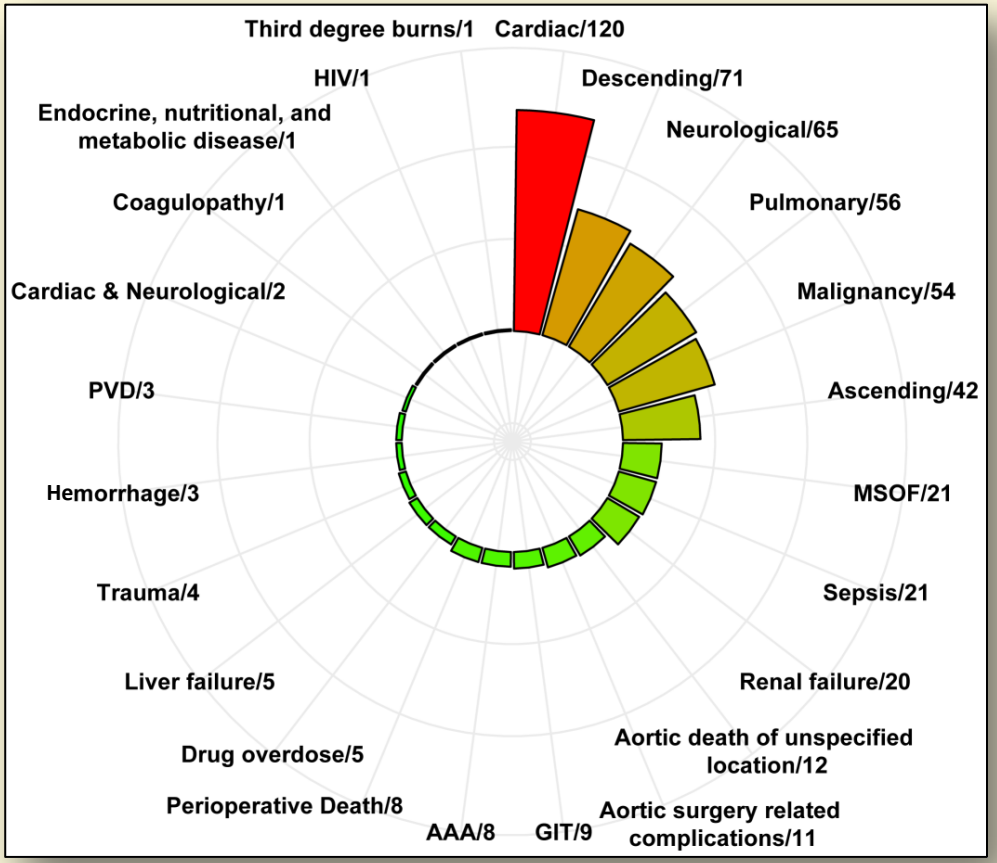


Surgical Treatment for Ascending Aortic Aneurysm



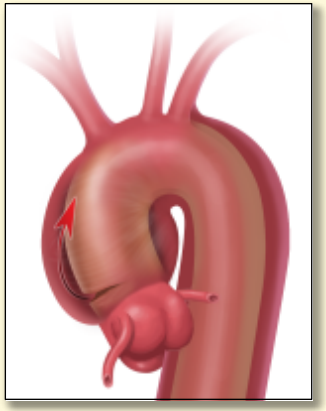
Results – Causes of Death

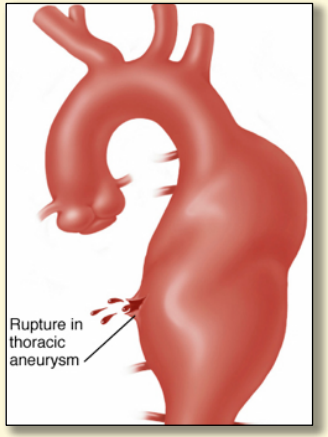
- Median F/U = 8.67 years (IQR, 5.12, 13.26)
- 620 (24.8%) patients died (out of a total of 2501)
  - 76 cause is unknown
- Top 5 causes of death:
  - Cardiac
  - Descending aortic
  - Neurological
  - Pulmonary
  - Malignancy



Results – Ascending Aortic Deaths

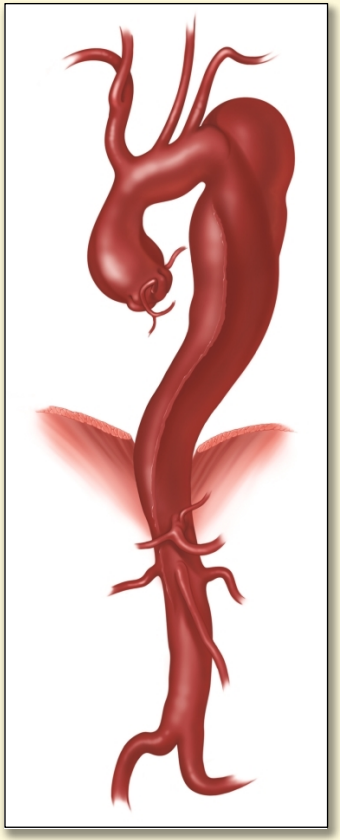
- Ascending aortic deaths = 6th place
- 42 deaths
- Average maximal ascending aortic size = 5.4cm
- 28/42 (65%) presented with acute Type A dissection



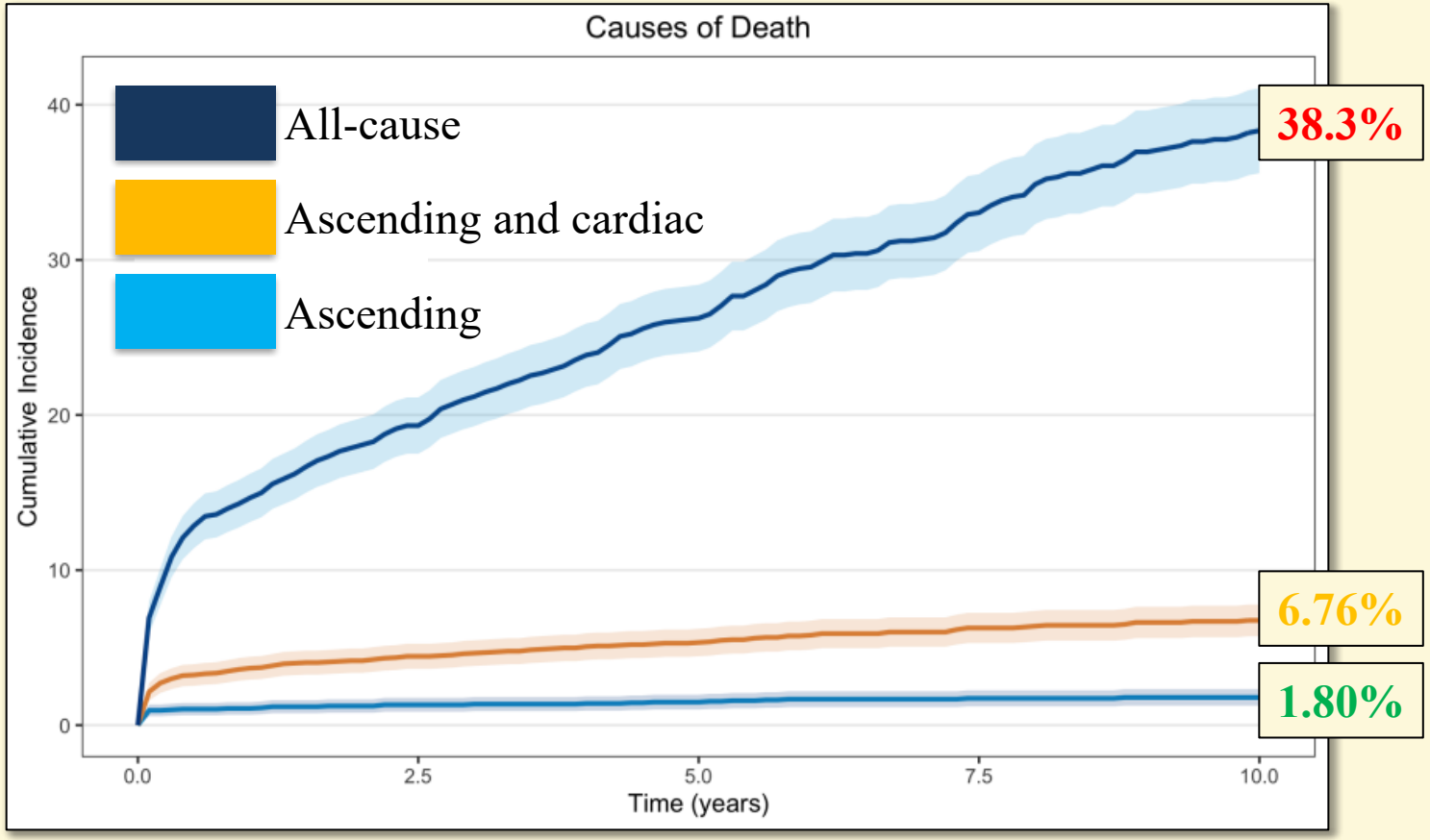


Results – Descending Aortic Deaths

- 71 deaths
- 2nd most common cause of death
- Moderate ascending dilation with predominant descending dilation:
  - Average maximal ascending aortic size = 4.5 cm
  - Average maximal descending size = 5.7cm
- 44/71 initially presented with acute Type B dissection/rupture



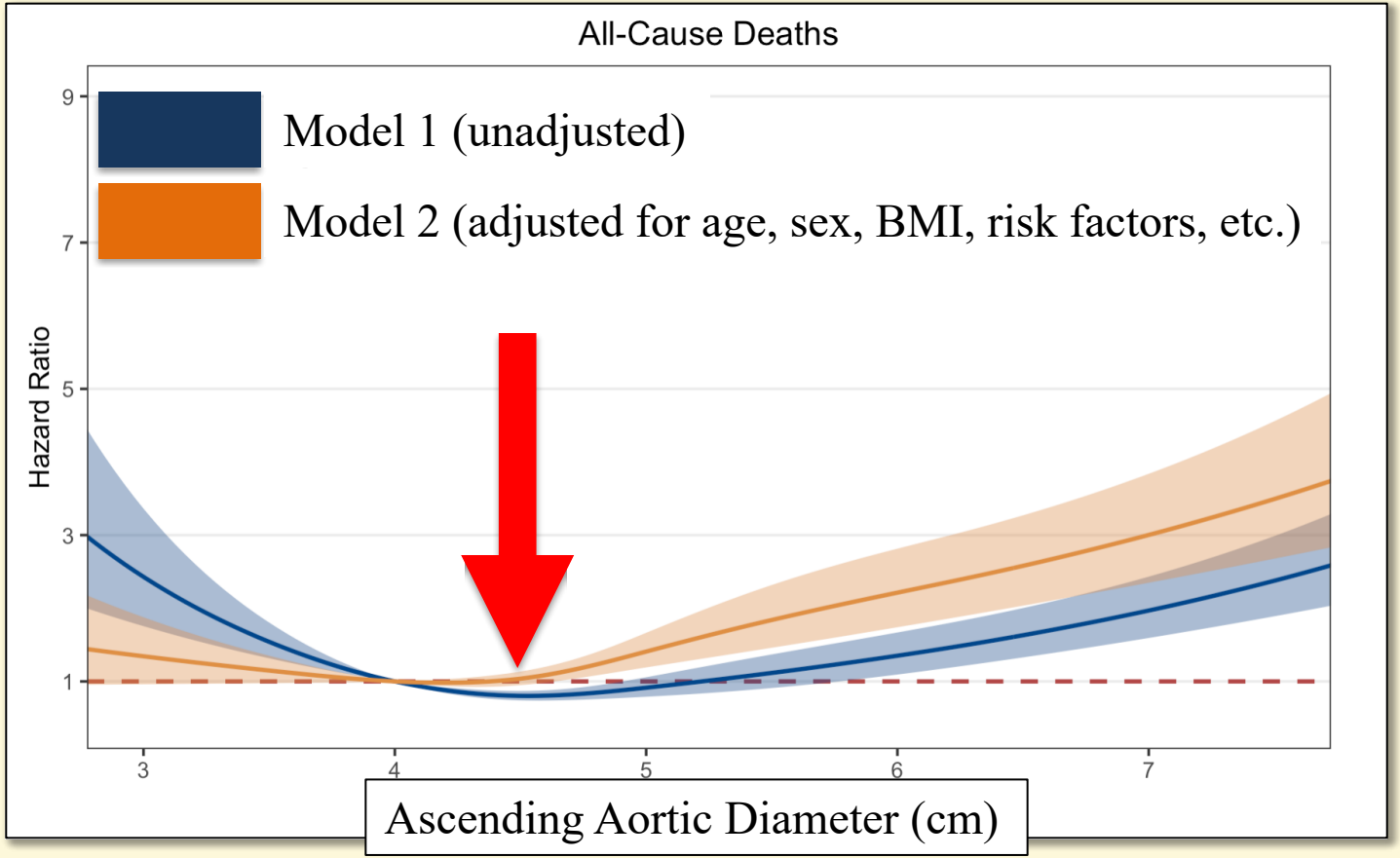
Results – Cumulative Death Incidence



Other (more subtle) mechanisms of aortic disease contributing to death:

- Aneurysm disease in other locations (like the brain causing "stroke”),
- Embolization causing limb or intestinal ischemia,
- Chronic microembolization contributing to renal failure,
- Visceral vessel osteal disease leading to abdominal malperfusion,
- Deliberate activity restriction (out of fear of the aneurysm) leading to general debility.

Results – Ascending Size and All-cause Mortality



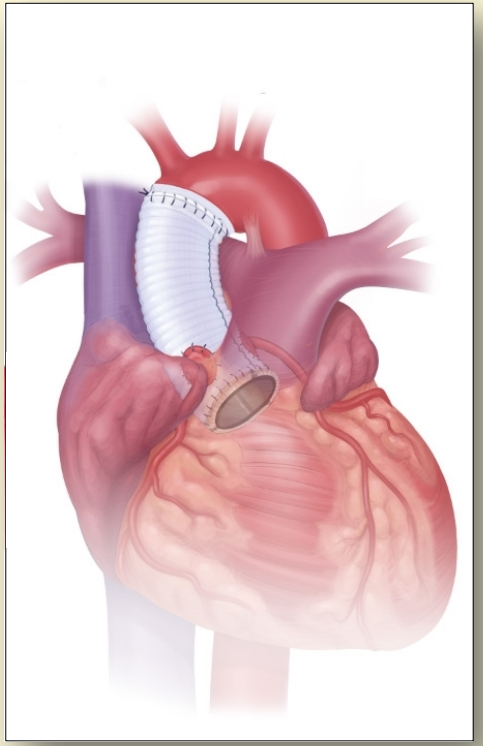
Patients Treated Surgically

- 1196 patients underwent ascending aneurysmectomy (average ascending size = 5.2cm):
  - 181 patients died during follow-up
  - 155 known cause of death on file

- Ascending aortic surgery -related deaths:
  - 12 patients (1%) – died within the first 30 days of ascending surgery
  - 8 patients (0.7%) – died in mid/long-term follow-up
    - 2 aortic deaths of unspecified location (likely descending)
    - 5 aortic surgery related complications
  - Overall ascending aortic surgery-related mortality: 20/1196 (1.7%)

- Other aortic causes of death (7/1196):
  - 5 patients died of descending aortic causes
  - 2 patients died of an abdominal aortic aneurysm

- All other deaths were non-aortic
  - 128/1196 (10.7%)



Patients Not Treated Surgically

- 885 patients did not undergo ascending aortic surgery (average ascending size = 4.6cm):
  - 240 patients died during follow-up
  - 205 known cause of death on file

- Ascending aortic deaths:
  - 12/885 (1.4%)

- Other aortic deaths:
  - 32/885 (3.6%)
    - 19 patients died of descending aortic causes
    - 4 patients died of an abdominal aortic aneurysm
    - 9 aortic deaths of unspecified location

- Non-aortic deaths:
  - 161/885 (18.2%)

Conclusions

- Ascending surgery is safe & dramatically protective.
- Surveillance and care for cardiac/general medical issues.
- Aortic size beyond 4.5cm increases all-cause mortality hazard in subtle ways.
- Most ascending deaths are due to acute Type A dissection even in extremely long follow-up.
- Diffuse thoracic aortic pathology necessitates careful vigilance of the descending aorta.