

September 15-17

2016

Crowne Plaza Hotel
Liège, Belgium

5th International Meeting on Aortic Diseases

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Modeling of predissection aortic size in acute type A dissection: More than 90% fail to meet the guidelines for elective ascending replacement

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September 17, 2016



CHU
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Disclosure of Interest

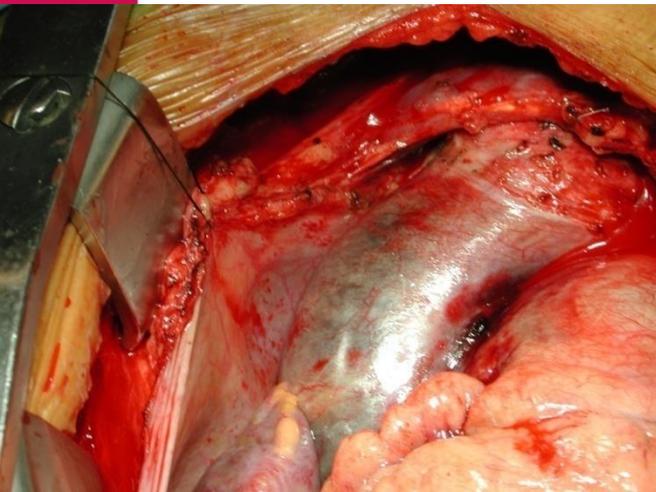
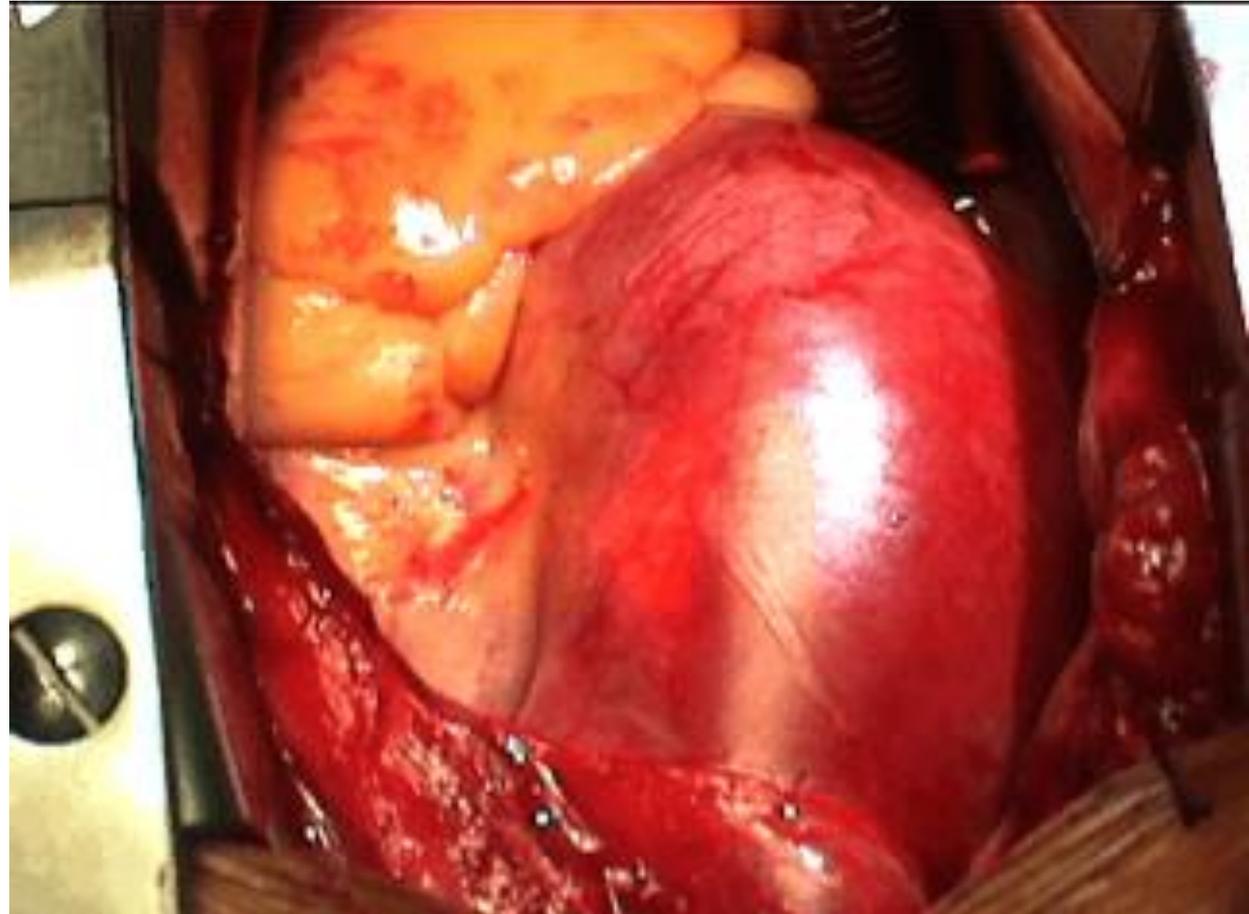
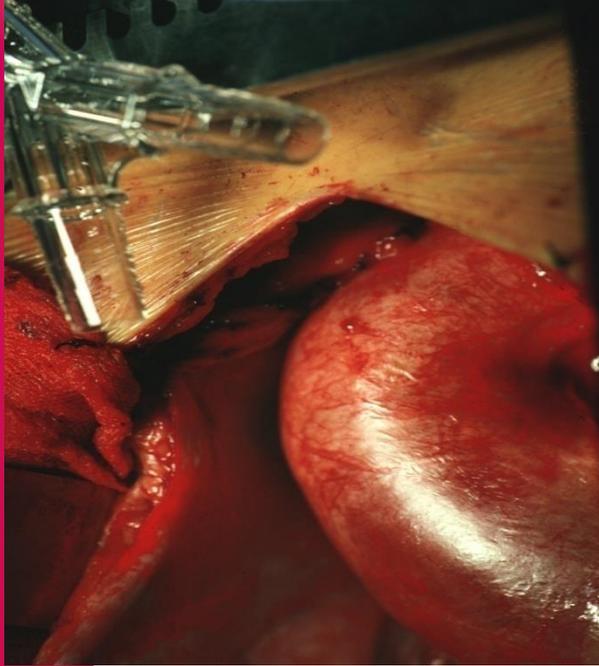
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I do not have any potential conflict of interest



Type A Dissection is a Catastrophic Presentation!!

How can we predict who will present with this?

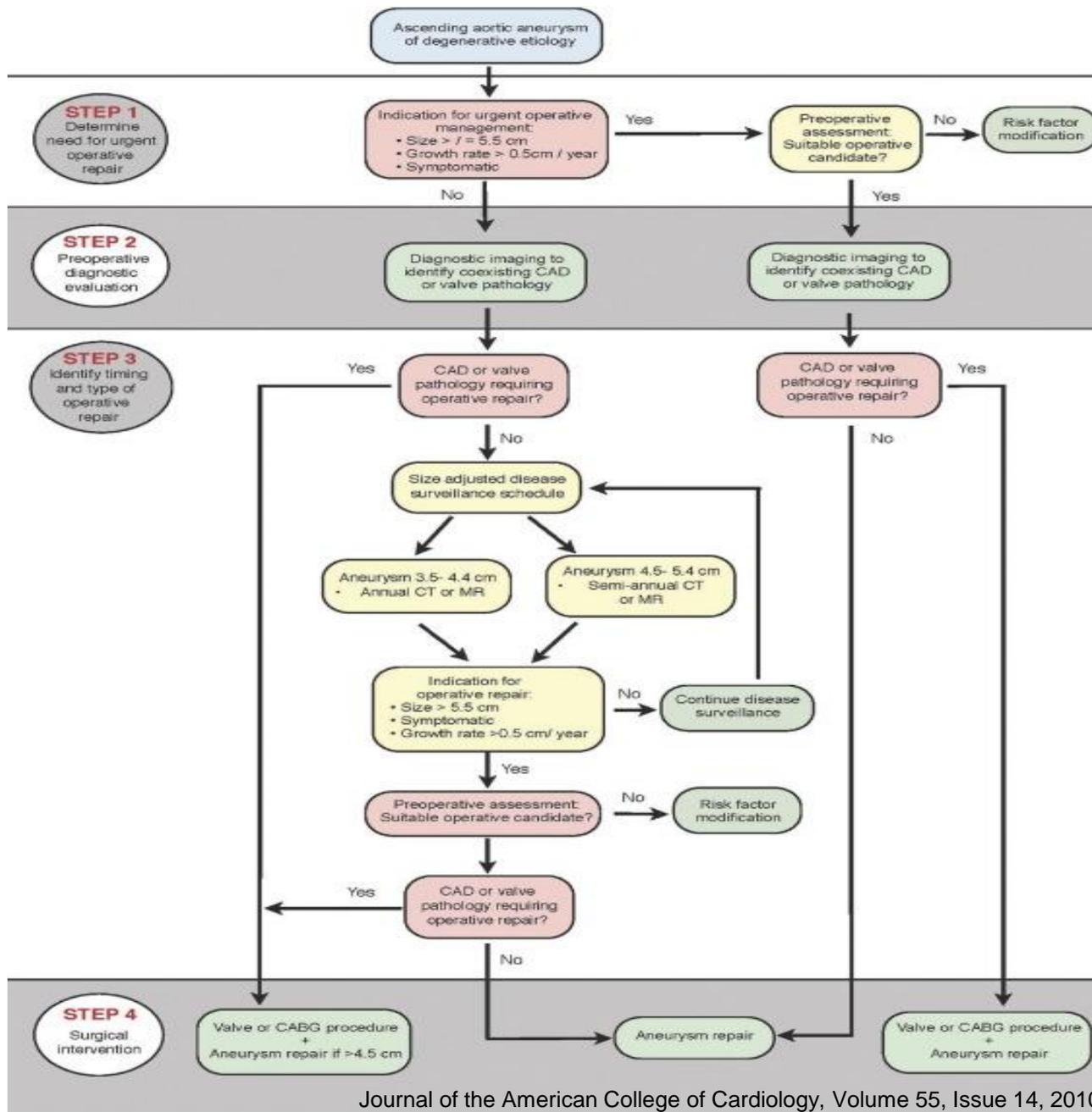




Diameter of Dissected Aorta

The ascending aortic diameter in patients with acute Type A dissection has been reported to be about 5 cm, with the diameter range spanning from those with a nondilated aorta to those with huge aneurysms

Ascending Aortic Aneurysm Guidelines





Predissection Aortic Size

Current guidelines for and most current reports ascending aortic replacement delineated from diameters of dissected aortas

True incidence of predissection ascending dilation may have been greatly overestimated



Necessity of Improved Diagnostic Stratification and Therapeutic Triggers

62 % of ascending aortic dissections occur in aneurysms less than 5.5cm

42% of dissections occur in patients with aneurysms less than 5.0cm

20% of dissections occur in patients with aneurysms less than 4.5cm

12% of dissections occur in patients with aneurysms less than 4.0cm

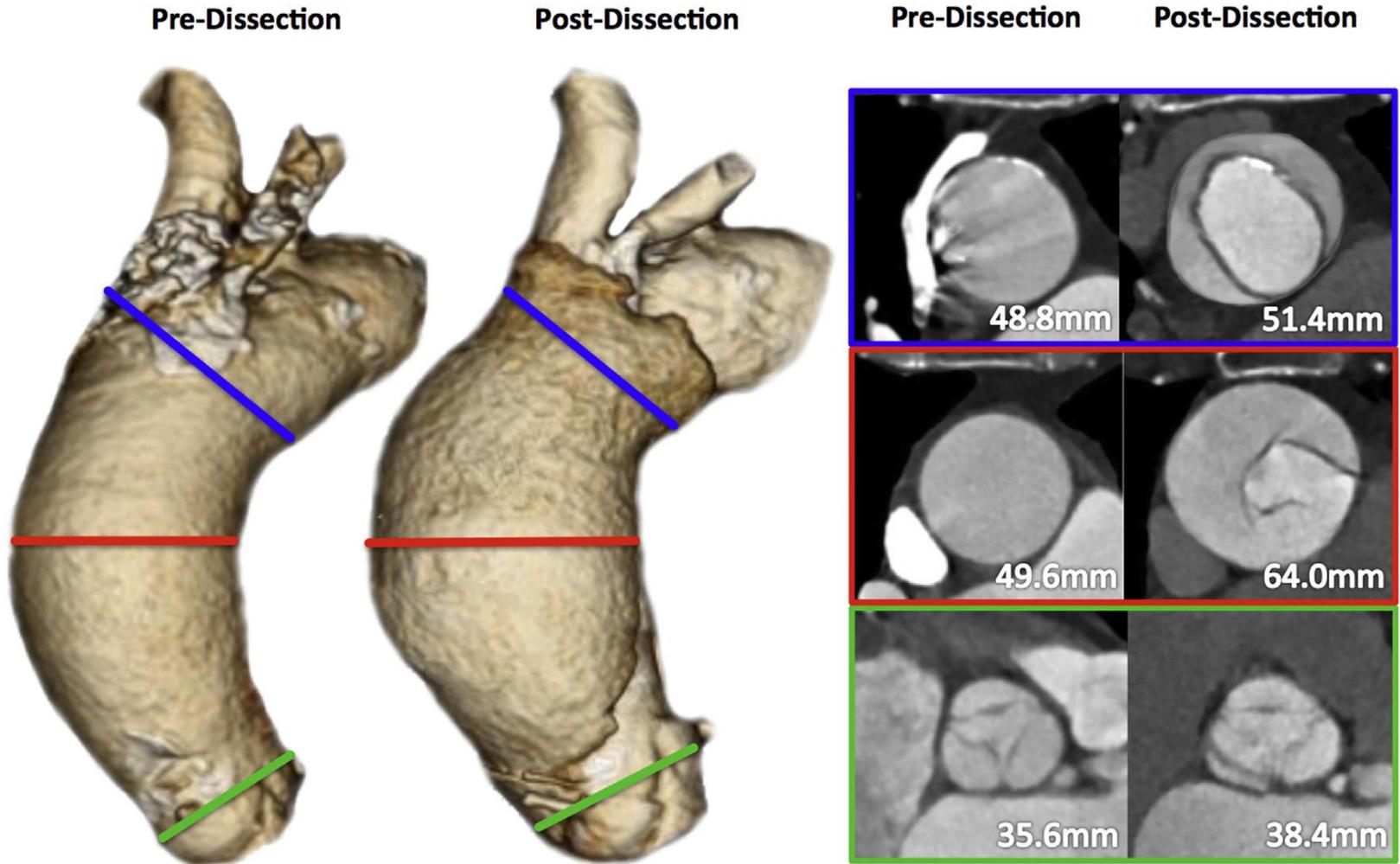
Therefore, 42% - 62% of aortic dissections fall under the size criteria for elective intervention

The current diagnosis of thoracic aortic aneurysms and *triggers for therapeutic intervention are inadequate*



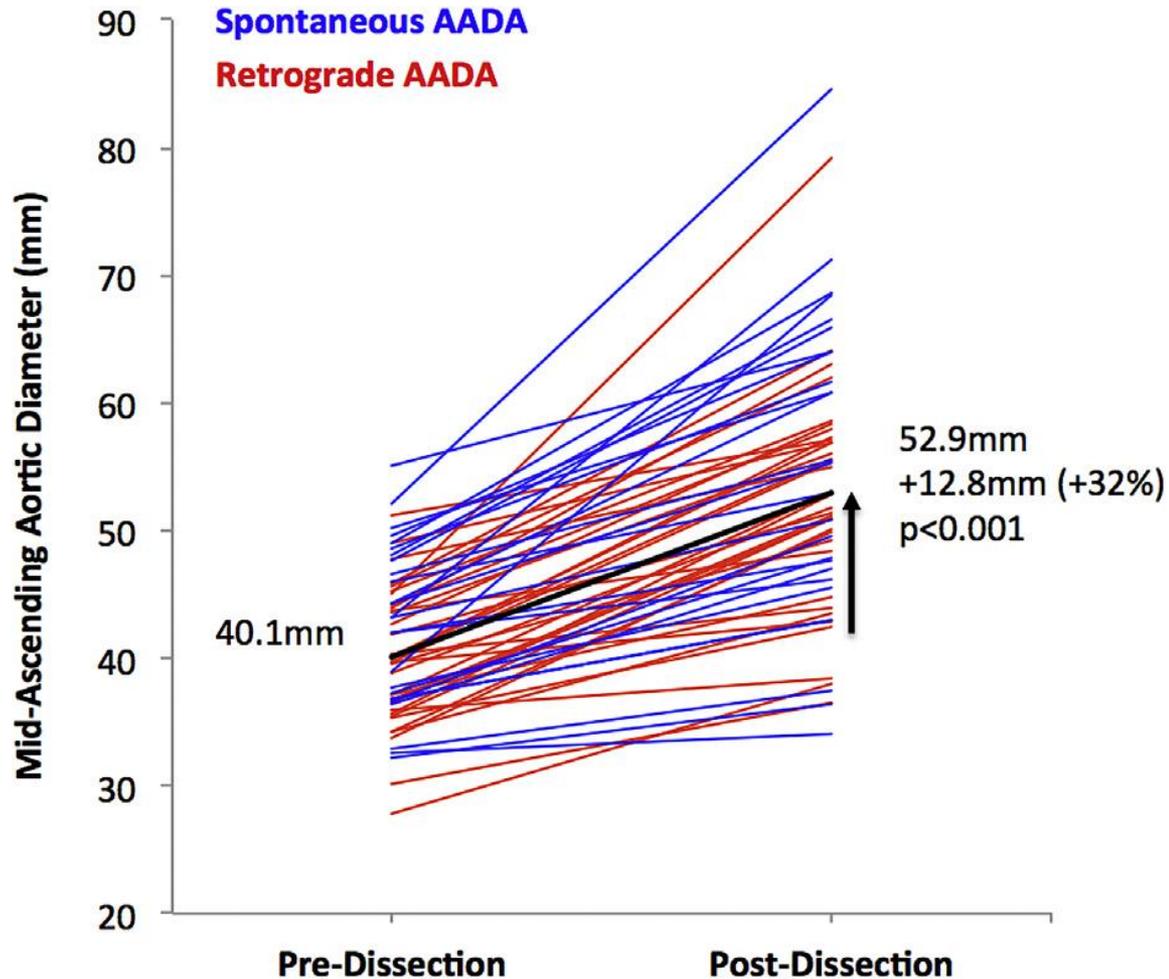


How does the Ascending Aorta Geometry Change When It Dissects



The average increase in diameter predissection to post dissection was 32%

Ascending Aortic Diameter Change After Acute Aortic Dissection Type A





Modeling of Predissection Aortic Size

The aim of the present study was to evaluate the incidence of ascending aortic dilatation in the acute type A dissection population according to the modeled predissection aortic diameters.



Study Analysis Cohorts

Inclusion - 343 patients underwent surgery for acute Stanford Type A aortic dissection

Exclusion – Connective tissue disease (Marfan and bicuspid aortic dissection)



Study Analysis Cohorts

343 patients were included in the present study

- 123 women
- 220 men

Acute Type A Dissection age difference $p < 0.001$

Women 67y

Men 59y

The cardiovascular risk profile did not significantly differ between both sexes.



Analysis Methodology

Analyze CTAs/TEEs obtained before and after acute aortic dissection type A

Acute dissection < 14d after symptom onset

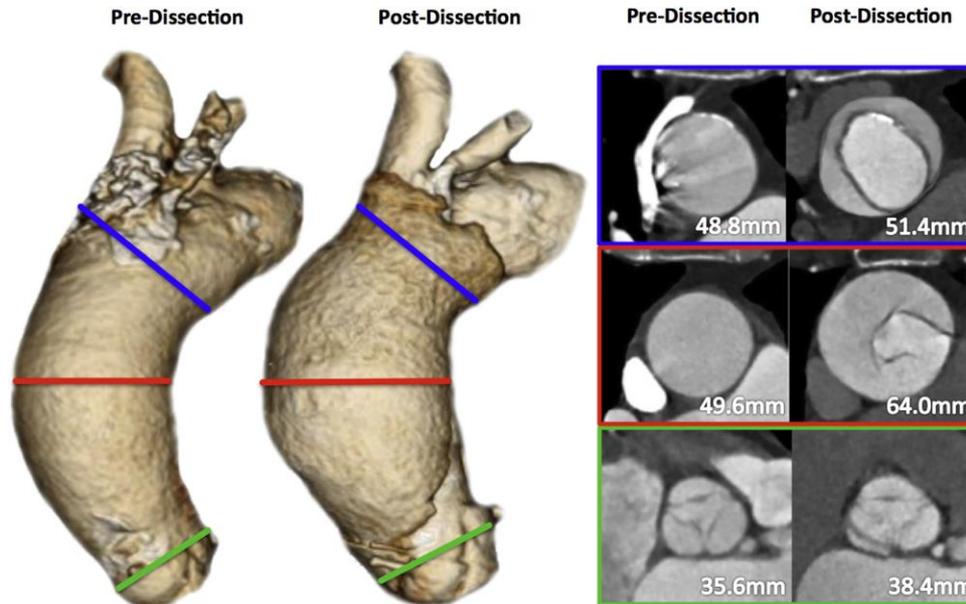
Preoperative CTA – 83

TEE – 260



Predissection Modeling

The aortic diameters were measured using true centerline measurements from the CTAs or averaged from multiple in-plane measurements from the TEEs.



The variation in the measured diameters on the CTAs and TEEs (both available for 48 patients) ranged from 0 to 5 mm.

In later study years, the use of multiplane TEE and 3-dimensional TEE became more common. The largest diameter present between the aortic valve plane and innominate artery was used.



Predissection Modeling

Predissection ascending aorta diameters modeled from the measured dissected aorta diameters by subtraction of the increase in diameter rate (30%)

Modeled Predissection = Measured Dissection diameter – 30% increase



Predissection Modeling

The modeled predissection ascending diameters were compared between men and women in 4 age categories

<45,

45-54,

55-64, and

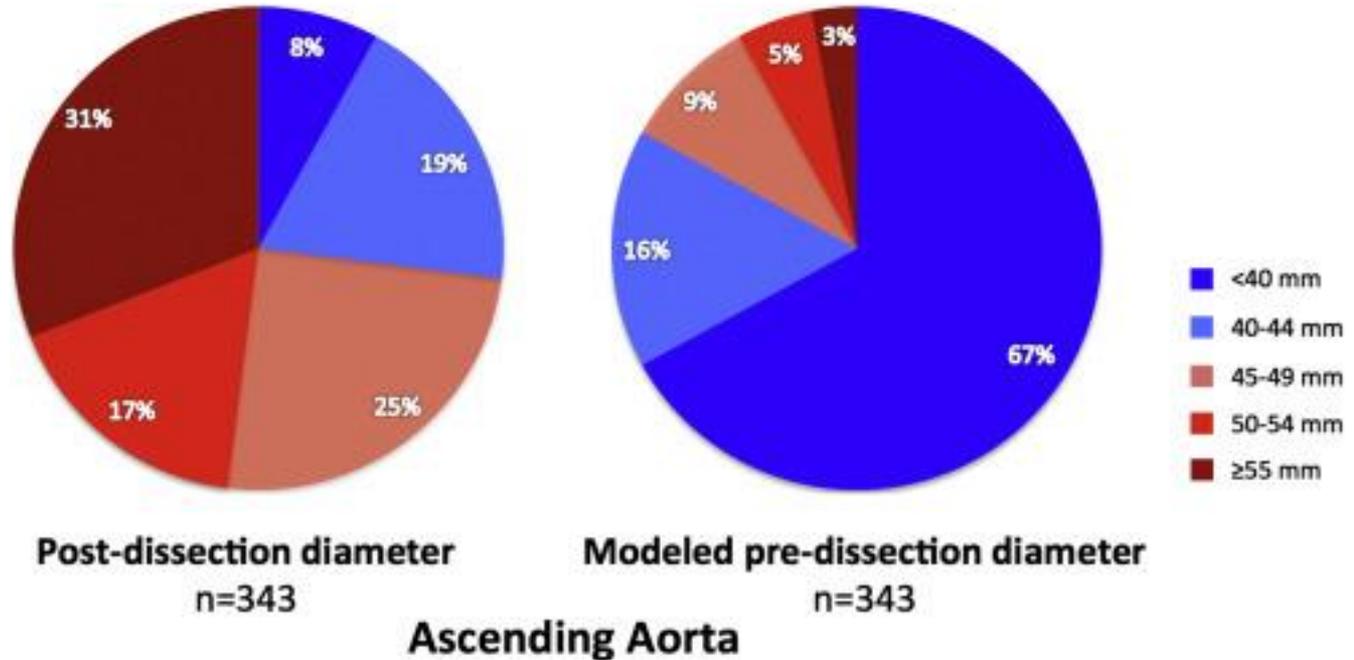
>64 years

Patient Cohort

Variable	All (n = 343)	Women (n = 123)	Men (n = 220)	P value
Age (y)	62 (53; 73)	67 (56; 77)	59 (50; 71)	<.001
BMI (kg/m ²)	28.1 (25.6; 32.0)	27.3 (23.2; 33.8)	28.3 (25.6; 32.0)	.396
BSA (m ²)	1.99 (1.83; 2.17)	1.83 (1.64; 1.96)	2.09 (1.95; 2.21)	<.001
Hypertension	295 (86)	109 (89)	186 (85)	.379
Diabetes	36 (10)	17 (14)	19 (9)	.165
History of stroke	28 (8)	13 (11)	15 (7)	.312
COPD	40 (12)	19 (15)	21 (10)	.127
Coronary artery disease	54 (16)	23 (19)	31 (14)	.173
Previous cardiac surgery	29 (9)	10 (8)	19 (9)	.968
Predissection ascending aortic diameter (cm)				
Age category				
<45 y	3.4 (3.2; 3.8)	3.3 (3.1; 3.6)	3.4 (3.2; 4.0)	.177
45-54 y	3.6 (3.2; 4.1)	3.5 (3.1; 3.9)	3.7 (3.3; 4.1)	.318
55-64 y	3.6 (3.3; 4.1)	3.6 (3.3; 4.2)	3.6 (3.3; 3.9)	.589
>64 y	3.8 (3.4; 4.4)	3.8 (3.5; 4.5)	3.9 (3.4; 4.3)	.985
Overall	3.7 (3.3; 4.1)	3.7 (3.4; 4.2)	3.7 (3.3; 4.1)	.810

Data presented as median (first quartile; third quartile) or n (%). *BMI*, Body mass index; *BSA*, body surface area; *COPD*, chronic obstructive pulmonary disease.

Distribution of postdissection and modeled predissection ascending aortic diameter in patients with acute type A aortic dissection.



Median diameter of the measured dissected ascending aorta was 4.9 cm

Median modeled predissection ascending diameter was 3.7 cm (M/Fp=0.81)



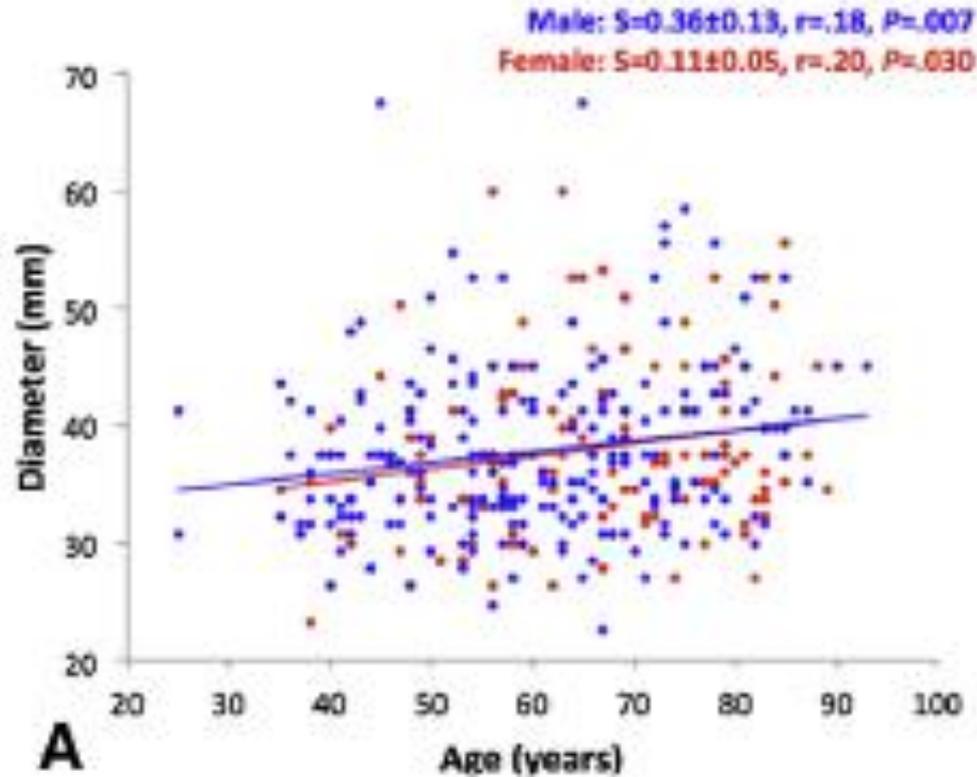
Modeled Predissection Ascending Diameter

The measured dissected ascending diameter
<5.0 cm in 178 patients (52%)
<5.5 cm in 237 patients (69%)

The modeled predissection ascending diameter
<5.0 cm (325/343) patients (92%)
<5.5 cm (334/343) patients (97%)



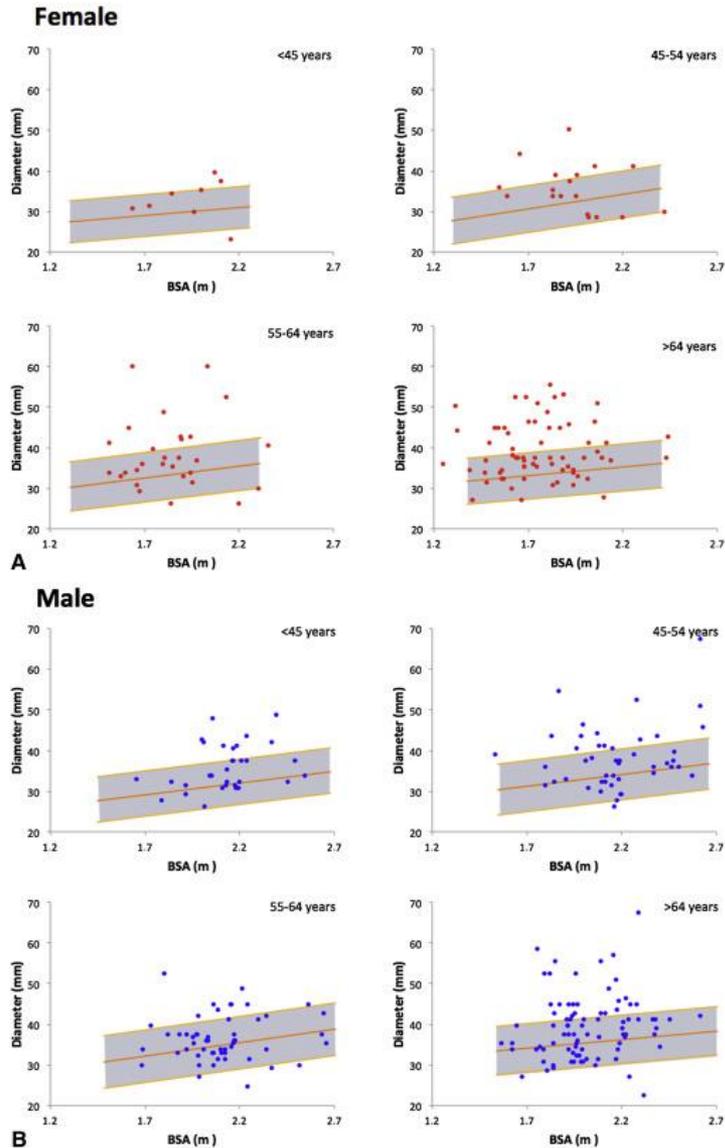
Sex-specific modeled predissection ascending aortic diameter in relation to age



The modeled predissection ascending diameter was similarly associated with age in both sexes (women, $r = .20, p < .030$; men, $r = .18, p < 0.007$)

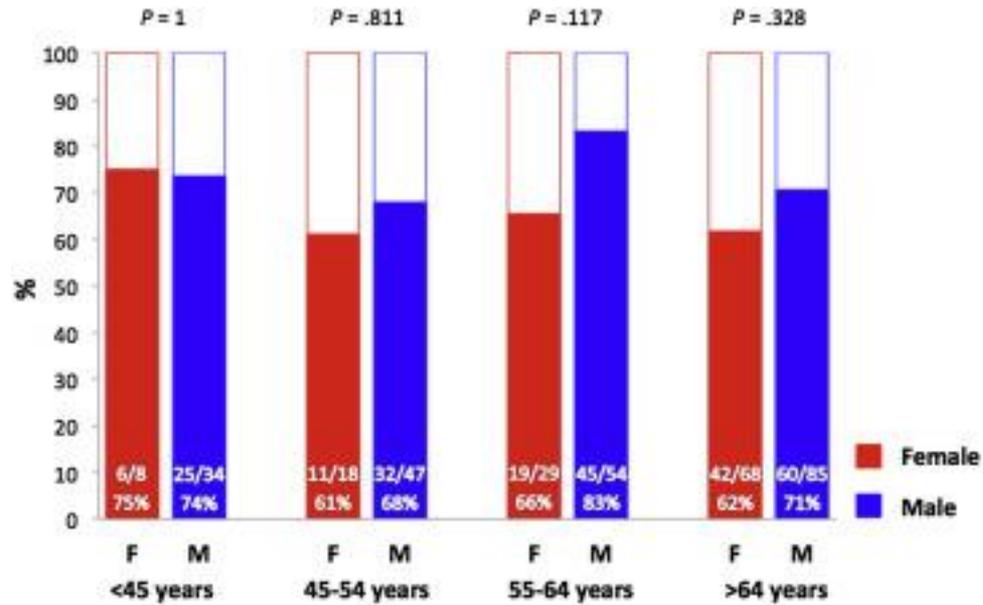


Distribution of modeled predissection ascending diameter in women and men for different age and body surface area categories compared with normal reference diameters





Sex-related incidence of nondilated ascending aorta in patients with acute type A dissection



Overall, 63% of women and 74% of men had a normal (nondilated) ascending aorta before type A dissection onset

Among patients aged 55 to 64 years, a tendency was seen toward a greater rate of nondilated ascending aortas in men than in women (83% vs 66%, $p < 0.117$)



Analysis of Modeled Predissection Outcomes

In most patients, the measured dissected aortic diameter <5.5 cm

In 97% the modeled predissection diameter was <5.5 cm



Predissection Aortic Diameter and Gender

The incidence of type A dissection was greater among men, with the average ratio of 3:2

The normal aortic diameter is greater in men

Smaller normal aortic dimensions in women might be protective against aortic dissection, explaining the observed lower incidence of Type A dissection among women

However, the ascending aorta dissected at the same average diameter in both sexes



CONCLUSIONS

Modeling of the predissection ascending aortic geometry enabled us to predict the incidence of aortic dilatation (or non-dilatation) in patients with acute type A dissection

More than 60% of patients with spontaneous, non-Marfan, nonbicuspid type A dissection had a nondilated ascending aorta before dissection

>90% of patients presenting with acute Type A aortic dissection would fail to meet the guidelines for elective ascending replacement before dissection onset



Conclusions

The ascending aorta dissects at the same average diameter in both sexes

Currently, no single biomarker or established imaging marker, such as aortic wall stress or strain function, is available to positively predict aortic dissection

Results support the hypothesis that additional research on the genetic, biochemical, and imaging predictors of aortic dissection is essential



Thank you



Study Limitations

- First, the diameter increase due to dissection might differ among patients; however, the same average diameter increase was subtracted for all patients.
- Second, in most patients, the dissected ascending aorta diameter was obtained from the TEEs, but for the modeled predissection diameter, we referred to a CTA-based study



- The findings of the present study can be summarized as follows. First, >90% of patients presenting with acute type A aortic dissection would fail to meet the guidelines for elective ascending replacement before dissection onset.
- Second, most patients with non-Marfan, tricuspid aortic valve who develop type A aortic dissection will have a normal, nondilated ascending aorta. Finally, the ascending aorta will dissect at the same average diameter in both sexes.



Age (y)	BSA (m ²)	Ascending diameter (mm) (n = 2952)	
		Female	Male
<45	<1.70	33.8	33.0
	1.70-1.89	34.4	36.3
	1.90-2.09	35.0	36.3
	>2.1	—	38.3
45-54	<1.70	35.2	38.6
	1.70-1.89	37.2	38.1
	1.90-2.09	38.9	39.7
	>2.1	40.6	40.6
55-64	<1.70	36.9	36.3
	1.70-1.89	37.0	39.7
	1.90-2.09	39.0	41.2
	>2.1	42.0	43.1
>64	<1.70	37.5	38.5
	1.70-1.89	39.2	41.0
	1.90-2.09	42.7	42.2
	>2.1	—	42.4

Data from Wolak and colleagues.⁵ BSA, Body surface area.









Distribution of Modeled Predissection Ascending Diameter

The distribution of the modeled predissection ascending diameter for both sexes and the different age and BSA categories compared with the normal reference diameters



Distribution of Modeled Predissection Ascending Diameter

Overall, 63% of women and 74% of men had a normal (nondilated) ascending aorta before type A dissection onset

Among patients aged 55 to 64 years, a tendency was seen toward a greater rate of nondilated ascending aortas in men than in women (83% vs 66%, $p < 0.117$).



Analysis of Modelled Predissection Outcomes

Analyze CTAs obtained before and after acute aortic dissection type A

The average diameter increase with acute dissection was 32%

The dissected aortic diameter <5.5 cm, and in 97% the modelled predissection diameter was <5.5 cm - the threshold for prophylactic ascending replacement

Not expect a large number of patients to have a diameter >5.5 cm at the moment of aortic dissection, because those patients with a diagnosed ascending aneurysm would have undergone elective surgery in accordance with the guidelines

However, no screening service for ascending aortic aneurysms is offered to the entire population in our region; therefore, the denominator of patients with ascending dilatation or aneurysm remains unknown.



Summary

>90% of patients presenting with acute Type A aortic dissection would fail to meet the guidelines for elective ascending replacement before dissection onset

Most patients with non-Marfan, tricuspid aortic valve who develop Type A aortic dissection will have a normal, nondilated ascending aorta

Finally, the ascending aorta will dissect at the same average diameter in both sexes.



Predissection Correlation

The modeled predissection ascending diameter was similarly associated with age in both sexes (women, $r = .20, p < .030$; men, $r = .18, p < 0.007$)

No significant correlation was found between the ascending aorta diameter and BSA (women, $p < 0.466$; men, $p < 0.066$)



Modeling the Predissection Aorta

Modeling the predissection diameter allowed identification of patients with a nondilated ascending aorta before dissection onset

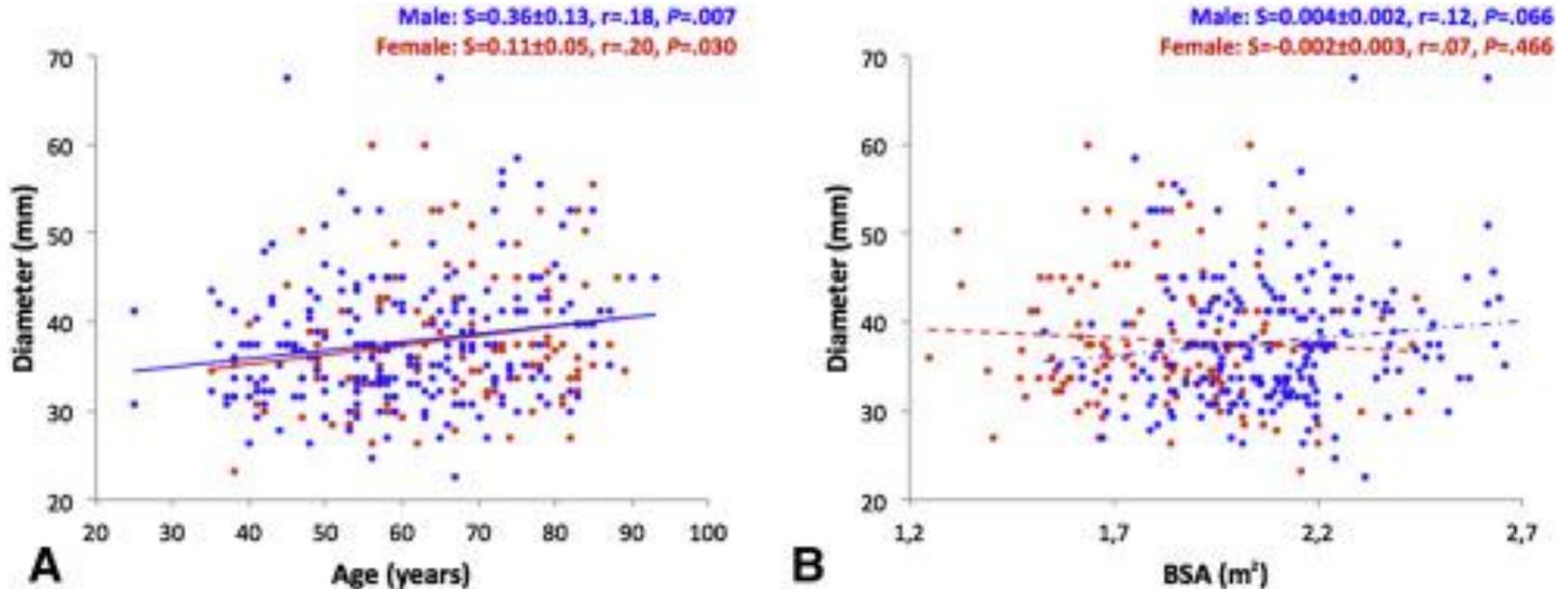
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Results support the hypothesis that additional research on the genetic, biochemical, and imaging predictors of aortic dissection is essential.



Sex-specific modeled predissection ascending aortic diameter in relation to age and body surface area

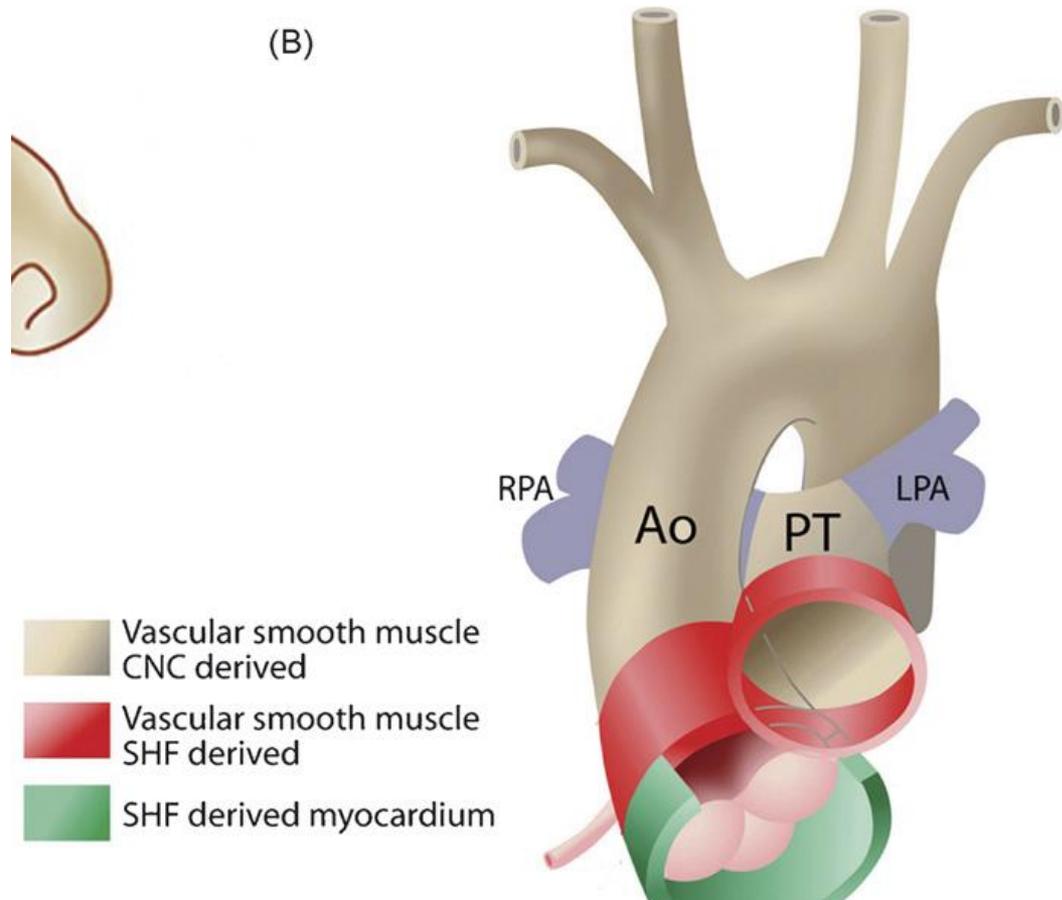


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No **significant** correlation was found between the ascending aorta diameter and BSA (women, $p < 0.466$; men, $p < 0.066$)



Embryologic Origin of Vascular Smooth Muscle of the Ascending Aorta



The vascular smooth muscle cells (vsmc) of the mid-ascending aorta to the periductal region are of neural crest origin, while the smooth muscle cells of the sinuses of Valsalva and descending aorta are of mesenchymal origin



Modeled Predissection Ascending Diameter

Median diameter of the measured dissected ascending aorta was 4.9 cm

Median estimated predissection ascending diameter was 3.7 cm (M/F p=0.81)