


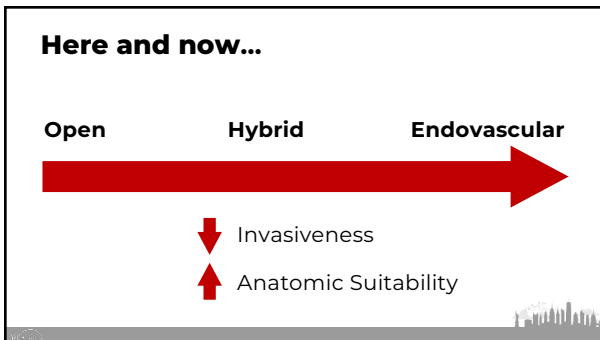
Primary and Redo Open Aortic Arch Repair
When Will They and Will They Not Be Replaced by Endo and Hybrid Techniques

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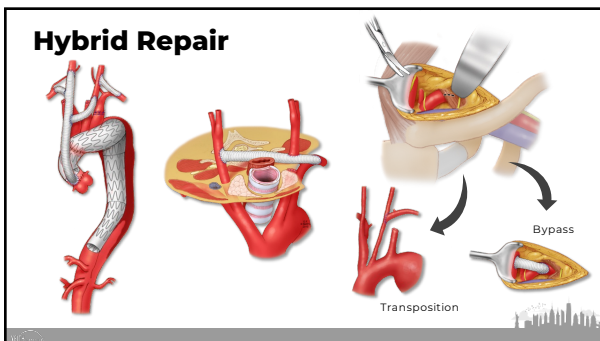


- Gore *Consultant*
- Artivion (Cryolife) *Advisory board*
- Terumo Aortic *Speaker*



6.5.2 Aortic Arch Aneurysms

		1. In patients with an aortic arch aneurysm who have symptoms attributable to the aneurysm, a hybrid or endovascular approach may be reasonable.
		2. In patients with an isolated aortic arch aneurysm who are asymptomatic and have no other aortic disease, a hybrid or endovascular approach may be reasonable.
		3. In patients undergoing open surgical repair of an aortic arch aneurysm, if the aneurysmal diameter is less than 5.5 cm, a hybrid or endovascular approach may be reasonable.
		4. In patients undergoing open surgical repair of an aortic arch aneurysm, if the aneurysmal diameter is 5.5 cm or greater, a hybrid or endovascular approach may be reasonable.
2b	C-EO	5. In patients with an aortic arch aneurysm who are asymptomatic but meet criteria for intervention, but have a high risk from open surgical repair, a hybrid or endovascular approach may be reasonable.



Results of hybrid repair

	Cao et al (2012) n = 1886		Moulakakis et al (2013) n = 956	
No. studies / patients	50	1886	26	956
30-day mortality	11%	(1.6% - 25%)	12%	(1.6% - 25%)
Stroke	7%	(0.8% - 25%)	8%	(0.6% - 18%)
Spinal cord ischemia	7%	(1% - 25%)	4%	(0.3% - 17%)
Dialysis	-	-	6%	(3.6% - 12%)

Limitations

- Retrospective design
- Outcomes not adjudicated
- Mixed aneurysm extent / etiology

Open Repair

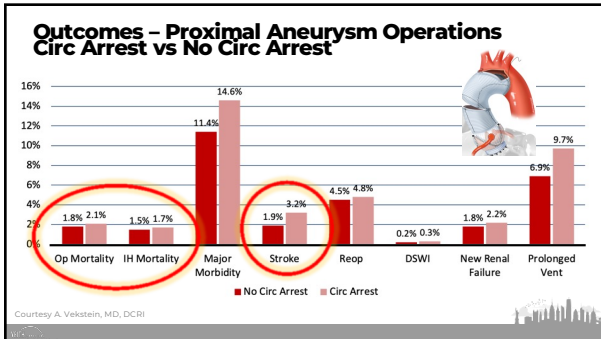
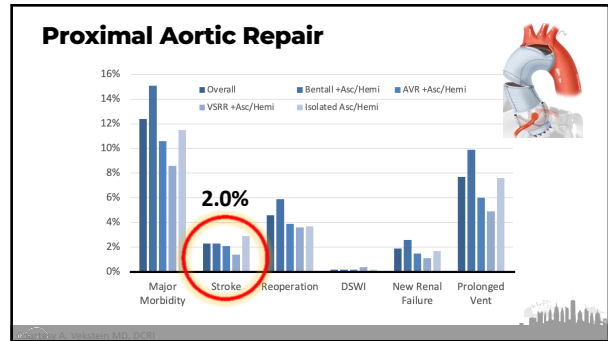
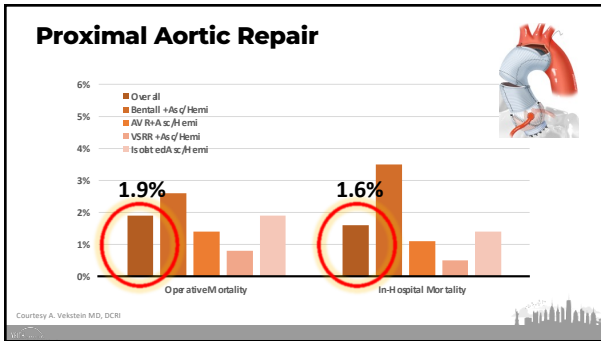
Penn Medicine

2023 ANTS AORTIC SYMPOSIUM 2023

National Trends and Outcomes in Thoracic Aortic Surgery

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 Co-Founder and Co-Director, Penn Aorta Center
 Co-Chair, Society of Thoracic Surgeons Aortic Surgery Task Force

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The Society of Thoracic Surgeons

Elective Ascending Hemiarach replacement

Mortality = 1.9%
Stroke = 3.0%

N. Desai; STS aortic database 2022

Total Arch

ADULT AORTA

The impact of age on patients undergoing aortic arch surgery: Evidence from a multicenter national registry

Joseph Chang, MD, MS,¹ Louis Mathias Stevens, MD, PhD,² Michael W. A. Chu, MD, MBA,³ Francisco Dagnino, MD,⁴ Mark D. Perence, MD, PhD,⁵ Marie Bonhomme, MD, MMSc,⁶ John Rosman, MD, MS,⁷ Israel El-Hamrawy, MD, PhD,⁸ Michael H. Yamashita, MD, MCh, MPH,⁹ Remy Akinci, MD,¹⁰ Blake Bittles, MD,¹¹ Travis Payne, MD,¹² and Maral Oshrokan, MD, PhD,¹³ on behalf of the Canadian Thoracic Aortic Collaborative (CTAC)

OBJECTIVE: Elderly patients are typically offered aortic surgery at smaller diameter thresholds as younger patients, despite limited data quantifying their operative risk. We aim to report the incremental risk experienced by elderly patients undergoing aortic arch surgery.

Methods: In total, 3,000 patients underwent aortic arch surgery between 2002 and 2016 in 10 centers. Patients were divided into 2 groups: <65 years (n = 1,926) vs ≥65 years (n = 1,074) and 125 patients (n = 48) who were in-hospital mortality, stroke, and the modified Society of Thoracic Surgeons composite for mortality or major morbidity (STS-COMP). Multivariable modeling was performed to determine the association of age with these outcomes.

CONCLUSIONS: Elderly patients undergoing aortic arch surgery experience a higher risk of mortality, stroke, and STS-COMP compared to younger patients. The risk of mortality or major morbidity (STS-COMP) was significantly higher in elderly patients.

ADULT AORTA

For patients aged 65 to 74 years

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National Outcomes of Elective Hybrid Arch

Origin	Period	Number	Non- Elective	Stroke	Mortality
CTAC	2002-2018	2,520	25%	7.5%	8.4%
STS	2011-2014	12,521	63%	12%	8%
STS/Hybrid	2014-2016	884	100%	6.9%	6.7%

ADULT AORTA

For patients aged 65 to 74 years

Coselli et al

Total aortic arch replacement using a frozen elephant trunk device: Results of a 1-year US multicenter trial

Joseph S. Coselli, MD,¹ Eric E. Roselli, MD,² Ourania Preventza, MD,³ S. Chris Malaisrie, MD,⁴ Allan Stewart, MD,⁵ Paul Stelzer, MD,⁶ Hiroo Takayama, MD,⁷ Edward P. Chen, MD,⁸ Anthony L. Estrera, MD,⁹ Thomas G. Gleason, MD,¹⁰ Michael P. Fischbein, MD,¹¹ Leonard N. Girardi, MD,¹² Himanshu J. Patel, MD,¹³ Joseph E. Bavaria, MD,¹⁴ and Scott A. LeMaire, MD¹⁵

OBJECTIVE: In this prospective US investigational device exemption trial, we assessed the safety and 1-year clinical outcomes of the Thoraflex Hybrid device (Terumo Aortic) for the frozen elephant trunk technique to repair the ascending aorta, aortic arch, and descending thoracic aorta.

Methods: For the trial, which involved 12 US sites, 65 patients without rupture were recruited into the primary study group, and 9 patients were recruited into the rupture group. All patients underwent open surgical repair of the ascending aorta, aortic arch, and descending thoracic aorta in cases of aneurysm and/or dissection. The primary end point was freedom from major adverse events (MAE), defined as permanent stroke, permanent paraplegia/paraparesis, unanticipated aortic-related

ADULT AORTA

For patients aged 65 to 74 years

TABLE 1. Early outcomes (at discharge or within 30 days) of Thoraflex study patients (N = 74) stratified by rupture status.

Outcome	Number (n)	Percentage (%)
Patients with at least 1 MAE	10	13.5
All-cause mortality	2	2.7
Aortic disease-related mortality	1	1.4
Persistent stroke	4	5.4
Persistent paraplegia/paraparesis (n = 64) [†]	3	4.7
Unanticipated aortic-related reoperation	2	2.7
Failed device patency	0	0
Postoperative lengths of stay, d	4.5 (3-6)	4 (3-9.8)
Intraoperative cross-clamp time, min	11 (7.3-17)	9 (8.8-26)

ADULT AORTA

For patients aged 65 to 74 years

FET: Results

Author (Year)	Cases	Stroke (%)	Paraplegia(%)	Mortality (%)
Shimamura (2008)	126	5.6	6.3	5.6
Sun (2014)	456	2.9	2.3	8.1
Shrestha (2016)	100	9.0	7.0	7.0
Hanover/Bologna (2018)	437	10.8	5.5	14.9
Roselli (2018)	72	2.8	4.2	4.2
Evita Registry (2020)	1165	7.0	7.0	15.0
J-ORCHESTRA (2022)	369	10.0	3.5	1.6
Thoraflex (2022)	65	6.0	5.0	3.0

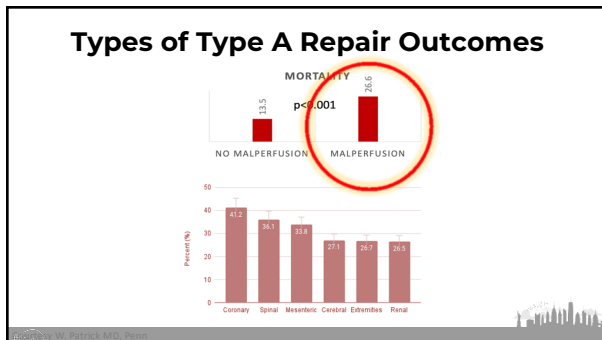
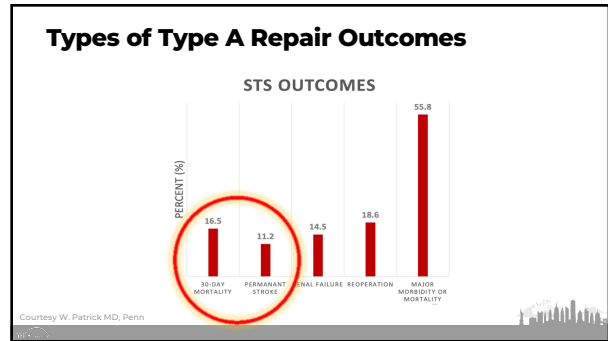
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Reoperative Arch

	N	Stroke	Early Death	Late Survival
Duke (2022)	214	3%	6%	76%(5-yr), 58% (10-yr)
Emory (2021)	365	6%	7%	66%(5-yr), 56% (10-yr)
Cornell (2023)	156	6%	3%	77%(5-yr), 66% (10-yr)
UTH/MHH (2020)	465	6%	8%	77%(5-yr), 67% (10-yr)

3-6% 3-8% 60% @ 10 yrs



Endo Arch "Achilles Heel"

Stroke
Durability

Stroke risk with endovascular arch repair

Technique	Design	Device	Stroke Rate, %
Branched	Single branch	Valiant Mona LSA Medtronic	33
		TBE, Gore	3.6 - 22
		Relay, Terumo	0
		Nexus, Endovascular	3.6
		Inoue, PTF	7.8
		Zenith, Cook	2.9 - 15.8
		Relay, Terumo	6.5 - 25.6
		WeFlow, Stryker	0
		Inoue, PTF	33
		Inoue, PTF	51
Triple branch	Patient-specific	Zenith, Cook Medical	51
		Terumo aortic	0
		Inoue, PTMC	42.9
Fenestrated	Patient-specific	Zenith, Cook Medical	7.5
		Relay Scallop	7.9
Alternative or "bail out"	Physician modified	Single or double fenestrated	17 - 9.6
		Parallel grafts	8.7 - 16.1
		In situ fenestrated	12

5-25%

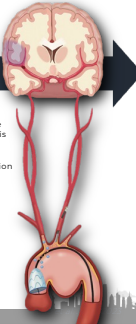
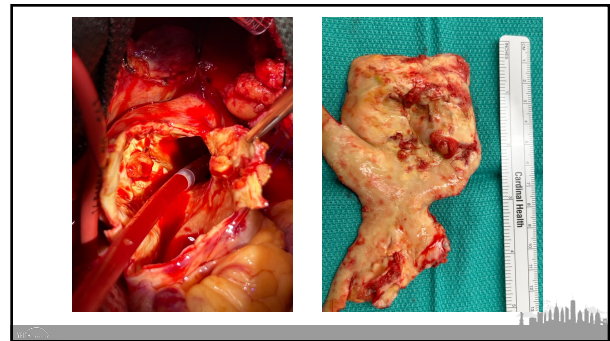
Risk of stroke with arch repair in 4,355 patients enrolled in the SVS VQI® registry

4,355 patients treated by TEVAR
Zone 0 (8%), Zone 1 (12%), Zone 2 (80%)


	Zone 0	Zone 1	Zone 2	P value
n	350	513	3,492	
Stroke	11.1%	5.3%	4.7%	<.0001
Mortality	6.9%	5.3%	3.5%	<.002

Stroke Mechanisms

SOLID EMBOLIZATION	AIR EMBOLIZATION	DECREASED PERFUSION
<p>High atheromatous burden</p> <ul style="list-style-type: none"> Female Advanced age Cerebrovascular disease Chronic kidney disease Ischemic cardiomyopathy Degenerative aneurysm <p>Imaging evidence of atheroma</p> <p>Procedure complexity</p> <ul style="list-style-type: none"> Zone 0 > 1 > 2 Tortuosity, angulation 	<p>Air embolization</p> <ul style="list-style-type: none"> Inadequate flushing Polyester based > Gore 	<ul style="list-style-type: none"> Compressed lumen Left subclavian coverage Incomplete circle of Willis Retrograde access Anemia Intraoperative hypotension Stent kink/collapse

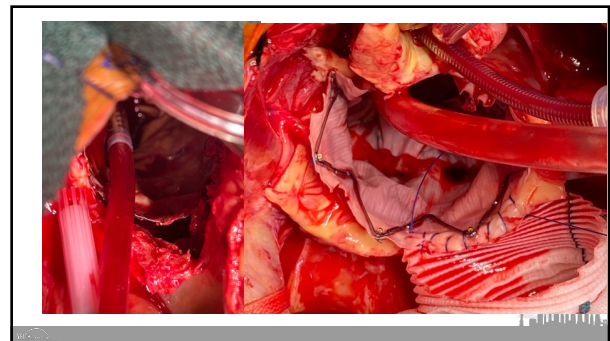
'Shaggy' aorta

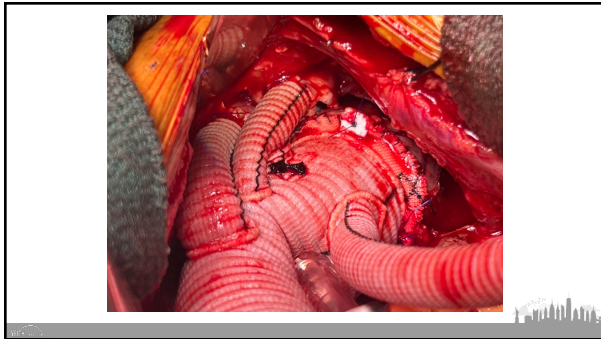


Absolute contra-indication!

Intraoperative Stroke Prevention

- Atheroma avoidance-TEE, epi-aortic
- Single cross-clamp (avoid partial clamping)
- Temper cardiomy suction
- Pump filter modification
- Cannulation modification (location)
- Temperature management
- pH strategy
- Cerebral Perfusion
- Perfusion pressure management
- Hct management
- Blood conservation
- Pharmaco-cerebroprotection



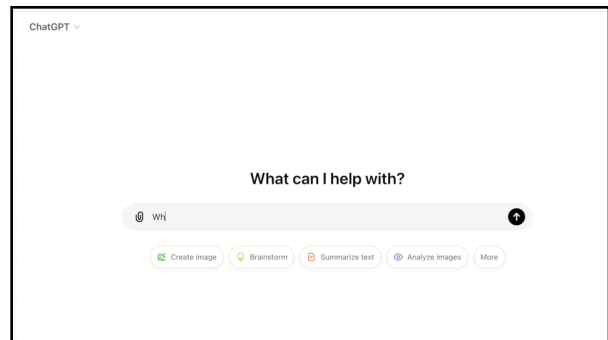


“Standard” Open

Elective Arch:

Mortality	<5%
Stroke	<5%
Paraplegia	<2%

- ### What have we learned?
- In fit patients, **Open arch repair** is safe and remains the standard or **benchmark**
 - **Stroke** remains a challenge
 - **Endovascular repair** is here for the select patients (suitable anatomy, unfit)
 - **But...**



Thank You!

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