2023 MID-ATLANTIC CONFERENCE

11th ANNUAL CURRENT CONCEPTS IN

VASCULAR THERAPIES

2023

Hilton Virginia Beach Oceanfront
Virginia Beach, Virginia

APRIL 20-22

TCAR IS THE FUTURE

In All Comers

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Sentara Vascular Specialist

EVMS Assistant Professor

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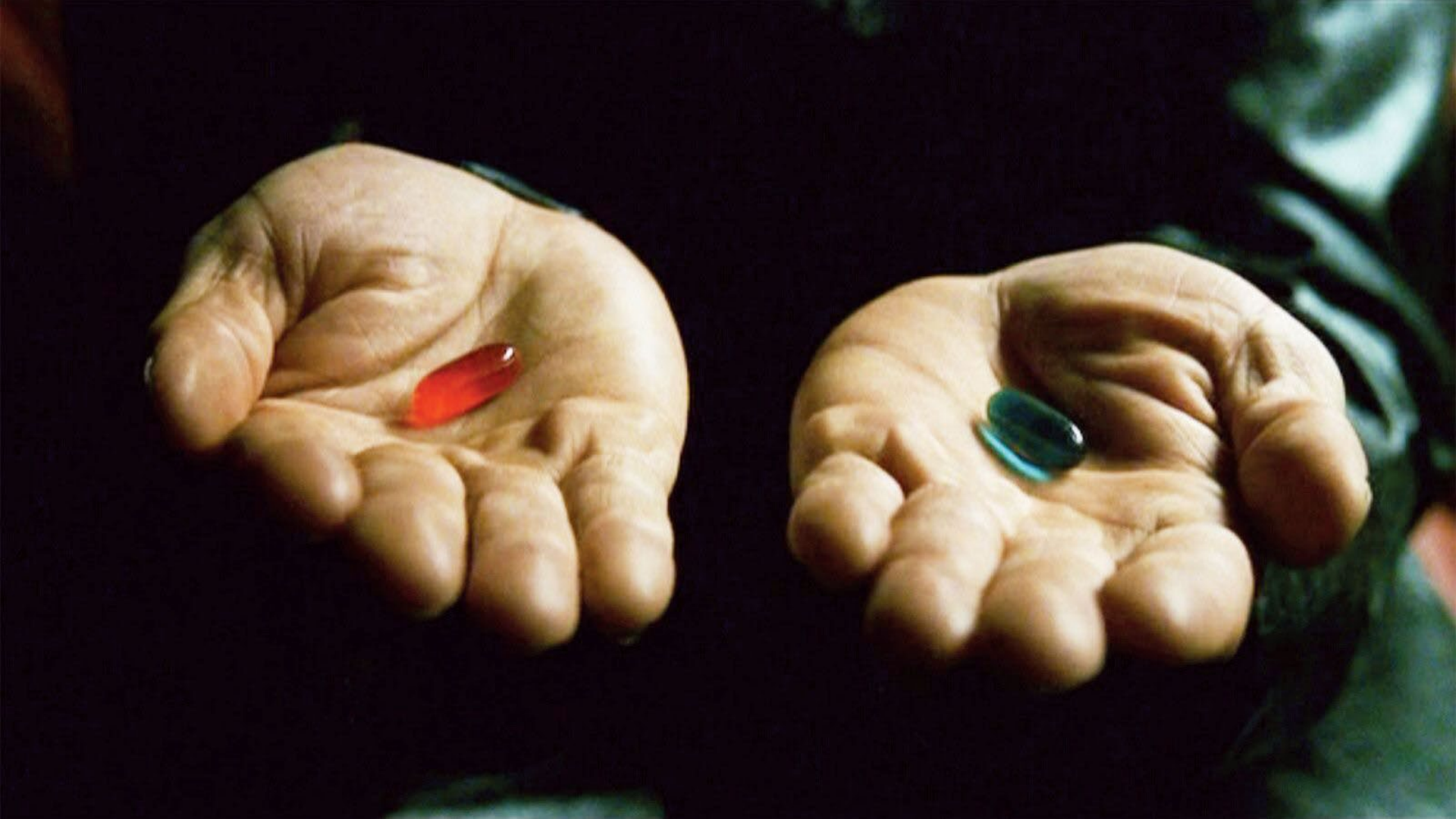

Overview

- Carotid Disease – the history
- CEA vs. TF vs. TCAR
- What is TCAR
- Why it is the future
- Medical Management

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Paying Attention? OR Were You Looking At The Woman In The Red Dress
MakeAGIF.com

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- Carotid Disease – the history
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- Medical Management

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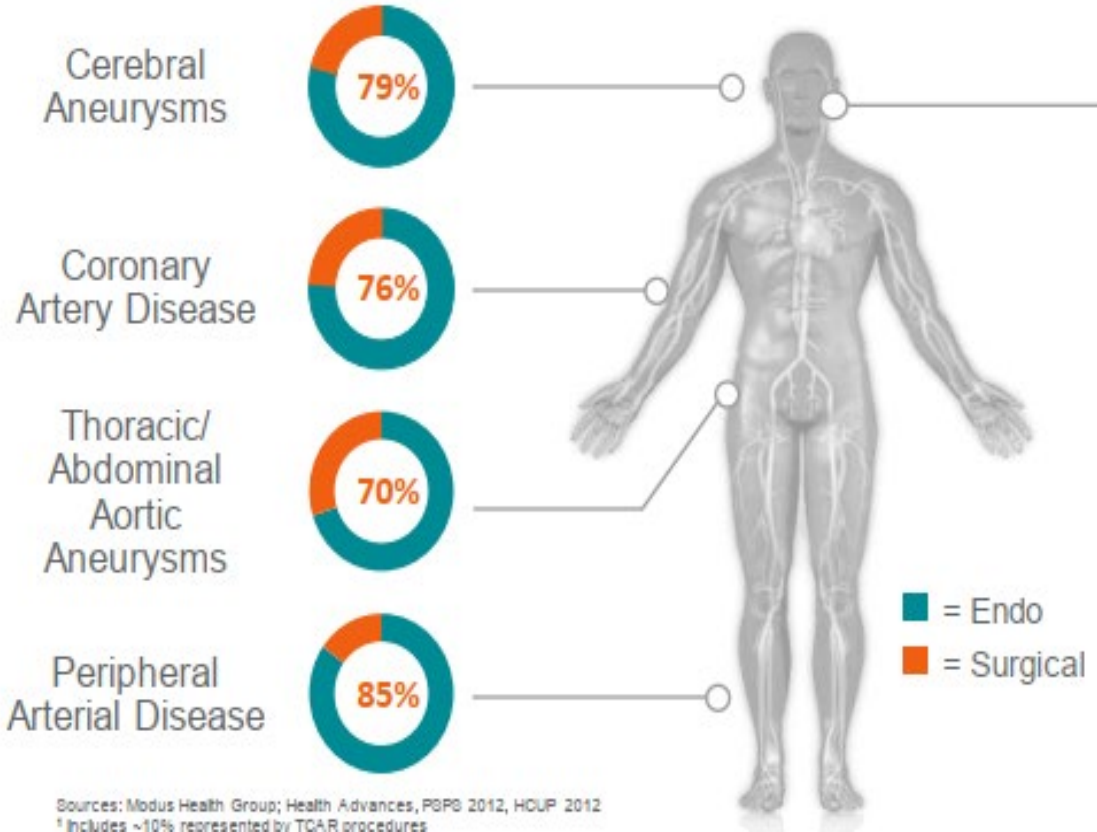
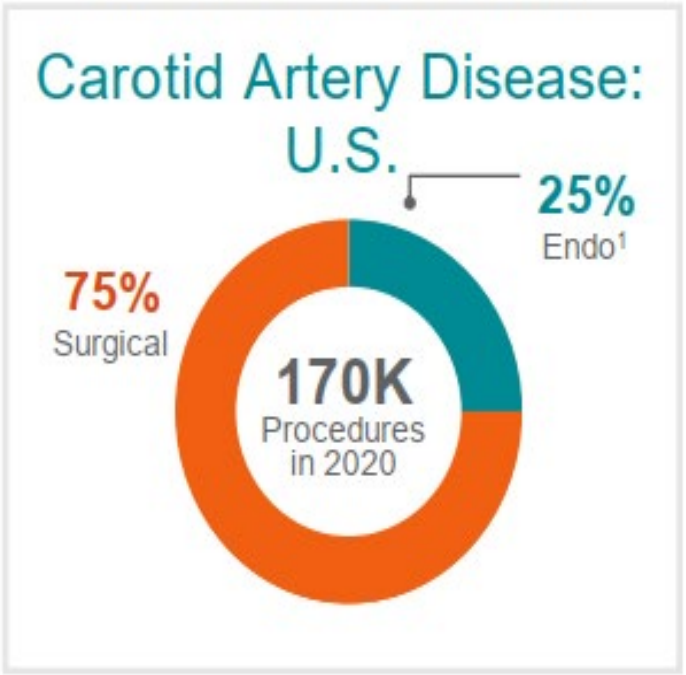
The New Normal: Endovascular Procedures

Realizing the Benefits of a Less Invasive Treatment Option



THE LAST FRONTIER:



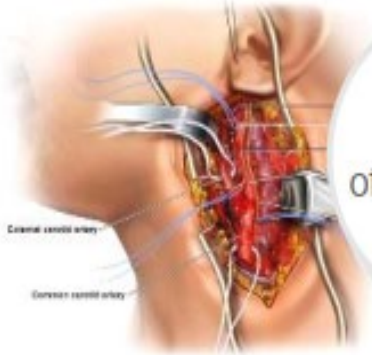
Sources: Modus Health Group; Health Advances, PSPS 2012, HCUP 2012

[1] Includes ~10% represented by TCAR procedures

SURGICAL:

Carotid Endarterectomy (CEA)

65+ years



~75% of procedures

SIGNIFICANT adverse events

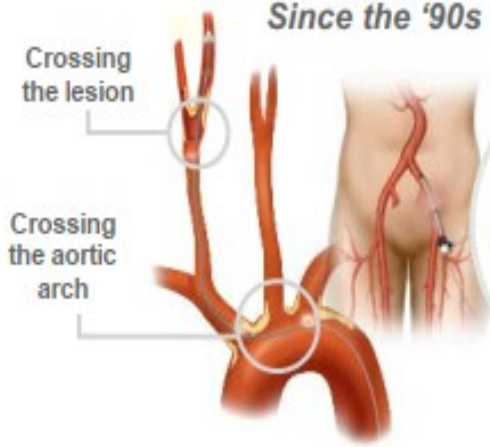
LOW 30-day stroke risk

A Dated Standard of Care

ENDOVASCULAR:

Transfemoral Carotid Artery Stenting (CAS)

Since the '90s



~15% of procedures*

LOWER adverse events

HIGHER (~2x) 30-day stroke risk

A Niche Procedure

Overview

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CREST Overview

- **DESIGN:** Randomized, multi-center trial from the year 2000 to 2011
- **OBJECTIVE:** Investigate the differences found in outcomes from CEA vs. TF-CAS
- **PRIMARY ENDPOINT:**
  - Stroke, Myocardial Infarction, or Death from any cause during the periprocedural period (30 days from procedure)
  - Any Ipsilateral Stroke within 4 years after procedure
- **CONCLUSION:** TF-CAS and CEA were associated with similar rates of the primary endpoint of *composite* S/D/MI and ipsilateral stroke at 4 years.
  - However, *individual* outcomes showed higher stroke rates and lower MI rates for TF-CAS vs. CEA

30-day Outcomes	CEA (N=1240)	TF-CAS (N=1262)	P-value
Stroke	2.3%	4.1%	0.01
Death	0.3%	0.7%	0.18
MI	2.3%	1.1%	0.03
Cranial Nerve Injury	4.7%*	0.3%	NR**

SAPPHIRE

- **DESIGN:** Randomized, controlled multicenter trial from 2000 to 2005
- **OBJECTIVE:** Evaluated the differences found in outcomes from CEA vs. TF-CAS in a high-risk population
- **PRIMARY ENDPOINT:** Composite of death, stroke, or MI within 30 days; ipsilateral stroke/death within 1 year
- **CONCLUSION:** TF-CAS was statistically equivalent to CEA for both primary endpoints

30-day Outcomes	CEA (N=167)	TF-CAS (N=167)	P-value
Stroke	3.1%	3.6%	0.77
Death	2.5%	1.2%	0.39
MI	6.1%	2.4%	0.10

ACT 1 OVERVIEW

- **DESIGN:** Prospective, multi-center trial from years 2005-2013
- **OBJECTIVE:** Compare outcomes of asymptomatic patients undergoing either carotid artery stenting or CEA
- **PRIMARY ENDPOINT:**
  - Composite Stroke, Death or MI within 30 days or ipsilateral stroke within 1 year
- **CONCLUSION:** There were no significant differences with the *composite* endpoint of S/D/MI and ipsilateral stroke at 1 year between TF-CAS and CEA (3.8% and 3.4%, respectively)
  - However, *individual* outcomes showed higher stroke rates and lower MI rates for TF-CAS vs. CEA at 30 days

30-Day Outcomes	CEA (N= 364)	TF-CAS (N= 1089)	P-Value
Stroke/Death/MI	2.6%	3.3%	0.60
Stroke/Death	1.7%	2.9%	0.33
Stroke	1.4%	2.8%	0.23
Death	0.3%	0.1%	0.43
MI	0.9%	0.5%	0.41

TCAR Paradigm Shift: Transcarotid

The TCAR® System combines advantages from both worlds: **surgical principles** of neuroprotection and game-changing **endovascular technology**

Minimally Invasive

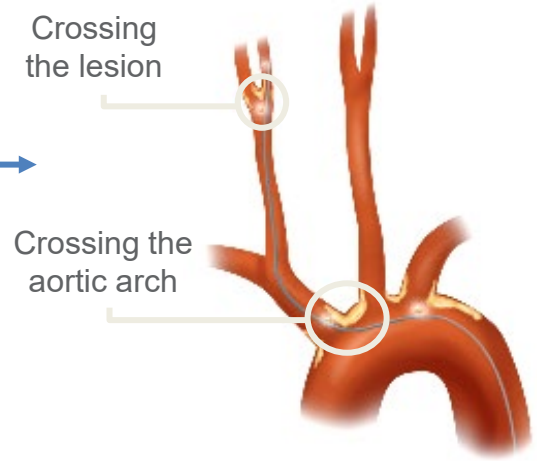
Avoids Aortic Arch

Avoids Cranial Nerve Plexus

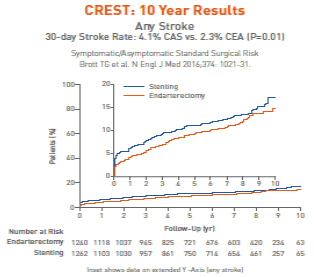
High Rate Flow Reversal Neuroprotection

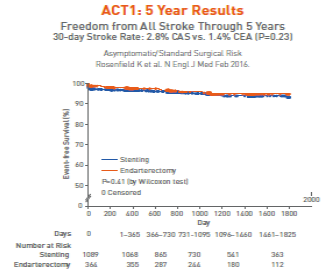
Accurate stenting

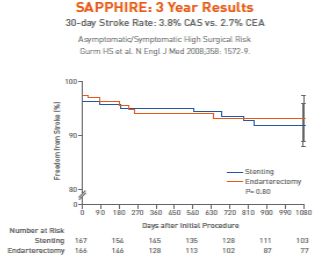
Pitfalls of a transfemoral approach

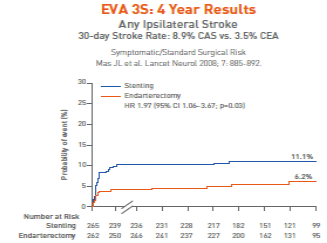


If the stent is **DELIVERED** safely, long term outcomes are equivalent to CEA







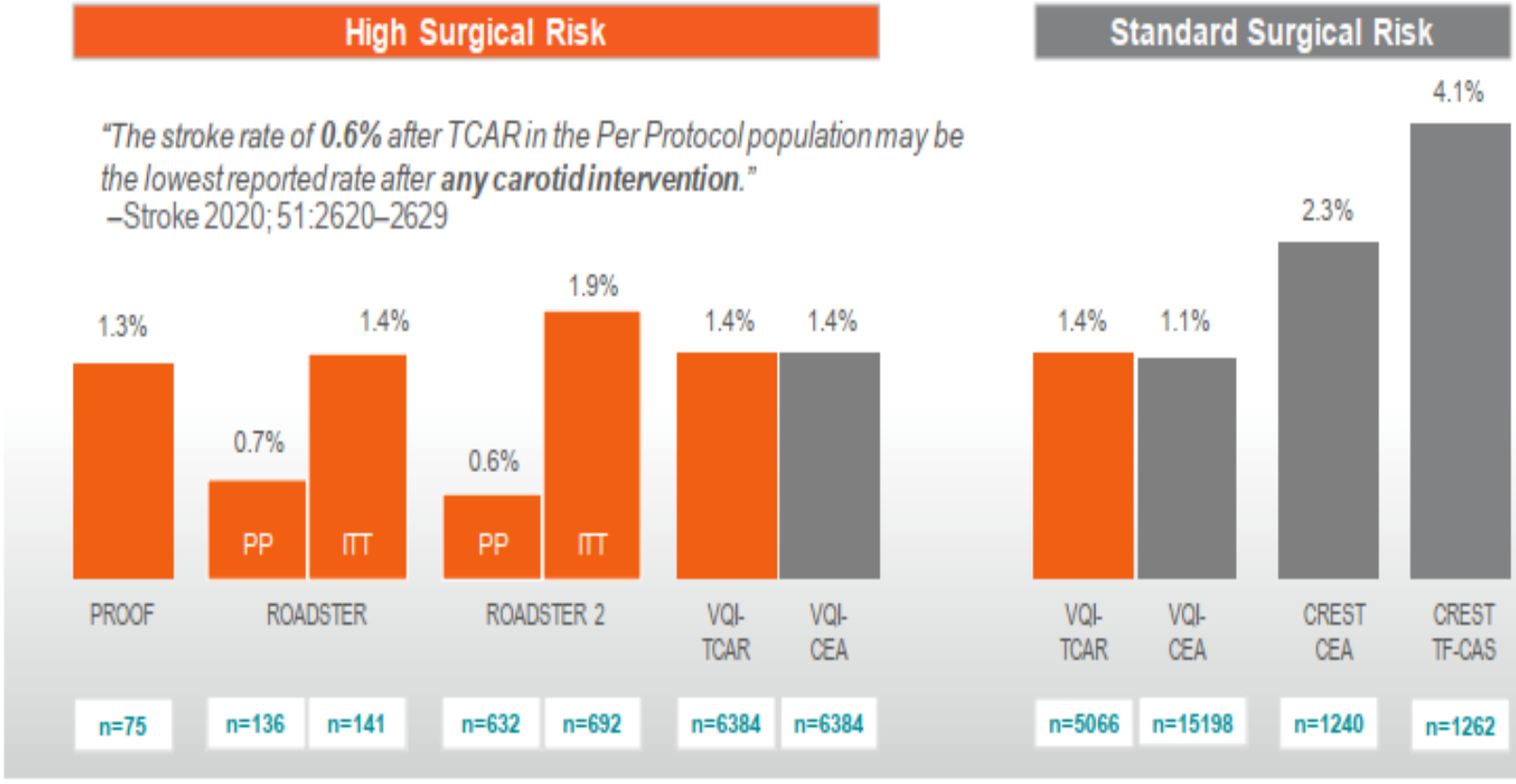


Brott TG, Calvet D, Howard G, et al. Long-term outcomes of stenting and endarterectomy for symptomatic carotid stenosis: a preplanned pooled analysis of individual patient data. *Lancet Neurol.* 2019;18(4):348-356.

SILKROAD MEDICAL®

Peripocedural Stroke Rates

Publications of TCAR, CEA, & TF-CAS



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SENTARA®

Dedicated TCAR® Toolset

Access	Guidewires	Neuroprotection	Carotid Stent	Balloons
✓	✓	✓	✓	✓

ENROUTE Enflate™ Transcarotid RX Balloon Dilatation Catheter

ENHANCE® Transcarotid Peripheral Access Kit*

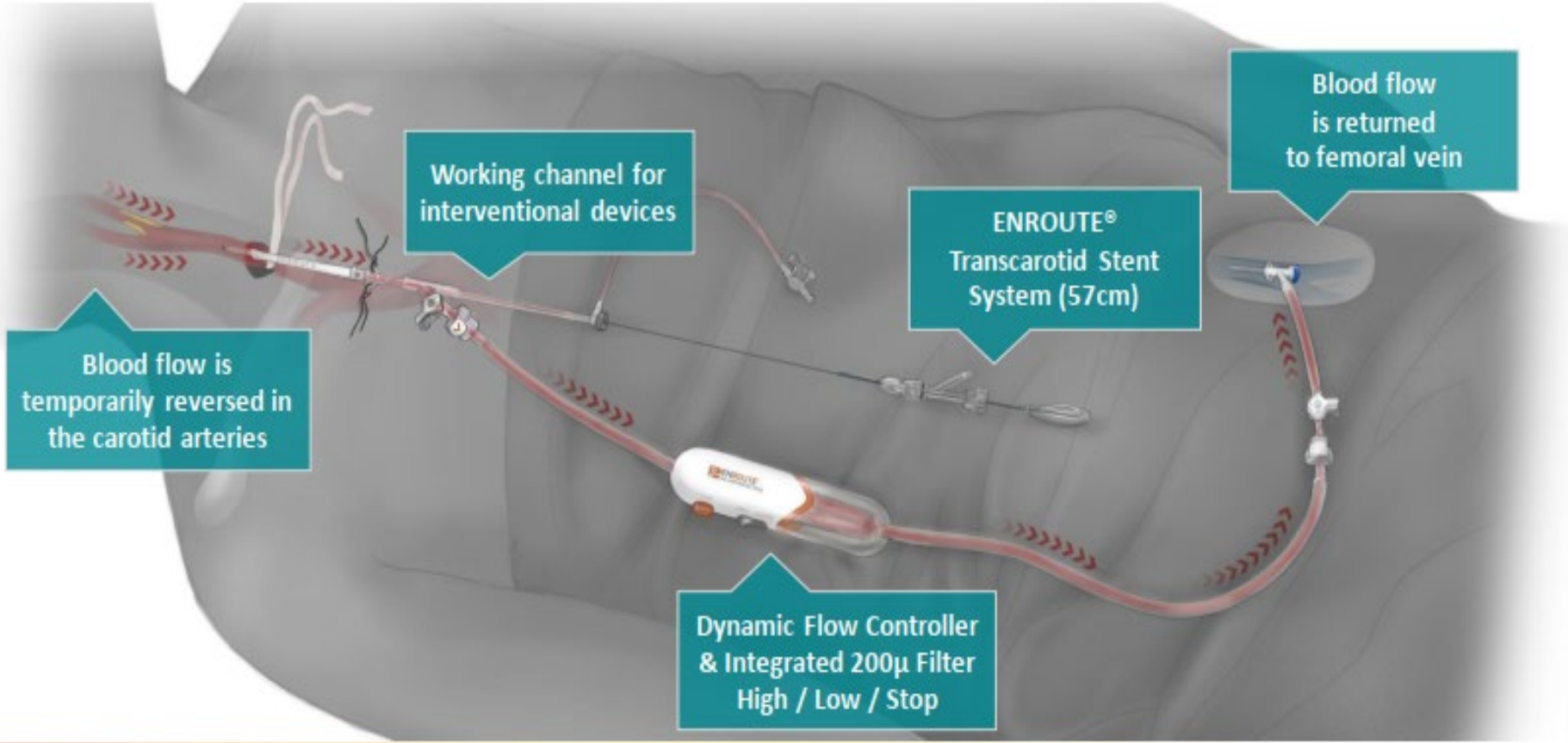
ENROUTE® Transcarotid Stent System*

Open vs. Closed Cell

ENROUTE® 0.014" Guidewire

ENROUTE® Transcarotid Neuroprotection System*

ENROUTE® Transcarotid Neuroprotection & Stent System



Surgically Inspired CEA-Like Neuroprotection

PROOF Study

TCAR – First in Man Experience

PROOF Study Safety Results[1,2]	Result (n=75)
Subjects completing 30-day follow-up	71 (94.7%)
Primary Endpoint: Composite of any major stroke, myocardial infarction and death from the index procedure through the 30-day post-procedural period	0/71 (0%)
Minor stroke *Minor contralateral stroke adjudicated as not device or procedure-related*	1/71 (1.3%)
Cranial nerve injury (Hoarseness)	2/71 (2.7%)

Study	Procedure	Embolic Protection	Patients	% w/ New DW-MRI Lesions
ICSS[3]	CEA	Clamp, backbleed	107	17%
PROOF[2]	**TCAR**	**Proximal Flow Reversal**	**56**	23% **(18% Ipsilateral)**
PROFI[4]	Transfemoral CAS	Proximal occlusion (MoMA)	31	45%
ICSS[3]	Transfemoral CAS	Distal filter (various)	51	73%
PROFI[4]	Transfemoral CAS	Distal filter (Emboshield)	31	87%

ROADSTER Study

Prospective, Multi-Center, Single-Arm Trial of TCAR in High Surgical Risk Patients with Carotid Stenosis - *Pivotal Results*

- **DESIGN:** IDE study with OPC of 11% S/D/MI at 30 days
- **OBJECTIVE:** Evaluate safety and efficacy of TCAR Procedure with ENROUTE Transcarotid Neuroprotection System
  - Direct carotid access
  - High rate flow reversal
  - FDA-approved carotid stents
- **CONCLUSION:** The results of the ROADSTER trial demonstrate that the use of the ENROUTE Transcarotid NPS is safe and effective at preventing stroke during CAS.

Demographics and Technical Results

ROADSTER Pivotal ITT[1] (n=141)	ROADSTER (n=141)	CREST[2] CEA (n=1,240)
	High Surgical Risk	Standard Risk
Age (mean)	72.9 ±9	69.2 ±8.7
Age ≥75	**47%**	28.5%[3]
Female	35%	33.6%
Symptomatic	25.5%	52.7%
Local Anesthesia	**53%**	10.0%
Reverse Flow Time (median)	12.9 minutes	n/a

ROADSTER Study

Prospective, Multi-Center, Single-Arm Trial of TCAR in High Surgical Risk Patients with Carotid Stenosis - *Pivotal Results*

Clinical Results			
ROADSTER[1]	PP (n=136)	ITT (n=141)	CREST[2] CEA
	High Surgical Risk	High Surgical Risk	Standard Risk
S/D/MI*	2.9%	3.5%	4.5%
Stroke	**0.7%**	**1.4%**	2.3%
Death	1.5%	1.4%	0.3%
MI	0.7%	0.7%	2.3%
Stroke/Death	**2.2%**	**2.8%**	2.6%
Cranial Nerve Injury (CNI)	0.7%	0.7%	5.3%
CNI Unresolved 6 Months	0%	0%	2.1%[4]

*Hierarchical

Primary Endpoint

All stroke, MI & death at 30-days

ROADSTER 2 Study

Post-Approval Study of Transcarotid Artery Revascularization in Patients With Significant Carotid Artery Disease – V. Kashyap MD; Stroke 2020

- **DESIGN:** Prospective, single arm, multicenter, post-approval study
- **OBJECTIVE:** Evaluate safety and efficacy of the TCAR Procedure with the ENROUTE Stent when used with the ENROUTE NPS and performed by a broad group of physicians with variable TCAR experience
- **CONCLUSION:** TCAR is a safe and effective procedure in a **broad user base** with varying TCAR experience levels. Excellent outcomes are achievable if you follow the protocol and society guidelines.

Demographics and Technical Results		
ROADSTER2	PP (n=632)	ITT (n=692)
Age ≥80	21.2%	21.1%
Age ≥75	41.8%	42.1%
Female	32.3%	32.2%
Symptomatic	26.3%	26%
Local Anesthesia	28.3%	28.3%
Reverse Flow Time (median)	10.9 minutes	11 minutes

ROADSTER 2 Study

Post-Approval Study of Transcarotid Artery Revascularization in Patients With Significant Carotid Artery Disease – V. Kashyap MD; Stroke 2020

Clinical Results		
ROADSTER2	PP (n=632)	ITT (n=692)
Procedural Success	**97.9%**	**96.5%**
S/D/MI*	1.7%	3.2%
Stroke	0.6%	1.9%
Death**	0.2%	0.4%
MI	0.9%	0.9%
Stroke/Death	**0.8%**	**2.3%**
Cranial Nerve Injury***	1.3%	1.4%

*Hierarchical
**One patient expired ~2 weeks post-procedure due to ruptured AAA
***Out of the 10 patients with CNI, 6 consented to an extended follow-up at 90 days. The CNI resolved in all 6 of those patients.

Stroke Rate in the FDA Analysis Population (PP)

81% of Physicians were New to TCAR

Excellent Outcomes Achievable with Adherence to Protocol

ROADSTER 1 vs ROADSTER 2

When the results from both population groups are compared between ROADSTER 1 and ROADSTER 2, we see that the data is **statistically equivalent**.

PER PROTOCOL

	R1 Pivotal Only n=136	R1 Pivotal + Continued Access n=203	R2 n=632	P Value
S/D/MI*	2.9%	2.5%	1.7%	0.27
Stroke	0.7%	0.5%	0.6%	1.00
Death**	1.5%	1.0%	0.2%	0.15
MI	0.7%	1.5%	0.9%	0.46
Stroke/Death	2.2%	1.5%	0.8%	0.41

INTENT TO TREAT

	R1 Pivotal Only n=141	R1 Pivotal + Continued Access n=219	R2 n=692	P Value
S/D/MI*	3.5%	3.7%	3.2%	0.67
Stroke	1.4%	1.4%	1.9%	0.77
Death**	1.4%	0.9%	0.4%	0.60
MI	0.7%	1.4%	0.9%	0.46
Stroke/Death	2.8%	2.3%	2.3%	1.00

VQI Data- Standard Surgical Risk

- **DESIGN:** Retrospective analysis using the latest VQI-TCAR Surveillance Project data from September 2016 to October 2020
- **OBJECTIVE:** Compare perioperative outcomes after TCAR versus CEA in SSR patients
- **CONCLUSION:** TCAR and CEA have equivalent risk of perioperative stroke, death, or MI and ipsilateral stroke through 1 year in standard risk patients undergoing carotid revascularization

30-Day Outcomes	TCAR (N= 5,066)	CEA (N= 15,198)	P-Value
Stroke/Death/MI	2.0%	2.0%	0.88
Stroke/Death	1.6%	1.4%	0.29
Stroke	1.4%	1.1%	0.11
Death	0.3%	0.4%	0.69
CNI	**0.3%**	**2.7%**	**<0.001**
1 Year Outcomes	**TCAR (N=5,066)**	**CEA (N=15,198)**	**P-Value**
Ipsilateral Stroke	1.4%	1.1%	0.06
Death	1.9%	2.0%	0.67

The Less Invasive Standard in Stroke Prevention

Benefits of a less invasive approach to carotid revascularization*

		Significantly Favors CEA	Significantly Favors TCAR
In-Hospital VQI Outcomes	Stroke	=	=
	Death	=	=

Benefit	Significantly Favors CEA	Significantly Favors TCAR
Less Risk of MI		✓
Less Risk of Cranial Nerve Injury		✓
Less Time in OR		✓
Shorter Length of Stay		✓
Less Risk of Bleeding requiring Intervention**		✓

TCAR Incision

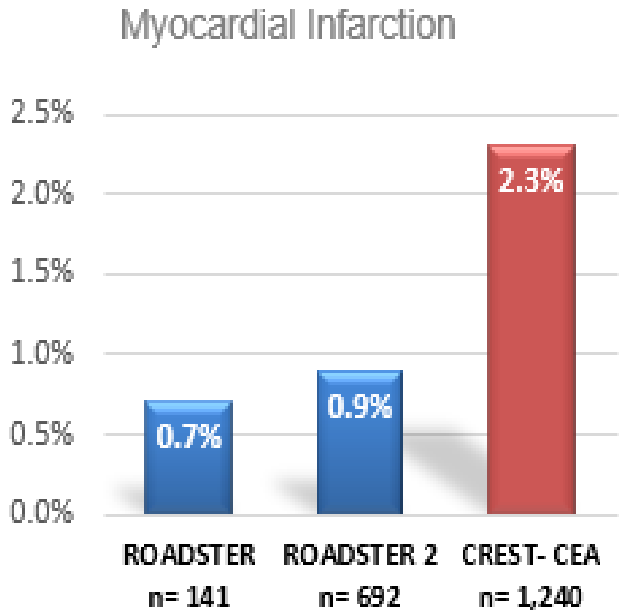
CEA Incision

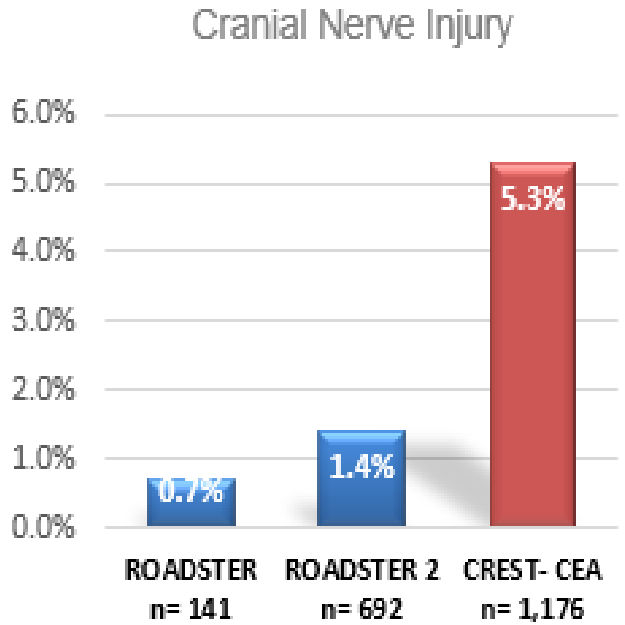
- 2021 VQI Data
- Learning Curve
- Impact of Age
- Additional MI & CNI Data

Malas MB, et al. TransCarotid Revascularization with Dynamic Flow reversal versus Carotid Endarterectomy in the Vascular Quality Initiative Surveillance Project. *Ann Surg.* 2020 Sep 15. doi: 10.1097/SLA.0000000000004496. Epub ahead of print.

*Patients matched based on symptomatic status, age, CAD, CHF, COPD, CKD, prior ipsilateral CEA, prior ipsilateral CAS, contralateral occlusion, ASA Class and statin use

MI & CNI RATES: TCAR v. CEA





ROADSTER: Kwolek, C. et al. Results of the ROADSTER multicenter trial of transcarotid stenting with dynamic flow reversal. *J Vasc Surg* 2015;62:1227-35.
ROADSTER 2: Rajhyap, V. et al. Early Outcomes in the ROADSTER 2 Study of Transcarotid Artery Revascularization in Patients With Significant Carotid Artery Disease. *Stroke*. 2020;51:2620–2629.
CREST: Gray, W. et al. Overview of the 2011 Food and Drug Administration Circulatory System Devices Panel Meeting on the ACCULINK and ACCUNET Carotid Artery Stent System. *Circulation*. 2012;125:2256–2264.

TCAR Associated with Improved Center-Level Outcomes

2021 JAMA Network Open study finds that availability of TCAR at a hospital was associated with a decrease in the likelihood of perioperative MACE after carotid revascularization

OVERALL RATES OF MACE WERE SIMILAR BETWEEN TCAR AND CEA

2.3% TCAR **VS** P=0.91 **2.4%** CEA

10% Risk Reduction

TCAR ADOPTION REDUCES RISK OF MACE BY 10% FOR ALL CAROTID INTERVENTIONS

COMPARED TO CENTERS ONLY OFFERING CEA

Columbo JA, Martinez-Camblor P, O'Malley AJ, et al. Association of Adoption of Transcarotid Artery Revascularization With Center-Level Perioperative Outcomes. *JAMA Netw Open*. 2021;4(2):e2037885.

The Less Invasive Standard in Stroke Prevention

Operating Room Efficiencies

Procedure Time[1]

TCAR: **73 Minutes**

vs

CEA: **121 Minutes**

Ability to treat **67% more** patients vs CEA

	TCAR	CEA
OR Time (minutes)	73	121
Cost per minute*	$37	$37
Total OR Time Cost	$2,701	$4,477
Reduced OR Cost over CEA:		**$1,776**

*Based on national survey average

Local anesthesia is used more often with TCAR vs CEA[2]

As a less invasive procedure, TCAR is more conducive to a local anesthesia approach, which allows for **reduced anesthesia cost**

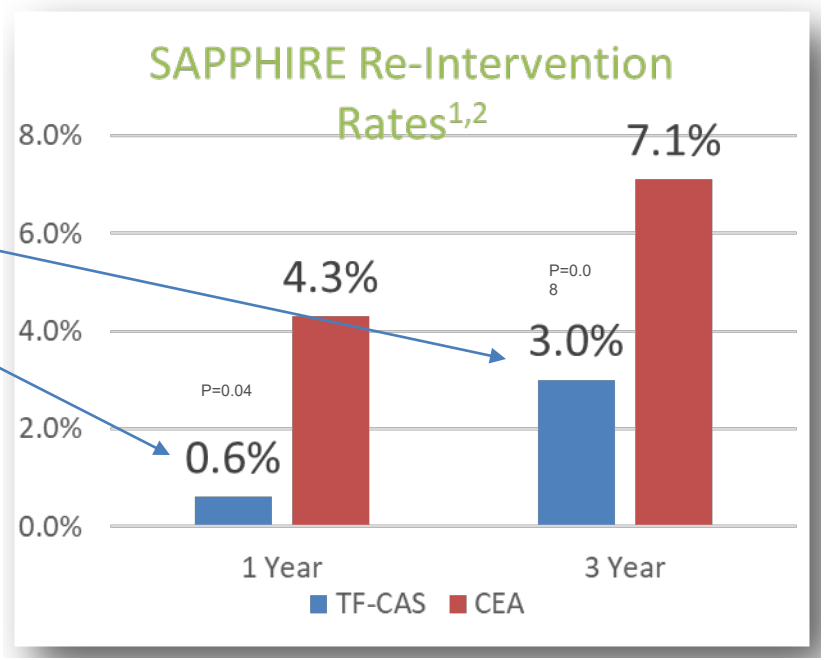
STENT DURABILITY AND RE-INTERVENTION DATA

- Reintervention rates in the SAPPHIRE trial at 1 and 3 years were lower in the stenting arm vs. CEA

Long-Term Results from the CREST study:

"No significant difference between the two treatment groups was observed in the percentage of patients who had restenosis or underwent revascularization."

-CREST: N Engl J Med 2016; 374:1021-1031



Note: SAPPHIRE required use of the Cordis Precise® Stent

1. Yadav et al. Protected carotid-artery stenting versus endarterectomy in high-risk patients. *N Engl J Med*. 2004 Oct 7;351(15):1493-501.
2. Gurm et al. Long-term results of carotid stenting versus endarterectomy in high-risk patients. *N Engl J Med*. 2008 Apr 10;358(15):1572-9.

TCAR vs CEA EMBOLIZATION RATES

- No significant differences in number of emboli (p=0.486) and seconds of embolic showers (p=0.493) between TCAR and CEA
  - TF-CAS showed significantly higher emboli rates compared with CEA or TCAR (p<0.001)

Pre-Protection	Protection	Post-Protection
• No significant difference b/w TCAR & CEA (p=0.177) • TF-CAS generated more discrete emboli than TCAR & CEA (p<0.001)	• No significant difference b/w TCAR & CEA (p=0.424) • TF-CAS generated more embolic events than TCAR & CEA (p<0.001)	• All 3 techniques showed similar rates of embolic events

Pre-protection

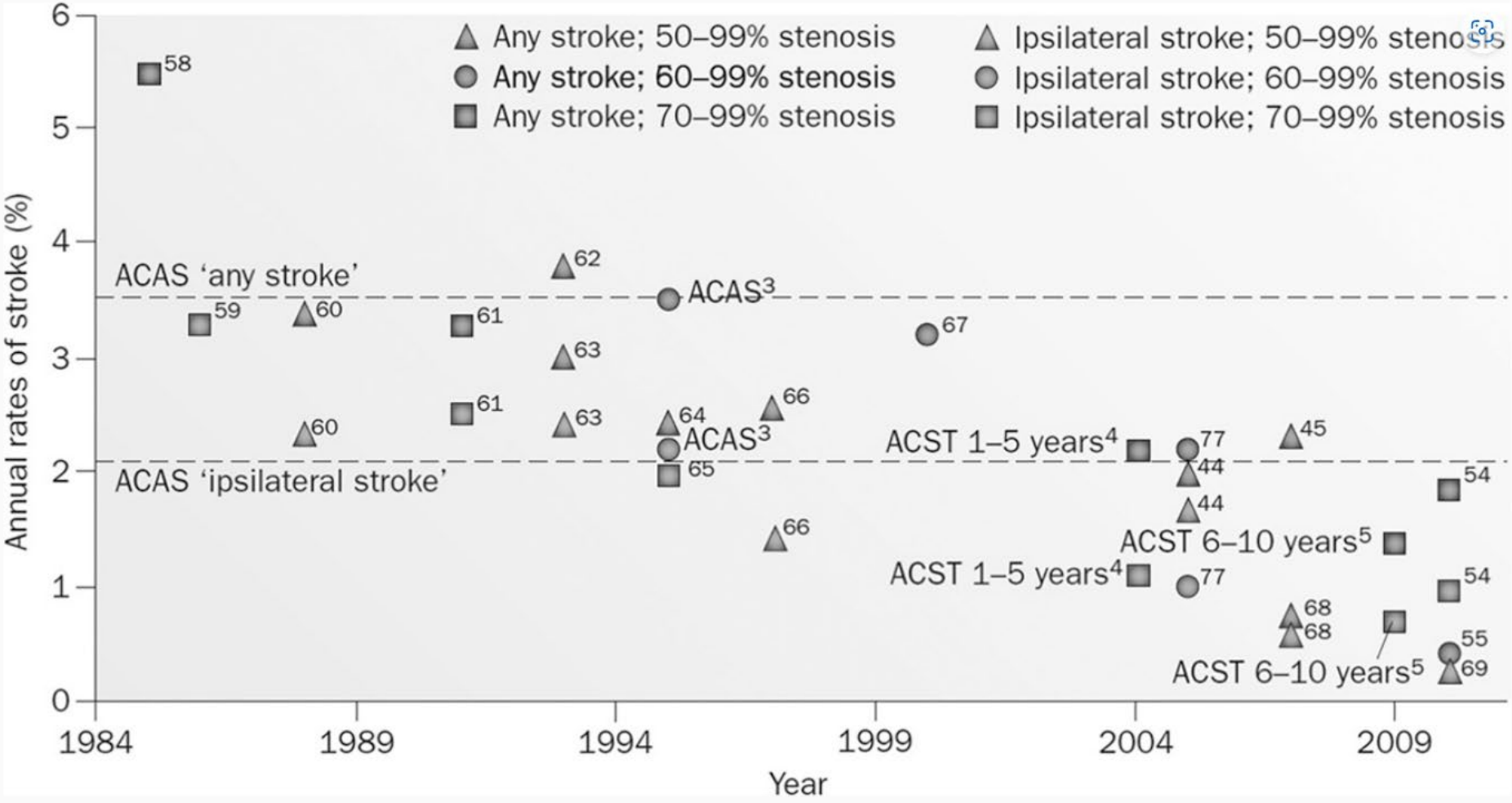
Before clamping, filter deployed, or reverse flow established

Protection

Until clamp removed, filter retrieved, or antegrade flow reestablished

Post-protection

After clamp/filter removed, or normal flow established


Any stroke; 50–99% stenosis
Any stroke; 60–99% stenosis
Any stroke; 70–99% stenosis
Ipsilateral stroke; 50–99% stenosis
Ipsilateral stroke; 60–99% stenosis
Ipsilateral stroke; 70–99% stenosis
ACAS 'any stroke'
ACAS 'ipsilateral stroke'
ACAS[3]
ACST 1–5 years[4]
ACST 6–10 years[5]
ACST 1–5 years[4]
ACST 6–10 years[5]
Annual rates of stroke (%)
Year
0
1
2
3
4
5
6
1984
1989
1994
1999
2004
2009
58
59
60
60
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45
54
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68
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55
69

Med Management

- Medical management has become excellent
- Strokes continue to happen

SENTARA®

2023 MID-ATLANTIC CONFERENCE

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VASCULAR THERAPIES

2023

Thank you!

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