

Decision making in symptomatic carotid artery disease CEA, CAS, TCAR?

Mauro Gargiulo



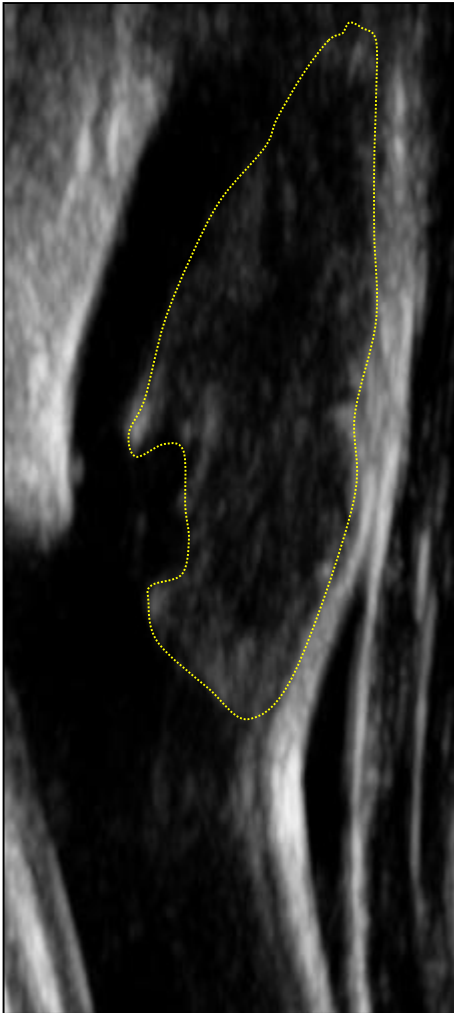
Vascular Surgery
University of Bologna - DIMES
Policlinico S.Orsola-Malpighi
Bologna, Italy
mauro.gargiulo2@unibo.it



Clinical case

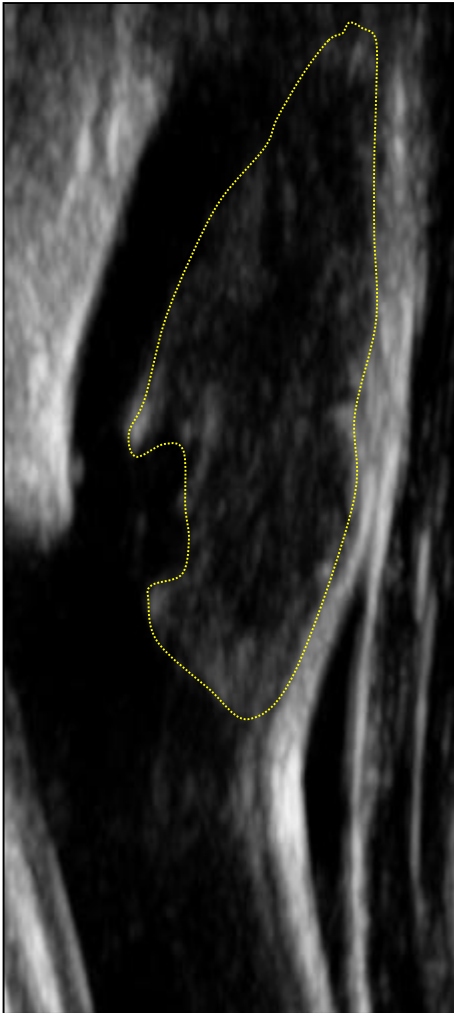
- Male, 74 years old
- Hypertension, Diabetes
- **Right TIA**: amaurosi fugax + left arm paresis
- No history of CAD or atrial fibrillation
- Cardiac Echo: no disease

Clinical case

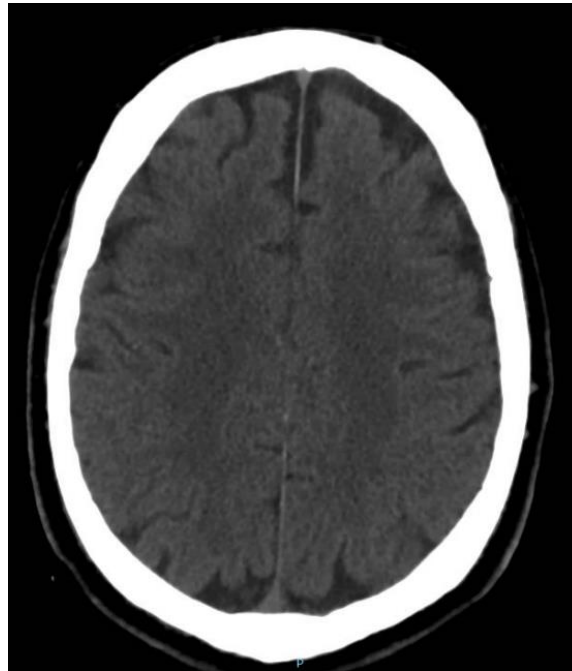


ICA Stenosis > 70%

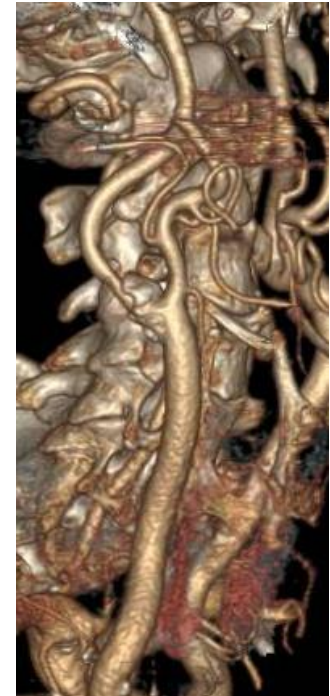
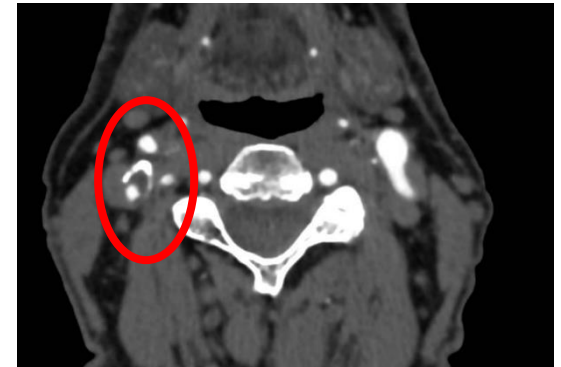
Clinical case



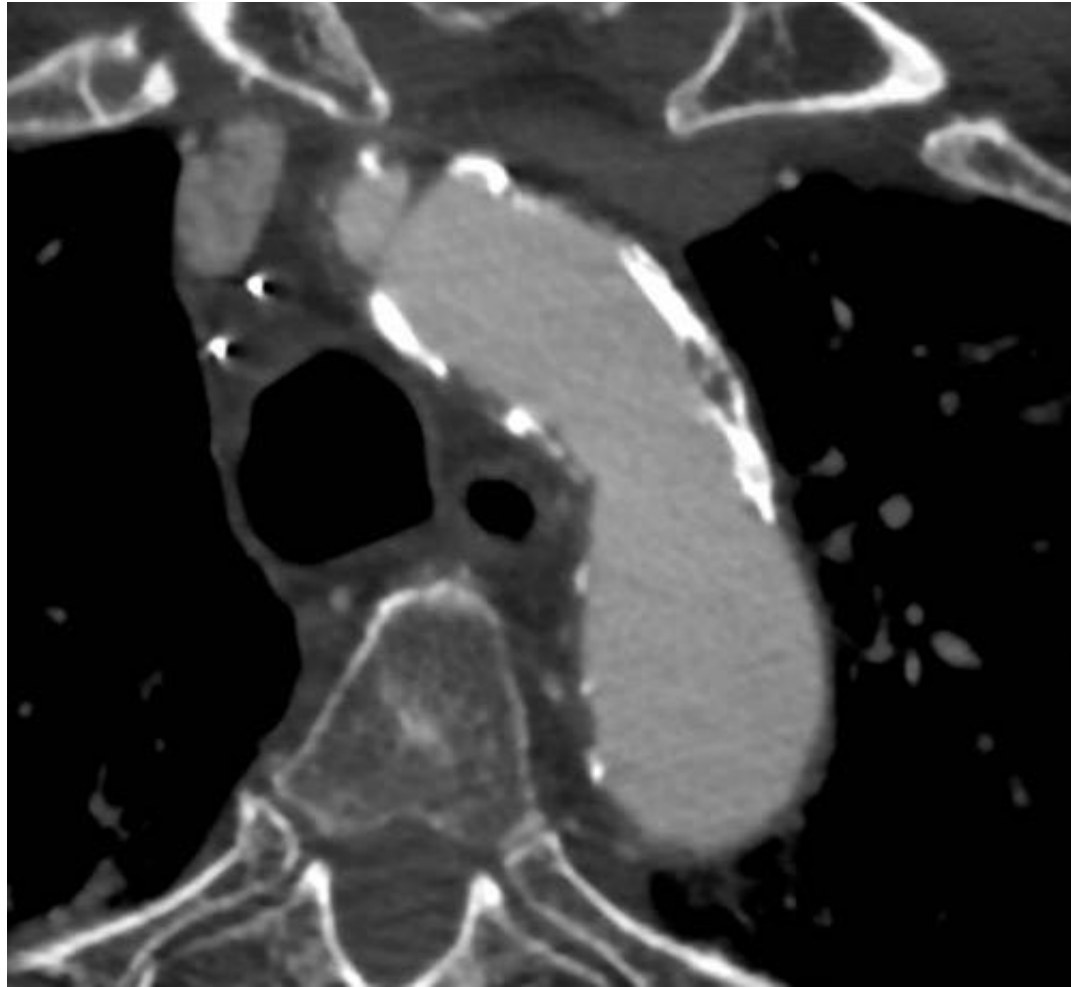
ICA Stenosis > 70%



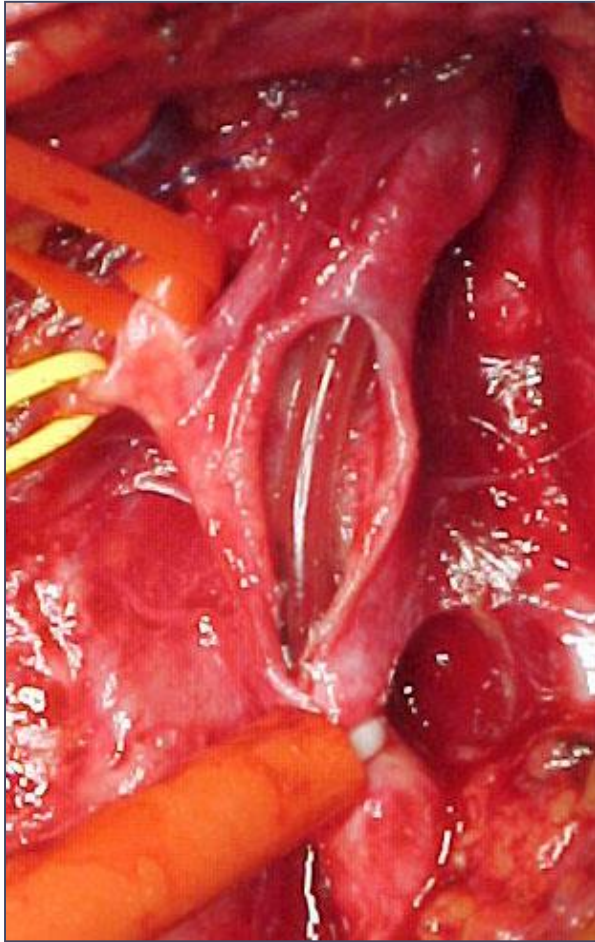
No brain ischemic lesions



Clinical case



Clinical case



Clinical case

● Postoperative period

- no MAE
- deficit VII cranial nerve
- Discharge: day 2 + BMT

● Follow up 3 months

- no MAE
- regression deficit VII cranial nerve
- no ICA restenosis

● Follow up 12 months

- no MAE
- no ICA restenosis

Current guidelines

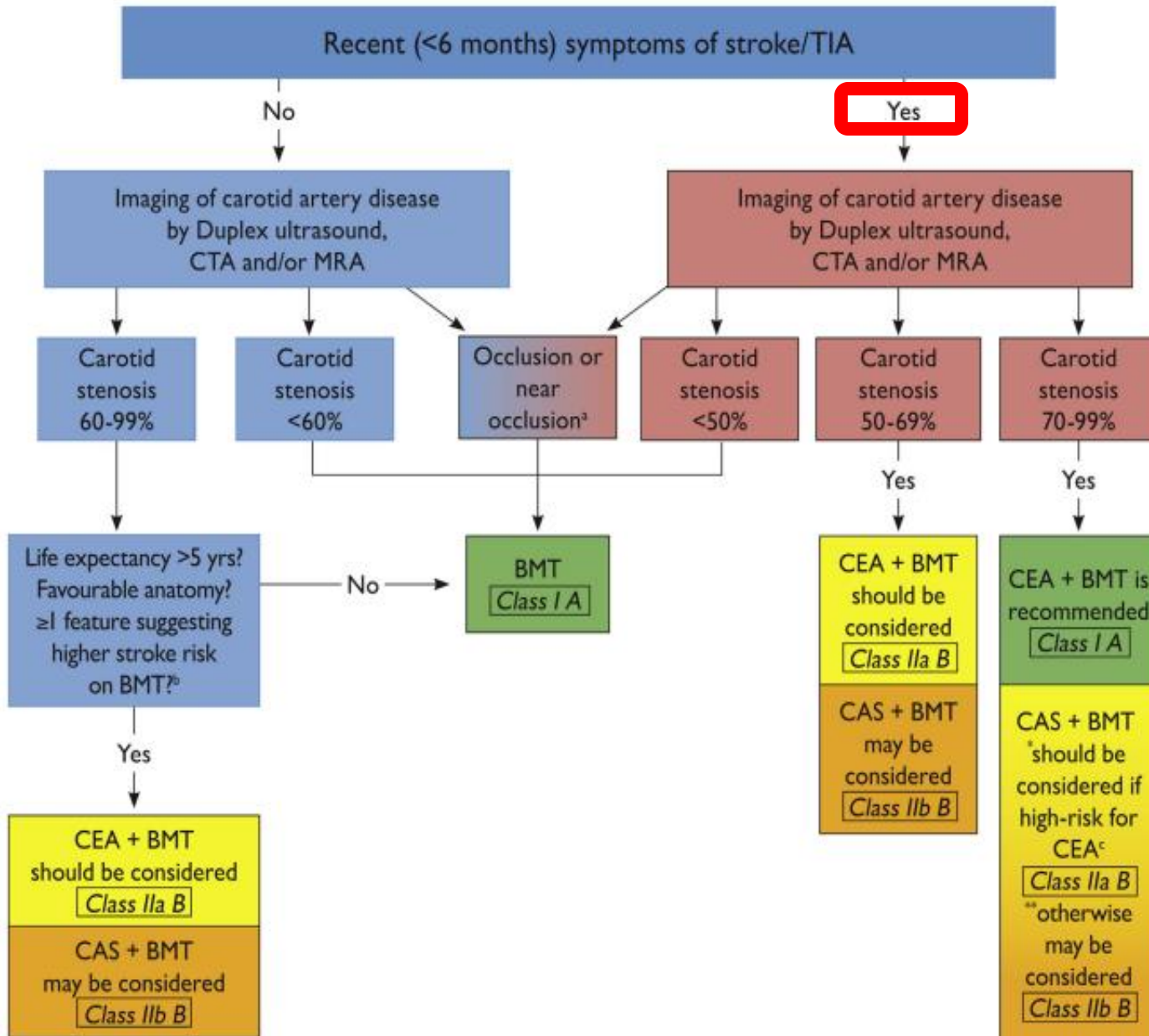
Eur J Vasc Endovasc Surg (2018) 55, 3–81

Editor's Choice — Management of Atherosclerotic Carotid and Vertebral Artery Disease: 2017 Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS)

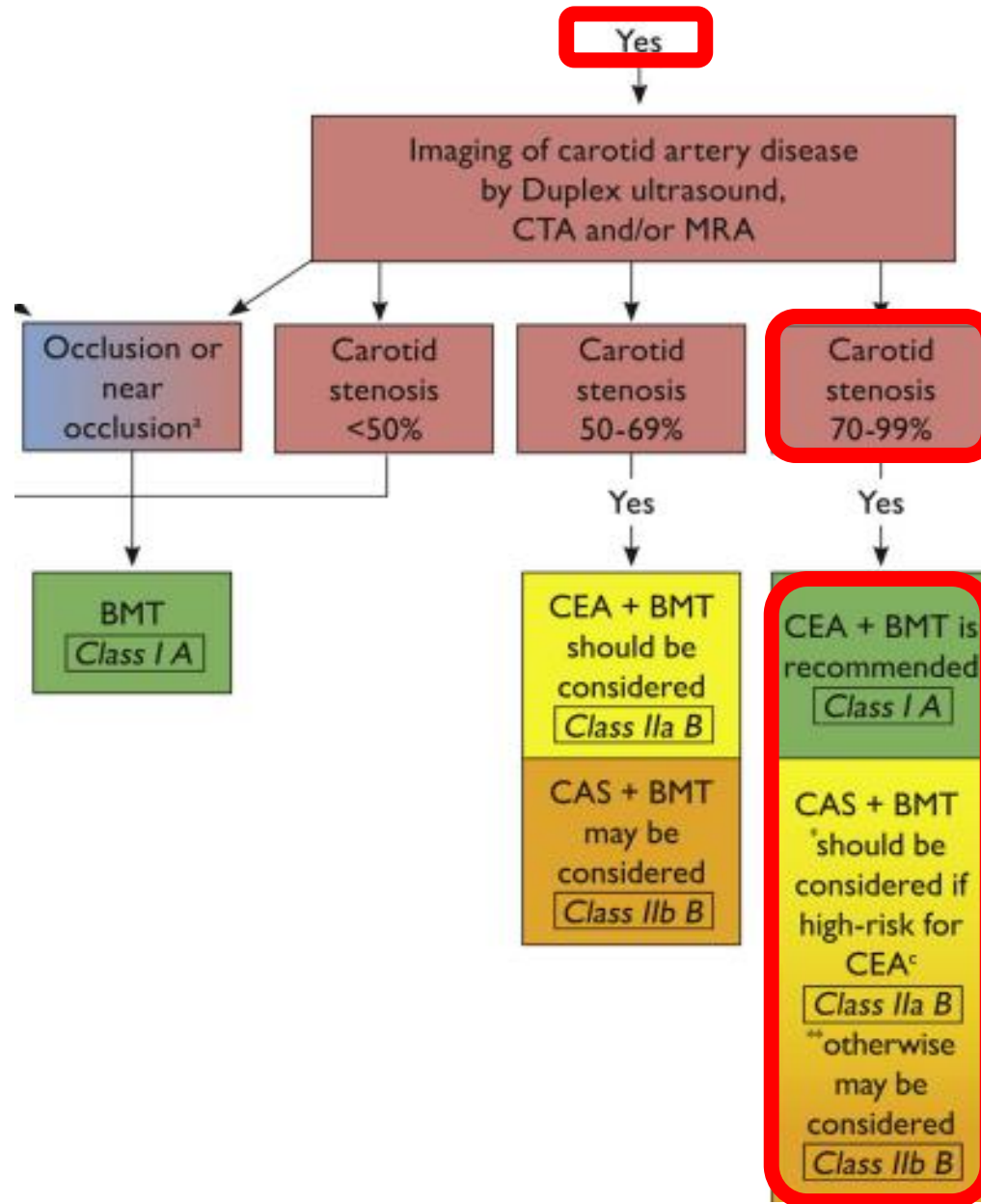
A.R. Naylor^a, J.-B. Ricco^a, G.J. de Borst^a, S. Debus^a, J. de Haro^a, A. Halliday^a, G. Hamilton^a, J. Kakisis^a, S. Kakkos^a, S. Lepidi^a, H.S. Markus^a, D.J. McCabe^a, J. Roy^a, H. Sillesen^a, J.C. van den Berg^a, F. Vermassen^a,
ESVS Guidelines Committee^b, P. Kolh, N. Chakfe, R.J. Hinchliffe, I. Koncar, J.S. Lindholt, M. Vega de Ceniga, F. Verzini,
ESVS Guideline Reviewers^c, J. Archie, S. Bellmunt, A. Chaudhuri, M. Koelemay, A.-K. Lindahl, F. Padberg, M. Venermo

Keywords: Carotid, Vertebral, Stroke, Transient ischaemic attack, Endarterectomy, Stenting, Medical therapy, Screening, Dementia, Asymptomatic, Symptomatic, Thrombolysis, Imaging, Bypass, Surgical techniques, Complications, Patch infection, Restenosis

Algorithm of management strategies



Symptomatic carotid artery stenoses



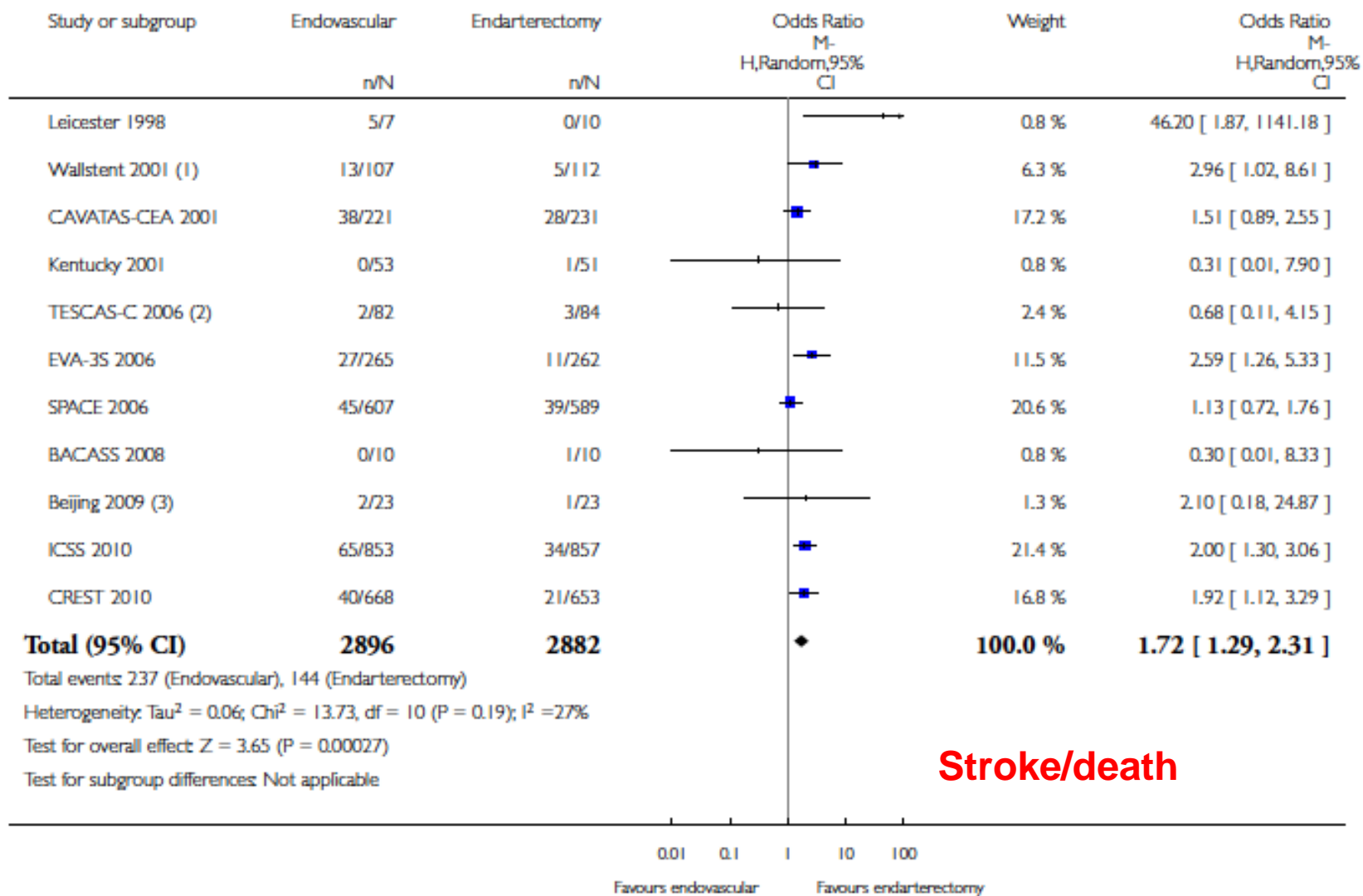
Percutaneous transluminal balloon angioplasty and stenting for carotid artery stenosis (Review)

Bonati LH, Lyrer P, Ederle J, Featherstone R, Brown MM



**THE COCHRANE
COLLABORATION®**

11 randomized controlled trial for **Symptomatic** carotid artery stenosis (1998-2010)



CEA vs. CAS: the RCTs

Randomized Clinical Trials

- CAVATAS 2001
- SAPPHIRE 2004
- EVA-3S 2006
- SPACE 2006
- ICSS 2010
- CREST 2010

Study	Centres	N pts (CAS/CEA)	Pts risk	Asympt	Filters	Stent	Outcome
CAVATAS 2001	22 centres in Europe, Australia, and Canada	505 (252/253)	normal	10%			
SAPPHIRE 2004	29 centres, USA	334 (167/167)	high	29%			
EVA-3S 2006	30 centers in France	527 (265/262)	normal	0			
SPACE 2007	35 centres in Germany, Austria and Switzerland	1214 (613/601)	normal	0			
ICSS 2009	50 academic centers in Europe, Australia, New Zealand, and Canada	1713 (855/858)	normal	0			
CREST 2010	108 centers in the USA and 9 centers in Canada	2522 (1271/1251)	normal	47%			

30-day outcomes

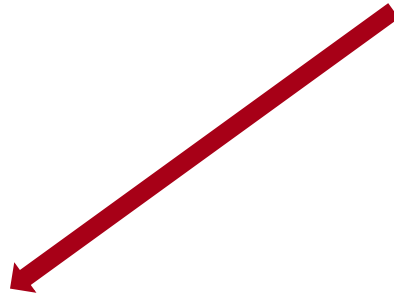
Study	30-day death, stroke CEA vs. CAS	p
EVA3S 2006	4.1% vs. 10.1%	0.01
SPACE 2007	6.6 % vs. 7.4 %	0.51
ICSS 2009	3.9 % vs. 7.6 %	0.001

30-day outcomes

Study	30-day death, stroke CEA vs. CAS	p	30-day death, stroke, or MI CEA vs. CAS	p
EVA3S 2006	4.1% vs. 10.1%	0.01	4.6% vs. 10.5%	0.02
SPACE 2007	6.6 % vs. 7.4 %	0.51	6.6 % vs. 7.4 %	0.51
ICSS 2009	3.9 % vs. 7.6 %	0.001	4.5 % vs. 7.6 %	0.006

ICA Stenosis $> 70\%$ - Which Strategy?

Symptomatic

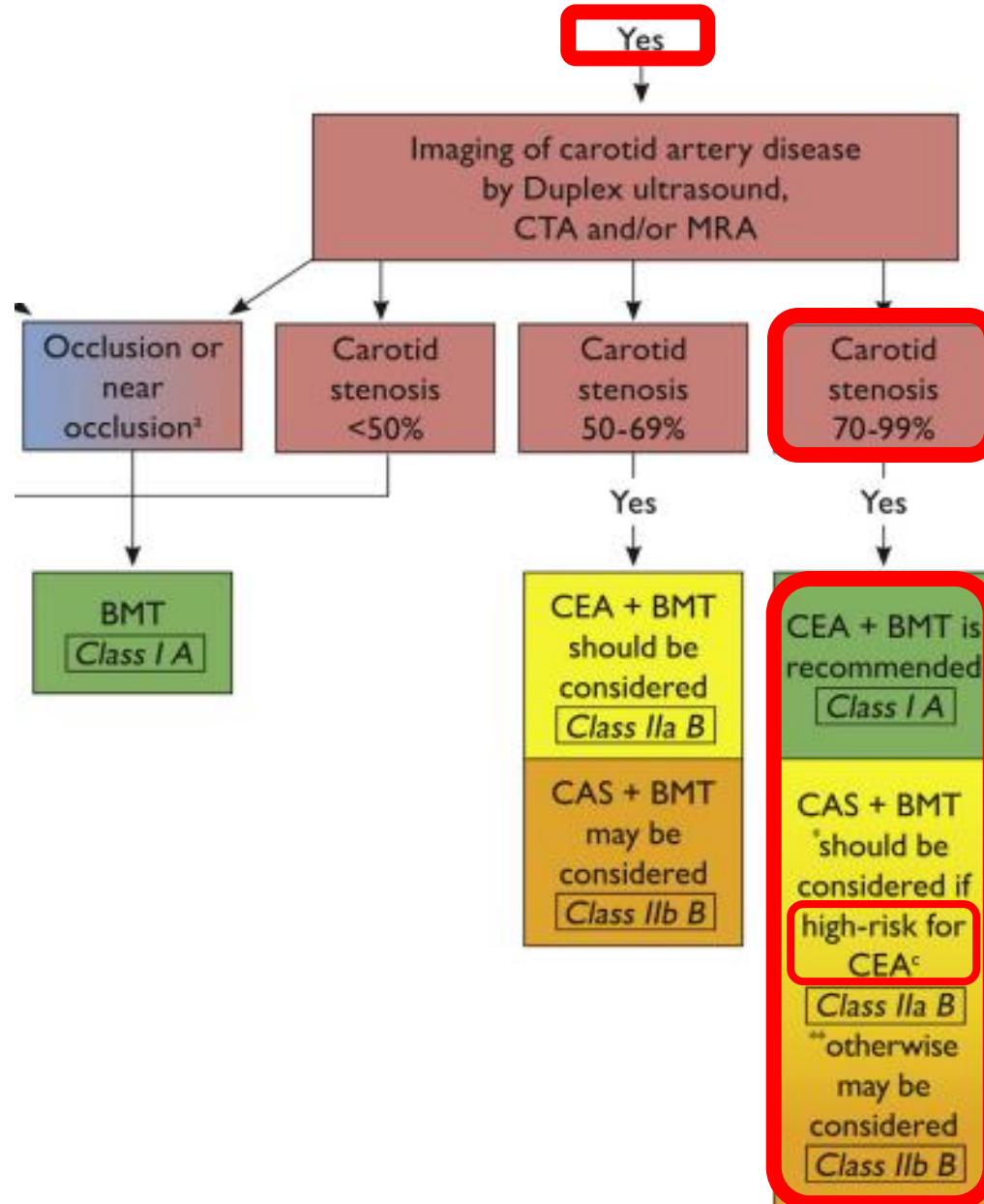


Standard risk



CEA

Symptomatic carotid artery stenoses



Study	Centres	N pts (CAS/CEA)	Pts risk	Asympt	Filters	Stent	Outcome
CAVATAS 2001	22 centres in Europe, Australia, and Canada	505 (252/253)	normal	10%	0%	26%	Stroke/death
SAPPHIRE 2004	29 centres, USA	334 (167/167)	high	29%	100%	100%	Stroke/death/MI
EVA-3S 2006	30 centers in France	527 (265/262)	normal	0	92%	100%	Stroke/death
SPACE 2007	35 centres in Germany, Austria and Switzerland	1214 (613/601)	normal	0	27%	100%	Stroke/death
ICSS 2009	50 academic centers in Europe, Australia, New Zealand, and Canada	1713 (855/858)	normal	0	80%	100%	Stroke/death/MI
CREST 2010	108 centers in the USA and 9 centers in Canada	2522 (1271/1251)	normal	47%	96%	100%	Stroke/death/MI

Carotid endarterectomy in **SAPPHIRE-eligible high-risk** patients:
implications for selecting patients for carotid angioplasty and stenting.

High Risk Patient for CEA

- Age > 80 years
- Contralateral Carotid Occlusion
- Severe Cardiac Dysfunction
- Severe Pulmonary Dysfunction
- Local and Anatomic Problems

Carotid endarterectomy in **SAPPHIRE-eligible high-risk** patients:
 implications for selecting patients for carotid angioplasty and stenting.

CEA outcomes

	<i>High-risk</i>		<i>Low-risk</i>	
	<i>Symptomatic</i>		<i>Symptomatic</i>	
Ipsilateral				
Major stroke	2.3		0.8	
Minor stroke	2.3		0.8	
Any stroke	4.6		1.6	<i>P= .01</i>
Contralateral				
Major stroke	0.0		0.8	
Minor stroke	0.0		0.0	
Any stroke	0.0		0.8	
Any side				
Major stroke	2.3		0.8	
Minor stroke	2.3		0.8	
Any stroke	4.6		1.6	

Carotid endarterectomy in **SAPHIRE-eligible high-risk** patients: implications for selecting patients for carotid angioplasty and stenting.

CEA outcomes

Death, stroke, MI

$P < .005$

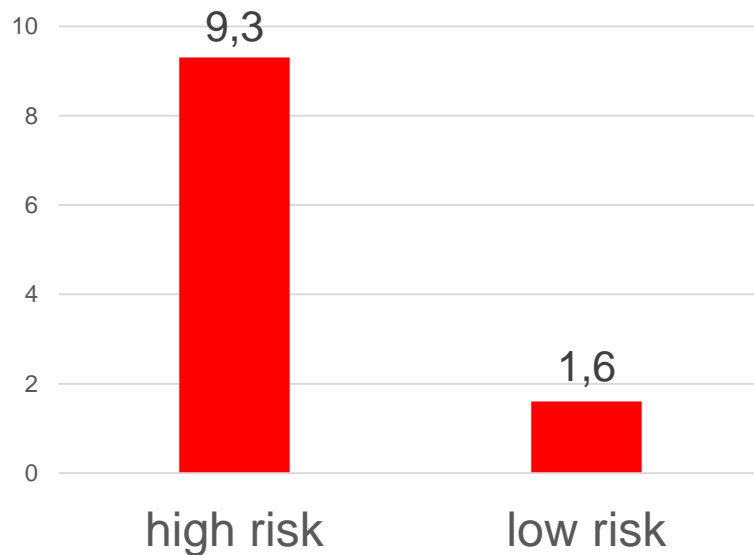


Table VII. Odds ratios of predictive factors for postoperative stroke and myocardial infarction at significance level of $P < 0.1$

	Odds ratio	95% Confidence interval	P
Stroke			
Age ≤ 60 y	7.7	2.3-25.7	$<.01$
Symptomatic presentation	3.3	1-11	$<.05$
Cervical radiation therapy	15.2	1.6-142.2	$<.05$
Class III/IV angina	10.8	1.2-96.4	$<.05$
Myocardial infarction			
Contralateral occlusion	3.0	0.8-11.1	$<.1$
History of CAD	6.5	1.4-29.0	$<.05$
Class III/IV angina	8.3	1.0-72.4	$<.1$
Positive cardiac stress test	3.5	1.1-10.7	$<.05$
SAPHIRE high-risk	3.6	1.1-11.5	$<.05$

CAD, Coronary artery disease; SAPHIRE, Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy [trial].

ICA Stenosis > 70% - Which Strategy?

Symptomatic

Clinical Standard risk

**Clinical High risk for
CEA**

CEA

TF-CAS

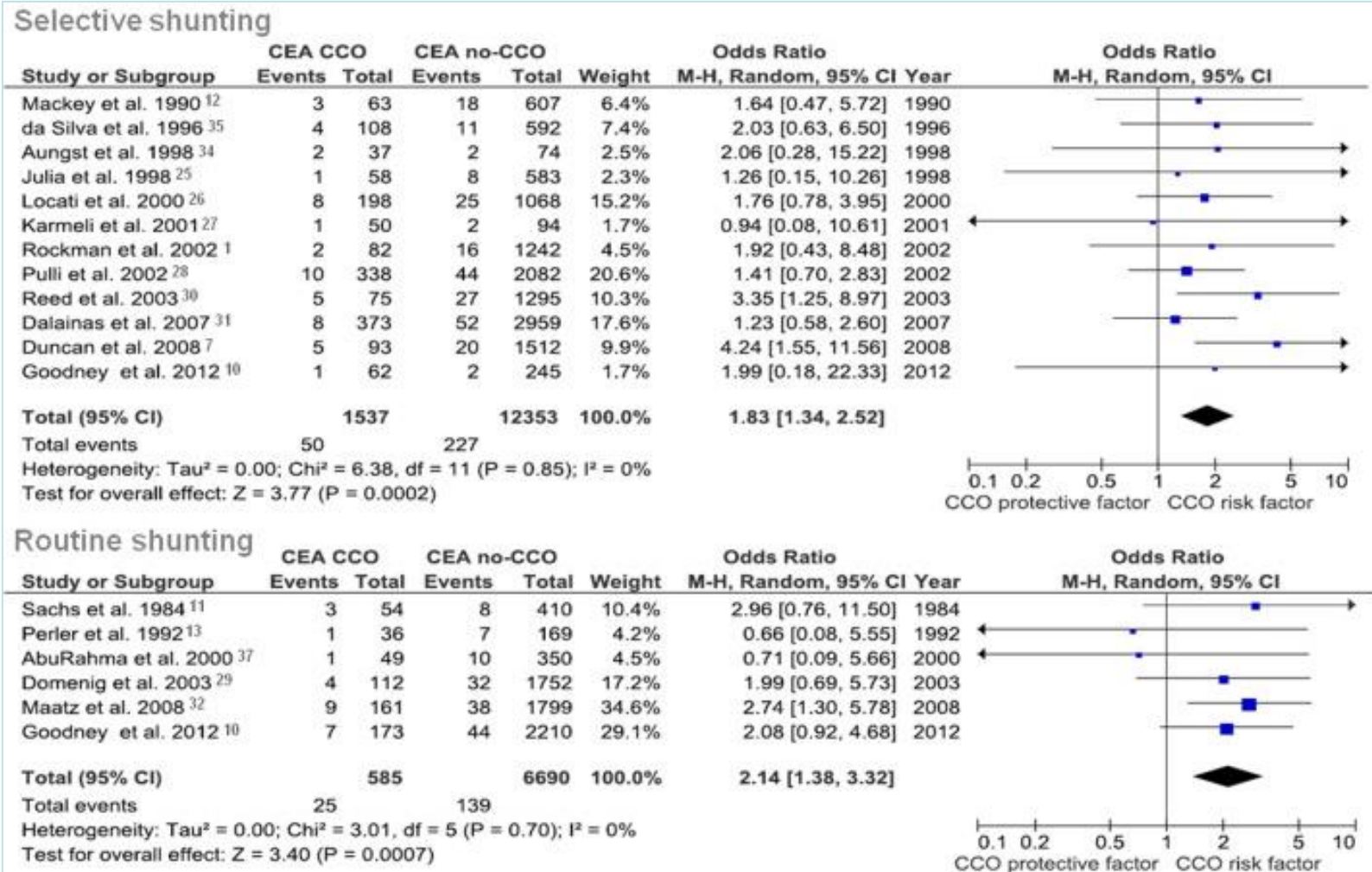
TF-CAS is preferable in specific settings

Clinical characteristics

- Age > 80 years
- Severe Cardiac Dysfunction
- Severe Pulmonary Dysfunction

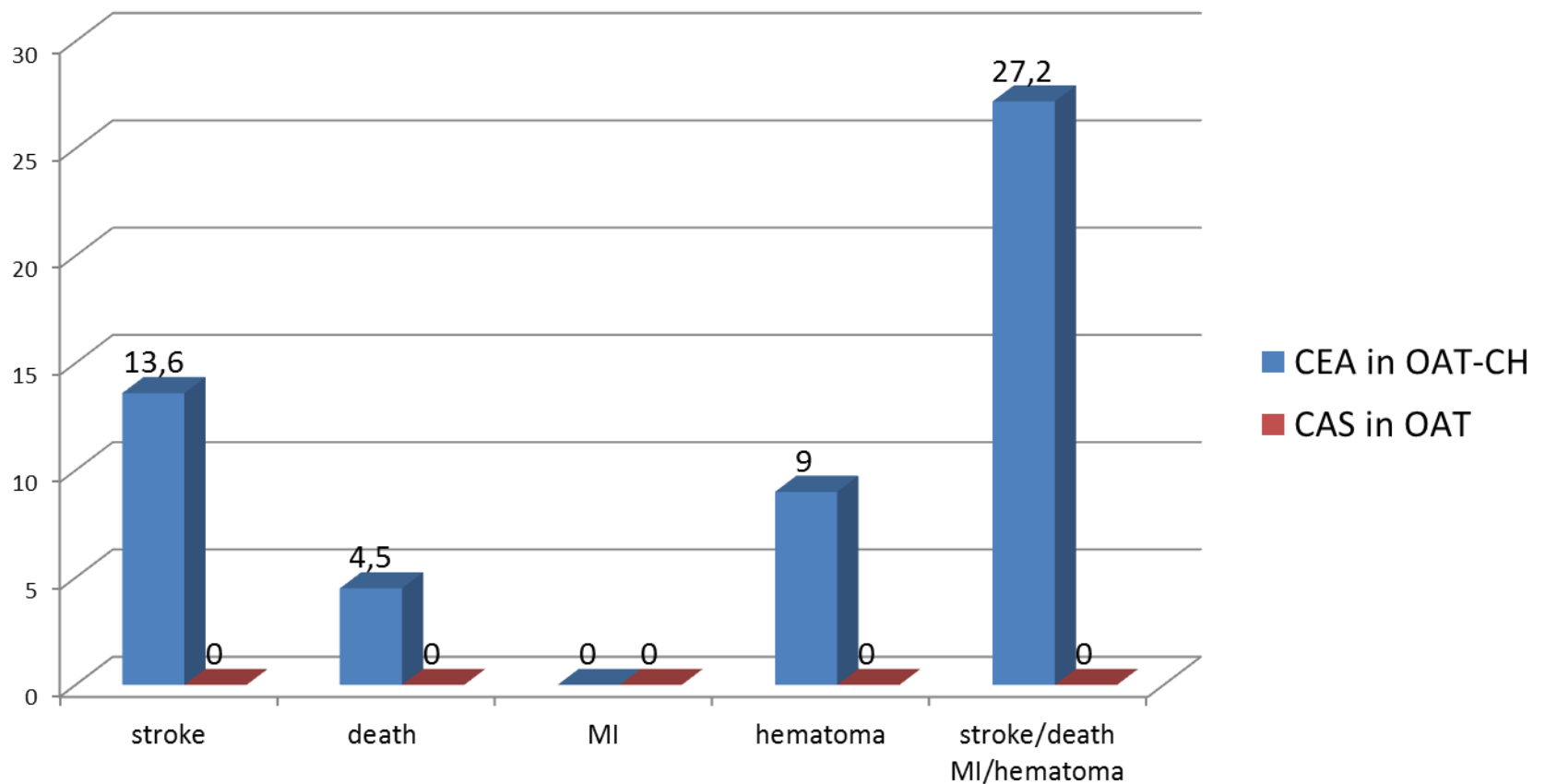
Contralateral Carotid Occlusion in Endovascular and Surgical Carotid Revascularization: A Single Centre Experience with Literature Review and Meta-analysis

G. Faggioli, R. Pini, R. Mauro, A. Freyrie, M. Gargiulo, A. Stella



Carotid Revascularization in Patients with **Ongoing Oral Anticoagulant Therapy**: The Advantages of Stent Placement

G Faggioli, R Pini, C Rapezzi, R Mauro, A Freyrie, M Gargiulo, A Stella



CAS is preferable in specific settings

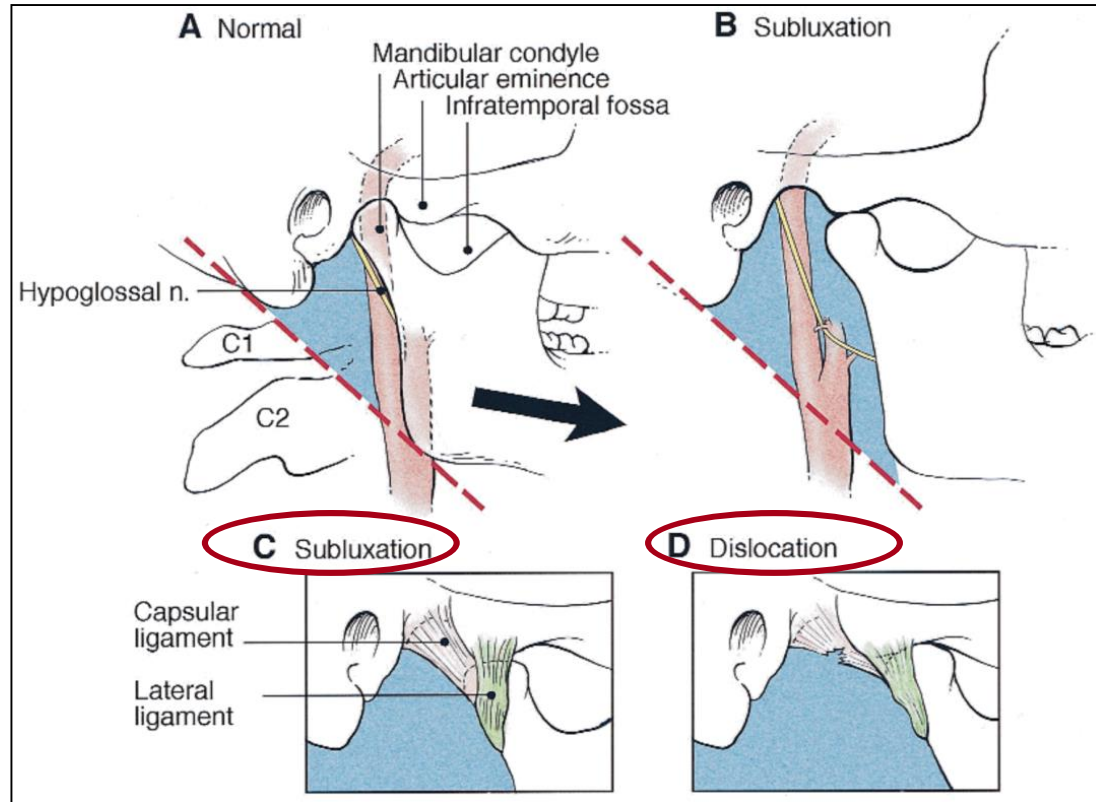
Clinical characteristics

- Age > 80 years
- Severe Cardiac Dysfunction
- Severe Pulmonary Dysfunction
- Contralateral carotid occlusion
- Oral anticoagulant therapy
- Local and Anatomic Problems

CAS is preferable in specific settings

Lesion Location

- Lesions at or above the level of C2
- Lesions of the the CCA very proximal to the arch



CAS is preferable in specific settings

The Irradiated Neck or Neck with previous surgery



ICA Stenosis > 70% - Which Strategy?

Symptomatic

Clinical Standard risk

**Clinical High risk for
CEA
and
Anatomical high risk
for TF-CAS**

CEA



Aortic arch anomalies are associated with increased risk of neurological events in carotid stent procedures

Faggioli GL, Ferri M, Freyrie A, Gargiulo M, Fratesi F, Rossi C, Stella A

Eur J Vasc Endovasc Surg 2007



Arch anomaly in CAS

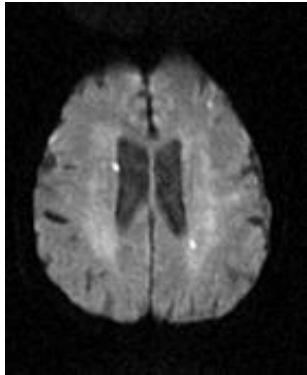
Technical failure

Neurological complications

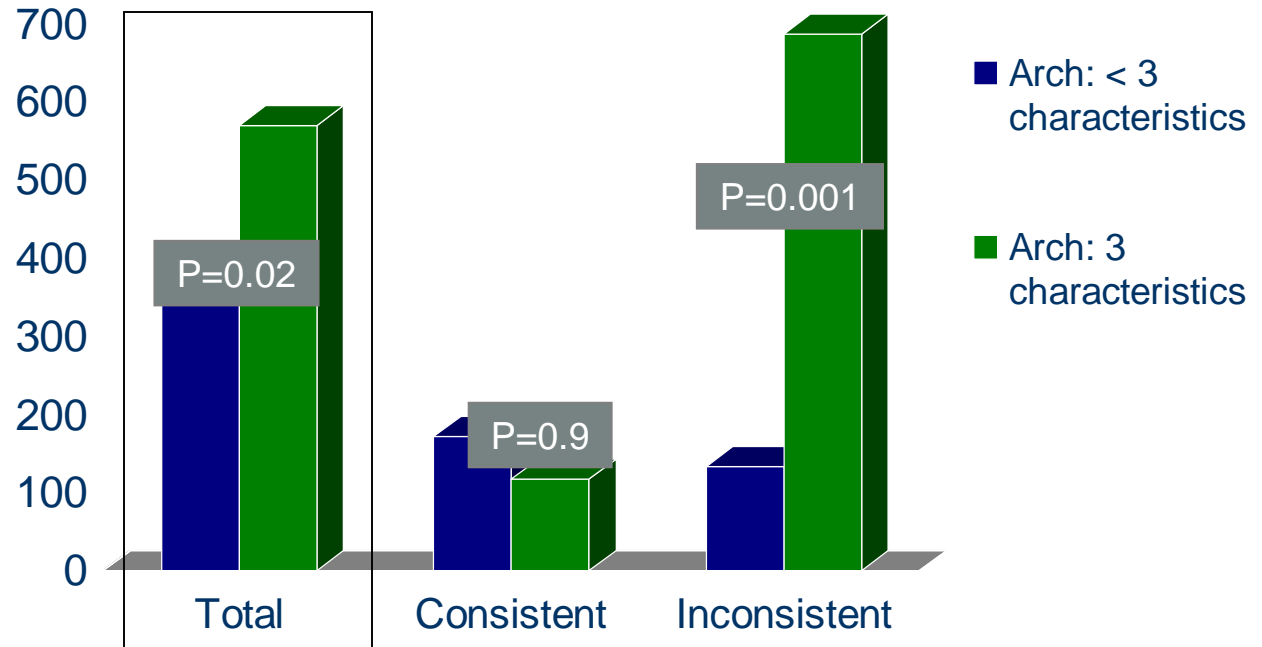
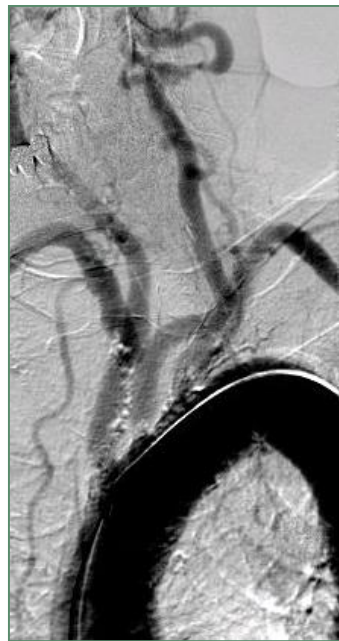
	Ajusted OR (95% CI)	p	Ajusted OR (95% CI)	p
Age (1 year increment)	1.14 (1.05-1.23)	0.001	1.03 (0.94-1.12)	0.5
Arch (anomalies vs normal)	2.11 (1.25-3.56)	0.005	2.01 (1.09-3.71)	0.026

Logistic regression

Atherosclerotic aortic lesions increase the risk of cerebral embolism during carotid stenting in patients with complex aortic arch anatomy



Lesion mean volume



Measurement and impact of proximal and distal tortuosity in carotid stenting procedures

Faggioli GL, Ferri M, Gargiulo M, Freyrie A, Fratesi F, Manzoli L, Stella A

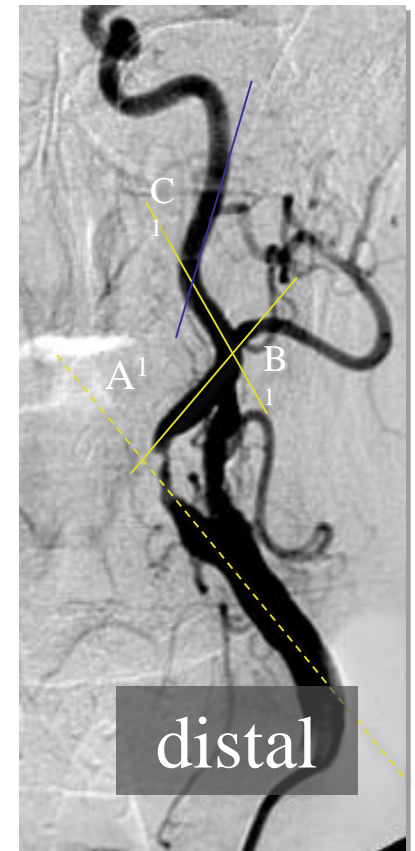
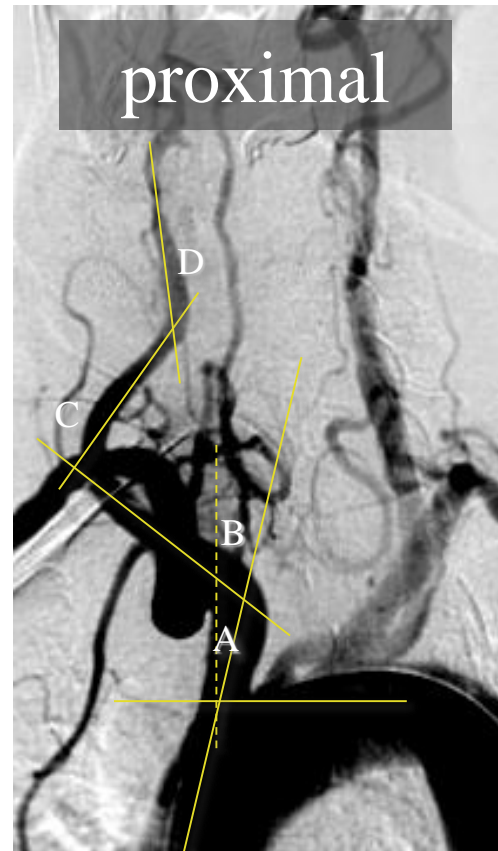
J Vasc Surg 2007; 46: 1119-24

- Evaluation of tortuosity index (TI) in pts undergoing CAS

TI = sum of all angles diverging from the ideal straight axis

- Correlation of TI proximal and distal to target lesion

Technical results
Clinical outcome



Tortuosity in CAS

Technical Failure

Neurological complications

	Ajusted OR (95% CI)	p	Ajusted OR (95% CI)	p
Age (1 year increment)	1.10 (1.02-1.19)	0.009	1.05 (0.98-1.13)	0.149
TI proximal > 150	3.07 (1.259-7.49)	0.014	2.72 (1.14-6.47)	0.023
TI distal > 150	.32 (.117-.877)	0.027	1.00 (.42-2.37)	0.995

Logistic regression

ICA Stenosis > 70% - Which Strategy?

Symptomatic

Clinical Standard risk



CEA

**Clinical High risk for
CEA
and
Anatomical high risk
for TF-CAS**



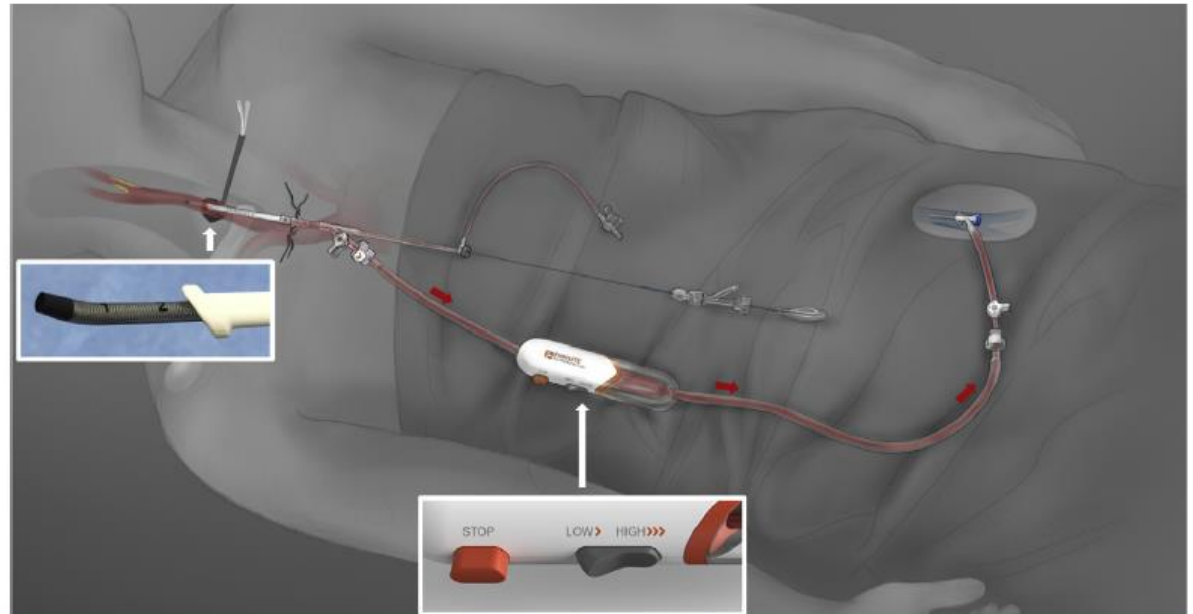
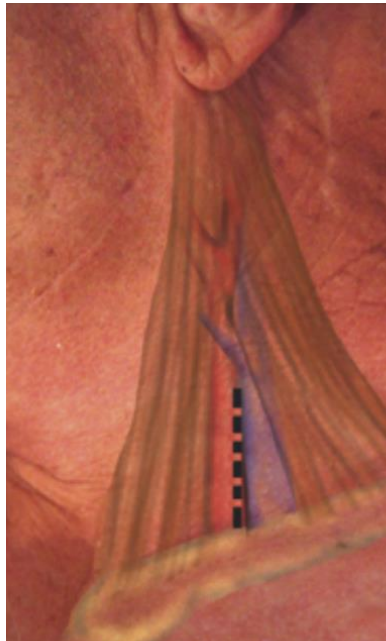
T-CAR

Technical aspects of transcarotid artery revascularization using the ENROUTE transcarotid neuroprotection and stent system



Mahmoud B. Malas, MD, MHS,^a Jose Leal, MD,^b Vikram Kashyap, MD,^c Richard Paul Cambria, MD,^d Christopher J. Kwolek, MD,^d and Enrique Criado, MD,^e *Baltimore, Md; Toledo, Spain; Cleveland, Ohio; Boston, Mass; and Midland, Mich*

. (J Vasc Surg 2017;65:916-20.)



T-CAR results

Analysis of 12 studies reporting the results of 739 TCS procedures

First author/ year	Patients, No.	age, years	CAS, No.	EPD	Technical success	Complications- treatment	Neurologic complications	Deaths, No.	MI, No.	FU, months	Outcome
Alexandrescu, ³⁴ 2006	26	73.7	29	(+)	28/29	1 inability to cross the lesion-CEA	0	0	0	11.6 (3-38)	1 TIA, 4 unrelated deaths
Feldtman, ³⁵ 2006	15	NR	15	(+)	12/15	3 inability to cross the lesion-CEA	1 stroke (fatal)	1	0	3-18	3 restenoses, PTA
Mathieu, ¹⁹ 2009	160	NR	160	50 (+), 110 (-)	NR	NR	2 strokes (1 major-fatal, 1 minor)	1	NR	NR	NR
Palombo, ²¹ 2010	44	72.1	44	(+)	44/44	0	13 TIA 1 TIA	0	0	NR	NR

First author/ year	Patients, No.	Mean age, years	CAS, No.	Technical success	Complications- treatment	Neurologic complications	Deaths	MI	FU, months	Outcome
Chang, ³¹ 2004	20	73	21	21/21		0	0	0	12	OK
Lin, ³² 2005	31	NR	31	28/31	No details-CEA	2 TIA	0	0	NR	NR
Pipinos, ³⁸ 2005	17	NR	17	17/17		0	0	0	12	OK
Griado, ¹⁷ 2007	97	72	103	100/103	1 CCA dissection, 1 inability to cross, 1 agitation-all CEA	2 minor strokes - 2 TIA	0	0	3-40	5 unrelated deaths, 1 stent occlusion
Christopoulos, ²⁸ 2011	25	79	25	24/25	4 CCA access site dissections, 3 resolved after stent placement, 1 interposition graft	1 TIA	0	0	3-24	OK
Pinter, ³⁰ 2011	44	71.4	44	42/44	1 dissection, 1 inability to cross-CEA	0	0	0	-	-
Leal, ²⁴ 2012	31	68.1	31	31/31		0	0	0	23.25	OK
Alvarez, ²⁷ 2012	212	79.9	219	211/219	4 inability to cross-CEA 2 CCA dissections-CCA-to-ICA bypass 1 failure of predilatation-CEA 1 stent thrombosis-no treatment	3 strokes, 1 TIA	1	1	18.8 ± 16.9	1 stroke

- Technical success 96.3%
- Stroke, myocardial infarction, and death 1.1%, 0.14% and 0.41%, respectively

ROADSTER 2

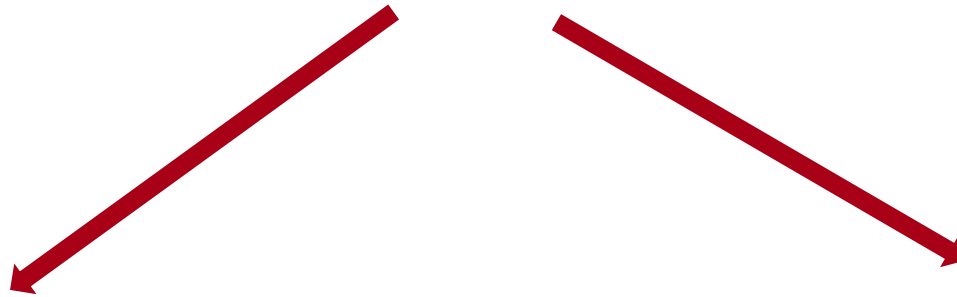
Clinical Outcomes

Symptomatic Patients – Per Protocol

	ROADSTER 1		ROADSTER 2	
	n=46		n=118	
Stroke/Death/MI	1	2.2%	1	0.8%
Stroke	0	0.0%	1	0.8%
Death	1	2.2%	0	0.0%
MI	0	0.0%	0	0.0%
Stroke/Death	1	2.2%	1	0.8%

ICA Stenosis > 70% - Which Strategy?

Symptomatic



Standard risk for CEA

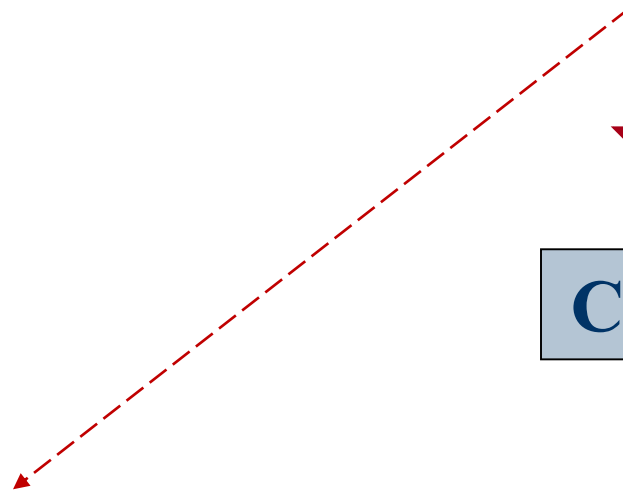
High risk for CEA



CEA



CAS



T-CAR



High risk for CAS