



**i-MEET**  
**NEXT GENERATION**  
Multidisciplinary European Endovascular Therapy

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# The **DOS & DON'TS**

**of carotid revascularization in the acute period**



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# Disclosure of Interest

## Disclosure

Speaker name:

.....

- I have the following potential conflicts of interest to report:
- Consulting
- Employment in industry
- Shareholder in a healthcare company
- Owner of a healthcare company
- Other(s)

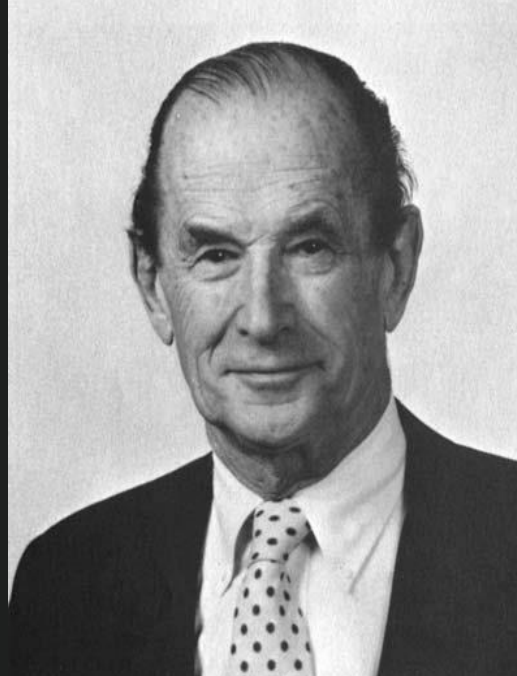


I do not have any potential conflict of interest

IMAGING  
DELAY OR NOT TO DELAY?  
SHUNT OR NO SHUNT  
CERVICAL BLOCK VS GENERAL ANESTHESIA  
CAS VS CEA



***Mahelz Mollins***

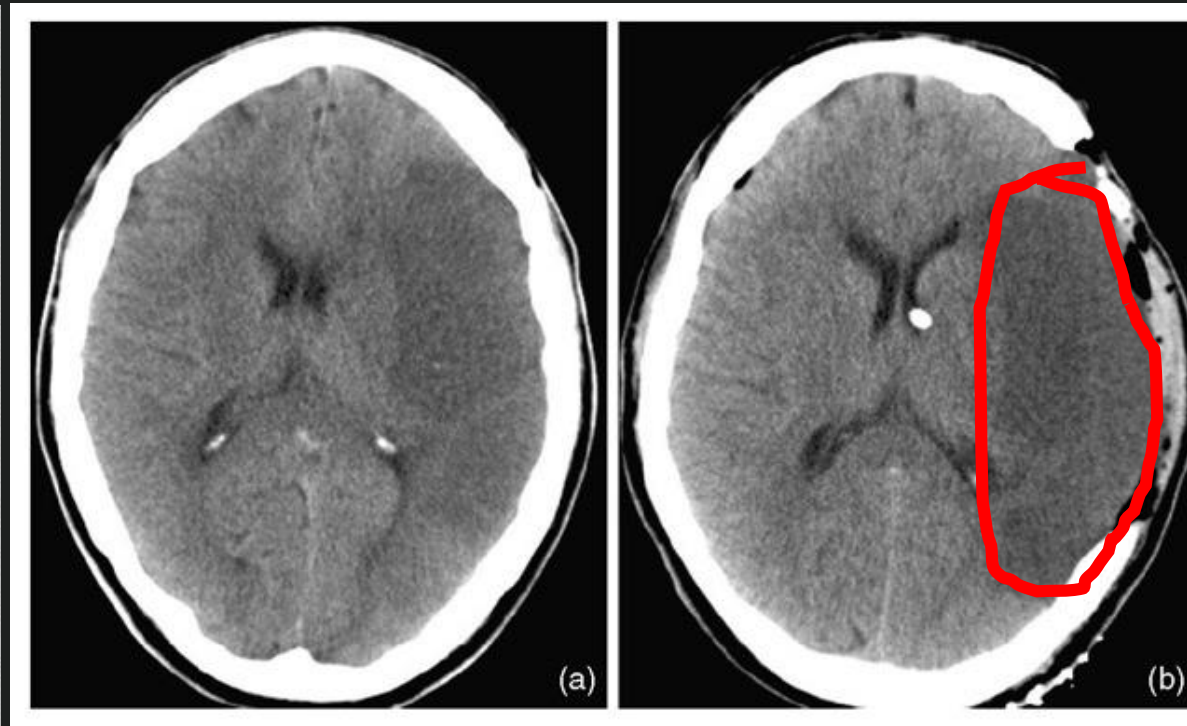
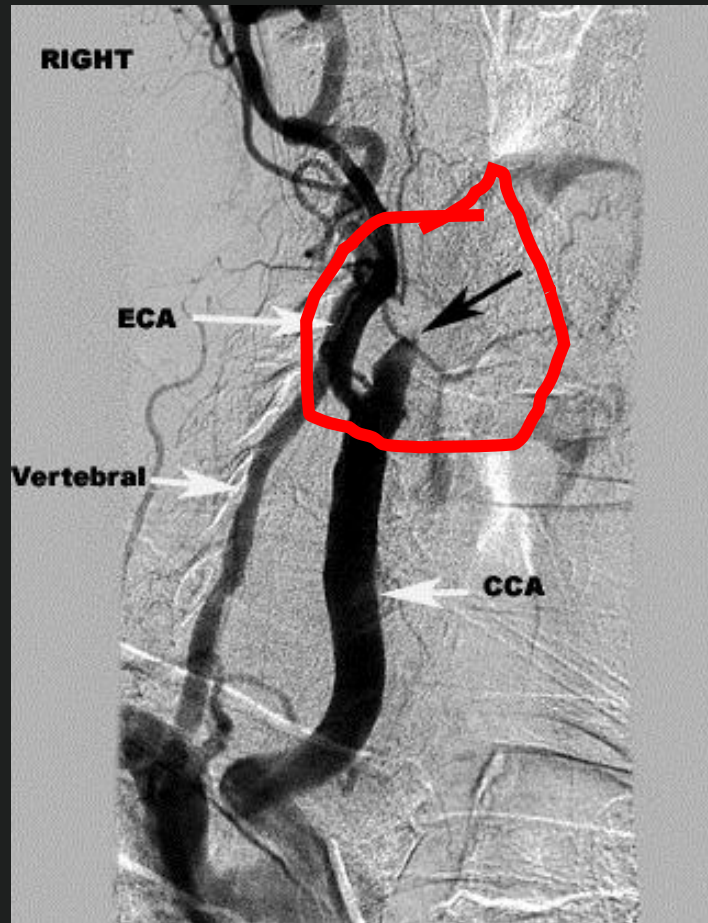


***Charles Robb***



***Michael DeBakey***





- *Acute stroke*
- *Carotid occlusion*
- *complications 20-60%*

Bauer RB, Meyer JS, Fields WS, et al. Joint study of extracranial arterial occlusion III. Progress report of controlled study of long-term survival in patients with and without operation. JAMA 1969;208:509-18.

**JAMA** The Journal of the  
American Medical Association

## **Joint Study of Extracranial Arterial Occlusion IV. A Review of Surgical Considerations**

William F. Blaisdell, MD; Roy H. Clauss, MD; J. Garber Galbraith, MD; Anthony M. Imparato, MD; Edwin J. Wyllie, MD

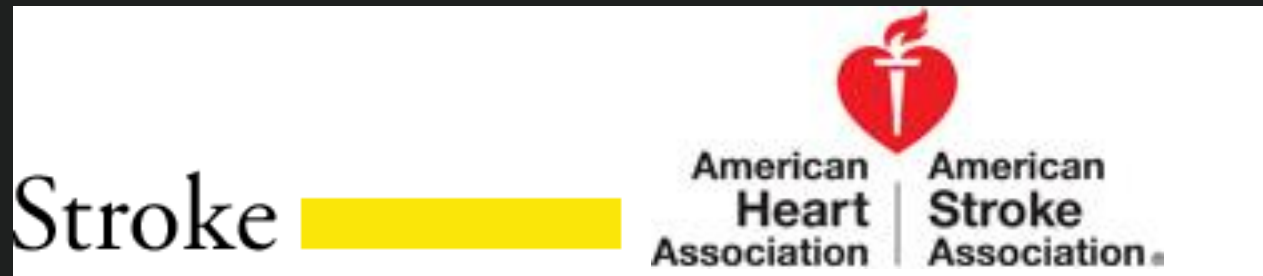
*JAMA*. 1969;209(12):1889-1895.

- 24 units, 2400 procedures, 1961-1968
- mortality 4.5%
- Most severe complications for those operated during first two weeks after stroke

# THE LANCET

European Carotid Surgery Trialist's Collaborative Group. MRC European carotid surgery trial, interim results for symptomatic patients with severe (70-90%) or with mild (0-29%) carotid stenosis. *Lancet* 1991; 337:1235-43

**ECST**



North American Symptomatic Carotid Endarterectomy Trial (NASCET) Steering committee. North American SCE Trial. Methods, patient characteristics, and progress. *Stroke* 1991;22:711-20.

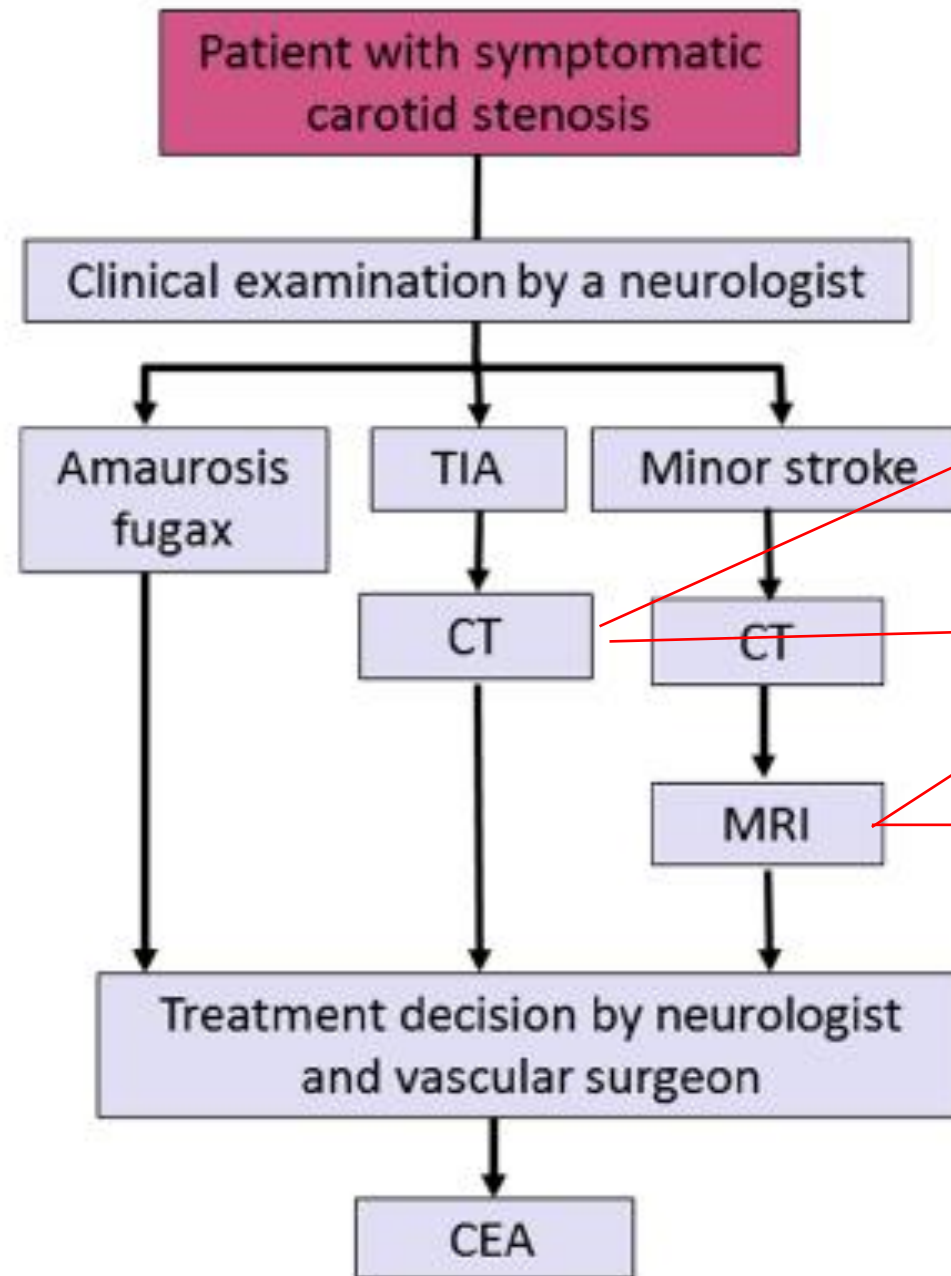
**NASCET**

**SVACS**



PP

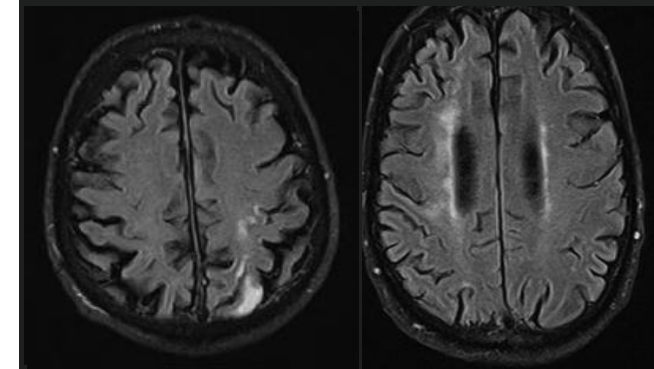
Duplex  
Transcranial  
doppler



Exclude bleeding

Circle of Willis  
Plaque morphology

Assess stroke territory



**DO YOU PREFER MDCT OR MRI IN  
SYMPTOMATIC PATIENTS?**

# DELAY OR NOT TO DELAY?

- ☐ First event
- ☐ Index event
- ☐ Most recent event

# RISK OF STROKE ON BMT

- ☐ Increasing age
- ☐ Recency of symptoms
- ☐ Irregular plaques
- ☐ Stenosis severity (excluding near total occlusion)
- ☐ Males
- ☐ Contralateral occlusion
- ☐ Hemispheric vs ocular symptoms
- ☐ Tandem lesions
- ☐ Cortical stroke
- ☐ No collaterals
- ☐ Increasing co-morbidities

	48 hours	72 hours	7 days	14 days	5 years
ECST+NASCET+VA ,BMT' patients <sup>172</sup>					21%
Fairhead <sup>207</sup>				20%	
Purroy <sup>208</sup>			10%		
Ois <sup>209</sup>		17%	22%	25%	
Bonifati <sup>210</sup>	8%				
Johansson <sup>211</sup>	5%		8%	11%	
Mono <sup>212</sup>		4%			
Merwick <sup>213</sup>			8%		
Marnane <sup>214</sup>	5%	9%	16%		

# PROCEDURAL RISK

National Audit	0-2 days % (95%CI)	3-7 days % (95%CI)	8-14 days % (95%CI)	≥15 days % (95%CI)
Sweden <sup>217</sup> n=2,596	17/148 11.5% (6.8-17.8)	29/804 3.6% (2.4-5.1)	27/677 4.0% (2.6-5.8)	52/967 5.4% (4.0-7.0)
UK <sup>218</sup> n=23,235	29/780 3.7% (2.5-5.3)	128/5126 2.5% (2.1-3.0)	132/6292 2.1% (1.8-2.5)	254/11037 2.3% (2.0-2.6)
Germany <sup>219</sup> n=56,279	157/5198 3.0% (2.6-3.5)	480/19117 2.5% (2.3-2.7)	427/16205 2.6% (2.4-2.9)	370/15759 2.3% (2.1-2.6)



**WOULD YOU PERFORM CAROTID  
REVASCULARISATION IN FIRST 48 HOURS?**

# DELAY OR NOT TO DELAY?

Eur J Vasc Endovasc Surg (2017) 54, 278–286

## Editor's Choice — Very Urgent Carotid Endarterectomy is Associated with an Increased Procedural Risk: The Carotid Alarm Study

A. Nordanstig <sup>a,b,\*</sup>, L. Rosengren <sup>a,b</sup>, S. Strömberg <sup>c</sup>, K. Österberg <sup>c</sup>, L. Karlsson <sup>d</sup>, G. Bergström <sup>d</sup>, Z. Fekete <sup>e</sup>, K. Jood <sup>a,b</sup>

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<sup>d</sup>The Sahlgrenska Centre for Cardiovascular and Metabolic Research, Wallenberg Laboratory, Institute of Medicine, The Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden

<sup>e</sup>Department of Neurology and Rehabilitation, Södra Älvsborg Hospital, Borås, Sweden

< 48 h (n = 75)	48 h–14 d (n = 343)	p <sup>a</sup>	OR (95% CI) very urgent CEA <sup>b</sup>
6 (8)	10 (3)	.049	2.90 (1.02–8.23)
6 (8)	9 (3)	.035	3.23 (1.11–9.36)
6 (8)	7 (2)	.016	4.17 (1.36–12.80)
6 (8)	5 (2)	.006	5.88 (1.75–19.81)

A short time interval between the neurologic index event and carotid endarterectomy is not a risk factor for carotid surgery

Pavlos Tsantilas, MD,<sup>a</sup> Andreas Kühnl, MD,<sup>a</sup> Michael Kallmayer, MD,<sup>a</sup> Jaroslav Pelisek, PhD,<sup>a</sup> Holger Poppert, MD,<sup>b</sup> Sofie Schmid, MD,<sup>a</sup> Alexander Zimmermann, MD,<sup>a</sup> and Hans-Henning Eckstein, PhD,<sup>a</sup> *Munich, Germany*

Total, No. (%)	Interval between index event and surgery				P value <sup>a</sup>
	0-2 days, No. (%)	3-7 days, No. (%)	8-14 days, No. (%)	15-180 days, No. (%)	
10 (2.5)	2 (3)	3 (3)	1 (2)	4 (2)	.93
6 (1.5)	0	2 (2)	1 (2)	3 (2)	1.0
3 (0.7)	0	1 (1)	0	2 (1)	.70
3 (0.7)	0	1 (1)	1 (2)	1 (1)	.87
4 (1.0)	2 (3)	1 (1)	0 (0)	1 (1)	.24

National Audit	0-2 days	3-7 days	8-14 days	≥15 days
Sweden <sup>217</sup> n=2,596	148/2596 (6%)	804/2596 (31%)	677/2596 (26%)	967/2596 (37%)
UK <sup>218</sup> n=23,235	780/23235 (3%)	5126/23235 (22%)	6292/23235 (27%)	11037/23235 (48%)
Germany <sup>219</sup> n=56,279	5198/56279 (9%)	19117/56279 (34%)	16205/56279 (29%)	15759/56279 (28%)

Recommendation 40	Class	Level
When revascularisation is considered appropriate in symptomatic patients with 50-99% stenoses, it is recommended that this be performed as soon as possible, preferably within 14 days of symptom onset	I	A

# LOCAL vs GENERAL

- ☐ Optimal neuromonitoring
- ☐ Uncomfortable and lack of protective effect of general anesthesia
- ☐ Cumbersome in stroke patient - noncooperative?

WOULD YOU PERFORM UNDER LOCAL  
ANESTHESIA IN SYMPTOMATIC  
PATIENTS?



# LOCAL vs GENERAL

Symptomatic, %

53.1

41.1

54.5

## CLINICAL RESEARCH STUDIES

From the Western Vascular Society

Anesthetic type and risk of myocardial infarction after carotid endarterectomy in the Carotid Revascularization Endarterectomy versus Stenting Trial (CREST)

	CAS (n = 1123), No. (%)	CEA-RA (n = 111), No. (%)	CEA-GA (n = 1038), No. (%)	P value
<i>Periprocedural event</i>				
Protocol MI	12 (1.1)	0 (0.0)	25 (2.4)	.019
Protocol and biomarker+- only MI	19 (1.7)	2 (1.8)	35 (3.4)	.04
Stroke	48 (4.3)	1 (0.9)	22 (2.1)	.006
Stroke or death	50 (4.5)	1 (0.9)	22 (2.1)	.003
Death	6 (0.5)	0 (0.0)	2 (0.2)	.053

+, Positive; *MI*, myocardial infarction.

# Shunt vs No Shunt

- ☐ Prevent additional ischemia of vulnerable tissue
- ☐ **Cause additional complications (dissection, embolisations etc)**

**DO YOU USE SHUNT IN  
SYMPTOMATIC PATIENTS?**

# Shunt vs No Shunt

## Multicenter Experience on Eversion Versus Conventional Carotid Endarterectomy in Symptomatic Carotid Artery Stenosis

### Observations From the Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE-1) Trial

Serdar Demirel, MD; Nicolas Attigah, MD; Hans Bruijnen, MD; Peter Ringleb, PhD; Hans-Henning Eckstein, PhD; Gustav Fraedrich, PhD; Dittmar Böckler, PhD; on behalf of the SPACE Investigators

65% were shunted in conventional technique

17% in eversion technique

that shunting is of particular importance in symptomatic patients such as those enrolled in the current trial, patients who appear predisposed to cerebral ischemia during carotid clamping. It is possible that this issue underlies the higher 30-day ipsilateral stroke rate in the E-CEA group, in which 6 of 8 patients who experienced intraoperative ipsilateral stroke did not have a shunt placed during their eversion procedure.

# SHUNT vs NO SHUNT

Original Article

## Routine Shunting During Carotid Endarterectomy in Patients With Acute Watershed Stroke

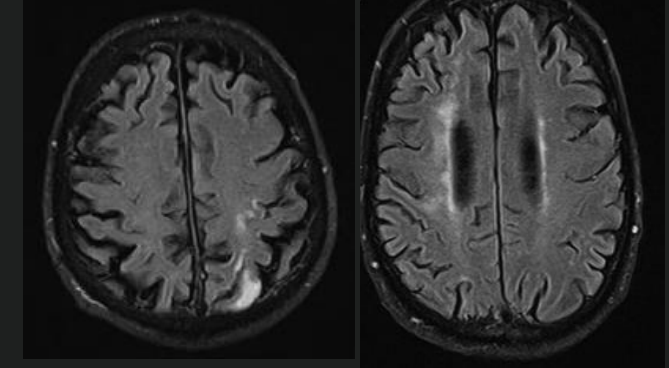
Vascular and Endovascular Surgery  
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DOI: 10.1177/1538574417708130  
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In watershed strokes



## Incompleteness of the Circle of Willis is Related to EEG-based Shunting During Carotid Endarterectomy

C.W.A. Pennekamp <sup>a</sup>, P.J. van Laar <sup>b</sup>, J. Hendrikse <sup>c</sup>, H.M. den Ruijter <sup>d,e</sup>, M.L. Bots <sup>d</sup>, H.B. van der Worp <sup>f</sup>, L.J. Kappelle <sup>f</sup>, W.F. Buhre <sup>g</sup>, R.L.A.W. Bleys <sup>h</sup>, F.L. Moll <sup>a</sup>, G.J. de Borst <sup>a,\*</sup>

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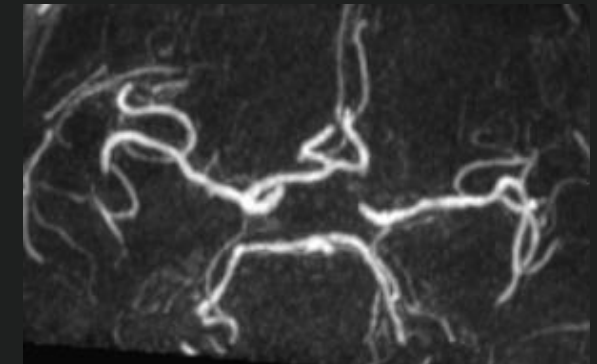
<sup>e</sup>Experimental Cardiology Laboratory, University Medical Center Utrecht, Utrecht, The Netherlands

<sup>f</sup>Department of Neurology, University Medical Center Utrecht, Utrecht, The Netherlands

<sup>g</sup>Department of Anesthesiology, University Medical Center Utrecht, Utrecht, The Netherlands

<sup>h</sup>Department of Anatomy, University Medical Center Utrecht, Utrecht, The Netherlands

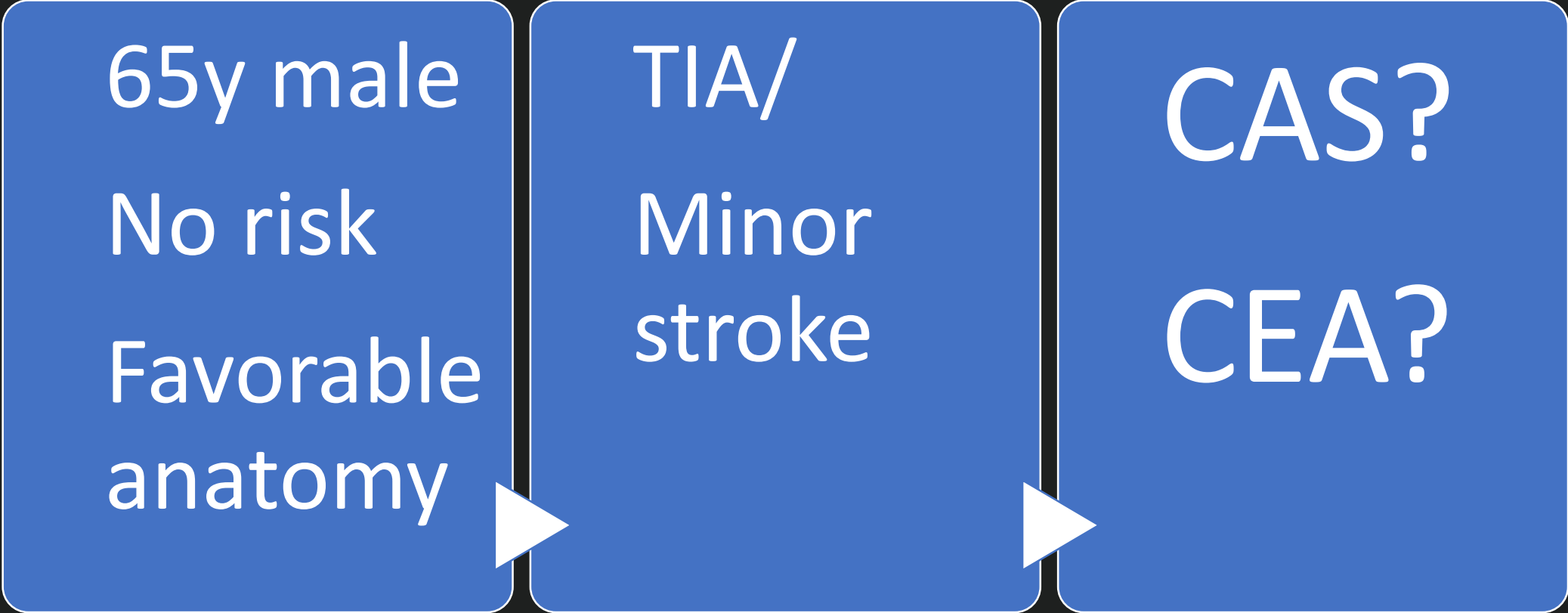
In incomplete CoW





# CEA vs CAS

65y male  
No risk  
Favorable  
anatomy



```
graph LR; A["65y male<br/>No risk<br/>Favorable<br/>anatomy"] --> B["TIA/<br/>Minor<br/>stroke"]; B --> C["CAS?<br/>CEA?"]
```

TIA/  
Minor  
stroke

CAS?  
CEA?

# CEA vs CAS

## Symptomatic carotid stenosis: is stenting as safe and effective as carotid endarterectomy?

*David Calvet and Jean-Louis Mas, on behalf of the Carotid Stenosis Trialists' Collaboration\**

EVA-3S [16], 10-year results

Postprocedural ipsilateral stroke

Postprocedural stroke

Carotid restenosis  $\geq 70\%$  or occlusion

ICSS [17<sup>■</sup>], 5-year results

Postprocedural ipsilateral stroke

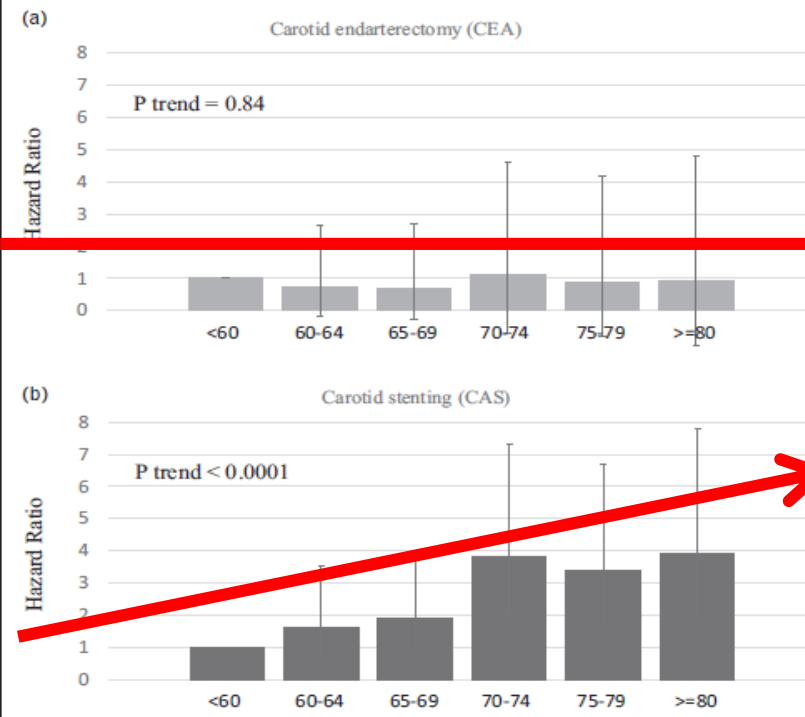
Postprocedural stroke

Carotid restenosis  $\geq 70\%$

CREST [18<sup>■</sup>], 10-year results

Postprocedural ipsilateral stroke

Carotid restenosis or revascularization

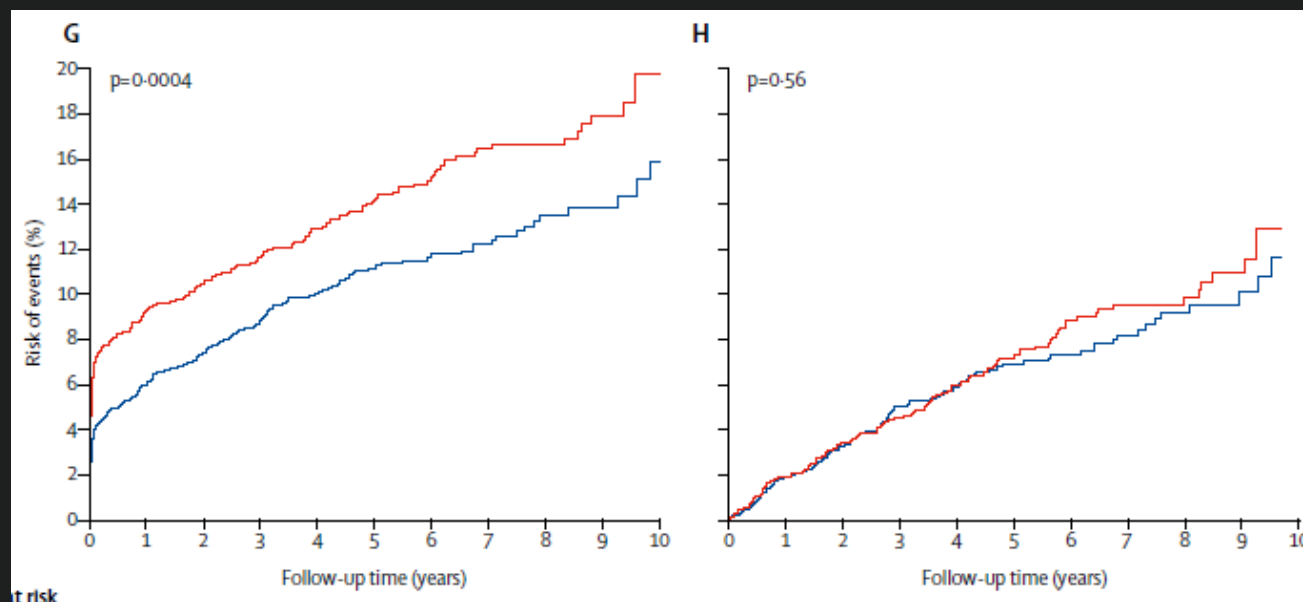


# CEA vs CAS

## Long-term outcomes of stenting and endarterectomy for symptomatic carotid stenosis: a preplanned pooled analysis of individual patient data



Thomas G Brott\*, David Calvet\*, George Howard, John Gregson, Ale Algra, Jean-Pierre Becquemin, Gert J de Borst, Richard Bulbulia, Hans-Henning Eckstein, Gustav Fraedrich, Jacoba P Greving, Alison Halliday, Jeroen Hendrikse, Olav Jansen, Jenifer H Voeks, Peter A Ringleb†, Jean-Louis Mas†, Martin M Brown†, Leo H Bonati†, on behalf of the Carotid Stenosis Trialists' Collaboration



at risk

Eur J Vasc Endovasc Surg (2015) 49, 506–512

## Peri-procedural Risk with Urgent Carotid Artery Stenting: A Population based Swedvasc Study

M. Jonsson <sup>a,\*</sup>, P. Gillgren <sup>a</sup>, A. Wanhainen <sup>b</sup>, S. Acosta <sup>c</sup>, D. Lindström <sup>d</sup>

<sup>a</sup>Section of Vascular Surgery, Department of Surgery, Södersjukhuset, Institution of Clinical Science and Education, Karolinska Institutet, 11883 Stockholm, Sweden

<sup>b</sup>Department of Surgical Sciences, Section of Vascular Surgery, Uppsala University, Uppsala, Sweden

<sup>c</sup>Vascular Centre, Malmö, Skåne University Hospital, 20502 Malmö, Sweden

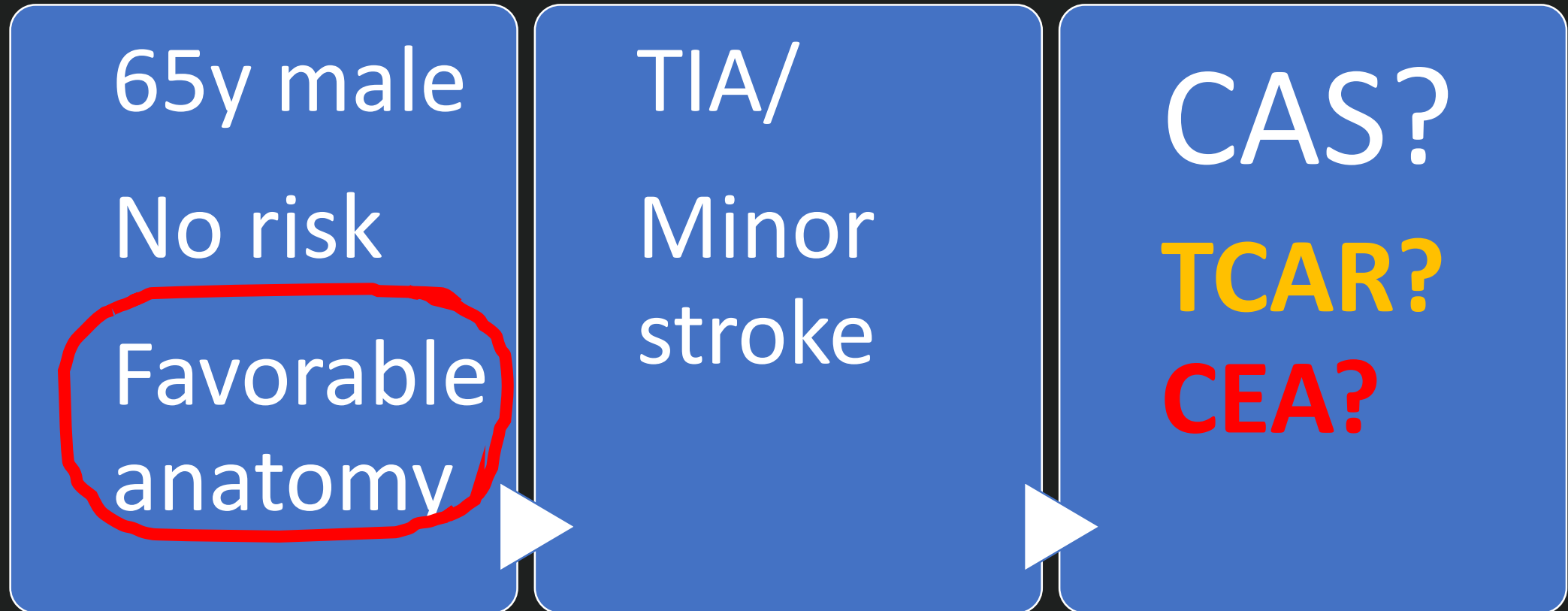
<sup>d</sup>Department of Vascular Surgery, Karolinska University Hospital, Department of Molecular Medicine and Surgery, Karolinska Institutet, 17176 Stockholm, Sweden

	Time to CAS (days)				<i>p</i>
	0–2 ( <i>n</i> = 13)	3–7 ( <i>n</i> = 85)	8–14 ( <i>n</i> = 80)	15–180 ( <i>n</i> = 145)	
Stroke, <i>n</i> (%)	0 (0.0)	3 (3.5)	5 (6.3)	5 (3.5)	0.626
AMI, <i>n</i> (%)	0 (0.0)	3 (3.5)	2 (2.5)	2 (1.4)	0.602
Deaths, <i>n</i> (%)	0 (0.0)	0 (0.0)	3 (3.8)	1 (0.7)	0.126
Stroke/death, <i>n</i> (%)	0 (0.0)	4 (4.7)	5 (6.3)	6 (4.1)	0.757
(95% CI)	(0–26.6)	(1.5–11.9)	(2.4–14.1)	(1.7–8.9)	
Stroke/death/AMI, <i>n</i> (%) (95%CI)	0 (0.0)	7 (8.2)	6 (7.5)	8 (5.5)	0.640
	(0–26.6)	(3.8–16.3)	(3.2–15.7)	(2.7–10.7)	

AMI = acute myocardial infarction; CAS = carotid artery stenting; CI = confidence interval.

	2005 - 2009	2009-2014
Stroke	4.9%	3.4%
Delay to CAS	15 days	10 days
Hospitals performing	9	7

# CEA vs CAS



Shaggy aortic arch  
Complex carotid plaque



# CEA vs CAS

Recommendation 37	Class	Level
It is recommended that most symptomatic patients aged >70 years with 50-99% stenoses should be treated by carotid endarterectomy, rather than carotid stenting.	I	A
Recommendation 38	Class	Level
When revascularisation is indicated in symptomatic patients aged <70 years, carotid stenting may be considered an alternative to endarterectomy, provided the documented procedural death/stroke rate is <6%.	IIb	A

# THANK YOU FOR YOUR ATTENTION



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