31 GIORNATE CARDIOLOGICHE TORINESI

TURIN
October
24th-26th
2019

CAROTID & CORONARIES ARTERIES

ACTUAL ROLE OF CAROTID STENTING

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Disclosure Statement of Financial Interest

I, Maria Antonella Ruffino, DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation

Eur J Vasc Endovasc Surg (2018) 55, 305—368

Editor's Choice — 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS)

Document covering atherosclerotic disease of extracranial carotid and vertebral, mesenteric, renal, upper and lower extremity arteries

Endorsed by: the European Stroke Organization (ESO)

The Task Force for the Diagnosis and Treatment of Peripheral Arterial Diseases of the European Society of Cardiology (ESC) and of the European Society for Vascular Surgery (ESVS)

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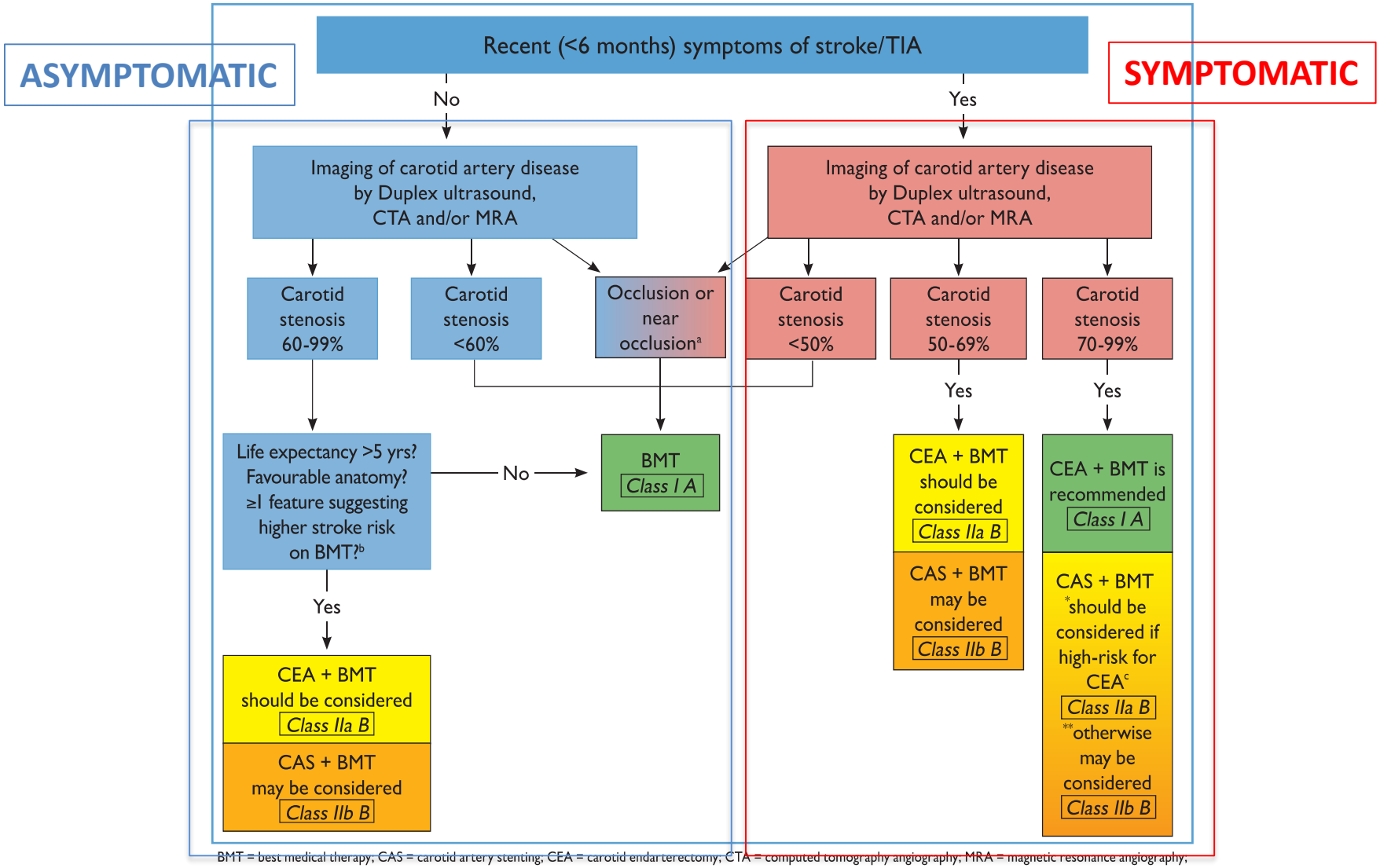

BMT = best medical therapy, CAS = carotid artery stenting, CEA = carotid endarterectomy, CTA = computed tomography angiography, MRA = magnetic resonance angiography, TIA = transient ischaemic attack.

[a]With post-stenotic internal carotid artery narrowed to the point of near occlusion.

[b]See Table 4.

[c]Age > 80 years, clinically significant cardiac disease, severe pulmonary disease, contralateral internal carotid artery occlusion, contralateral recurrent laryngeal nerve palsy, previous radical neck surgery or radiotherapy and recurrent stenosis after CEA.

Figure 4. Management of extracranial carotid artery disease.

INDICATIONS FOR INVASIVE TREATMENT IN sCAD

Recommendations on revascularization in patients with symptomatic carotid disease*

Recommendations	Class[a]	Level[b]
CEA is recommended in symptomatic patients with 70—99% carotid stenoses, provided the documented procedural death/stroke rate is <6%.[138,147]	I	A
CEA should be considered in symptomatic patients with 50—69% carotid stenoses, provided the documented procedural death/stroke rate is <6%.[138,147]	IIa	A
In recently symptomatic patients with a 50—99% stenosis who present with adverse anatomical features or medical comorbidities that are considered to make them 'high risk for CEA', CAS should be considered, provided the documented procedural death/stroke rate is <6%.[135,145,152]	IIa	B
When revascularization is indicated in 'average surgical risk' patients with symptomatic carotid disease, CAS may be considered as an alternative to surgery, provided the documented procedural death/stroke rate is <6%.[152,153]	IIb	B
When decided, it is recommended to perform revascularization of symptomatic 50—99% carotid stenoses as soon as possible, preferably within 14 days of symptom onset.[138,154,155]	I	A
Revascularization is not recommended in patients with a <50% carotid stenosis.[138]	III	A

INDICATIONS FOR INVASIVE TREATMENT IN aCAD

(life exectancy > 5 years)

- Stenosis >60%

and

- Progressive stenosis
- Hystory of controlateral stroke
- Ipsilateral silent stroke (MRI)
- Impaired flow reserve (controlateral occlusion)
- Suspicious plaque morphology

Recommendations for management of asymptomatic carotid artery disease

Recommendations	Class[a]	Level[b]
In 'average surgical risk' patients with an asymptomatic 60—99% stenosis, CEA should be considered in the presence of clinical and/or more imaging characteristics[c] that may be associated with an increased risk of late ipsilateral stroke, provided documented perioperative stroke/death rates are <3% and the patient's life expectancy is >5 years.[116]	IIa	B
In asymptomatic patients who have been deemed 'high risk for CEA'[d] and who have an asymptomatic 60—99% stenosis in the presence of clinical and/or imaging characteristics[c] that may be associated with an increased risk of late ipsilateral stroke, CAS should be considered, provided documented perioperative stroke/death rates are <3% and the patient's life expectancy is >5 years.[135,136]	IIa	B
In 'average surgical risk' patients with an asymptomatic 60—99% stenosis in the presence of clinical and/or imaging characteristics[d] that may be associated with an increased risk of late ipsilateral stroke, CAS may be an alternative to CEA provided documented perioperative stroke/death rates are <3% and the patient's life expectancy is >5 years.[110,129,132,137]	IIb	B

INDICATIONS FOR CAS IN aCAD

- Restenosis after carotid endoarterectomy
- Controlateral carotid artery occlusion
- Hostile neck (radiation, surgery)
- (Tandem stenosis) – relative indication
- Severe anticoagulation regimen (recent coronary stent)
- General medical controindications to CEA
- aCAD and planned CABG surgery (?)

Comparison of Trends and In-Hospital Outcomes of Concurrent Carotid Artery Revascularization and Coronary Artery Bypass Graft Surgery

The United States Experience 2004 to 2012

Dmitriy N. Feldman, MD,[a] Rajesh V. Swaminathan, MD,[b] Joshua D. Geleris, MD,[a] Peter Okin, MD,[a] Robert M. Minutello, MD,[a] Udhay Krishnan, MD,[a] Daniel J. McCormick, DO,[c] Geoffrey Bergman, MD,[a] Harsimran Singh, MD,[a] S. Chiu Wong, MD,[a] Luke K. Kim, MD[a]

ABSTRACT

OBJECTIVES The aim of this study was to compare trends and outcomes of 3 approaches to carotid revascularization in the coronary artery bypass graft (CABG) population when performed during the same hospitalization.

BACKGROUND The optimal approach to managing coexisting severe carotid and coronary disease remains controversial. Carotid endarterectomy (CEA) or carotid artery stenting (CAS) are used to decrease the risk of stroke in patients with carotid disease undergoing CABG surgery.

METHODS The authors conducted a serial, cross-sectional study with time trends of 3 revascularization groups during the same hospital admission: 1) combined CEA+CABG; 2) staged CEA+CABG; and 3) staged CAS+CABG from the Nationwide Inpatient Sample database 2004 to 2012. The primary composite endpoints were in-hospital all-cause death, stroke, and death/stroke.

RESULTS During the 9-year period, 22,501 concurrent carotid revascularizations and CABG surgeries during the same hospitalization were performed. Of these, 15,402 (68.4%) underwent combined CEA+CABG, 6,297 (28.0%) underwent staged CEA+CABG, and 802 (3.6%) underwent staged CAS+CABG. The overall rate of CEA+CABG decreased by 16.1% ($p_{trend} = 0.03$) from 2004 to 2012, whereas the rate of CAS+CABG did not significantly change during these years ($p_{trend} = 0.10$). The adjusted risk of death was greater, whereas risk of stroke was lower with both combined CEA+CABG (death odds ratio [OR]: 2.08, 95% confidence interval [CI]: 1.08 to 3.97; p = 0.03; stroke OR: 0.65, 95% CI: 0.42 to 1.01; p = 0.06) and staged CEA+CABG (death OR: 2.40, 95% CI: 1.43 to 4.05; p = 0.001; stroke OR: 0.50, 95% CI: 0.31 to 0.80; p = 0.004) approaches compared with CAS+CABG. The adjusted risk of death or stroke was similar in the 3 groups.

CONCLUSIONS In patients with concomitant carotid and coronary disease undergoing combined revascularization, combined CEA+CABG is utilized most frequently, followed by staged CEA+CABG and staged CAS+CABG strategies. The staged CAS+CABG strategy was associated with lower risk of mortality, but higher risk of stroke. Future studies are needed to examine the risks/benefits of different carotid revascularization strategies for high-risk patients requiring concurrent CABG. (J Am Coll Cardiol Intv 2017;10:286–98) © 2017 by the American College of Cardiology Foundation.

TABLE 4 Unadjusted and Adjusted Association Between CEA and CABG and In-Hospital Outcomes (CAS and CABG as Reference) in Key Subgroups

Subgroups	Timing of CEA	Outcome	Adjusted OR (95% CI)	p Value	p Value for Interaction
Age ≥80 yrs	Combined	Death	3.17 (1.82–5.54)	<0.001	<0.001
		Stroke	0.72 (0.41–1.24)	0.23	0.02
		Death or stroke	2.05 (1.39–3.04)	<0.001	<0.001
	Staged	Death	6.67 (3.35–13.35)	<0.001	<0.001
		Stroke	0.84 (0.36–1.95)	0.69	0.16
		Death or stroke	2.57 (1.61–4.10)	<0.001	0.35
Age <80 yrs	Combined	Death	2.66 (1.39–5.06)	0.003	
		Stroke	0.71 (0.46–1.09)	0.11	
		Death or stroke	1.45 (0.98–2.14)	0.06	
	Staged	Death	2.24 (1.16–4.34)	0.02	
		Stroke	0.50 (0.31–0.81)	0.004	
		Death or stroke	1.28 (0.85–1.92)	0.76	
Male	Combined	Death	2.88 (1.51–5.50)	0.001	<0.001
		Stroke	0.77 (0.49–1.20)	0.25	0.005
		Death or stroke	1.61 (1.08–2.38)	0.02	0.005
	Staged	Death	3.17 (1.64–6.14)	0.001	0.38
		Stroke	0.76 (0.46–1.25)	0.28	<0.001
		Death or stroke	1.67 (1.12–2.51)	0.01	<0.001
Female	Combined	Death	3.48 (1.810–6.70)	<0.001	
		Stroke	0.84 (0.52–1.34)	0.46	
		Death or stroke	1.77 (1.18–2.64)	0.006	
	Staged	Death	2.44 (1.14–5.20)	0.02	
		Stroke	0.34 (0.17–0.68)	0.003	
		Death or stroke	0.84 (0.51–1.38)	0.48	
Asymptomatic	Combined	Death	2.21 (1.31–3.73)	0.003	<0.001
		Stroke	0.72 (0.47–1.12)	0.14	<0.001
		Death or stroke	1.46 (1.02–2.09)	0.04	0.10
	Staged	Death	1.91 (1.12–3.26)	0.02	<0.001
		Stroke	0.40 (0.24–0.64)	<0.001	<0.001
		Death or stroke	1.08 (0.74–1.57)	0.69	<0.001
Symptomatic	Combined	Death	3.06 (1.10–8.52)	0.03	
		Stroke	4.07 (2.21–7.47)	<0.001	
		Death or stroke	3.25 (1.91–5.53)	<0.001	
	Staged	Death	0.92 (0.28–3.00)	0.88	
		Stroke	4.70 (2.60–8.48)	<0.001	
		Death or stroke	3.95 (2.38–6.56)	<0.001	

Abbreviations as in Tables 1 to 3.

Asymptomatic	Combined	Death	2.21 (1.31–3.73)	0.003	<0.001
		Stroke	0.72 (0.47–1.12)	0.14	<0.001
		Death or stroke	1.46 (1.02–2.09)	0.04	0.10
	Staged	Death	1.91 (1.12–3.26)	0.02	<0.001
		Stroke	0.40 (0.24–0.64)	<0.001	<0.001
		Death or stroke	1.08 (0.74–1.57)	0.69	<0.001
Symptomatic	Combined	Death	3.06 (1.10–8.52)	0.03	
		Stroke	4.07 (2.21–7.47)	<0.001	
		Death or stroke	3.25 (1.91–5.53)	<0.001	
	Staged	Death	0.92 (0.28–3.00)	0.88	
		Stroke	4.70 (2.60–8.48)	<0.001	
		Death or stroke	3.95 (2.38–6.56)	<0.001	

RELATIVE CONTRAINDICATIONS TO CAS IN aCAD

- Hostile arch
- Complex femoral access
- Echolucent plaque (double layer stent?)
- Apparent local thrombus formation
- Non-responder to antiplatelet therapy

Eur J Vasc Endovasc Surg (2019) 58, 479–493

REVIEW

Editor's Choice – Overview of Primary and Secondary Analyses From 20 Randomised Controlled Trials Comparing Carotid Artery Stenting With Carotid Endarterectomy

Andrew J. Batchelder, Athanasios Saratzis, A. Ross Naylor *

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WHAT THIS PAPER ADDS

This paper provides an overview of primary/secondary outcome data from 20 randomised controlled trials comparing carotid endarterectomy (CEA) with carotid artery stenting (CAS) in symptomatic and asymptomatic patients, including meta-analyses for peri-operative risks and late ipsilateral stroke. Secondary analyses include (i) risk factors for stroke after CEA/CAS; (ii) the effect of peri-operative stroke or myocardial infarction on long term survival; (iii) non-stroke complications; (iv) the significance of new white matter lesions on late stroke and cognitive impairment; and (v) whether asymptomatic 70%–99% restenoses increase the risk of ipsilateral stroke after CEA and CAS.

ASYMPTOMATIC PATIENTS: peri-operative stroke/death

CAS is associated with significantly higher rates of "any stroke" compared to CEA

	Death	Stroke	Death/ Stroke	Disabling Stroke	Death/ Disabling stroke	MI	Death/ Stroke/MI
	7 RCTs n = 2286	8 RCTs n = 3467	8 RCTs n = 3467	5 RCTs n = 2918	Insufficient data	5 RCTs n = 2948	5 RCTs n = 2948
CEA	0.7% (0.3–1.8)	1.9% (1.3–2.9)	2.1% (1.5–3.1)	0.5% (0.2–1.2)	Insufficient data	1.8% (1.1–2.8)	3.1% (2.2–4.3)
CAS	0.7% (0.3–1.7)	3.0% (2.3–3.8)	3.1% (2.4–4.0)	0.5% (0.3–1.0)	Insufficient data	0.8% (0.5–1.4)	3.3% (2.5–4.2)
OR (95% CI)	1.02 (0.18–5.90)	1.73 (1.06–2.84)	1.64 (1.02–2.64)	1.57 (0.40–6.19)	Insufficient data	0.53 (0.24–1.16)	1.14 (0.72–1.81)

Significant benefit favouring CEA No significant difference between CAS and CEA

Figure 2. Thirty day outcomes after carotid artery stenting (CAS) *vs.* carotid endarterectomy (CEA) in 3467 asymptomatic patients randomised within seven randomised controlled trials (RCTs).[10,12,28,65,101,105,106] OR = odds ratio; CI = confidence interval; MI = myocardial infarction.

	Death	Stroke	Death/ Stroke	Disabling Stroke	Death/ Disabling stroke	MI	Death/ Stroke/MI
		3 RCTs n = 3034	3 RCTs n = 3034	2 RCTs n = 2634		2 RCTs n = 2634	2 RCTs n = 2634
CEA	Insufficient data	1.5% (0.9–2.4)	1.6% (1.0–2.5)	0.3% (0.1–1.0)	Insufficient data	1.5% (0.6–3.9)	3.2% (2.3–4.5)
CAS	Insufficient data	2.7% (2.2–3.5)	2.7% (2.1–3.6)	0.5% (0.2–1.0)	Insufficient data	0.8% (0.3–1.9)	3.3% (2.6–4.3)
OR (95% CI)		1.82 (1.02–3.23)	1.71 (0.98–3.00)	1.57 (0.40–6.19)		0.53 (0.24–1.16)	1.11 (0.70–1.78)

Significant benefit favouring CEA No significant difference between CAS and CEA

Figure 3. Thirty day outcomes following carotid artery stenting (CAS) *vs.* carotid endarterectomy (CEA) in three randomised controlled trials (RCTs) that randomised > 500 asymptomatic patients.[28,65,101] OR = odds ratio; CI = confidence interval; MI = myocardial infarction.

SYMPTOMATIC PATIENTS: peri-operative stroke/death

CAS is associated with significantly higher rates of “any stroke”, “death/stroke”, and “death/stroke/MI

	Death	Stroke	Death/ Stroke	Disabling Stroke	Death/ Disabling stroke	MI	Death/ Stroke/MI
	9 RCTs n = 4257	9 RCTs n = 5535	10 RCTs n = 5754	6 RCTs n = 4855	5 RCTs n = 3534	6 RCTs n = 3980	6 RCTs n = 3719
CEA	1.4% (0.9–2.0)	4.6% (3.26–6.37)	5.08% (3.7–6.9)	1.8% (1.1–3.1)	3.2% (2.5–4.1)	1.6% (1.0–2.3)	5.1% (4.13–6.30)
CAS	1.9%	8.5% (5.87–12.14)	9.3% (6.8–12.6)	3.28% (1.6–6.7)	5.21% (3.0–8.9)	0.8% (0.5–1.4)	8.4% (5.0–13.8)
OR (95% CI)	1.38 (0.81–2.34)	1.73 (1.38–2.18)	1.71 (1.38–2.11)	1.35 (0.91–1.99)	1.42 (1.00–2.02)	0.50 (0.24–1.02)	1.61 (1.21–2.14)

Significant benefit favouring CEA No significant difference between CAS and CEA

Figure 4. 30 day outcomes following carotid artery stenting (CAS) *vs.* carotid endarterectomy (CEA) in ten randomised controlled trials (RCTs) which included 5797 symptomatic patients.[1,8,9,12,17,22,31,65,105,107] OR = odds ratio; CI = confidence interval; MI = myocardial infarction.

	Death	Stroke	Death/ Stroke	Disabling Stroke	Death/ Disabling stroke	MI	Death/ Stroke/MI
	3 RCTs n = 3413	4 RCTs n = 4754	4 RCTs n = 4754	4 RCTs n = 4754	3 RCTs n = 3413	3 RCTs n = 3551	2 RCTs n = 3031
CEA	0.9% (0.5–1.47)	4.8% (4.0–5.7)	5.5% (4.7–6.5)	2.4% (1.8–3.1)	3.2% (2.5–4.2)	1.0% (0.3–3.1)	5.2% (4.2–6.5)
CAS	1.2% (0.48–2.92)	7.8% (6.8–9.0)	8.7% (7.6–9.9)	3.3% (2.6–4.1)	4.3% (3.4–5.4)	0.7% (0.4–1.3)	8.0% (5.9–10.7)
OR (95% CI)	1.67 (0.88–3.17)	1.66 (1.32–2.10)	1.61 (1.29–2.01)	1.39 (0.98–1.97)	1.38 (0.96–1.98)	0.51 (0.25–1.07)	1.60 (1.19–2.14)

Significant benefit favouring CEA No significant difference between CAS and CEA

Figure 5. Thirty day outcomes following carotid endarterectomy (CEA) *vs.* carotid artery stenting (CAS) in four randomised controlled trials (RCTs) that randomised > 500 symptomatic patients.[17,22,31,65] OR = odds ratio; CI = confidence interval; MI = myocardial infarction.

CHARACTERISTIC OF PERI-OPERATIVE STROKE

CAS

- *94% are ischemic with 6% being due to ICH*
- *91% are ipsilateral*
- *9% controlateral/vertebrobasilar*
- *Risk of immediate stroke 4.7%*
- *Delayed stroke 2.5%*

CEA

- *86% are ischemic with 14% being due to ICH*
- *93% are ipsilateral*
- *7% controlateral/vertebrobasilar*
- *Risk of immediate stroke 1.9%*
- *Delayed stroke 2%*

FACTOR ASSOCIATED WITH INCREASED 30 DAY DEATH/STROKE

- AGE: threshold of 70 years was statistically significant

- GENDER: significantly higher after CAS in women (5.5% vs 2.2% for CEA)

- OPERATING IN THE FIRST 14 DAYS AFTER SYMPTOMS ONSET:
  - when CAS performed less than 7 days after symptoms onset 9.4%(vs 2.8% for CEA)
  - when CAS performed between 8-14 days after 8.1% (vs 3.4% for CEA)

- PRE-EXISTING CORONARY ARTERY DISEASE (CHD):
  - significantly higher after CAS in patient >75 years.

- LESION CHARACTERISTICS:
  - Sequential lesions and remote lesions extending beyond the bulb, plaque length >13 mm

- EXTENSIVE WMLs ON PRE-OPERATIVE MRI:
  - in patients with ARWMC >/ CAS should be avoid

- CAS TECHNIQUE: open cell stents and post-dilatation, number of stents

- ANNUAL CAS VOLUME OF PERFORMING SPECIALIST

NEW ISCHEMIC WMLs AFTER CEA/CAS

New WMLs were signifcantly more common after CAS and may be associated with higher rates of late stroke/TIA.

No evidence that new WMLs predispose to cognitive impairment

Table 2. Incidence of new acute and persisting white matter lesions after carotid endarterectomy (CEA) and carotid artery stenting (CAS) in symptomatic patients: an International Carotid Stenting Study substudy[a]

Timepoint	CAS *n/m* (%)	CEA *n/m* (%)	OR (95% CI)	*p* value
Day 1 post-operatively	62/124 (50)	18/107 (17)	5.21 (2.78–9.79)	<.001
1 month post operative FLAIR MRI	28/86 (33)	6/75 (8)	5.93 (2.25–15.62)	<.001

Data are given as *n*/m (%), where m is total number of patients per study group. OR = odds ratio; CI = confidence interval; MRI = magnetic resonance imaging; FLAIR = fluid attenuated inversion recovery.

[a] Based on data from Bonati *et al.*[32].

LATE STROKE

Table 3. Meta-analysis: five year rates of stroke after carotid endarterectomy (CEA) and carotid artery stenting (CAS) in 4289 symptomatic patients (excluding peri-operative risk)[a]

Stroke type	CEA (*n* = 2168)	CAS (*n* = 2121)	CAS *vs.* CEA HR (95% CI)
Ipsilateral stroke – %	3.1 (2.3–4.1)	3.2 (2.3–4.2)	1.06 (0.73–1.54)
Major stroke – %	1.4 (0.9–2.2)	1.2 (0.7–1.9)	0.86 (0.48–1.56)
Any stroke – %	6.9 (5.7–8.3)	7.3 (6.0–8.8)	1.08 (0.84–1.38)

Data are given as mean (95% CI) unless stated otherwise. CI = confidence interval; HR = hazard ratio; CEA = carotid endarterectomy; CAS = carotid artery stenting.

[a] Based on a meta-analysis of individual patient data from Endarterectomy Versus Angioplasty in patients with symptomatic severe carotid stenosis trial (EVA-3S), SPACE (Stent Protected percutaneous Angioplasty of the Carotid artery versus Endarterectomy trial), International Carotid Stenting Study (ICSS), and Carotid Revascularization Endarterectomy versus Stenting Trial (CREST). Adapted from Brott *et al.*[125]

RESTENOSIS AFTER CEA/CAS

Restenoses were more common after CAS (prevalence of restenosis >70% was 5.8% for CEA and 10.0% for CAS), but did not increase late ipsilateral stroke.

CEA was associated with a small but significant increase in stroke ipsilateral to 70-99% restenosis

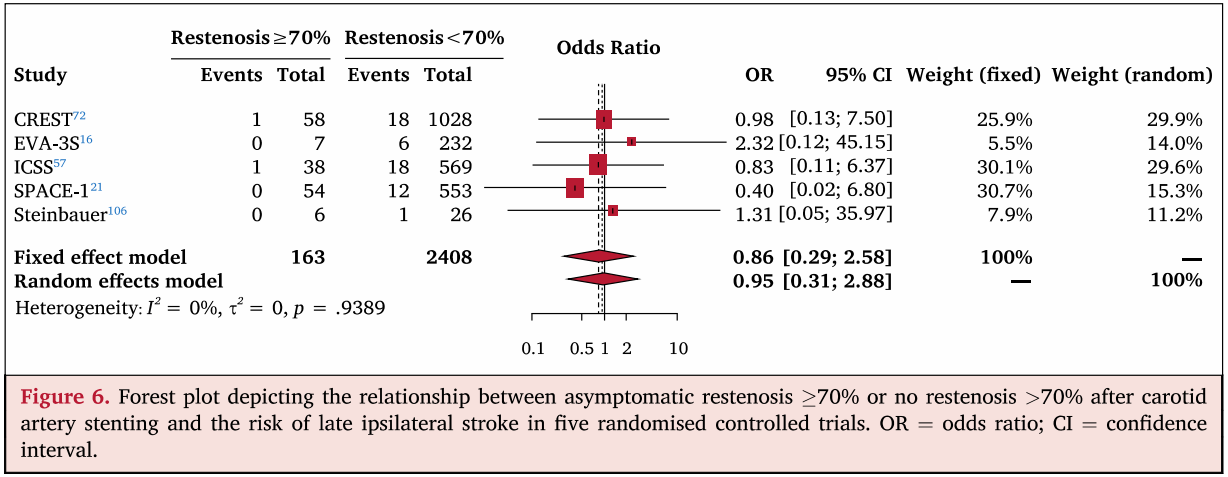

Figure 6. Forest plot depicting the relationship between asymptomatic restenosis ≥70% or no restenosis >70% after carotid artery stenting and the risk of late ipsilateral stroke in five randomised controlled trials. OR = odds ratio; CI = confidence interval.

The crude risky of ipsilateral stroke in CAS patients with 70%-99% restenosis was 1.2% vs 2.28% in patients with 0%-69% restenosis.

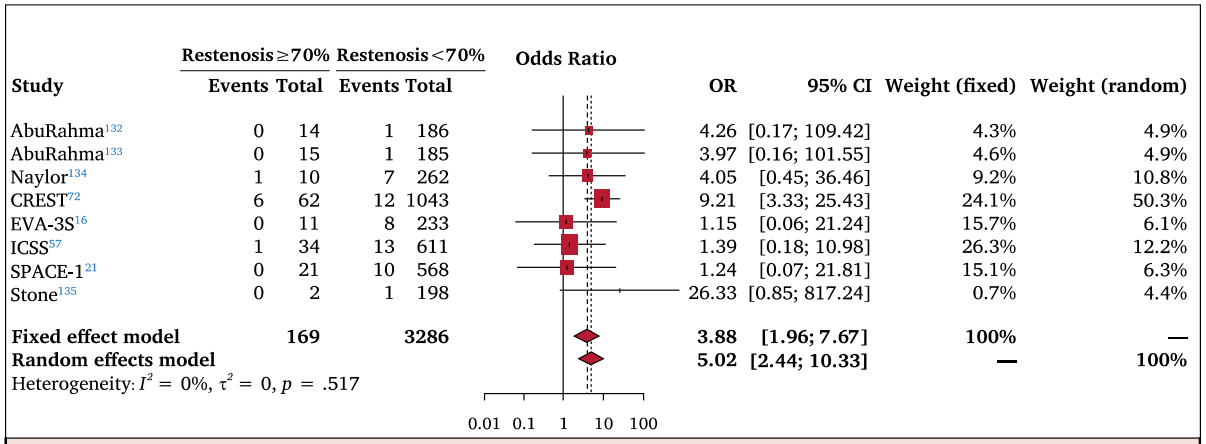

Figure 7. Forest plot depicting the relationship between asymptomatic restenosis ≥70% or no restenosis >70% after carotid endarterectomy and the risk of late ipsilateral stroke in eight randomised controlled trials. OR = odds ratio; CI = confidence interval.

The crude risky of ipsilateral stroke in CEA patients with 70%-99% restenosis was 4.7% vs 1.6% in patients with 0%-69% restenosis.

CAS IS ALREADY A FACT!

ORIGINAL ARTICLE

Surgical and Endovascular Treatment of Extracranial Carotid Stenosis

A Secondary Analysis of Statutory Quality Assurance Data From 2009 to 2014

Hans-Henning Eckstein, Pavlos Tsantilas, Andreas Kühnl, Bernhard Haller, Thorben Breitkreuz, Alexander Zimmermann, and Michael Kallmayer

GERMAN REGISTRY

TABLE 1

Periprocedural mortality and periprocedural rates of cerebral, local, and general complications after elective surgical (CEA, 2009–2014) and endovascular (CAS, 2012–2014) treatment of asymptomatic and symptomatic carotid stenosis in Germany

	Elective/Asymptomatic		Elective/Symptomatic	
	n	%	n	%
Surgical treatment (CEA)	**85 738**	**100%**	**56 336**	**100%**
Cerebral complications and deaths				
any stroke or death	1175	1.4%	1436	2.5%
any severe stroke (mRS >2) or death	769	0.9%	1057	1.9%
any stroke	783	0.9%	983	1.7%
any severe stroke (mRS >2)	377	0.4%	604	1.1%
death of any cause	392	0.5%	453	0.8%
Local complications				
postoperative bleeding necessitating reoperation	1990	2.3%	1436	2.5%
cranial nerve lesion	1073	1.3%	652	1.2%
General complications				
any*1	1925	2.2%	1941	3.4%
myocardial infarction*2	93/27 981	0.3%	67/17 975	0.4%
Endovascular treatment (CAS)	**8360**	**100%**	**4726**	**100%**
Cerebral complications and deaths				
any stroke or death	144	1.7%	173	3.7%
any severe stroke (mRS >2) or death	83	1.0%	117	2.5%
any stroke	111	1.3%	129	2.7%
any severe stroke (mRS >2)	50	0.6%	73	1.5%
death of any cause	33	0.4%	44	0.9%
Local complications				
Inguinal puncture site*3	66	0.8%	48	1.0%
General complications				
any*1	159	1.9%	146	3.1%
myocardial infarction*2	6/5813	0.1%	3/3192	0.1%

*1 other cardiovascular complications, deep venous thrombosis (pelvic or lower limb veins), pulmonary complications, other; *2data available only for 2013 and 2014. *3 hemorrhage, hematoma, AV fistula, aneurysm, or other complication; CAS, carotid artery stenting; CEA, carotid endarterectomy; mRS, Modified Rankin Scale.

COMPLICAYION RATES aCAD BESIDES STROKE

CAS

- *Neck hematoma requiring exploration 0.8%*
- *Cranial nerve injury 0.5%*
- *MI 0.1%*
- *Treatment for hypertension 1.4%*
- *Treatment for hypotension 10.5%*
- *Treatment for bradicardia 4.2%*

CEA

- *Neck hematoma requiring exploration 2.2%*
- *Cranial nerve injury 5.4%*
- *MI 0.3%*
- *Treatment for hypertension 6.1%*
- *Treatment for hypotension 4.2%*
- *Treatment for bradicardia 1.0%*

NIH Public Access
Author Manuscript
J Am Coll Cardiol. Author manuscript; available in PMC 2012 October 4.

Published in final edited form as:
J Am Coll Cardiol. 2011 October 4; 58(15): 1557–1565. doi:10.1016/j.jacc.2011.05.054.

Health-Related Quality of Life after Carotid Stenting versus Carotid Endarterectomy: Results from CREST (Carotid Revascularization Endarterectomy Versus Stenting Trial)

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Results—At both 2-weeks and 1-month, CAS patients had better outcomes for multiple components of the SF-36, with large differences for role physical function, pain, and the physical component summary scale (all $p<0.01$). On the disease-specific scales, CAS patients reported less difficulty with driving, eating/swallowing, neck pain, and headaches but more difficulty with walking and leg pain (all $p<0.05$). However, by 1 year there were no differences in any HRQOL measure between CAS and CEA. In the exploratory analyses, periprocedural stroke was associated with poorer 1-year HRQOL across all SF-36 domains, but periprocedural MI or cranial nerve palsy were not.

Conclusions—Among patients undergoing carotid revascularization, CAS is associated with better HRQOL during the early recovery period as compared with CEA—particularly with regard to physical limitations and pain—but these differences diminish over time and are not evident after 1-year. Although CAS and CEA are associated with similar overall HRQOL at 1-year, event-specific analyses confirm that stroke has a greater and more sustained impact on HRQOL than MI.

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eTABLE 3

Characteristics of the patients undergoing elective surgical (CEA, 2009–2014) and endovascular (CAS, 2012–2014) treatment of carotid artery stenosis in Germany

	CEA		CAS	
	n	%	n	%
Overall (N)	142 074	100%	13 086	100%
Men	96 396	67.8%	9119	69.7%
Age (years; median, Q25–Q75)	72 (65–77)	–	71 (63–76)	–
Treated side (right)	71,379	50.2%	6539	50.0%
ASA class				
classes I + II	41 751	29.4%	8069	61.7%
class III	96 638	68.0%	4773	36.5%
classes IV + V	3685	2.6%	244	1.9%
Clinical manifestations on admission[*1]				
asymptomatic	85 738	60.3%	8360	63.9%
amaurosis fugax	9869	6.9%	798	6.1%
transient ischemic attack	20 453	14.4%	1354	10.3%
mild stroke (mRS 0–2)	14 391	10.1%	1351	10.3%
severe stroke (mRS 3–5)	8597	6.1%	779	6.0%
other manifestations	3026	2.1%	444	3.4%
interval from index event to treatment[*1]	**9 days (5–17)**		**9 days (5–19)**	

ASA, American Society of Anesthesiologists; CAS, carotid artery stenting; CEA, carotid endarterectomy; mRS, modified Rankin scale;
[*1] temporal interval; median and interquartile distance;
[*2] All degrees of stenosis are given according to the NASCET (North American Symptomatic Carotid Endarterectomy Trial) criteria;
[*3] CEA was performed in 566 hospitals, divided in groups of 111–115 hospitals. The caseload quintiles, in cases per year, were: 1–10 (1st quintile), 11–25 (2nd quintile), 26–46 (3rd quintile), 47–79 (4th quintile), and 80–734 (5th quintile). CAS was performed in 366 hospitals; the caseload quintiles, in cases per year, were 1–2/3–6/7–12/13–26/ and 27–240 ;
[*4] median and interquartile distance (Q25 to Q75).

60% of treatment performed for aCAD

CEA is performed 10 times more than CAS

CONCLUSIONS - I

According to ESC guidelines and real world data, CAS is a reliable alternative to CEA in selected patients with CAD

There are a number of scenario that should be primarily treated by CAS

Patients should undergo informed consent – **in an unbiased fashion** – about **all** types of complications

- Perioperative death/stroke was significantly higher after CAS, especially in symptomatic patients

- At nine years, late ispilateral stroke rates were about 4% from both CEA and CAS

- Complications beyond stroke

CONCLUSIONS - II

To improve the 10 year survival, peri-operative stroke/MI must be prevented delivering better risk factors control and BMT

Reducing procedural death/stroke after CAS might be achieved through emerging CAS technologies, but improved CAS selection is essential, preferentially performing CEA in:

- Symptomatic patients aged >70 years
- Interventions less tha 14 days from symptoms onset
- Situations where stroke risk after CAS is higher