Stroke Prevention and Carotid intervention

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המרכז הרפואי שערי צדק
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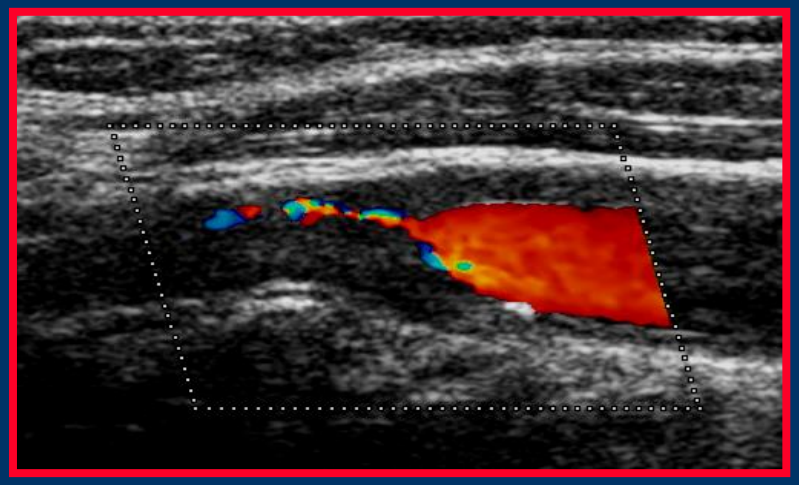
Carotid artery stenosis



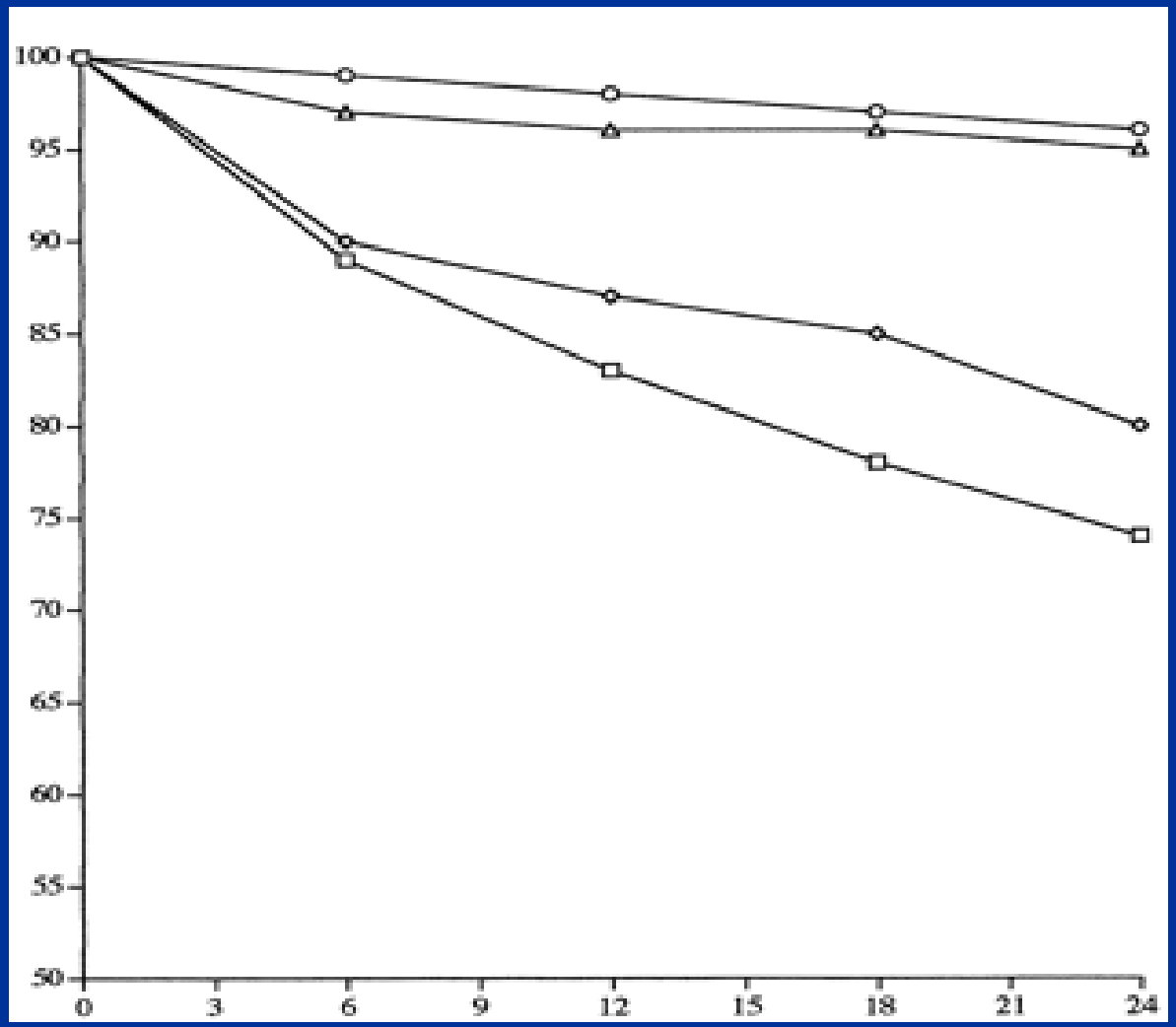
Asymptomatic

- Prevalence: 2-3%
- Risk of death & stroke ~ 1%/y
- Cardiovascular risk ~ 7%/y

Symptomatic

- **10-15% of ischemic stroke**
- High recurrent risk
  - 6% <30 days
  - 20% < 1 year

Natural History of Carotid Atherosclerosis



ACAS (60-99%)

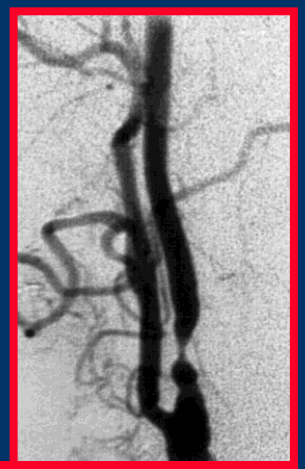
ECST asymp (70-99%)

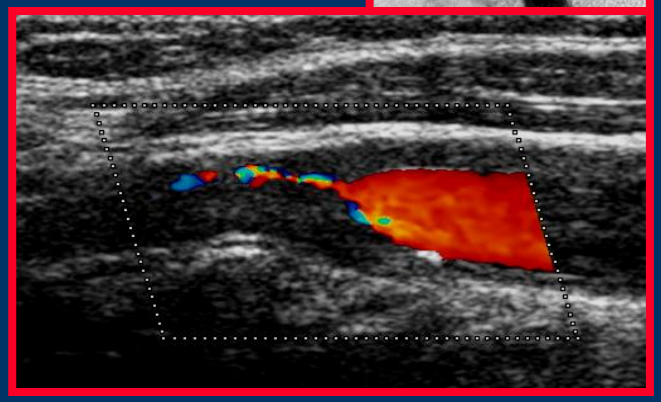
ECST (80-99%)

NASCET (70-99%)

Golledge J. Stroke. 2000;31:774

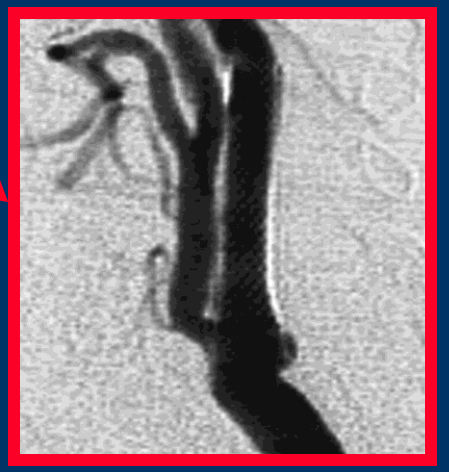
Treatment options:





revascularization

CEA



CAS

Medical treatment

Risk factor management


NASCET
Participating Countries
Canada
United States
Australia Sweden
Scotland Ireland
Italy Israel
Finland England
South Africa
Netherlands
Germany

E.C.S.T

EUROPEAN CAROTID SURGERY TRIAL

Targeting Carotid Endarterectomy for Symptomatic Carotid Stenosis:

From Subgroup Analysis to Individual Risk Modelling

Carotid Endarterectomy Trialists' Collaboration

Patients and follow-up

- ECST 3018
- NASCET 2885
- VA#309 189
- Total 6092: 3334 CEA 2758 medical

- Total follow-up: 35,000 patient years
- Outcomes: 1710 strokes and 1492 deaths

***Data unavailable for Fields *et al* (1970) and Shaw *et al* (1984)**

CETC

ECST, NASCET & VA studies combined and reanalysed after standardisation to NASCET angiographic measurement method (n>6000)

any stroke at 5 years including operative risk

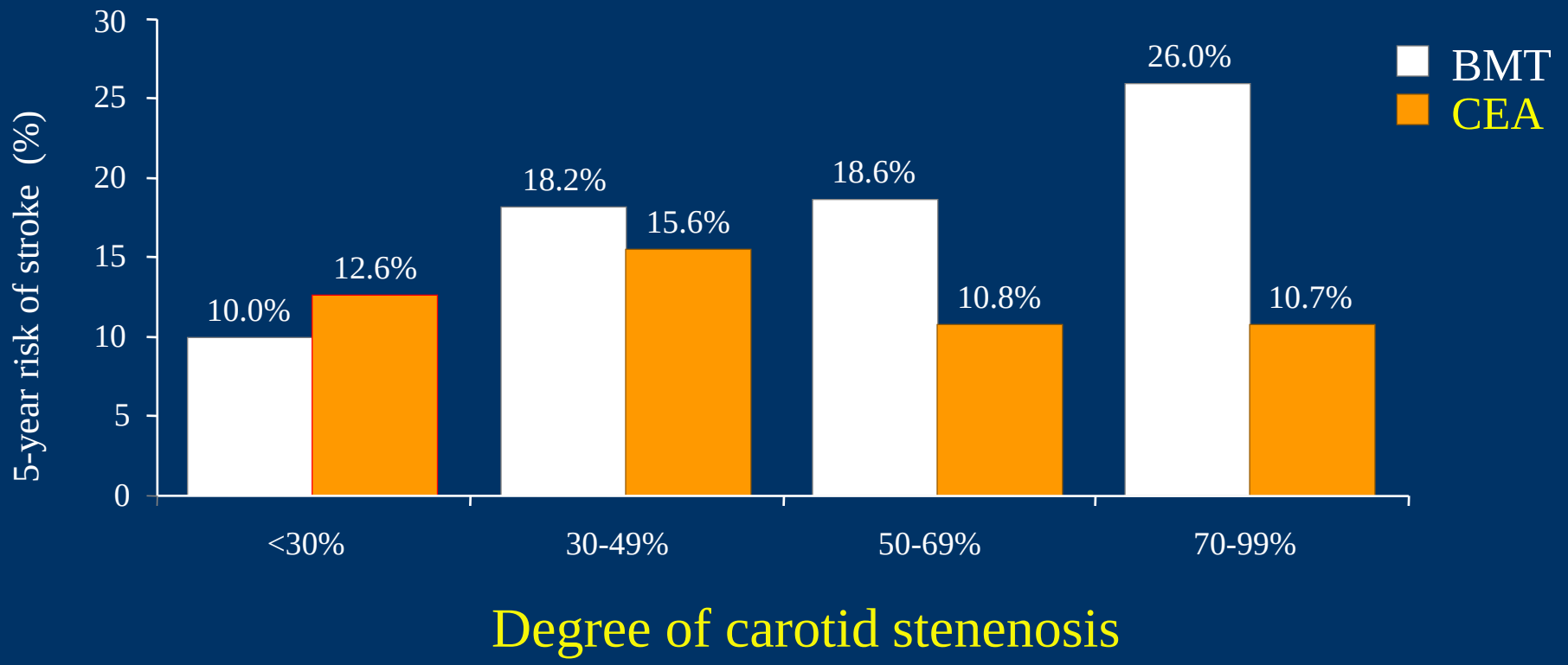
stenosis		CEA	BMT	AR	NNT	strokes prev /1000 CEAs
<30%	n=1746	18.36%	15.71%	-2.6		
30-49%	n=1054	22.80%	25.50%	2.6%	38	26
50-69%	n=2312	20.00%	27.70%	7.8%	13	78
70-99%	n=1344	17.13%	32.70%	15.6%	6	156
nr occln	n= 262	16.82%	15.15%	-1.7%	n/b	n/b

Lancet 2004;363:915-924

Lancet 2003;361:107-116

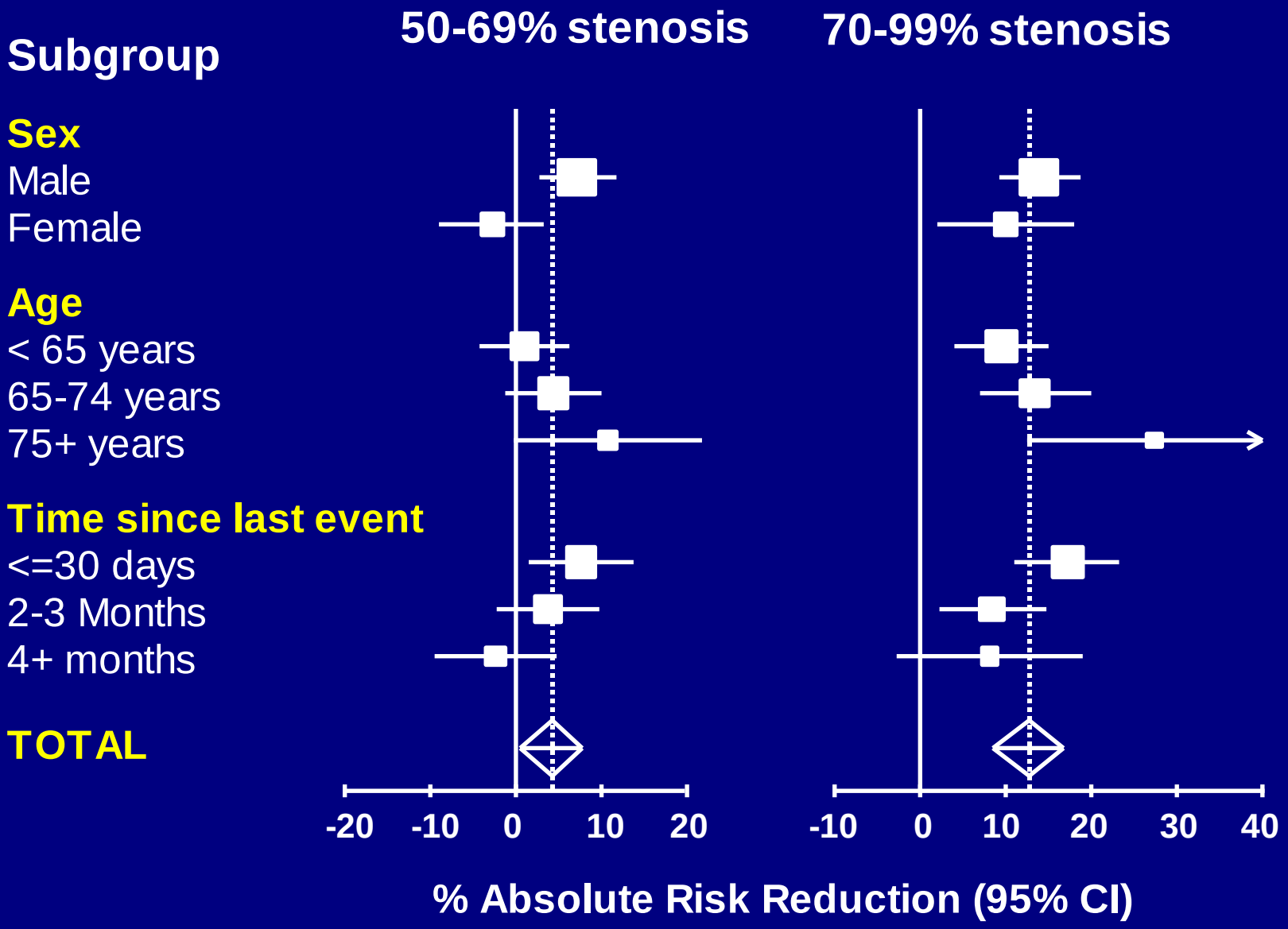
Stroke 2004;35:2855-2861

Symptomatic carotid stenosis

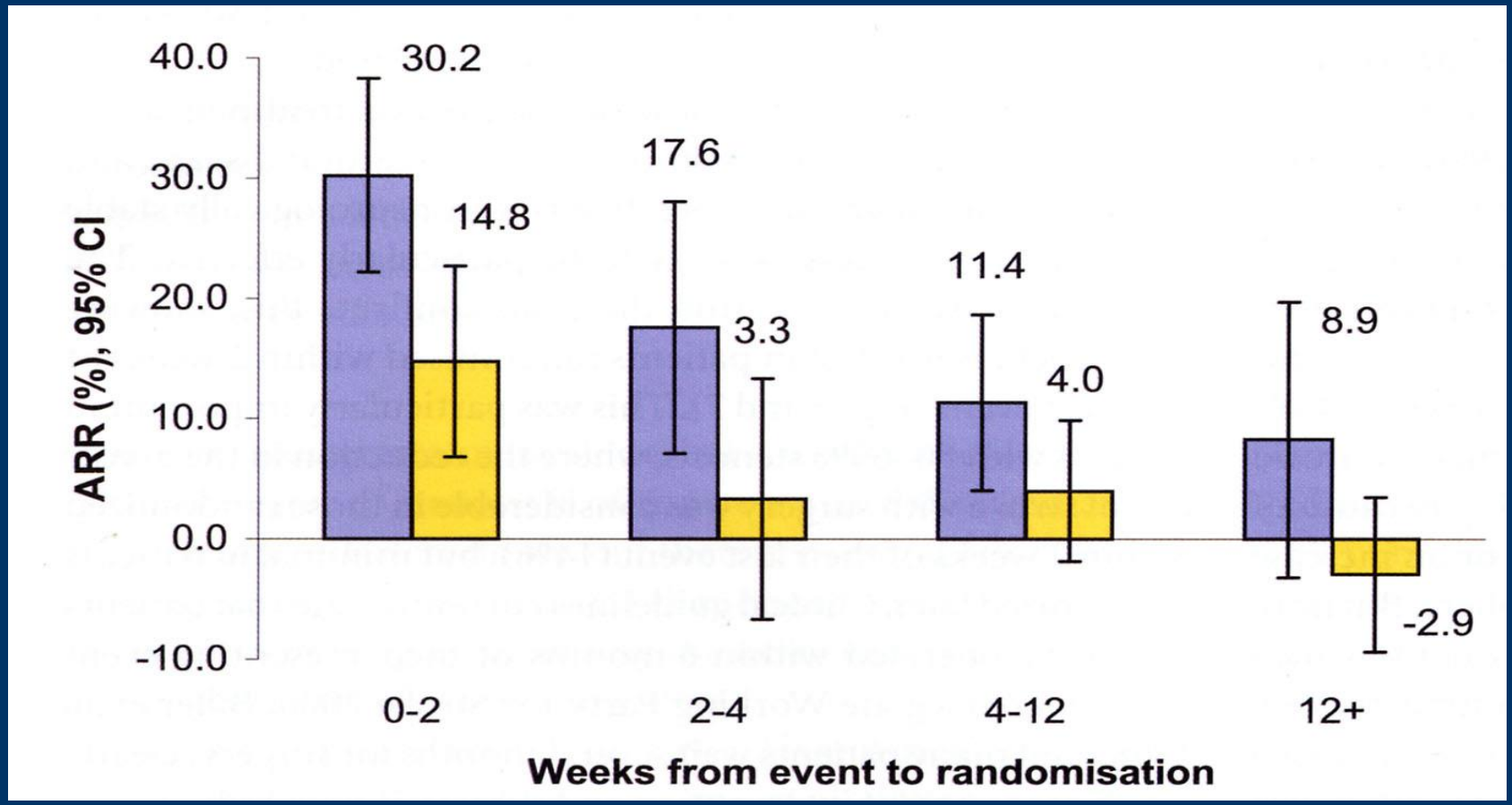


Rothwell PM: Cerebrovasc Disease (2004) 17 Suppl 1:89-104

Effect of surgery on the 5 year risk of ipsilateral ischaemic stroke and surgical stroke or death



Absolute risk reduction of ipsilateral ischaemic stroke/any surgical stroke or death in patients with 50-69% (yellow) and >70% stenosis (blue) by time between last event and randomisation: NASCET+ECST



Recurrent stroke in symptomatic carotid stenosis awaiting revascularization

A pooled analysis

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Derek Hayden, MBBCh
Jakob Bjellerup, MD
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ABSTRACT

Objective: We aimed to quantify the risk and predictors of ipsilateral ischemic stroke in patients with symptomatic carotid stenosis awaiting revascularization (carotid endarterectomy [CEA] or carotid artery stenting) by pooling individual patient data from recent prospective studies with high rates of treatment with modern stroke prevention medications.

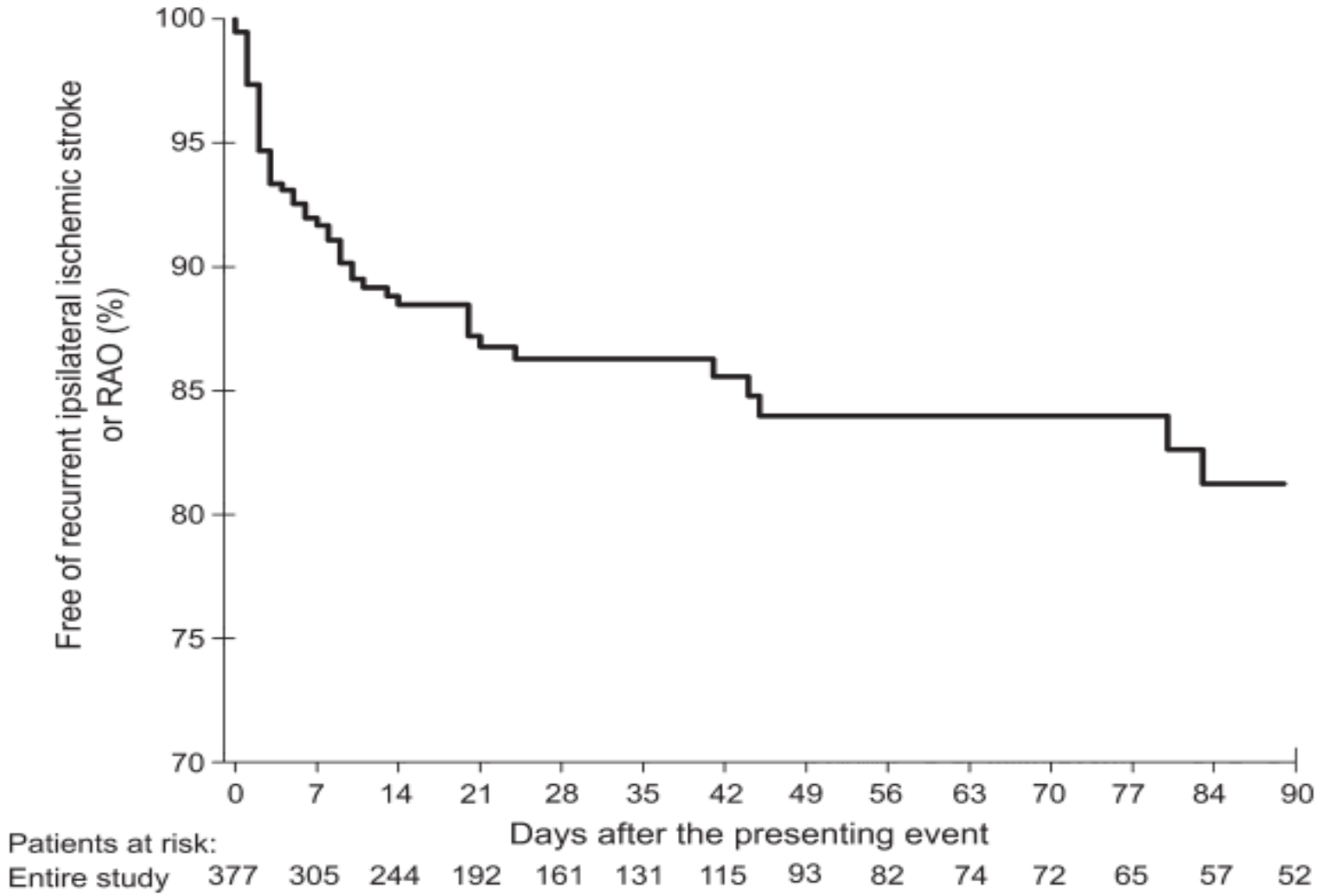
Methods: Data were included from 2 prospective hospital-based registries (Umeå, Barcelona) and one prospective population-based study (Dublin). Patients with symptomatic 50%–99% carotid stenosis eligible for carotid revascularization were included and followed for early recurrent ipsilateral stroke or retinal artery occlusion (RAO).

Results: Of 607 patients with symptomatic 50%–99% carotid stenosis, 377 met prespecified inclusion criteria. Ipsilateral recurrent ischemic stroke/RAO risk pre-revascularization was 2.7% (1 day), 5.3% (3 days), 11.5% (14 days), and 18.8% (90 days). On bivariate analysis, presentation with a cerebral vs ocular event was associated with higher recurrent stroke risk (log-rank $p = 0.04$). On multivariable Cox regression, recurrence was associated with older age (adjusted hazard ratio [HR] per 10-year increase 1.5, $p = 0.02$) with a strong trend for association with cerebral (stroke/TIA) vs ocular symptoms (adjusted HR 2.7, $p = 0.06$), but not degree of stenosis, smoking, vascular risk factors, or medications.

Conclusions: We found high risk of recurrent ipsilateral ischemic events within the 14-day time period currently recommended for CEA. Randomized trials are needed to determine the benefits and safety of urgent vs subacute carotid revascularization within 14 days after symptom onset.

Neurology® 2016;86:498–504

Figure 2 **Kaplan-Meier analysis of the main outcomes**



Kaplan-Meier analysis of the risk of recurrent ipsilateral ischemic stroke or retinal artery occlusion (RAO) within 90 days of the presenting event, prior to carotid endarterectomy (CEA)/carotid artery stenting (CAS). (CEA/CAS was used as censoring event.)

AHA/ASA Guideline

2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Reviewed for evidence-based integrity and endorsed by the American Association of Neurological Surgeons and Congress of Neurological Surgeons

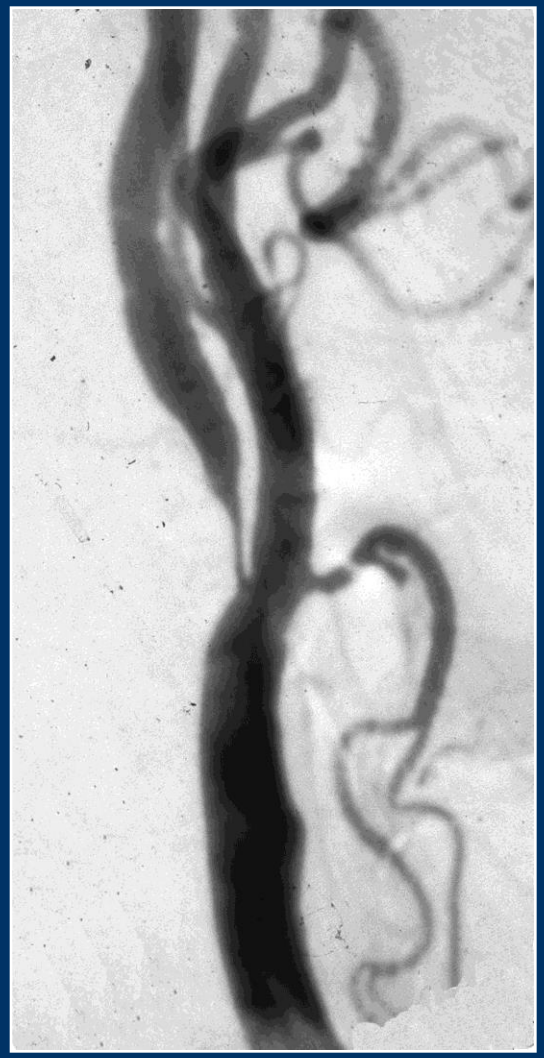
Endorsed by the Society for Academic Emergency Medicine

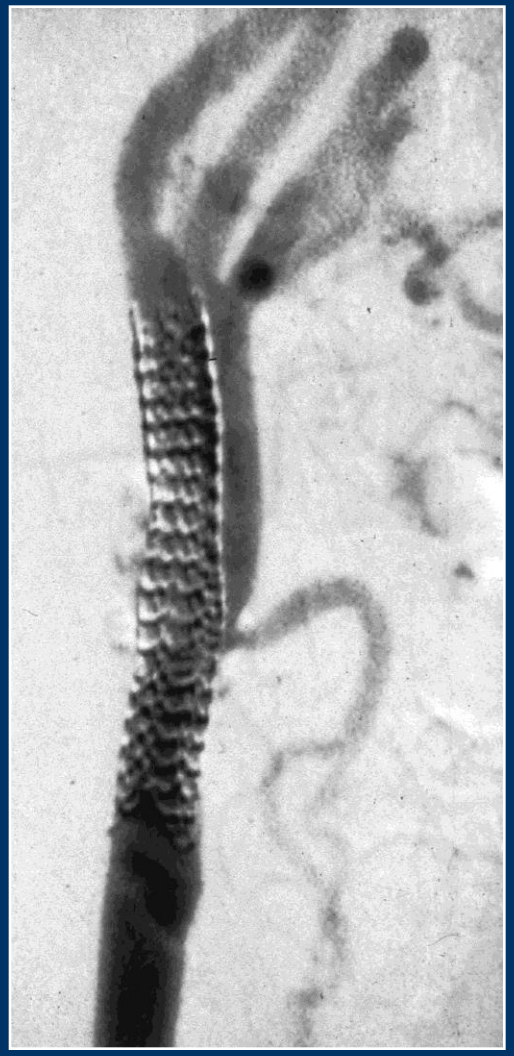
William J. Powers, MD, FAHA, Chair; Alejandro A. Rabinstein, MD, FAHA, Vice Chair; Teri Ackerson, BSN, RN; Opeolu M. Adeoye, MD, MS, FAHA; Nicholas C. Bambakidis, MD, FAHA; Kyra Becker, MD, FAHA; José Biller, MD, FAHA; Michael Brown, MD, MSc; Bart M. Demaerschalk, MD, MSc, FAHA; Brian Hoh, MD, FAHA; Edward C. Jauch, MD, MS, FAHA; Chelsea S. Kidwell, MD, FAHA; Thabele M. Leslie-Mazwi, MD; Bruce Ovbiagele, MD, MSc, MAS, MBA, FAHA; Phillip A. Scott, MD, MBA, FAHA; Kevin N. Sheth, MD, FAHA; Andrew M. Southerland, MD, MSc; Deborah V. Summers, MSN, RN, FAHA; David L. Tirschwell, MD, MSc, FAHA; on behalf of the American Heart Association Stroke Council

6.9. Carotid Revascularization

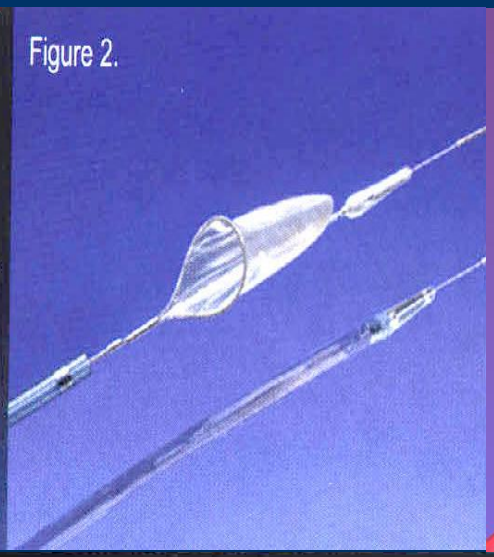
6.9. Carotid Revascularization	COR	LOE	New, Revised, or Unchanged
1. When revascularization is indicated for secondary prevention in patients with minor, nondisabling stroke (mRS score 0–2), it is reasonable to perform the procedure between 48 hours and 7 days of the index event rather than delay treatment if there are no contraindications to early revascularization.	**IIa**	**B-NR**	Recommendation revised from 2014 Secondary Prevention.
The risk of recurrent stroke resulting from symptomatic carotid stenosis is highest in the first few days after the initial event.[268–272] Although there is evidence that early or emergency revascularization via either CEA or carotid angioplasty and stenting may be safe in selected cases,[273–275] there are no high-quality prospective data supporting early versus late carotid revascularization in all cases.[276] In cases of minor, nondisabling stroke, a meta-analysis by De Rango et al[269] demonstrates favorable rates of complications when treated at least 48 hours after the initial event, and the risks are not different when treated between 0 to 7 and 0 to 15 days. Revascularization between 48 hours and 7 days after initial stroke is supported by these data in cases of nondisabling stroke (mRS score 0–2).[277]			See Table LXIII in online Data Supplement 1.

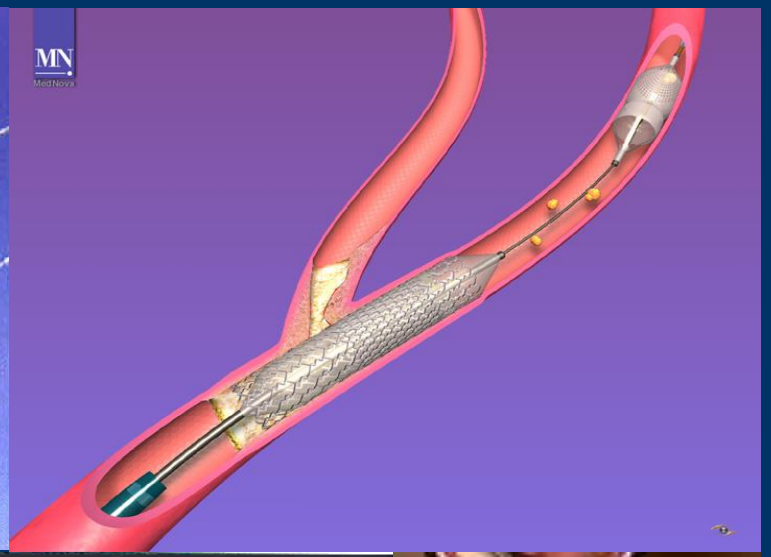
Carotid stenting

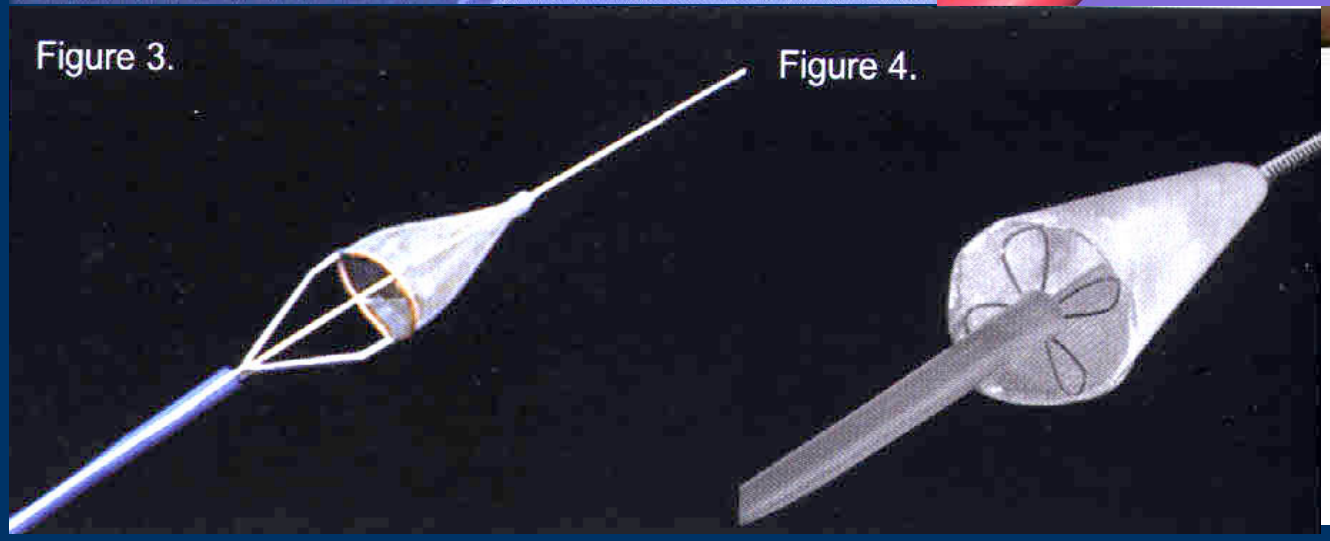


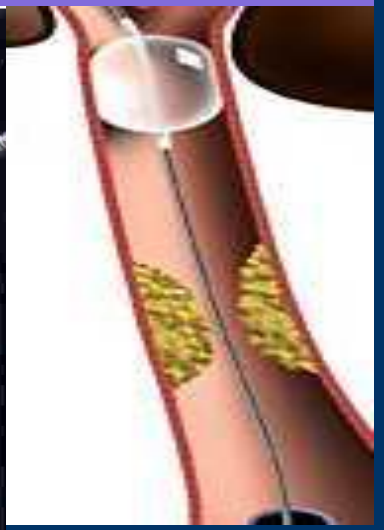


Cerebral protection devices







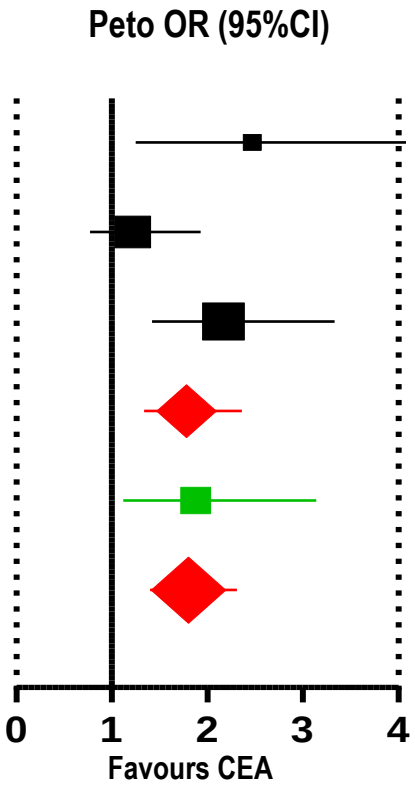


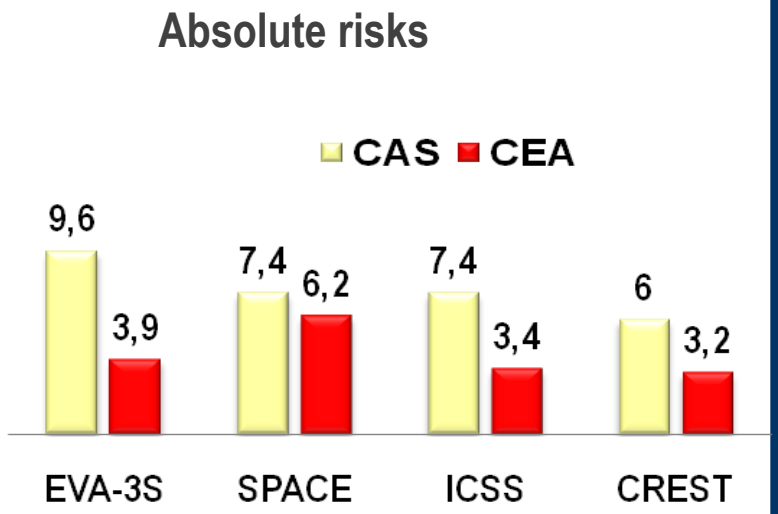
Symptomatic carotid stenosis

Is CAS as safe as CEA?

Stroke or death within 30 days of treatment (per protocol analysis)

Study	CAS	CEA
EVA-3S	25/260	10/257
SPACE	44/591	35/567
ICSS	61/828	28/821
Subtotal *	130/1679	73/1645
CREST	40/668	21/653
Total	170/2347	94/2298



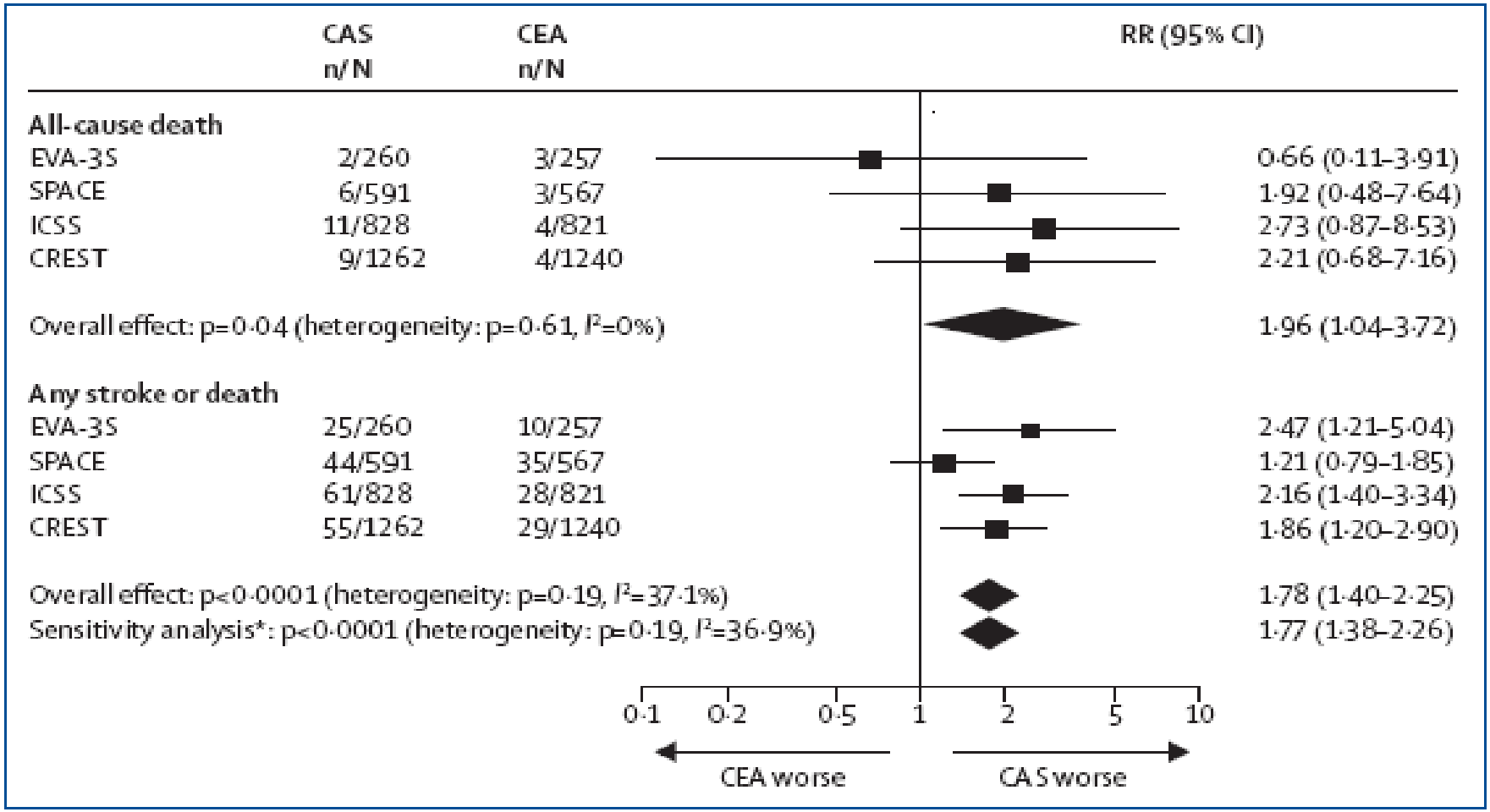


OR (Fixed) = 1.80 (1.40 – 2.31), p = 0.000

Heterogeneity p = 0.23

*Carotid Stenting Trialists' Collaboration, Lancet 2010

CEA or CAS
Meta-analysis



Amarenco P et al.: Lancet (2010); 376: 1028-1030

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Stenting versus Endarterectomy for Treatment of Carotid-Artery Stenosis

Thomas G. Brott, M.D., Robert W. Hobson, II, M.D.,* George Howard, Dr.P.H., Gary S. Roubin, M.D., Ph.D., Wayne M. Clark, M.D., William Brooks, M.D., Ariane Mackey, M.D., Michael D. Hill, M.D., Pierre P. Leimgruber, M.D., Alice J. Sheffet, Ph.D., Virginia J. Howard, Ph.D., Wesley S. Moore, M.D., Jenifer H. Voeks, Ph.D., L. Nelson Hopkins, M.D., Donald E. Cutlip, M.D., David J. Cohen, M.D., Jeffrey J. Popma, M.D., Robert D. Ferguson, M.D., Stanley N. Cohen, M.D., Joseph L. Blackshear, M.D., Frank L. Silver, M.D., J.P. Mohr, M.D., Brajesh K. Lal, M.D., and James F. Meschia, M.D., for the CREST Investigators†

METHODS

We randomly assigned patients with symptomatic or asymptomatic carotid stenosis to undergo carotid-artery stenting or carotid endarterectomy. The primary composite end point was stroke, myocardial infarction, or death from any cause during the periprocedural period or any ipsilateral stroke within 4 years after randomization.

RESULTS

For 2502 patients over a median follow-up period of 2.5 years, there was no significant difference in the estimated 4-year rates of the primary end point between the stenting group and the endarterectomy group (7.2% and 6.8%, respectively; hazard ratio with stenting, 1.11; 95% confidence interval, 0.81 to 1.51; P=0.51). There was no differential treatment effect with regard to the primary end point according to symptomatic status (P=0.84) or sex (P=0.34). The 4-year rate of stroke or death was 6.4% with stenting and 4.7% with endarterectomy (hazard ratio, 1.50; P=0.03); the rates among symptomatic patients were 8.0% and 6.4% (hazard ratio, 1.37; P=0.14), and the rates among asymptomatic patients were 4.5% and 2.7% (hazard ratio, 1.86; P=0.07), respectively. Periprocedural rates of individual components of the end points differed between the stenting group and the endarterectomy group: for death (0.7% vs. 0.3%, P=0.18), for stroke (4.1% vs. 2.3%, P=0.01), and for myocardial infarction (1.1% vs. 2.3%, P=0.03). After this period, the incidences of ipsilateral stroke with stenting and with endarterectomy were similarly low (2.0% and 2.4%, respectively; P=0.85).

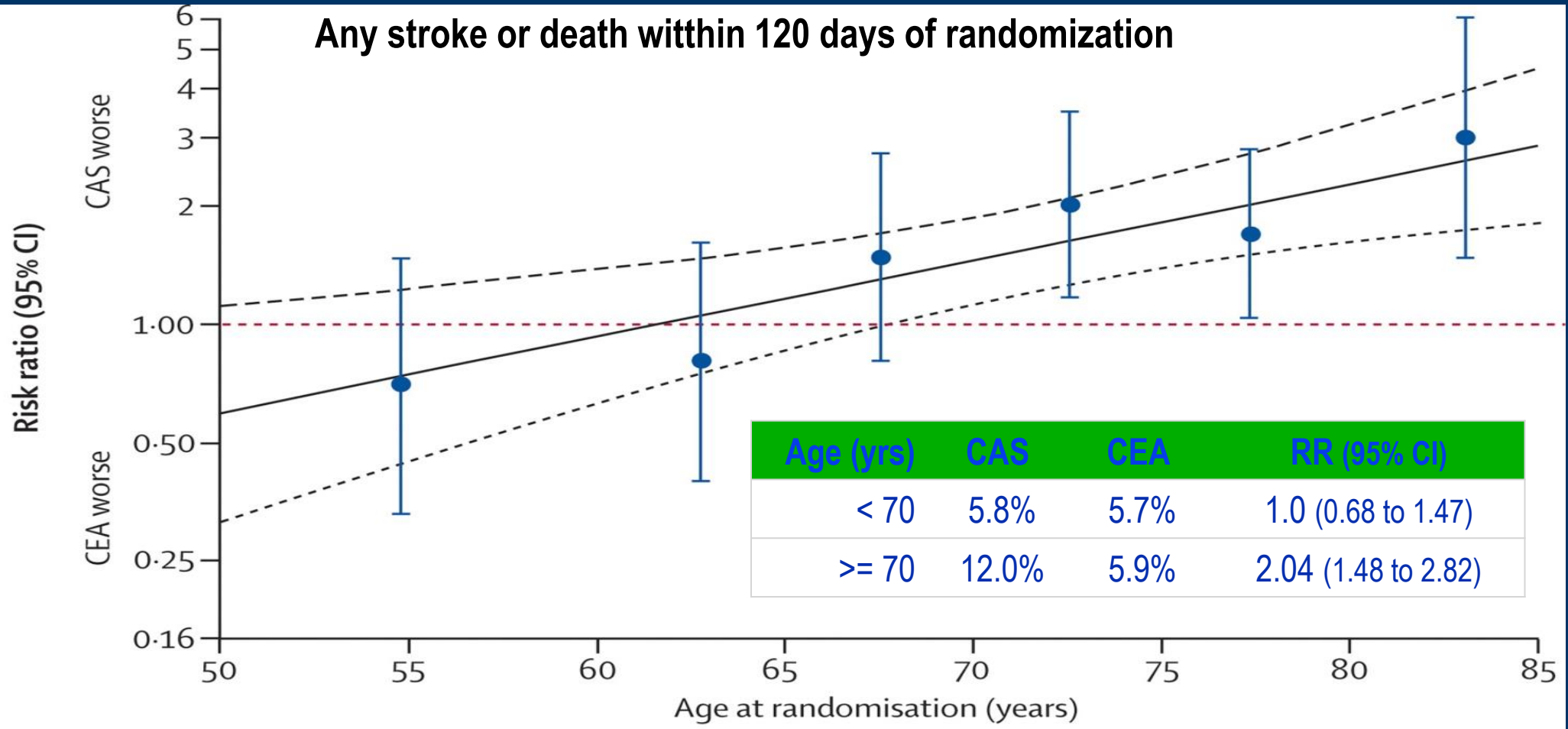
CONCLUSIONS

Among patients with symptomatic or asymptomatic carotid stenosis, the risk of the composite primary outcome of stroke, myocardial infarction, or death did not differ significantly in the group undergoing carotid-artery stenting and the group undergoing carotid endarterectomy. During the periprocedural period, there was a higher risk of stroke with stenting and a higher risk of myocardial infarction with endarterectomy. (ClinicalTrials.gov number, NCT00004732.)

Symptomatic carotid stenosis

CAS vs. CEA : effect of age

Carotid Stenting Trialists' Collaboration, Lancet 2010



Age (yrs)	CAS	CEA	RR (95% CI)
< 70	5.8%	5.7%	1.0 (0.68 to 1.47)
>= 70	12.0%	5.9%	2.04 (1.48 to 2.82)

Eur J Vasc Endovasc Surg. 2015 Sep 4. pii: S1078-5884(15)00594-8. doi: 10.1016/j.ejvs.2015.07.032. [Epub ahead of print]

Stroke/Death Rates Following Carotid Artery Stenting and Carotid Endarterectomy in Contemporary Administrative Dataset Registries: A Systematic Review.

Paraskevas KI[1], Kalmykov EL[2], Naylor AR[2].

Abstract

BACKGROUND: Randomised trials have reported higher stroke/death rates after carotid artery stenting (CAS) versus carotid endarterectomy (CEA). Despite this, the 2011 American Heart Association (AHA) guidelines expanded CAS indications, partly because of the Carotid Revascularization Endarterectomy versus Stenting Trial, but also because of improving outcomes in industry sponsored CAS Registries. The aim of this systematic review was: (i) to compare stroke/death rates after CAS/CEA in contemporary dataset registries, (ii) to examine whether published stroke/death rates after CAS fall within AHA thresholds, and, (iii) to see if there had been a decline (over time) in procedural risk after CAS/CEA.

METHODS: PubMed/Medline, Embase, and Cochrane databases were systematically searched according to the recommendations of the PRISMA statement from January 1, 2008 until February 23, 2015 for administrative dataset registries reporting outcomes after both CEA and CAS.

RESULTS: Twenty-one registries reported outcomes involving more than 1,500,000 procedures. Stroke/death after CAS was significantly higher than after CEA in 11/21 registries (52%) involving "average risk for CEA" asymptomatic patients and in 11/18 registries (61%) involving "average risk for CEA" symptomatic patients. In another five registries, CAS was associated with higher stroke/death rates than CEA for both symptomatic and asymptomatic patients, but formal statistical comparison was not reported. CAS was associated with stroke/death rates that exceeded risk thresholds recommended by the AHA in 9/21 registries (43%) involving "average risk for CEA" asymptomatic patients and in 13/18 registries (72%) involving "average risk for CEA" symptomatic patients. In 5/18 registries (28%), the procedural risk after CAS in "average risk" symptomatic patients exceeded 10%.

CONCLUSIONS: Data from contemporary administrative dataset registries suggest that stroke/death rates following CAS remain significantly higher than after CEA and often exceed accepted AHA thresholds. There was no evidence of a sustained decline in procedural risk after 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*

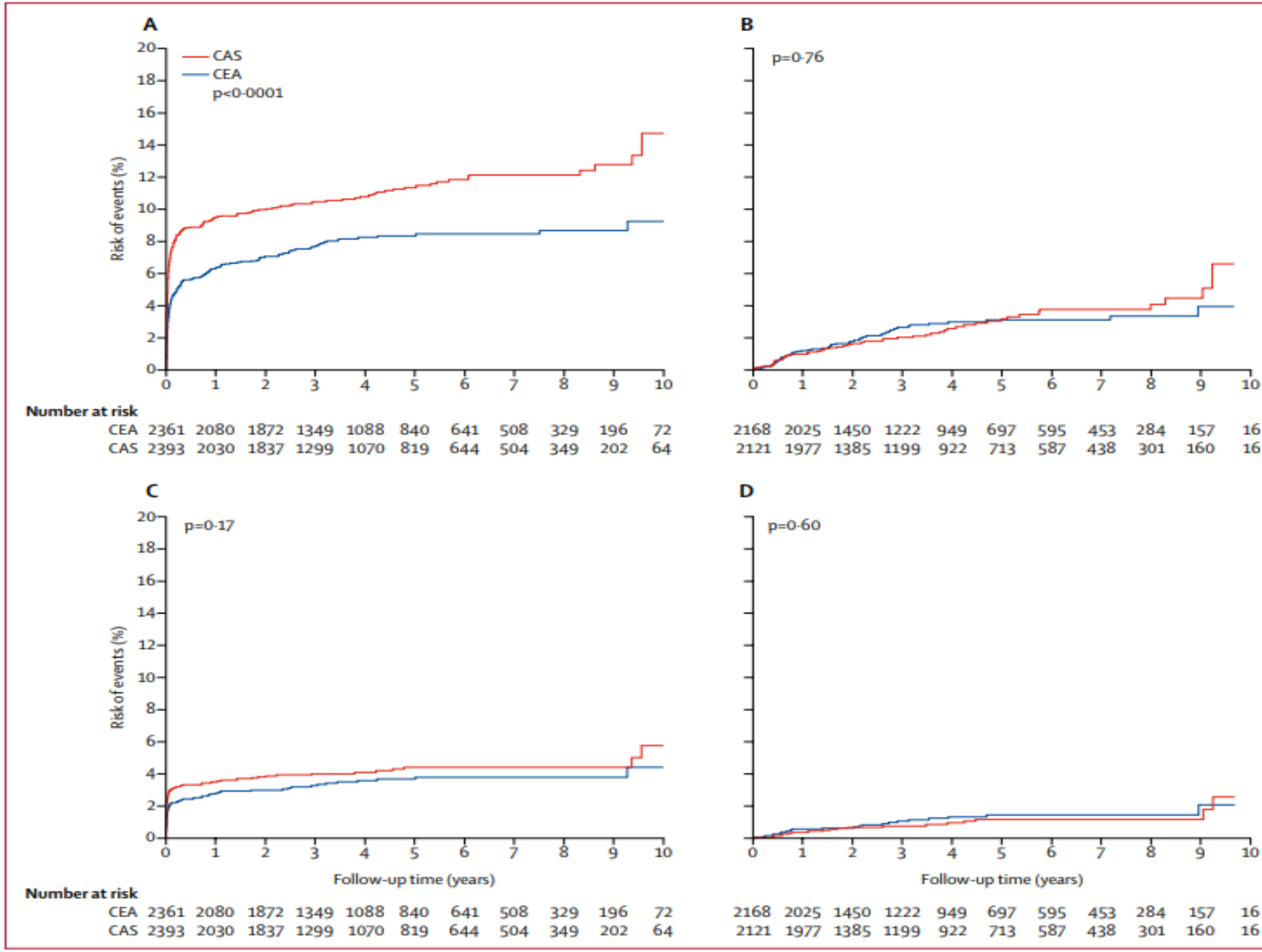
Summary

Background The risk of periprocedural stroke or death is higher after carotid artery stenting (CAS) than carotid endarterectomy (CEA) for the treatment of symptomatic carotid stenosis. However, long-term outcomes have not been sufficiently assessed. We sought to combine individual patient-level data from the four major randomised controlled trials of CAS versus CEA for the treatment of symptomatic carotid stenosis to assess long-term outcomes.

Methods We did a pooled analysis of individual patient-level data, acquired from the four largest randomised controlled trials assessing the relative efficacy of CAS and CEA for treatment of symptomatic carotid stenosis (Endarterectomy versus Angioplasty in Patients with Symptomatic Severe Carotid Stenosis trial, Stent-Protected Percutaneous Angioplasty of the Carotid Artery versus Endarterectomy trial, International Carotid Stenting Study, and Carotid Revascularization Endarterectomy versus Stenting Trial). The risk of ipsilateral stroke was assessed between 121 days and 1, 3, 5, 7, 9, and 10 years after randomisation. The primary outcome was the composite risk of stroke or death within 120 days after randomisation (periprocedural risk) or subsequent ipsilateral stroke up to 10 years after randomisation (postprocedural risk). Analyses were intention-to-treat, with the risk of events calculated using Kaplan-Meier methods and Cox proportional hazards analysis with adjustment for trial.

Findings In the four trials included, 4775 patients were randomly assigned, of whom a total of 4754 (99·6%) patients were followed up for a maximum of 12·4 years. 21 (0·4%) patients immediately withdrew consent after randomisation and were excluded. Median length of follow-up across the studies ranged from 2·0 to 6·9 years. 129 periprocedural and 55 postprocedural outcome events occurred in patients allocated CEA, and 206 and 57 for those allocated CAS. After the periprocedural period, the annual rates of ipsilateral stroke per person-year were similar for the two treatments: 0·60% (95% CI 0·46–0·79) for CEA and 0·64% (0·49–0·83) for CAS. Nonetheless, the periprocedural and postprocedural risks combined favoured CEA, with treatment differences at 1, 3, 5, 7, and 9 years all ranging between 2·8% (1·1–4·4) and 4·1% (2·0–6·3).

Interpretation Outcomes in the postprocedural period after CAS and CEA were similar, suggesting robust clinical durability for both treatments. Although long-term outcomes (periprocedural and postprocedural risks combined) continue to favour CEA, the similarity of the postprocedural rates suggest that improvements in the periprocedural safety of CAS could provide similar outcomes of the two procedures in the future.


A
CAS
CEA
p<0·0001
Risk of events (%)
0
2
4
6
8
10
12
14
16
18
20
0 1 2 3 4 5 6 7 8 9 10
Number at risk
CEA 2361 2080 1872 1349 1088 840 641 508 329 196 72
CAS 2393 2030 1837 1299 1070 819 644 504 349 202 64
B
p=0·76
0 1 2 3 4 5 6 7 8 9 10
2168 2025 1450 1222 949 697 595 453 284 157 16
2121 1977 1385 1199 922 713 587 438 301 160 16
C
p=0·17
Risk of events (%)
0
2
4
6
8
10
12
14
16
18
20
0 1 2 3 4 5 6 7 8 9 10
Follow-up time (years)
Number at risk
CEA 2361 2080 1872 1349 1088 840 641 508 329 196 72
CAS 2393 2030 1837 1299 1070 819 644 504 349 202 64
D
p=0·60
0 1 2 3 4 5 6 7 8 9 10
Follow-up time (years)
2168 2025 1450 1222 949 697 595 453 284 157 16
2121 1977 1385 1199 922 713 587 438 301 160 16

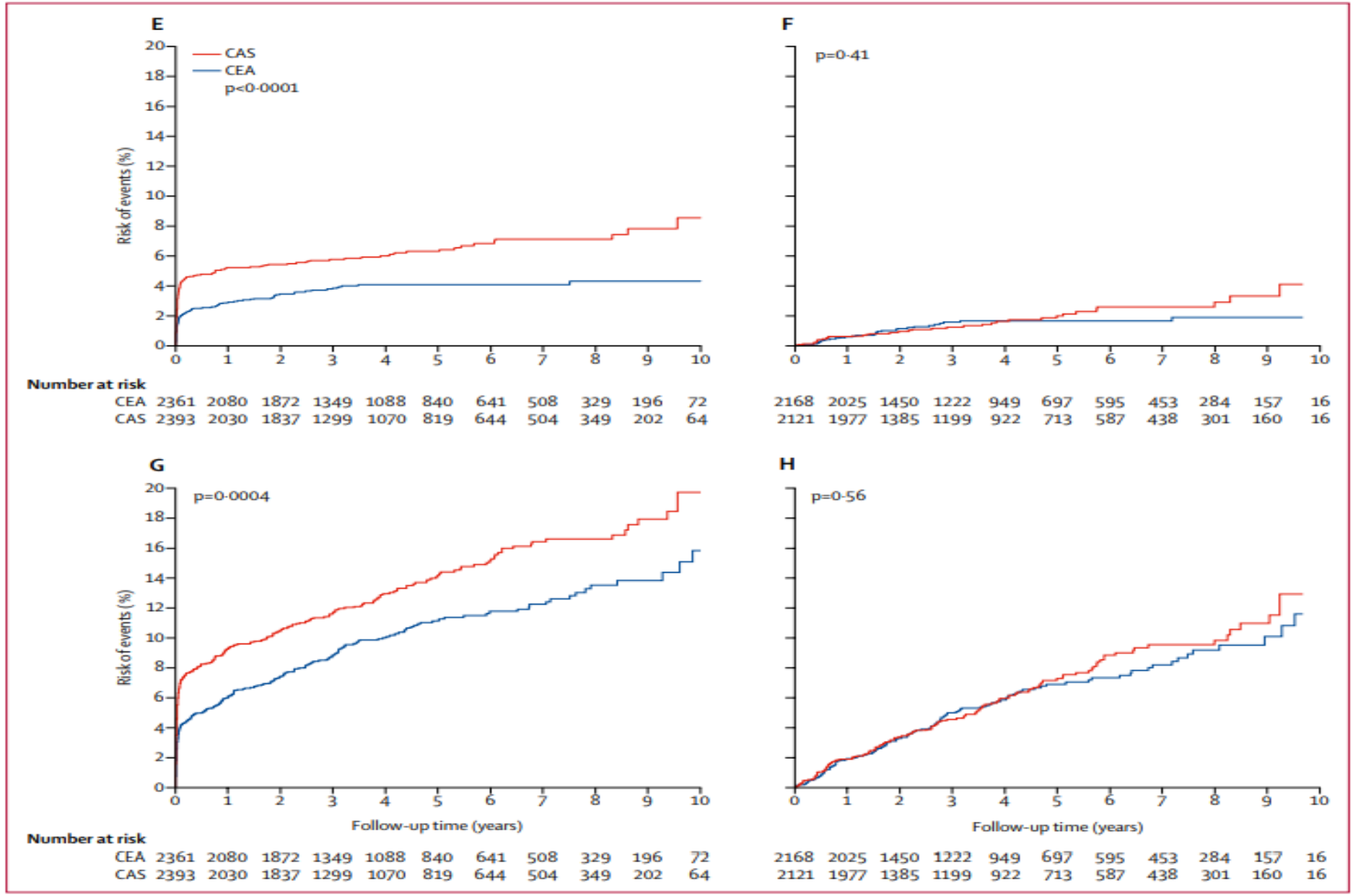


***Figure 2*: Kaplan-Meier estimates of risk of events for the primary outcome, postprocedural ipsilateral stroke, and the secondary outcomes of major stroke, minor stroke, and all stroke**

(A) Primary outcome. (B) Postprocedural ipsilateral stroke. (C,D) Major stroke. (E,F) Minor stroke. (G,H) All stroke. The risk of events estimates are provided for all outcomes, including both periprocedural and postprocedural events on the left of the figure (A, C, E, G) and for postprocedural events only (ie, >120 days; B, D, F, H) on the right of the figure. p values are for treatment differences using the log-rank test. CAS=carotid artery stenting. CEA=carotid endarterectomy.

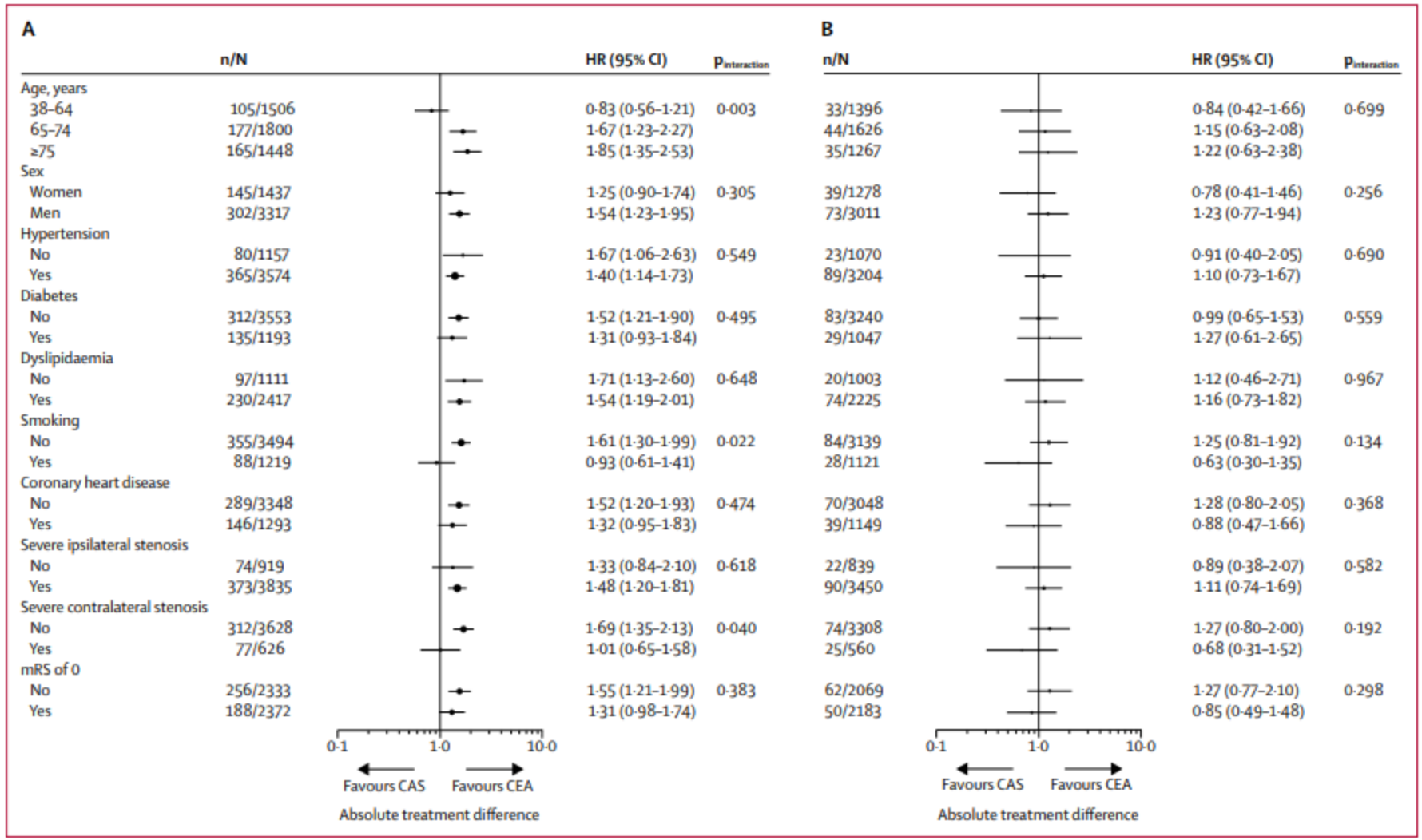


***Figure 3*: Forest plots of treatment effects for the entire follow-up period**

(A) Periprocedural and postprocedural. (B) Postprocedural. Data are the CAS to CEA HR (95% CI) from proportional hazards analysis within strata defined by covariates. The size of the circle showing the treatment effect is proportional to the inverse of the standard error of the estimated difference. The p value assessing potential effect modification was estimated by the addition of an interaction term to the proportional hazards model. HR=hazard ratio. CAS=carotid artery stenting. CEA=carotid endarterectomy. HR=hazard ratio. mRS=modified Rankin Scale.

Periprocedural events dominate outcomes of carotid stenting and endarterectomy

In the past, the risk of stroke or death from symptomatic carotid stenosis was very high, approximately 10% per year. Historical guidelines have recommended that if surgery or stenting can be performed with a risk of stroke with treatment differences between CEA and CAS for risk of stroke or death or subsequent ipsilateral stroke ranging between 2·8% (95% CI 1·1–4·4) and 4·1% (2·0–6·3) at various follow-up times up to 10 years.

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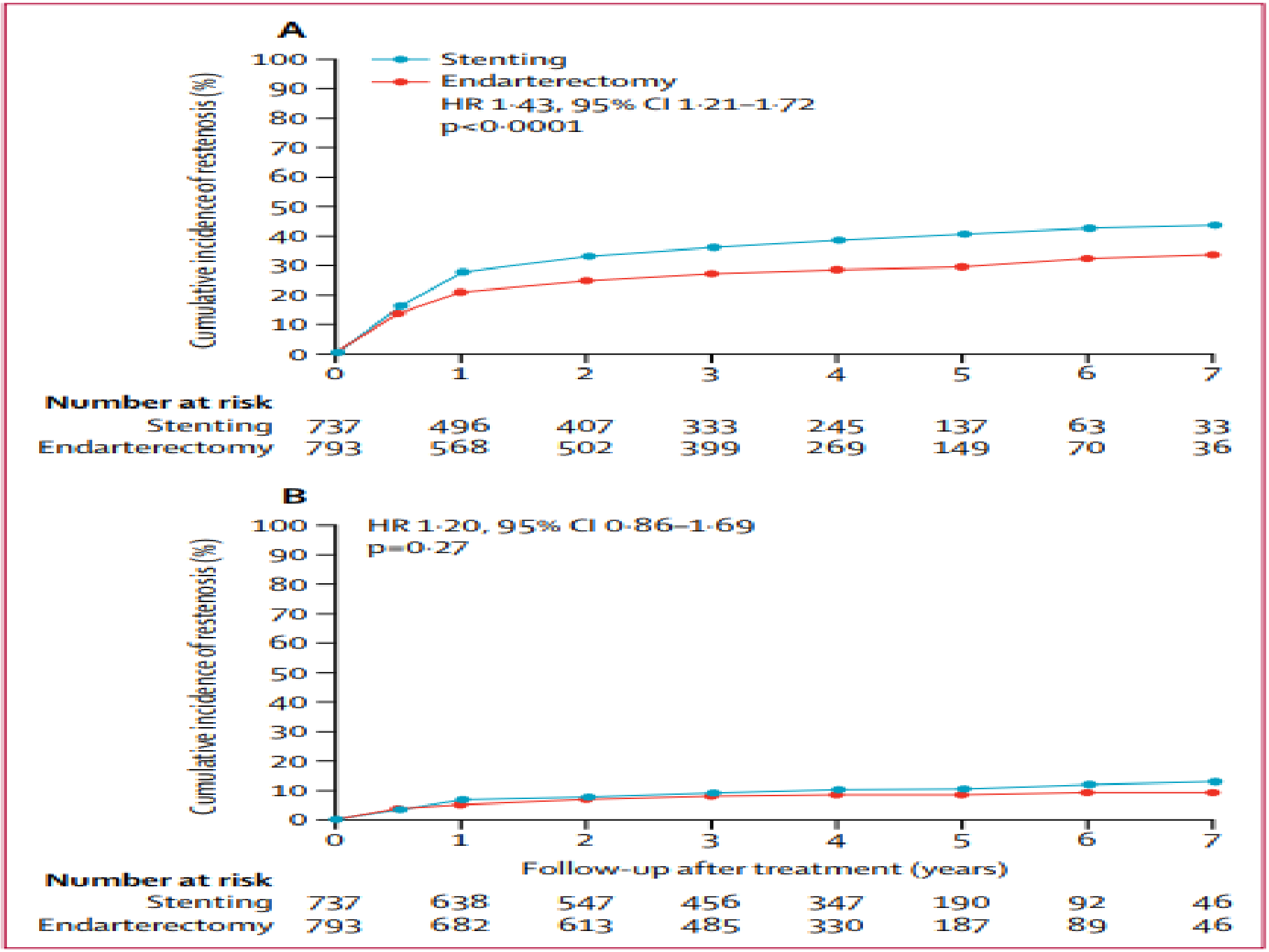
Summary

Background The risk of stroke associated with carotid artery restenosis after stenting or endarterectomy is unclear. We aimed to compare the long-term risk of restenosis after these treatments and to investigate if restenosis causes stroke in a secondary analysis of the International Carotid Stenting Study (ICSS).

Methods ICSS is a parallel-group randomised trial at 50 tertiary care centres in Europe, Australia, New Zealand, and Canada. Patients aged 40 years or older with symptomatic carotid stenosis measuring 50% or more were randomly assigned either stenting or endarterectomy in a 1:1 ratio. Randomisation was computer-generated and done centrally, with allocation by telephone or fax, stratified by centre, and with minimisation for sex, age, side of stenosis, and occlusion of the contralateral carotid artery. Patients were followed up both clinically and with carotid duplex ultrasound at baseline, 30 days after treatment, 6 months after randomisation, then annually for up to 10 years. We included patients whose assigned treatment was completed and who had at least one ultrasound examination after treatment. Restenosis was defined as any narrowing of the treated artery measuring 50% or more (at least moderate) or 70% or more (severe), or occlusion of the artery. The degree of restenosis based on ultrasound velocities and clinical outcome events were adjudicated centrally; assessors were masked to treatment assignment. Restenosis was analysed using interval-censored models and its association with later ipsilateral stroke using Cox regression. This trial is registered with the ISRCTN registry, number ISRCTN25337470. This report presents a secondary analysis, and follow-up is complete.

Findings Between May, 2001, and October, 2008, 1713 patients were enrolled and randomly allocated treatment (855 were assigned stenting and 858 endarterectomy), of whom 1530 individuals were followed up with ultrasound (737 assigned stenting and 793 endarterectomy) for a median of 4·0 years (IQR 2·3–5·0). At least moderate restenosis (≥50%) occurred in 274 patients after stenting (cumulative 5-year risk 40·7%) and in 217 after endarterectomy (29·6%; unadjusted hazard ratio [HR] 1·43, 95% CI 1·21–1·72; p<0·0001). Patients with at least moderate restenosis (≥50%) had a higher risk of ipsilateral stroke than did individuals without restenosis in the overall patient population (HR 3·18, 95% CI 1·52–6·67; p=0·002) and in the endarterectomy group alone (5·75, 1·80–18·33; p=0·003), but no significant increase in stroke risk after restenosis was recorded in the stenting group (2·03, 0·77–5·37; p=0·154; p=0·10 for interaction with treatment). No difference was noted in the risk of severe restenosis (≥70%) or subsequent stroke between the two treatment groups.

Interpretation At least moderate (≥50%) restenosis occurred more frequently after stenting than after endarterectomy and increased the risk for ipsilateral stroke in the overall population. Whether the restenosis-mediated risk of stroke differs between stenting and endarterectomy requires further research.


A
Cumulative incidence of restenosis (%)
100
90
80
70
60
50
40
30
20
10
0
Stenting
Endarterectomy
HR 1·43, 95% CI 1·21–1·72
p<0·0001
0
1
2
3
4
5
6
7
Number at risk
Stenting 737 496 407 333 245 137 63 33
Endarterectomy 793 568 502 399 269 149 70 36
B
Cumulative incidence of restenosis (%)
HR 1·20, 95% CI 0·86–1·69
p=0·27
Follow-up after treatment (years)
Number at risk
Stenting 737 638 547 456 347 190 92 46
Endarterectomy 793 682 613 485 330 187 89 46

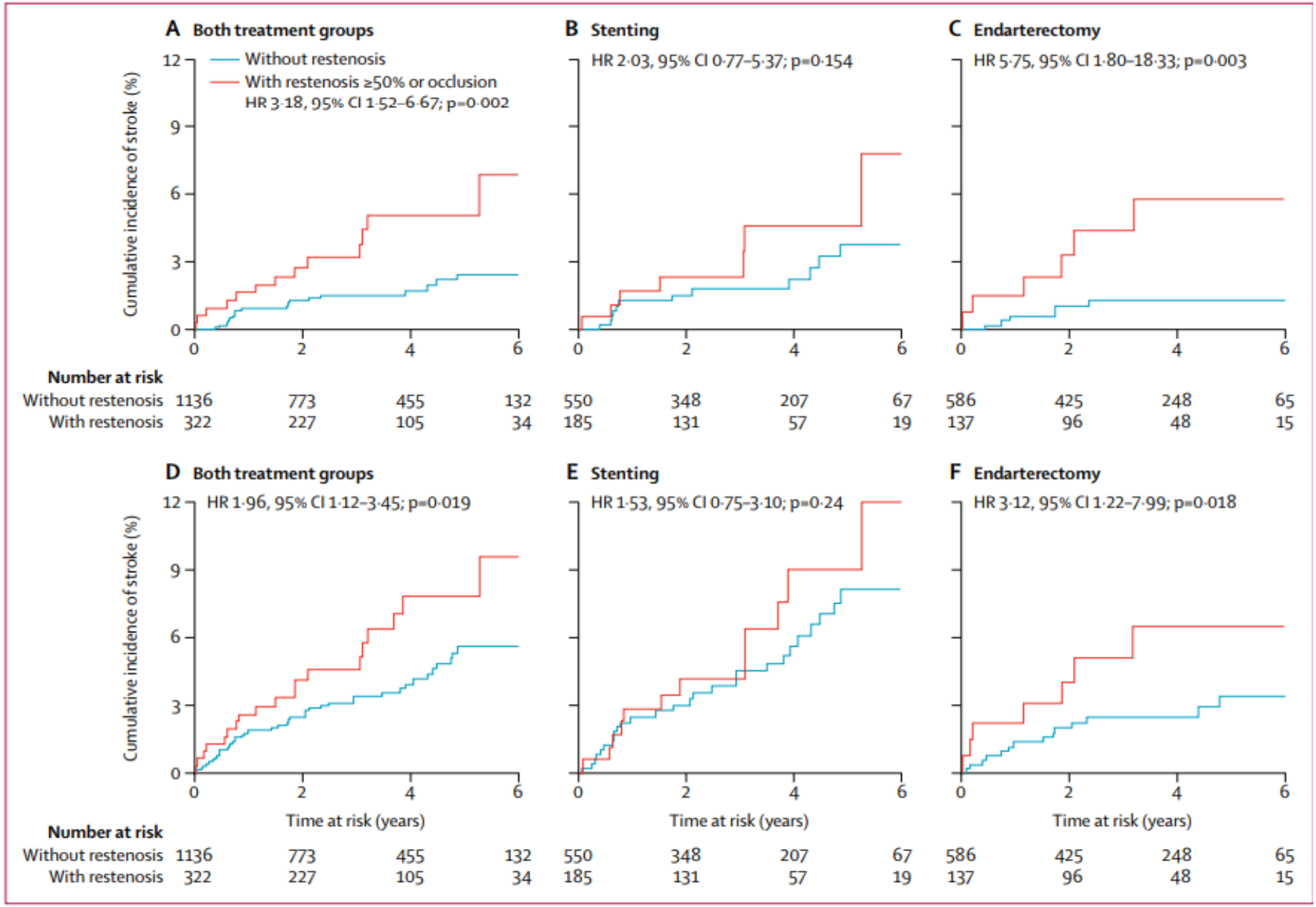


Figure 3: **Kaplan-Meier curves of time to (A–C) ipsilateral stroke and (D–F) stroke in any territory with and without at least moderate (≥50%) carotid artery restenosis or occlusion**

AHA/ASA Guideline

Guidelines for the Prevention of Stroke in Patients With Stroke and Transient Ischemic Attack

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists.

Endorsed by the American Association of Neurological Surgeons and Congress of Neurological Surgeons

Walter N. Kernan, MD, Chair; Bruce Ovbiagele, MD, MSc, MAS, Vice Chair; Henry R. Black, MD; Dawn M. Bravata, MD; Marc I. Chimowitz, MBChB, FAHA; Michael D. Ezekowitz, MBChB, PhD; Margaret C. Fang, MD, MPH; Marc Fisher, MD, FAHA; Karen L. Furie, MD, MPH, FAHA; Donald V. Heck, MD; S. Claiborne (Clay) Johnston, MD, PhD; Scott E. Kasner, MD, FAHA; Steven J. Kittner, MD, MPH, FAHA; Pamela H. Mitchell, PhD, RN, FAHA; Michael W. Rich, MD; DeJuran Richardson, PhD; Lee H. Schwamm, MD, FAHA; John A. Wilson, MD; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Peripheral Vascular Disease

Abstract—The aim of this updated guideline is to provide comprehensive and timely evidence-based recommendations on the prevention of future stroke among survivors of ischemic stroke or transient ischemic attack. The guideline is addressed to all clinicians who manage secondary prevention for these patients. Evidence-based recommendations are provided for control of risk factors, intervention for vascular obstruction, antithrombotic therapy for cardioembolism, and antiplatelet therapy for noncardioembolic stroke. Recommendations are also provided for the prevention of recurrent stroke in a variety of specific circumstances, including aortic arch atherosclerosis, arterial dissection, patent foramen ovale, hyperhomocysteinemia, hypercoagulable states, antiphospholipid antibody syndrome, sickle cell disease, cerebral venous sinus thrombosis, and pregnancy. Special sections address use of antithrombotic and anticoagulation therapy after an intracranial hemorrhage and implementation of guidelines. (***Stroke*****. 2014;45:2160-2236.)**

Key Words: AHA Scientific Statements ■ atrial fibrillation ■ carotid stenosis ■ hypertension ■ ischemia ■ ischemic attack, transient ■ prevention ■ stroke

Extracranial Carotid Disease Recommendations

- For patients with a TIA or ischemic stroke within the past 6 months and ipsilateral severe (70%–99%) carotid artery stenosis as documented by noninvasive imaging, CEA is recommended if the perioperative morbidity and mortality risk is estimated to be <6% (*Class I; Level of Evidence A*).
- For patients with recent TIA or ischemic stroke and ipsilateral moderate (50%–69%) carotid stenosis as documented by catheter-based imaging or noninvasive imaging with corroboration (eg, magnetic resonance angiogram or computed tomography angiogram), CEA is recommended depending on patient-specific factors, such as age, sex, and comorbidities, if the perioperative morbidity and mortality risk is estimated to be <6% *(Class I; Level of Evidence B*).

- When the degree of stenosis is <50%, CEA and CAS are not recommended *(Class III; Level of Evidence A*).

- When revascularization is indicated for patients with TIA or minor, nondisabling stroke, it is reasonable to perform the procedure within 2 weeks of the index event rather than delay surgery if there are no contraindications to early revascularization *(Class IIa; Level of Evidence B*).

- CAS is indicated as an alternative to CEA for symptomatic patients at average or low risk of complications associated with endovascular intervention when the diameter of the lumen of the ICA is reduced by >70% by noninvasive imaging or >50% by catheter-based imaging or noninvasive imaging with corroboration and the anticipated rate of periprocedural stroke or death is <6% *(Class IIa; Level of Evidence B*). (Revised recommendation)

- It is reasonable to consider patient age in choosing between CAS and CEA. For older patients (ie, older than ≈70 years), CEA may be associated with improved outcome compared with CAS, particularly when arterial anatomy is unfavorable for endovascular intervention. For younger patients, CAS is equivalent to CEA in terms of risk for periprocedural complications (ie, stroke, MI, or death) and long-term risk for ipsilateral stroke *(Class IIa; Level of Evidence B*). (New recommendation)

- Among patients with symptomatic severe stenosis (>70%) in whom anatomic or medical conditions are present that greatly increase the risk for surgery or when other specific circumstances exist such as radiation-induced stenosis or restenosis after CEA, CAS is reasonable *(Class IIa; Level of Evidence B*). (Revised recommendation)
- CAS and CEA in the above settings should be performed by operators with established periprocedural stroke and mortality rates of <6% for symptomatic patients, similar to that observed in trials comparing CEA to medical therapy and more recent observational studies *(Class I; Level of Evidence B*). (Revised recommendation)
- Routine, long-term follow-up imaging of the extracranial carotid circulation with carotid duplex ultrasonography is not recommended *(Class III; Level of Evidence B*). (New recommendation)
- For patients with a recent (within 6 months) TIA or ischemic stroke ipsilateral to a stenosis or occlusion of the middle cerebral or carotid artery, EC/IC bypass surgery is not recommended *(Class III; Level of Evidence A*).

- For patients with recurrent or progressive ischemic symptoms ipsilateral to a stenosis or occlusion of a distal (surgically inaccessible) carotid artery, or occlusion of a midcervical carotid artery after institution of optimal medical therapy, the usefulness of EC/IC bypass is considered investigational *(Class IIb; Level of Evidence C*). (New recommendation)
- Optimal medical therapy, which should include antiplatelet therapy, statin therapy, and risk factor modification, is recommended for all patients with carotid artery stenosis and a TIA or stroke, as outlined elsewhere in this guideline *(Class I; Level of Evidence A*).

Restenosis and risk of stroke after stenting or endarterectomy for symptomatic carotid stenosis in the International Carotid Stenting Study (ICSS): secondary analysis of a randomised trial

Leo H Bonati, John Gregson, Joanna Dobson, Dominick J H McCabe, Paul J Nederkoorn, H Bart van der Worp, Gert J de Borst, Toby Richards, Trevor Cleveland, Mandy D Müller, Thomas Wolff, Stefan T Engelter, Philippe A Lyrer, Martin M Brown, for the International Carotid Stenting Study investigators*

Lancet Neurol 2018; 17: 587–96

Symptomatic stenosis dilemma

CEA?

BMT ?