



Update Guideline on management for Carotid stenosis: **CEA vs BMT, CEA vs CAS**

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Introduction



- **Stroke is the 3rd cause of death but the 1st disability for peoples.**
 - In USA > 700.000 new cas. / year.
 - In Europe, 1.4 milion cas. / year, 1.1 million death/ year.
 - Vietnam, 200.000 cas./ year.
- **Carotid stenosis is one of leading cause stroke.**
 - 20 – 30% of stroke due to carotid stenosis.



Cing CS, et al. Refining the indications for carotid endarterectomy in patients with symptomatic carotid stenosis: A systemic review. *Vasc Surg* 1999; 30:606-18



Introduction





Introduction

- **5 – 12% new stroke have indication for CEA.**
- **Benefit of CEA to prevent stroke for patients with carotid stenosis have been proved.**
- **Need more trials: BMT vs CAS vs CEA? How to do CAS, CEA?**



CLINICAL PRACTICE GUIDELINE DOCUMENT

European Society for Vascular Surgery (ESVS) 2023 Clinical Practice Guidelines on the Management of Atherosclerotic Carotid and Vertebral Artery Disease[☆]

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| Recommendation 1 | Class | Level | References |
|--|-------|-------|------------|
| Duplex ultrasound (as first-line), computed tomographic angiography and/or magnetic resonance angiography are recommended for evaluating the extent and severity of extracranial carotid stenoses | I | A | 18 |
| Recommendation 2 | | | |
| When carotid endarterectomy is being considered, it is recommended that Duplex ultrasound stenosis estimation be corroborated by computed tomographic angiography or magnetic resonance angiography, or by a repeat Duplex ultrasound performed by a second operator | I | A | 18 |
| Recommendation 3 | | | |
| When carotid stenting is being considered, it is recommended that any Duplex ultrasound study be followed by computed tomographic angiography or magnetic resonance angiography which will provide additional information on the aortic arch, as well as the extra- and intracranial circulation | I | A | 18 |
| Recommendation 4 | | | |
| Units who base management decisions on Duplex ultrasound stenosis measurement should state which measurement method is being used | I | C | 12,14 |
| Recommendation 5 | | | |
| Intra-arterial digital subtraction angiography should not be performed in patients being considered for revascularisation, unless there are significant discrepancies on non-invasive imaging | III | A | 18 |

Table 1. Diagnostic velocity criteria for NASCET-based carotid stenosis measurement.

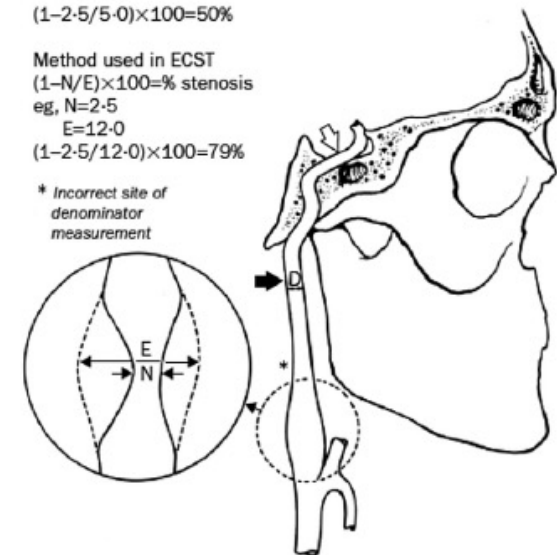
| % stenosis NASCET | PSV ICA cm/s | PSV _{ICA} / PSV _{CCA} ratio | St Mary's ratio ¹⁵ PSV _{ICA} /EDV _{CCA} |
|--------------------------------|----------------------------|--|---|
| <50% | <125 ¹⁶ | <2 ¹⁶ | <8 |
| 50–69% | ≥125 ¹⁶ | 2.0–4 ¹⁶ | 8–10 |
| 60–69% | | | 11–13 |
| 70–79% | ≥230 ¹⁶ | ≥4 ¹⁶ | 14–21 |
| 80–89% | | | 22–29 |
| >90% but not near occlusion | ≥400 ¹⁶ | ≥5 ¹⁷ | ≥30 |
| Near-occlusion | High, low – string flow | Variable | Variable |
| Occlusion | No flow | Not applicable | Not applicable |

Reproduced with permission from Oates C, Naylor AR, Hartshorne T, Charles SM, Humphries K, Aslam M, Khodabaksh P. Reporting carotid ultrasound investigations in the United Kingdom. *Eur J Vasc Endovasc Surg* 2009;37:251–61.

Method used in NASCET and VA309
 $(1-N/D) \times 100 = \% \text{ stenosis}$
 eg, N=2.5
 D=5.0
 $(1-2.5/5.0) \times 100 = 50\%$

Method used in ECST
 $(1-N/E) \times 100 = \% \text{ stenosis}$
 eg, N=2.5
 E=12.0
 $(1-2.5/12.0) \times 100 = 79\%$

* Incorrect site of denominator measurement



Carotid Endarterectomy vs BMT

Table 18. Individual patient meta-analysis of five year risks of any stroke, including peri-operative stroke or death, from European Carotid Surgery Trial (ESCT), North American Symptomatic Carotid Endarterectomy Trial (NASCET), and Symptomatic Veterans Affairs Carotid Study (SVACS) randomised controlled trials*

| Stenosis severity, NASCET – % | Patients – n | 5 y risk of any stroke (including peri-op stroke) – % | | ARR at 5 y – % | RRR at 5 y – % | NNT to prevent one stroke at 5 y | Strokes prevented per 1 000 CEAs at 5 y |
|-------------------------------|--------------|---|------|----------------|----------------|----------------------------------|---|
| | | CEA + BMT | BMT | | | | |
| 0–30 | 1 746 | 18.4 | 15.7 | -2.7 | N/b | N/b | None |
| 30–49 | 1 429 | 22.8 | 25.5 | +2.7 | N/b | N/b | 27 |
| 50–69 | 1 549 | 20.0 | 27.8 | +7.8 | 28 | 13 | 78 |
| 70–99 | 1 095 | 17.1 | 32.7 | +15.6 | 48 | 6 | 156 |
| CNO | 262 | 22.4 | 22.3 | -0.1 | N/b | N/b | None |

CEA = carotid endarterectomy; BMT = best medical therapy; ARR = absolute risk reduction in stroke; RRR = relative risk reduction in stroke; NNT = number needed to treat to prevent one stroke at five years; N/b = no benefit; CNO = chronic near occlusion.

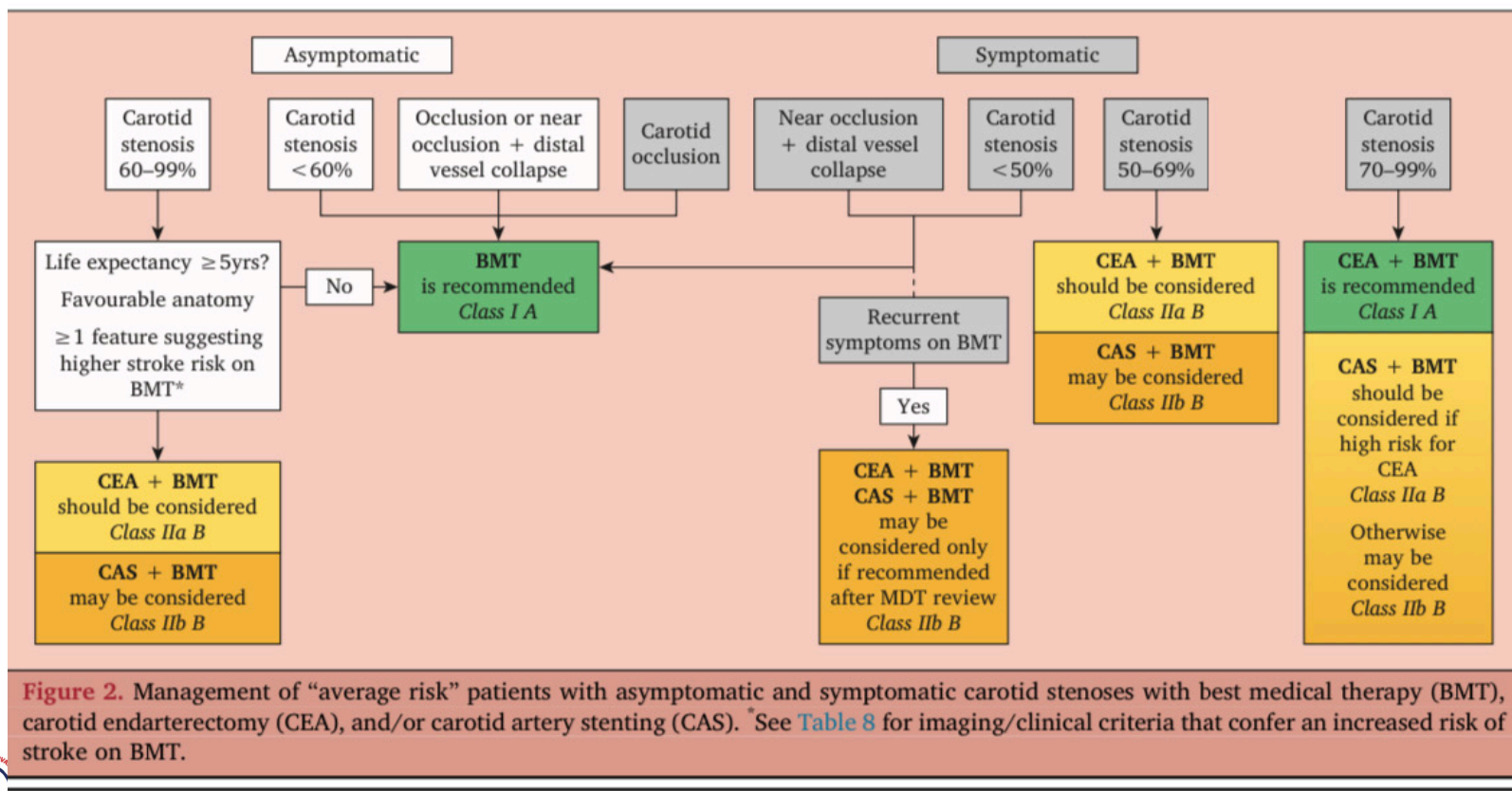
* Data derived from the Carotid Endarterectomy Trialists Collaboration.^{357–359}





| Recommendation 35 | Class | Level |
|--|-------|-------|
| Carotid endarterectomy is recommended in patients reporting carotid territory symptoms within the preceding 6 months and who have a 70–99% carotid stenosis, provided the documented procedural death/stroke rate is <6% | I | A |
| Recommendation 36 | | |
| Carotid endarterectomy should be considered in patients reporting carotid territory symptoms within the preceding 6 months and who have a 50–69% carotid stenosis, provided the documented procedural death/stroke rate is <6% | IIa | A |





Carotid Endarterectomy vs Carotid Stenting

Table 20. Meta-analysis of 30 day outcomes in 10 randomised controlled trials (RCTs)^a on patients with symptomatic carotid artery disease comparing carotid artery stenting (CAS) with carotid endarterectomy (CEA)^b

| | Death | Stroke | Death / stroke | Disabling stroke | Death / disabling stroke | MI | Death / stroke / MI |
|---------------------|----------------|----------------|----------------|------------------|--------------------------|----------------|---------------------|
| RCTs / patients – n | 9 / 4 257 | 9 / 5 535 | 10 / 5 797 | 6 / 4 855 | 5 / 3 534 | 6 / 3 980 | 6 / 3 719 |
| CAS (95% CI) – % | 1.9 (1.4–2.6) | 8.5 (5.9–12.1) | 9.3 (6.8–12.6) | 3.3 (1.6–6.7) | 5.2 (3.0–8.9) | 0.8 (0.5–1.4) | 8.4 (5.0–13.8) |
| CEA (95% CI) – % | 1.4 (0.9–2.0) | 4.6 (3.3–6.4) | 5.1 (3.7–6.9) | 1.8 (1.1–3.1) | 3.2 (2.5–4.1) | 1.6 (1.0–2.3) | 5.1 (4.1–6.3) |
| OR (95% CI) | 1.38 (0.8–2.3) | 1.73 (1.4–2.1) | 1.71 (1.4–2.1) | 1.35 (0.9–2.0) | 1.42 (1.0–2.0) | 0.50 (0.2–1.0) | 1.61 (1.2–2.1) |

Red shading indicate a statistically significant result favouring CEA. MI = myocardial infarction; OR = odds ratio; CI = confidence intervals. CREST-1; EVA-3S; ICSS; Kuliha; Naylor; Brooks; Steinbauer; SPACE-1; SAPPHERE; Wallstent.

Reproduced with permission from Batchelder A, Saratzis A, Naylor AR. Overview of Primary and Secondary Analyses from 20 randomised controlled trials comparing carotid artery stenting with carotid endarterectomy. *Eur J Vasc Endovasc Surg* 2019;**58**:479–93.

Carotid Endarterectomy vs Carotid Stenting

Table 21. Meta-analysis of 30 day outcomes after carotid artery stenting (CAS) versus carotid endarterectomy (CEA) in four randomised controlled trials (RCTs) which randomised more than 500 patients with symptomatic carotid artery disease[†]

| | Death | Stroke | Death / stroke | Disabling stroke | Death / disabling stroke | MI | Death / stroke / MI |
|---------------------|----------------|----------------|----------------|------------------|--------------------------|----------------|---------------------|
| RCTs / patients – n | 3 / 3 413 | 4 / 4 754 | 4 / 4 754 | 4 / 4 754 | 3 / 3 413 | 3 / 3 551 | 2 / 3 031 |
| CAS (95% CI) – % | 1.2 (0.5–2.9) | 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) |
| CEA (95% CI) – % | 0.9 (0.5–1.5) | 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) |
| OR (95% CI) | 1.67 (0.9–3.2) | 1.66 (1.3–2.1) | 1.61 (1.3–2.0) | 1.39 (0.9–2.0) | 1.38 (0.9–2.0) | 0.51 (0.3–1.0) | 1.60 (1.2–2.1) |

Red shade: statistically significant result favouring CEA. MI = myocardial infarction; OR = odds ratio; CI = confidence interval.

* Carotid Revascularization versus Stenting Trial (CREST) -1; Endarterectomy versus Stenting in patients with Symptomatic Severe carotid Stenosis (EVA-3S); The International Carotid Stenting Study (ICSS); Stent Protected Angioplasty versus Carotid Endarterectomy (SPACE) -1.

[†] Reproduced with permission from Batchelder A, Saratzis A, Naylor AR. Overview of Primary and Secondary Analyses from 20 randomised controlled trials comparing carotid artery stenting with carotid endarterectomy. *Eur J Vasc Endovasc Surg* 2019;58:479–93.

Carotid Endarterectomy vs Carotid Stenting

Table 22. Age and 30 day rates of death or stroke after carotid endarterectomy (CEA) and carotid artery stenting (CAS) in patients with symptomatic carotid artery disease randomised within The International Carotid Stenting Study (ICSS), Carotid Revascularization versus Stenting Trial (CREST), Endarterectomy versus Stenting in patients with Symptomatic Severe carotid Stenosis (EVA-3S), Stent Protected Angioplasty versus Carotid Endarterectomy (SPACE)*

| Age – y | CAS | | CEA | | CAS vs. CEA |
|---------|----------------------|------------------|----------------------|------------------|--------------------------|
| | 30 d death or stroke | HR (95% CI) | 30 d death or stroke | HR (95% CI) | HR (95% CI) [†] |
| <60 | 13 / 407 (3.2) | 1.0 [‡] | 21 / 407 (5.2) | 1.0 [‡] | 0.62 (0.31–1.23) |
| 60–64 | 20 / 351 (5.7) | 1.79 (0.89–3.60) | 18 / 341 (5.3) | 1.01 (0.34–1.9) | 1.07 (0.56–2.01) |
| 65–69 | 31 / 462 (6.7) | 2.16 (1.13–4.13) | 18 / 422 (4.3) | 0.81 (0.43–1.52) | 1.61 (0.90–2.88) |
| 70–74 | 58 / 480 (12.1) | 4.01 (2.19–7.32) | 26 / 436 (6.0) | 1.20 (0.68–2.13) | 2.09 (1.32–2.32) |
| 75–79 | 48 / 403 (11.9) | 3.94 (2.14–7.28) | 30 / 461 (6.5) | 1.29 (0.74–2.25) | 1.91 (1.21–3.01) |
| ≥80 | 36 / 290 (12.4) | 4.15 (2.20–7.84) | 16 / 291 (5.5) | 1.09 (0.57–2.10) | 2.43 (1.35–4.38) |

Data are presented as *n* (%) unless stated otherwise. HR = hazard ratio; CI = confidence interval.

* Data derived from Howard.¹⁶⁹

[†] Age based HR calculation for CAS compared with CEA. If HR is < 1.0, CAS is associated with lower peri-operative death/stroke. If HR is > 1.0, CAS is associated with higher rates of peri-operative stroke or death.

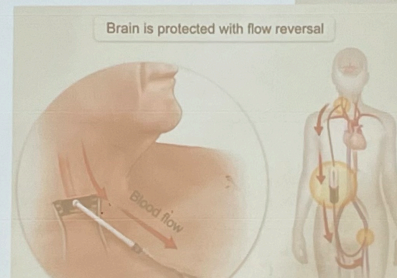
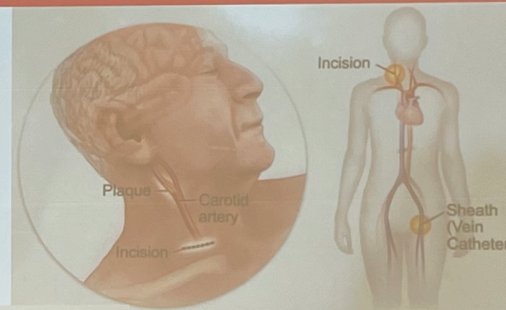
[‡] All HR age based calculations compared against age < 60 years.



| | | |
|---|-----|---|
| Recommendation 37 | | |
| It is recommended that most patients who have suffered carotid territory symptoms within the preceding 6 months and who are aged >70 years and who have 50–99% stenoses should be treated by carotid endarterectomy, rather than carotid stenting | I | A |
| Recommendation 38 | | |
| When revascularisation is indicated in patients who have suffered carotid territory symptoms within the preceding 6 months and who are aged <70 years, carotid stenting may be considered an alternative to endarterectomy, provided the documented procedural death/stroke rate is <6% | IIb | A |
| Recommendation 39 | | |
| Carotid endarterectomy or carotid stenting are not recommended in symptomatic patients with a chronic internal carotid near-occlusion, unless associated with recurrent ipsilateral symptoms (despite optimal medical therapy) and following multidisciplinary team review | III | C |

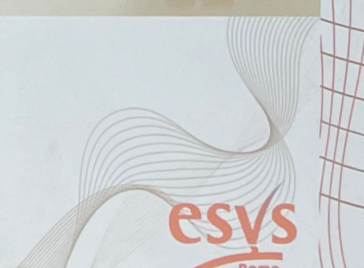
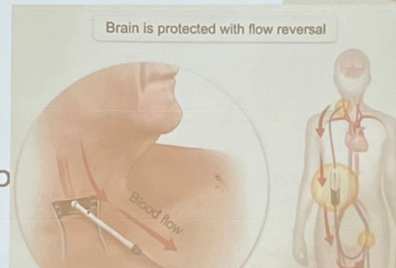
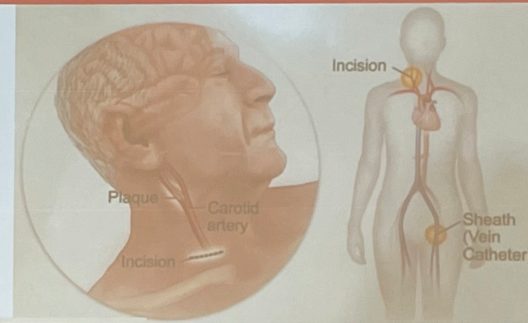
TCAR/Asymptomatic Carotid Stenosis

- Several registries showed favorable TCAR outcome compared to transfemoral CAS or even CEA in ACS patients.
- ROADSTER 1
- ROADSTER 2
- SVS/VQI Data
- SVS/VQI/TCAR Surveillance Project(TSP)



TCAR/Asymptomatic Carotid Stenosis

- 30-day perioperative stroke rate of 1-2% and stroke/death rate of 1 to below 3%.
- Most if not all reporting 30 days up to one year data.
- Longer follow up is needed.
- Recently CMS approved TCAR for standard risks patients.



Take home messages

