Asymptomatic carotid stenosis (ACS) is commonly defined as the presence of atherosclerotic narrowing of the proximal internal carotid artery by ≥50% at the level of bifurcation in individuals with no history of recent (within the last six months) ischemic stroke/TIA involving ipsilateral carotid territory. Although the presence of 50%–69% narrowing is considered as moderate stenosis, narrowing ≥70% is generally considered as severe stenosis. However, there are no standard criteria proposed on the severity of stenosis and duration of recent ischemic event and definitions vary among studies depending on the method used for assessment of stenosis. Some criteria also use >60% definition. Table 1 summarises the definitions of all major trials addressing the management of ACS.

The importance of optimal management ACS comes from the fact that it is not just a risk factor for stroke but to coronary artery disease and mortality as well. Results from the Second Manifestations of ARTerial disease (SMART) study provides evidence that patients with ACS should be treated optimally as they are at risk of vascular events (HR 1.5; 95% CI 1.1–2.1) and mortality (HR 1.8; 95% CI 1.2–2.6). However, the management of ACS remains controversial, largely because only a small proportion of patients are ever destined to suffer a stroke, along with growing evidence that the risk of stroke declines with modern medical therapy, risk factors control and statin use.

**WHAT DO THE GUIDELINES SAY?**

A significant controversy in the management of patients with ACS is the selection of patients for carotid revascularisation, notably in the face of evidence that ipsilateral strokes on optimal medical therapy have declined significantly over time. Table 2 summarises all the available guidelines published till date addressing the management of ACS. The evidence supporting these recommendations is largely drawn from the randomised controlled trials (RCTs) explained below. The 2017 European Society of Vascular Surgery guidelines (ESVS) suggest that carotid endarterectomy (CEA) (class IIa recommendation, level of evidence B) or carotid stenting (class IIb, level of evidence B) should be considered for patients with ACS (60%–99%) at average surgical risk, provided the documented perioperative stroke/death rate is less than 3% and the patient’s life expectancy exceeds 5 years. This is in line with the other guidelines; Although all the guidelines suggest forming a multidisciplinary

### Table 1: Definitions of asymptomatic carotid stenosis used in major studies

| Study  | Publication (year) | Mode of assessment | Severity of stenosis | Duration of last ipsilateral CORI |
|--------|--------------------|--------------------|----------------------|-----------------------------------|
| ACAS[3] | 1995               | Arteriogram        | >60%                 | Not mentioned                     |
| ASCT-1[4] | 2010            | USG doppler (for confirmation) | >60% (no fixed cut-off) | >180 days                         |
| CREST-1[5] | 2010              | Angiography        | >60%                 | >180 days                         |
| ACT-1[6] | 2016               | Angiography or doppler USG or both | 70-99%             | >180 days                         |
| SPACE-2[7] | 2016              | USG                | 70-99% (ECST)        | >180 days                         |
| CORI: Cerebrovascular or retinal ischemic event, CTA: Computed tomography angiography, MRA: Magnetic resonance angiography, USG: Ultrasonography |

### Table 2: Summary of recommendations on the management of asymptomatic carotid stenosis

| Organisation | Publication (year) | Recommendations  |
|--------------|--------------------|------------------|
| RACP[8]      | 2010               | Should not be performed in majority of patients | NA | Gold standard | Determining suitability for procedures is often done as a team approach |
| SVS[9]       | 2011               | Insufficient data | Should not be performed | I | No comment |
| AHA[10]      | 2011               | IIb               | IIA                      | IIA | No comment |
| ESC/ESVS[11] | 2017               | IIb               | IIA                      | IIA | I |

ACCF=American College of Cardiology Foundation; AHA=American Heart Association; CAS=Carotid artery stenting; CEA=Carotid endarterectomy; ESC=European Society of Cardiology; ESVS=European Society for Vascular surgery; RACP=Royal Australasian College of Physicians; SVS=Society for Vascular Surgery; Levels of recommendation: Class I (Strong): Benefit >> risk. Intervention is recommended, Class IIa (Moderate): Benefit >> risk. Intervention is reasonable, Class IIb (Weak): Benefit ≥ risk. Intervention may be considered, Class III (Moderate or strong): Benefit ≤ risk. Intervention is not recommended or potentially harmful
Table 3: Randomised controlled trials comparing CEA vs medical treatment alone in patients with asymptomatic carotid stenosis

| Trial (Year)                  | n   | Follow-up | 30-day stroke and death | Definition                                                                 | Long-term stroke rate | P       |
|------------------------------|-----|-----------|--------------------------|---------------------------------------------------------------------------|-----------------------|---------|
| VA cooperative group[11] (1993) | 444 | Mean 4.0 years | 4.7% 1.3%                | Ipsilaterial TIA, transient monocular blindness, stroke                  | 8.0% 20.6%            | <0.001  |
| ACAS[3] (1995)               | 1662| Median 2.7 years | 2.3% 0.4%                | Periprocedural stroke or death, and postoperative ipsilateral stroke     | 5.1% 11.0%            | 0.004   |
| ACST-1[4] (2010)             | 3120| Median 6.1 years | 2.6% 0.7%                | Any stroke or perioperative death                                       | 5Y: 6.9% 10.9%        | 0.0001  |
| SPACE-2[7] (2019)            | 316 | Interim - 1 year | 2.5% NA                  | Any stroke or perioperative death                                       | 2.5% 0.9%            | N.S.    |
| AMTEC[16] (2015)             | 55  | Median 3.3 years | NA NA                    | Any non-fatal ipsilateral stroke and death                              | 6.5% 37.5%            | 0.008   |

Table 4: Randomised controlled trials comparing CEA vs CAS in patients with asymptomatic carotid stenosis

| Trial (Year)                  | n   | Follow-up | 30-day MI, stroke and death | Definition                                                                 | Long-term stroke rate | P       |
|------------------------------|-----|-----------|-----------------------------|---------------------------------------------------------------------------|-----------------------|---------|
| SAPPHIRE (subgroup)[12] (2008) | 237 | 78% at 3 years | 10.2% 5.4% 0.2             | Periprocedural MI, stroke, and post-procedural ipsilateral stroke        | 29.2% 21.4%           | N.R.    |
| CREST-1 subgroup[13] (2010)   | 1181| Median 7.4 years | 3.6% 3.5% N.S.          | Periprocedural MI, stroke, and post-procedural ipsilateral stroke        | 5Y: 5.4% 6.1%        | 0.95    |
| ACT-1[15] (2016)              | 1453| Up to 5 years | 2.6% 3.3% 0.60            | Post-procedural ipsilateral stroke                                      | 10Y: 10.1% 9.6%      |        |
| SPACE-2[7] (2019)             | 400 | 1 year | 2.5% 2.5% N.S.            | Any non-fatal stroke or perioperative death                             | 2.7% 2.2% 0.51       |        |

ACT-1: Asymptomatic carotid trial 1, CAS–Carotid artery stenting, CEA–Carotid endarterectomy, CREST-1: Carotid revascularisation endarterectomy versus stenting trial, MI=Myocardial Infarction, N.R.= Not reported, N.S.= Not significant, SAPPHIRE: Stenting and angioplasty with protection in patients at high risk for endarterectomy.

Table 5: Summary of optimal medical therapy[27]

| Treatment                  | Details                                                                 |
|----------------------------|-------------------------------------------------------------------------|
| Life style modification    | Smoking cessation, moderation of alcohol intake, moderate intensity exercise 4 to 7 days per week, at least 150 min per week, Mediterranean diet |
| Antithrombotic therapy     | Aspirin 75-325 mg/day, Clopidogrel 75 mg per day, Ticagrelor 90 mg BD (if intolerant or allergic to Aspirin) |
| Lipid-lowering therapy     | LDL target <70 mg/dL, High-dose statin, If not controlled - add ezetimibe, PCSK9 inhibitor |
| Antihypertensive therapy   | Target <130/80 mm Hg, Target HbA1c <7.0% |

LDL=Low-density lipoprotein

Carotid Revascularisation and the Evolution of Medical Management

The current evidence on management of ACS is based on several landmark trials. Three randomised controlled trials (RCTs) conducted in the 1990s investigated whether CEA could reduce the risk of stroke in patients with asymptomatic carotid stenosis, namely VA cooperative study group, Asymptomatic carotid atherosclerosis study (ACAS) and Asymptomatic carotid surgery trial 1 (ACST-1) trials.[3,4,15] [Table 3] These trials predominantly recruited participants with a stenosis ≥50%, although ACST-1 had no fixed minimum cut-off. All these trials reported significant benefit in favour of CEA. Although there are no direct RCTs evaluating the safety and efficacy of CAS over medical therapy, three RCTs compared the safety and efficacy of CAS with CEA, namely Stenting and angioplasty with protection in patients at high risk for endarterectomy (SAPPHIRE), Carotid revascularisation endarterectomy versus stenting trial (CREST-1) and Asymptomatic carotid trial 1 (ACT-1) trial.[5,6,16] [Table 4] None of the three studies showed a difference in event rates between CEA and CAS, providing evidence that carotid artery stenting with embolic protection is a reasonable alternative to endarterectomy in patients at average risk for CEA. However, the major limitation across all surgical trials in ACS is that the best medical management was not well established. Although aggressive medical treatment in ACAS trial constituted only aspirin,[37], current concept of aggressive medical treatment includes lipid lowering therapy[18,19] and optimal medical management of comorbidities like diabetes mellitus[20,21], hypertension[22,23], modification of life style including smoking.
In the OxVasc study, the risk of ipsilateral stroke was 0.6% per annum. These results signify that RCTs done so far have not included the best medical treatment. To support this notion, use of lipid lowering therapy and antihypertensive drugs increased significantly towards the end of study period indicating this notion, use of lipid lowering therapy and antihypertensive drugs increased significantly towards the end of study period. This might have been different. There have been claims that advances in technology and increased experience may have led to reduction in risk following CAS and CEA which may increase the benefit of intervention in these patients. Naylor et al.[34] reanalysed the 5 and 10-years data from the ACAS and ACST trial with an assumption of 0% procedural risk. Modelling for a 0% procedural risk meant that more than 90% of these procedures were still unnecessary. On the contrary, in some cohort studies that included all three treatment groups, the results are conflicting [Table 6]. All these factors highlight the need for studies that can evaluate the efficacy of optimal medical management in comparison with CEA and CAS.

### Table 6: Cohort studies comparing carotid revascularisation versus medical therapy in patients with asymptomatic carotid stenosis

| Trial (Year)       | n    | Follow-up       | 30-day stroke | Long-term stroke rate | P     |
|--------------------|------|-----------------|----------------|-----------------------|-------|
|                     |      |                 | CEA CAS MT    | CEA CAS MT            |       |
| Libman et al.[35]   | 215  | Mean 3.8 Years  | 4.7% - 0      | Any stroke 13% - 16%  | N.S.  |
| Lim et al.[36]      | 409  | Mean 5 years    | 2.0% 0.6%     | Any ipsilateral 5.6%  | 5.5%  |
| Kang et al.[37]     | 1089 | Median 2.3 years| 0.98% 4.0%    | Any Ipsilateral 0.65% | 3.68% | 1.98% <0.001 |
| Keyhani et al.[38]  | 5221 | Mean 5 years    | 2.5% N.A.     | Any stroke 6.7% 6.2%  | N.A.  |

N.S.=Not specified; NA: Not available, MT: Medical treatment, CEA=Carotid endarterectomy, CAS=Carotid artery stenting. *CEA in combination with medical treatment, †stroke and death.

### Table 7: Clinical/imaging features associated with an increased risk of stroke in patients with ACS

| Imaging/clinical parameter | OR/HR (95% CI) |
|----------------------------|----------------|
| Spontaneous MES on TCD     | 7.46 (2.24-24.89) |
| Plaque echolucency on Duplex US | 2.61 (1.47-4.63) |
| Spontaneous MES on TCD + uniformly or predominantly echoluent plaque (70-99% stenosis) | 10.61 (2.98-37.82) |
| Stenosis progression (50-99% stenosis) | 1.92 (1.14-3.25) |
| Severe stenosis (50-70%) | - |
| Silent infarction on CT (60-99% stenosis) | 3.0 (1.46-6.29) |
| Impaired cerebrovascular reserve (70-99% stenosis) | 6.14 (2.77-4.95) |
| Intraplaque haemorrhage on MRI | 3.66 (2.77-4.95) |
| Contralateral stroke/TIA | 3.0 (1.94-7.73) |
| Lipid rich necrotic core | 1.5 (0.4-5.5) |
| Plaque ulceration | 2.4 (0.4-13.2) |
| AHA lesion type 4, 5 or 6 | 28.7 (1.6-513.0) |

MES=Microembolic signals; TCD=Transcranial doppler; OR=Odds Ratio, HR=Hazard Ratio, CI=Confidence Interval, US=Ultrasonound, CT=Computed tomography, MRI=Magnetic resonance imaging, AHA=American Heart Association.

### Risk Stratification

Offering routine carotid revascularisation to every patient with asymptomatic carotid artery stenosis is no longer considered the optimal management. Equally suboptimal, however, is the policy of offering only best medical treatment to these patients and not considering any of them for revascularisation. Some patients may not respond to medical management, and they may benefit from carotid revascularisation. It is essential to identify these subsets of patients who are at high risk of recurrence of events. Degree of stenosis alone may not be the best approach for identification of these patients.

In the last few years, several methods have been proposed as reliable predictors for the identification of patients at high risk of stroke.[39] For some of these predictors, the evidence is adequate and robust, whereas for others it is weaker. Microembolic signals detected on transcranial Doppler is a simple, convenient and cost-effective method that can help in risk stratification of these patients.[40] Table 7 summarises the clinical and imaging features that are associated with increased risk of stroke/TIA in ACS patients.[41]

### Need for Future Trials

Although there are trials supporting revascularisation and emerging evidence towards best medical therapy, there is a lack of consensus as reflected in the guidelines addressing the management of these patients. Though guidelines recommend...
Asymptomatic carotid stenosis is a risk factor for stroke, myocardial infarction and mortality. Improvements in medical therapy have reduced the risk of cerebrovascular events possibly below a threshold where carotid revascularisation would still benefit the average risk patient. Although the results of the ongoing trials CREST-2,[44] ECST-2,[45] and ACST-2[46] awaited, all patients with ACS should receive optimal medical management for control of risk factors and comorbidities and patients with vulnerable plaque should be considered for revascularisation.

**Table 8: Summarised characteristics of the on-going RCTs in patients with ACS**

| Study       | Design                                    | Eligibility                               | Primary outcome                                                                 | Estimated enrollment | Estimated completion (month/year) |
|-------------|-------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------|----------------------|-----------------------------------|
| CREST-2[44] | 2 two-arm trials                           | >70% ACS (NASCET)                         | Stroke and death within 44 days of randomisation and ipsilateral stroke thereafter up to 4 years | 2480                 | December 2022                     |
| ECST-2[46]  | OMT vs OMT + revascularisation (CEA or CAS, prespecified before randomisation) | >50% SCS/ACS (NASCET)                     | Any stroke at any time, plus non-stroke death occurring within 30 days of revascularisation | 2000                 | March 2022                        |
| ACST-2[46]  | CEA vs CAS                                 | ACS patients with uncertainty of treatment with CEA/CAS | Peri-procedural risks (within 30 days) of CEA or CAS and long-term (5-year) prevention of stroke and of disabling or fatal stroke | 3600                 | 2021                              |

Crest-2: Carotid Revascularisation Endarterectomy versus Stenting Trial 2; ECST-2: European Carotid Surgery Trial 2 ACST-2: Asymptomatic Carotid Surgery Trial; CAS: Carotid artery stenting; CEA: Carotid endarterectomy; OMT: Optimal medical treatment; ACS: Asymptomatic carotid stenosis; SCS: Symptomatic carotid stenosis; NASCET: North American Symptomatic Carotid Endarterectomy Trial

**REFERENCES**

1. den Hartog AG, Achterberg S, Moll FL, Kappelle LJ, Visseren FL, van der Graaf Y, et al. Asymptomatic carotid artery stenosis and the risk of ischemic stroke according to subtype in patients with clinical manifest arterial disease. Stroke 2013;44:1002-7.
2. Chatzikonstantinou A, Wolf ME, Schaefer A, Hennerici MG. Asymptomatic and symptomatic carotid stenosis: An obsolete classification? Stroke Res Treat 2012;2012:340798. doi: 10.1155/2012/340798.
3. Walker MD, Marler JR, Goldstein M, Grady PA, Toole JF, Baker WH, et al. Endarterectomy for asymptomatic carotid artery stenosis. JAMA 1995;273:1421-8.
4. Hallday A, Harrison M, Hayter E, Kong X, Mansfield A, Marro J, et al. Ten-year stroke prevention after successful carotid endarterectomy for asymptomatic stenosis (ACST-1): A multicentre randomised trial. Lancet 2010;376:1074-84.
5. Brott TG, Hobson RW II, Howard G, Roubin GS, Clark WM, Brooks W, et al. Stenting versus endarterectomy for treatment of carotid-artery stenosis. N Engl J Med 2010;363:11-23.
6. Rosenfield K, Matsumura JS, Chaturvedi S, Riles T, Ansel GM, Metzger DC, et al. Randomized trial of stent versus surgery for asymptomatic carotid stenosis. N Engl J Med 2016;374:1011-20.
7. Reiff T, Eckstein HH, Mansmann U, Jansen O, Friedrich G, Mudra H, et al. Angioplasty in asymptomatic carotid artery stenosis vs. endarterectomy compared to best medical treatment: One-year interim results of SPACE-2. Int J Stroke 2019;15:1747493019833017. doi: 10.1177/1747493019833017.
8. Goessens BM, Visseren FL, Kappelle LJ, Algra A, van der Graaf Y. Asymptomatic carotid artery stenosis and the risk of new vascular events in patients with manifest arterial disease: The SMART study. Stroke 2007;38:1470-5.
9. Beckman JA, Ansel GM, Lyden SP, Das TS. Carotid artery stenting in asymptomatic carotid artery stenosis: JACC review topic of the week. J Am Coll Cardiol 2020;75:648-56.
10. Eckstein HH. European Society for Vascular Surgery guidelines on the management of atherosclerotic carotid and vertebral artery disease. Eur J Vasc Endovasc Surg 2018;55:1-2.
11. Aboyans V, Ricco JB, Bartelink M, Björck M, Brodmann M, Coenen T, et al. 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). Eur Heart J 2018;39:763-816.

12. Ricotta JJ, Aburahma A, Ascher E, Eskandari M, Faries P, Lal BK, et al. Updated Society for Vascular Surgery guidelines for management of extracranial carotid disease: Executive summary. J Vase Surg 2011;54:832-6.

13. Goldstein LB, Bushnell CD, Adams RJ, Appel LJ, Braun LT, Chaturvedi S, et al. Guidelines for the primary prevention of stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 2011;42:517-84.

14. Carotid Stenting Guidelines Committee: An Inter-collegiate Committee of the RACP (ANZAN, CSANZ), RACS (ANZSVS) and RANZCR. Guidelines for patient selection and performance of carotid artery stenting. Intern Med J 2011;41:344-7.

15. Hobsom RW 2nd, Weiss DG, Fields WS, Goldstone J, Moore WS, Towne JB, et al. Efficacy of carotid endarterectomy for asymptomatic carotid stenosis. The Veterans Affairs Cooperative Study Group. N Engl J Med 1993;328:221-7.

16. James RS, Yadav JS, Fayed P, Katzen BT, Mishkel GJ, Bjaiva TK, et al. Long-term results of carotid stenting versus endarterectomy in high-risk patients. N Engl J Med 2008;358:1572-9.

17. Antithrombotic Trialists’ (ATT) Collaboration, Baigent C, Blackwell L, Collins R, Emberson J, Godwin J, et al. Aspirin in the primary and secondary prevention of vascular disease: Collaborative meta-analysis of individual participant data from randomised. Lancet 2009;373:1849-60.

18. Sillesen H, Amarenco P, Hennerici MG, Callahan A, Goldstein LB, Zivin J, et al. Atorvastatin reduces the risk of cardiovascular events in patients with carotid atherosclerosis: A secondary analysis of the Stroke Prevention by Aggressive Reduction in Cholesterol Levels (SPARCL) trial. Stroke 2008;39:3297-302.

19. Cholesterol Treatment Trialsist’s (CTT) Collaboration, Baigent C, Blackwell L, Emberson J, Holland LE, Reith C, et al. Efficacy and safety of more intensive lowering of LDL cholesterol: A meta-analysis of data from 170,000 participants in 26 randomised trials. Lancet 2010;376:1670-81.

20. American Diabetes Association. 6. Glycemic targets: Standards of medical care in diabetes-2021. Diabetes Care 2021;44(Suppl 1):S73-84.

21. Rangaswami J, Bhatt V, de Boer IH, Staruschenko A, Sharp JA, Singh RR, et al. Cardiorenal protection with the newer antidiabetic agents in patients with diabetes and chronic kidney disease: A scientific statement from the American Heart Association. Circulation 2020;142:e265-86.

22. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: Executive summary: A report of the American College of Cardiology/American Heart Association Task Force on clinical practice guidelines. Hypertension 2018;71:1269-324.

23. Kitagawa K, Yamamoto Y, Arima H, Maeda T, Sunami N, Kanzawa T, et al. Effect of standard vs intensive blood pressure control on the risk of recurrent stroke: A randomized clinical trial and meta-analysis. JAMA Neurol 2019;76:1309-18.

24. Lin JS, O’Connor E, Evans CV, Senger CA, Rowland MG, Groom HC. Behavioral counseling to promote a healthy lifestyle in persons with cardiovascular risk factors: A systematic review for the U.S. Preventive Services Task Force. Ann Intern Med 2014;161:568-78.

25. de Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: Final report of the Lyon Diet Heart Study. Circulation 1999;99:779-85.

26. Paraskevas KI, Mikhailidis DP, Veitch FJ, Spence JD. Definition of best medical treatment in asymptomatic and symptomatic carotid artery stenosis. Angiology 2016;67:411-9.

27. Hackam DG. Optimal medical management of asymptomatic carotid stenosis. Stroke 2021;52:2191-8.

28. Kolos I, Loukianov M, Dupik N, Boytsov S, Deev A. Optimal medical treatment versus carotid endarterectomy: The rationale and design of the Aggressive Medical Treatment Evaluation for Asymptomatic Carotid Artery Stenosis (AMTEC) study. Int J Stroke Off J Int Stroke Soc 2015;10:269-74.

29. Cannon CP, Blazing MA, Giugliano RP, McCagg A, White JA, Theroux P, et al. Ezetimibe added to statin therapy after acute coronary syndromes. N Engl J Med 2015;372:2387-97.

30. Sabatine MS, Giugliano RP, Keech AC, Honarpour N, Wiviott SD, Murphy SA, et al. Evolocumab and clinical outcomes in patients with cardiovascular disease. N Engl J Med 2017;376:1713-22.

31. Rothwell PM. Carotid stenting: More risky than endarterectomy and often no better than medical treatment alone. Lancet 2010;375:957-9.

32. Marquardt L, Geragthy OC, Mehta Z, Rothwell PM. Low risk of ipsilateral stroke in patients with asymptomatic carotid stenosis on best medical treatment: A prospective, population-based study. Stroke 2010;41:e11-7.

33. Spence JD, Coates V, Li H, Tamayo A, Muñoz C, Hackam DG, et al. Effects of intensive medical therapy on microemboli and cardiovascular risk in asymptomatic carotid stenosis. Arch Neurol 2010;67:180-6.

34. Naylor AR. Why is the management of asymptomatic carotid disease so controversial? Surgeon 2015;13:34-43.

35. Libman RB, Sacco RL, Shi T, Correll JW, Mohr JP. Outcome after carotid endarterectomy for asymptomatic carotid stenosis. Surg Neurol 1994;41:443-9.

36. Lim S, Mora-Pinzon M, Park T, Yoon W, Crisostomo PR, Cho JS. Medical therapy does not confer stroke prevention for all patients: Identification of high-risk patients with asymptomatic carotid stenosis is still needed. Int Angiol 2019;38:372-80.

37. Kang J, Kim YW, Kim DI, Woo SY, Park YJ. Outcomes of carotid revascularization versus optimal medical treatment alone for asymptomatic carotid stenosis: Inverse-probability-of-treatment weighting using propensity scores. World Neurosurg 2021;146:e419-30.

38. Keyhani S, Cheng EM, Hoggatt KJ, Austin PC, Madden E, Hebert PL, et al. Comparative effectiveness of carotid endarterectomy vs initial medical treatment in patients with asymptomatic carotid stenosis. JAMA Neurol 2020;77:1110-21.

39. Paraskevas KI, Veith FJ, Spence JD. How to identify which patients with asymptomatic carotid stenosis could benefit from endarterectomy or stenting. Stroke Vasc Neurol 2018;3:92-100.

40. Markus HS, King A, Shipley M, Topakian R, Cullinane M, Rehills L, et al. Asymptomatic embolisation for prediction of stroke in the Asymptomatic Carotid Emboli Study (ACES): A prospective observational study. Lancet Neurol 2010;9:663-71.

41. Naylor AR, Ricco JB, de Borst GJ, Debus S, de Haro J, Halliday A, et al. Editor’s choice-management of atherosclerotic carotid and vertebral artery disease: 2017 clinical practice guidelines of the European Society for Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg 2018;55:3-81.

42. Kamtchum-Tatuene J, Noubiap JJ, Wilman AH, Saqqur M, Shuaib A, et al. Comparative effectiveness of carotid endarterectomy vs initial medical treatment versus carotid endarterectomy: Final report of the Lyon Diet Heart Study. Circulation 1999;99:779-85.

43. Keyhani S, Cheng EM, Hoggatt KJ, Austin PC, Madden E, Hebert PL, et al. Comparative effectiveness of carotid endarterectomy vs initial medical treatment versus carotid endarterectomy: Final report of the Lyon Diet Heart Study. Circulation 1999;99:779-85.

44. Mott M, Koroshetz W, Wright CB. CREST-2: Identifying the best
method of stroke prevention for carotid artery stenosis: National Institute of Neurological Disorders and Stroke organizational update. Stroke 2017;48:e130-1.

45. ISRCTN-ISRCTN97744893: European Carotid Surgery Trial 2. Available from: https://www.isrctn.com/ISRCTN97744893. doi: 10.1186/ISRCTN97744893.

46. Bulbulia R, Halliday A. The asymptomatic carotid surgery trial-2 (ACST-2): An ongoing randomised controlled trial comparing carotid endarterectomy with carotid artery stenting to prevent stroke. Health Technol Assess 2017;21:1-40.

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