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CONTEMPORARY MANAGEMENT OF CAROTID ARTERY STENOSIS: EVALUATING CEA, TRANSFEMORAL STENTING, TCAR, AND BMT

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ABSTRACT

Carotid artery stenosis causes 10% to 20% of all strokes. This review evaluates the evolving, complementary roles of carotid endarterectomy (CEA), transfemoral stenting (TFCAS), transcarotid revascularization (TCAR), and best medical therapy (BMT). Aggressive BMT forms the universal foundation of care, reserving intervention for symptomatic (≥50%) or high-risk asymptomatic (>70%) patients. CEA remains a durable gold standard where routine patch angioplasty minimizes perioperative stroke and thrombosis. While traditional TFCAS carries elevated stroke risks in patients over 70, modern dual-layer stents and proximal protection significantly mitigate microembolic complications. TCAR successfully bridges open and endovascular approaches; by utilizing direct access and neuroprotective flow reversal, it minimizes embolic and cranial nerve injuries while providing the highest probability of preventing long-term restenosis. Ultimately, modern management has transitioned from competing modalities into a highly individualized selection paradigm.

KEYWORDS

Carotid Artery Stenosis, Stroke Prevention, Carotid Endarterectomy (CEA), Carotid Artery Stenting (CAS), Transcarotid Artery Revascularization (TCAR), Best Medical Therapy (BMT), Atherosclerosis, Neuroprotection

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Introduction

Carotid artery stenosis is defined as the narrowing of the common or internal carotid artery, which is typically caused by atherosclerosis. It has been determined that this condition is responsible for 10–20% of all strokes (Flaherty et al., 2013; Veunac et al., 2022). Although acute-phase endovascular interventions, specifically mechanical thrombectomy (MT) and thromboaspiration, have become firmly established as standard clinical protocols, stroke remains a primary driver of long-term morbidity (Berkhemer et al., 2015). We use various methods to prevent carotid artery stroke in both symptomatic and asymptomatic patients. Carotid artery interventions, including carotid endarterectomy (CEA) and, more recently, carotid artery stenting (CAS), have been utilised for over half a century to reduce the risk of stroke in individuals with carotid stenosis (Morris et al., 2017; 'Randomised Trial of Endarterectomy for Recently Symptomatic Carotid Stenosis', 1998; 'Transcarotid Arterial Revascularization of Symptomatic Internal Carotid Artery Disease', n.d.).The present review outlines the historical development of interventional methods for the treatment of carotid artery disease, summarises the key findings from large-scale randomised clinical trials, and analyses the current guidelines for the treatment of carotid artery stenosis, we will compare carotid endarterectomy (CEA) with transfemoral carotid artery stenting (TFCAS), transcarotid artery revascularisation (TCAR) and best medical therapy (BMT).

Methods

This systematic review evaluates contemporary management of carotid artery stenosis: evaluating CEA, transfemoral stenting, TCAR, and BMT. A comprehensive literature search was conducted across PubMed and Google Scholar. Eligible publications comprised randomized controlled trials, prospective and retrospective cohort studies, meta-analyses, and systematic reviews. The methodological quality of each study was rigorously appraised to ensure validity and minimize bias in the synthesis of evidence.

Carotid endarterectomy (CEA)

Carotid endarterectomy (CEA) involves the surgical resection of atherosclerotic plaques narrowing the common and internal carotid arteries (ICA). This procedure serves as a cornerstone in stroke prevention by eliminating the risk of plaque destabilization, which otherwise leads to cerebral embolism or complete vascular occlusion. Following arterial isolation and clamping, the plaque is excised through an arteriotomy, successfully re-establishing hemodynamically optimal, laminar flow within the circle of Willis (Jamilian et al., 2024). It remains the primary surgical intervention for carotid artery stenosis, supported by an extensive body of literature establishing its clinical indications. Carotid endarterectomy (CEA) has been demonstrated to offer significant protective benefits to patients with severe carotid stenosis (70%–99%), with a marked reduction in five-year cumulative mortality from stroke and in operative mortality. Although patients with moderate stenosis (50%–69%) also derive statistically significant benefits, as confirmed by a pooled reanalysis of individual patient data from the landmark NASCET and ECST trials, the long-term clinical utility becomes more moderate during prolonged follow-up. In patients with near-total stenosis, however, no clear prophylactic benefits of CEA were observed, although surgical intervention may still be considered in patients with near-total stenosis who experience recurrent transient ischaemic attacks (TIAs) (Barnett et al., 1998; Morris et al., 2017; 'Randomised Trial of Endarterectomy for Recently Symptomatic Carotid Stenosis', 1998). To optimize patient selection, a meticulous preoperative risk assessment addressing both high-risk anatomical features and systemic comorbidities is paramount. Furthermore, tailoring the surgical strategy requires precise preoperative characterization of the plaque and vascular anatomy utilizing multi-modality imaging, including duplex ultrasonography, magnetic resonance imaging (MRI), and computed tomography or digital subtraction angiography (Hara & Rai, 2022).

At the present time, there are a number of approaches to CEA, which will be outlined below. One of the widely debated intra-procedural techniques is patch angioplasty (PA) versus primary closure (PC). According to the 2023 Clinical Practice Guidelines on the Management of Atherosclerotic Carotid and Vertebral Artery Disease routine patch closure in comparison to routine primary closure, during carotid endarterectomy provides superior 30-day outcomes; a meta-analysis of 10 RCTs (n=2,157) revealed significantly lower risks of both ipsilateral stroke (1.5% vs. 4.5%; OR=0.2, 95% CI: 0.1–0.6) and internal carotid artery thrombosis (0.5% vs. 3.1%; OR=5.6, 95% CI: 2.4–12.5) (Ren et al., 2013; Rerkasem & Rothwell, 2011). Accordingly, the recommendations are as follows, for patients undergoing conventional carotid endarterectomy, current guidelines mandate routine patch angioplasty over routine primary arteriotomy closure to optimize perioperative outcomes, and for patients undergoing carotid endarterectomy, the selection of specific patch angioplasty materials remains at the discretion of the operating surgeon, based on individual anatomical variations and clinical judgment (R. Naylor et al., 2023).

The choice between locoregional anaesthesia (LRA) and general anaesthesia (GA) for carotid endarterectomy (CEA) remains a subject of ongoing debate. A comprehensive analysis of pooled data from five randomized controlled trials (RCTs) has revealed a substantial reduction in the 30-day risk of stroke or death when CEA was performed under LRA (adjusted RR=0.70; 95% CI: 0.50–0.99). This tendency is further substantiated by neuroimaging data, which has demonstrated that new ischemic brain lesions (NIBL) occur with considerably higher frequency in patients undergoing GA compared to those receiving LRA (17.1% vs. 6.7%; p=.031) (Knappich et al., 2019). In contrast, the GALA trial – the largest individual randomised controlled trial (RCT) conducted to date to address this clinical question – reported no statistically significant differences in the baseline incidence of perioperative mortality, stroke, or myocardial infarction between the general anaesthesia (GA) (4.8%) and local anaesthetic (LRA) (4.5%) cohorts ('General Anaesthesia versus Local Anaesthesia for Carotid Surgery (GALA)', 2008). The selection of anaesthetic technique (general or locoregional) for carotid endarterectomy must be tailored to the individual patient, as determined by the surgical and anaesthetic teams, taking into account institutional experience, patient preferences, and the anticipated perioperative antiplatelet regimen (R. Naylor et al., 2023).

Carotid cross-clamping poses an inherent risk of hemodynamic hypoperfusion and subsequent ischemic stroke, a complication mitigated by the placement of an intraluminal shunt. Historically, surgical practice patterns regarding shunt utilization—classified as routine, selective, or non-shunting strategies—have remained highly variable, driven primarily by institutional training and operator preference rather than standardized algorithmic consensus. In a Cochrane systematic review comprising data from six randomised controlled trials (n = 1,270 carotid endarterectomy procedures), it was not possible to formulate definitive recommendations regarding optimal strategies for carotid artery bypass grafting (Chongruksut et al., 2014). A further analysis of 28,457 carotid endarterectomies from the SVS-VQI registry was conducted, encompassing 4,128 cases of routine, 1,740 previously unperformed and 12,489 selective bypass procedures. This analysis revealed no statistically significant disparities in the incidence of perioperative transient ischaemic attack (TIA) or stroke across the three treatment cohorts (Wiske et al., 2018). Therefore the latest guidelines says that for patients undergoing carotid endarterectomy, decisions regarding shunting (routine, selective, never) should be considered at the discretion of the operating surgeon (R. Naylor et al., 2023).

Carotid artery stenting (CAS)

Carotid artery stenting (CAS) serves as a vital endovascular modality for stroke prevention, functioning through mechanical plaque pacification rather than surgical excision. While longitudinal evidence, including the landmark CREST trial, has convincingly demonstrated the long-term equivalence of CAS and carotid endarterectomy (CEA) in terms of efficacy, first-generation CAS was historically limited by an excess of 30-day minor strokes (Hill et al., 2012). This periprocedural complication was mechanistically linked to the prolapse of atherothrombotic material through single-layer metallic stent cells. To mitigate this embolic risk, contemporary CAS has undergone a paradigm shift; the integration of second-generation dual-layer micromesh stents combined with proximal cerebral protection—such as flow reversal or cessation—has significantly reduced microembolic load and cerebral injury, thereby substantially optimizing the perioperative safety profile of the procedure. Additionally transitioning from traditional transfemoral access to safer transradial or transcarotid routes has significantly reduced procedural navigation errors and access-site complications. (Musialek et al., 2024, 2025). Prior to selecting a specific revascularization modality, establishing definitive interventional indications through a multidisciplinary neurological consultation is needed. While intervention thresholds are well-standardized for symptomatic carotid stenosis (≥50%), asymptomatic cohorts present a greater clinical challenge. Advances in contemporary guideline-directed medical therapy—notably high-intensity statins and antiplatelet agents—have significantly reduced stroke rates in stable asymptomatic patients, prompting modern guidelines to mandate the identification of high-risk features (such as silent embolic infarctions on neuroimaging, stenosis progression, or intraplaque hemorrhage) before recommending revascularization. Furthermore, because landmark data indicate that the absolute benefit of asymptomatic intervention requires two to five years to mature, patient life expectancy is a critical factor in the decision process. Nevertheless, despite optimal medical management, individuals with severe asymptomatic stenosis (>70%) maintain a considerable residual stroke risk of 2–3% annually, thereby remaining strong candidates for prophylactic revascularization (A. R. Naylor et al., 2018).

Comparison of CEA and CAS

In the Carotid Revascularization and Medical Management for Asymptomatic Carotid Stenosis Trials (CREST-2), among patients with severe, asymptomatic carotid stenosis, combining carotid artery stenting (CAS) with intensive medical therapy led to a lower 4-year rate of a composite of perioperative stroke, death, or ipsilateral stroke compared to intensive medical therapy alone. In contrast, adding carotid endarterectomy (CEA) to intensive medical therapy provided no significant therapeutic advantage over exclusive medical management (Brott et al., 2026). For symptomatic carotid stenosis, carotid artery stenting (CAS) carries a higher periprocedural risk of stroke or death than carotid endarterectomy (CEA), driven primarily by an excess of minor, non-disabling strokes in patients older than 70 years. Beyond the perioperative period, both modalities demonstrate equivalent long-term efficacy in preventing recurrent stroke. Nonetheless, when balancing immediate procedural safety with long-term durability, the cumulative evidence continues to favor endarterectomy (Müller et al., 2020).

Transcarotid Artery Revascularization (TCAR)

Transcarotid artery revascularization (TCAR) circumvents a diseased aortic arch by establishing direct surgical access via the common carotid artery. Crucially, before the stenotic lesion is crossed, a dedicated circuit initiates neuroprotective flow reversal, redirecting blood away from the brain to capture dislodged plaque fragments. By eliminating the 'unprotected state' typical of filter-based TFCAS, this immediate flow reversal drastically optimizes safety; diffusion-weighted MRI studies demonstrate that TCAR reduces the incidence of new ipsilateral brain lesions to just 13%–18%, compared to the 87.1% observed with distal filter protection (Lal et al., 2020). Transcarotid artery revascularization (TCAR) requires specific anatomical parameters, including a ≥5-cm clavicle-to-bifurcation distance, a lesion-free common carotid artery (CCA) puncture site, and diameters of ≥6 mm for the CCA and ≥4 mm for the internal carotid artery. While excessive calcification, tortuosity, and acute thrombus limit its use, approximately 75% of patients remain eligible for TCAR. Conversely, carotid endarterectomy (CEA) can be technically challenging in patients with a tracheostoma, high bifurcation, prior neck irradiation, or hostile neck anatomy from previous surgeries. Rather than being antagonistic, these modalities play a complementary role; incorporating TCAR into clinical practice as an additional revascularization option has been shown to reduce perioperative adverse event rates (Musialek et al., 2025; Schermerhorn, 2024). In a multicenter cohort of 155 high-risk patients (77% asymptomatic, 23% symptomatic), the procedure achieved a 98.7% technical success rate with zero perioperative or 1-year strokes and a minimal 1.3% cranial nerve deficit rate. The 1-year mortality rate was 2.6%, with all deaths resulting strictly from non-neurological causes (Kashyap et al., 2022).Meta-analytic data demonstrate that transcarotid artery revascularization (TCAR) significantly reduces the risks of stroke (OR=0.63; 95% CI: 0.47–0.85), mortality, and composite stroke/death compared to transfemoral stenting (TFCAS), alongside lower radiation exposure. The incidence of transient ischemic attack (TIA) and myocardial infarction remains consistent. In comparison with carotid endarterectomy (CEA), TCAR has been shown to offer reduced operative times, minimised blood loss and a lower incidence of cranial nerve injury. It is of particular significance to note that the safety and efficacy of TCAR over TFCAS is especially evident in elderly populations (Liang & Schermerhorn, 2022; Wu et al., 2024). In a network meta-analysis of ten studies ($n=12,550$), TCAR demonstrated non-significant trends toward reduced restenosis compared to both CAS ($OR=0.45$, $95\%\text{ CI: }0.05\text{–}4.24$, $P=.487$) and CEA ($OR=0.62$, $95\%\text{ CI: }0.07\text{–}5.70$). Despite the lack of conventional statistical significance—compounded by a single direct CEA-versus-TCAR comparison—TCAR achieved the highest cumulative P-score (0.7092), suggesting it may be the mathematically superior modality for mitigating long-term restenosis risk (Amran et al., 2026).

Best Medical Therapy (BMT)

Contemporary best medical therapy (BMT) for patients with asymptomatic carotid artery stenosis encompasses a multifaceted approach of lifestyle modifications and strict pharmacological management. Foundational lifestyle recommendations mandate smoking cessation, adherence to a healthy diet, and regular physical activity. Contemporary medical management for asymptomatic carotid stenosis remains anchored on standard risk-factor modification: antiplatelet and statin therapies, smoking cessation, and strict control of hypertension and diabetes mellitus (AbuRahma, Avgerinos, Chang, Darling, Duncan, Forbes, Malas, Murad, et al., 2022; AbuRahma, Avgerinos, Chang, Darling, Duncan, Forbes, Malas, Perler, et al., 2022; A. R. Naylor et al., 2018). The pharmacological cornerstone of BMT consists of long-term anti-platelet therapy—preferentially low-dose aspirin, or clopidogrel for intolerant individuals—which must be maintained peri-procedurally and transitioned to dual anti-platelet therapy for at least one month following carotid artery stenting (CAS) (Paraskevas et al., 2016). Concurrently, aggressive lipid-lowering therapy using statins (such as atorvastatin or rosuvastatin) is required to achieve either a 50% reduction in low-density lipoprotein (LDL) cholesterol or an absolute target of <1.8 mmol/L (70 mg/dL) (A. R. Naylor et al., 2018). Furthermore, rigorous anti-hypertensive treatment is necessary to maintain blood pressure below 140/90 mm Hg in non-diabetic patients and <140/85 mm Hg in diabetic cohorts, with strict peri-procedural limits set below 180/90 mm Hg for both CEA and CAS, regardless of the specific anti-hypertensive agent utilized (Sutton-Tyrrell et al., 1994). Finally, for patients with concurrent diabetes, BMT explicitly requires tight glycemic control to further attenuate their intrinsically elevated risk of stroke and cardiovascular events (Banerjee et al., 2012; Gaba et al., 2018). Best medical therapy (BMT) constitutes the universal foundation of care for all patients with asymptomatic carotid stenosis, serving as an essential prerequisite to any revascularization modality (CEA, CAS, or TCAR). Nevertheless, prophylactic intervention should be strongly considered for patients identified as high-risk for stroke despite optimal medical management. The risk stratification is driven by severe stenosis (≥80%), rapid disease progression, and vulnerable plaque or neuroimaging markers. The latter include, but are not limited to, Doppler-detected microemboli, silent infarctions, impaired cerebrovascular reserve, plaque echolucency, ulceration, and intraplaque haemorrhage. Management must be highly individualized, carefully weighing objective clinical and anatomical risk factors against each patient's socio-cultural context and personal preferences (Bonati et al., 2021; Paraskevas et al., 2016).

Table 1. A comparison of the different modalities

Modality	Primary Mechanism	Key Periprocedural Risk	Long-Term Restenosis Risk	Ideal Patient Profile
CEA	Surgical excision of plaque	Cranial nerve injury, myocardial infarction	Low to Moderate	Hostile aortic anatomy, age greater than 70, heavily calcified plaques
TFCAS	Endovascular stenting via femoral artery	Higher minor stroke risk (especially in elderly)	Higher (relative to CEA/TCAR)	Age less than 70, hostile neck anatomy (radiation, prior surgery)
TCAR	Direct carotid access with flow reversal	Transient local access complications	Lowest numerical risk (Highest P-score)	High surgical risk, elderly patients, severe aortic arch disease
BMT	Pharmacological stabilization & lifestyle	High residual risk if high-risk plaque features present	N/A (Disease progression risk)	Stable, low-risk asymptomatic stenosis

Conclusions

Intensive best medical therapy (BMT) remains the mandatory foundation of care, with revascularization selectively reserved for symptomatic (≥50%) or high-risk asymptomatic (>70%) carotid stenosis. While carotid endarterectomy (CEA) stands as the durable surgical gold standard requiring routine patch closure, traditional endovascular risks have been heavily mitigated by dual-layer stents, alternative access routes, and proximal protection systems. Transcarotid artery revascularization (TCAR) successfully bridges these open and endovascular techniques, avoiding the diseased aortic arch via neuroprotective flow reversal to deliver low restenosis rates for high-risk cohorts. Ultimately, these modalities represent complementary rather than adversarial strategies, requiring an individualized approach that matches patient-specific anatomical, physiological, and metabolic risks to each treatment's unique strengths.

Future perspectives focus on shifting from luminal stenosis to AI-driven identification of vulnerable plaque morphology. Long-term trials must redefine intervention thresholds against aggressive modern BMT, including GLP-1 receptor agonists and SGLT2 inhibitors, while device engineering optimizes dual-layer stents and expands TCAR anatomical eligibility to broaden safely treatable patient cohorts.

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REFERENCES

1. AbuRahma, A. F., Avgerinos, E. D., Chang, R. W., Darling, R. C., Duncan, A. A., Forbes, T. L., Malas, M. B., Murad, M. H., Perler, B. A., Powell, R. J., Rockman, C. B., & Zhou, W. (2022). Society for Vascular Surgery clinical practice guidelines for management of extracranial cerebrovascular disease. *Journal of Vascular Surgery, 75*(1 Suppl.), 4S–22S. https://doi.org/10.1016/j.jvs.2021.04.073
2. AbuRahma, A. F., Avgerinos, E. D., Chang, R. W., Darling, R. C., Duncan, A. A., Forbes, T. L., Malas, M. B., Perler, B. A., Powell, R. J., Rockman, C. B., & Zhou, W. (2022). The Society for Vascular Surgery implementation document for management of extracranial cerebrovascular disease. *Journal of Vascular Surgery, 75*(1 Suppl.), 26S–98S. https://doi.org/10.1016/j.jvs.2021.04.074
3. Amran, M. Y., Fitrah, Y. A., Larassaphira, N. P., Gunawan, A. M. A. K., Abdillah, A. M. H., Toaha, A. R. M., Zainal, A. T. F., & Gunadi, S. G. A. (2026). Comparative safety and efficacy of invasive therapies for carotid artery stenosis: A systematic review and network meta-analysis. *Journal of NeuroInterventional Surgery, 18*(6), 1545–1557. https://doi.org/10.1136/jnis-2025-023900
4. Banerjee, C., Moon, Y. P., Paik, M. C., Rundek, T., Mora-McLaughlin, C., Vieira, J. R., Sacco, R. L., & Elkind, M. S. V. (2012). Duration of diabetes and risk of ischemic stroke: The Northern Manhattan Study. *Stroke, 43*(5), 1212–1217. https://doi.org/10.1161/STROKEAHA.111.641381
5. Barnett, H. J. M., Taylor, D. W., Eliasziw, M., Fox, A. J., Ferguson, G. G., Haynes, R. B., Rankin, R. N., Clagett, G. P., Hachinski, V. C., Sackett, D. L., Thorpe, K. E., Meldrum, H. E., & Spence, J. D. (1998). Benefit of carotid endarterectomy in patients with symptomatic moderate or severe stenosis. *New England Journal of Medicine, 339*(20), 1415–1425. https://doi.org/10.1056/NEJM199811123392002
6. Berkhemer, O. A., Fransen, P. S. S., Beumer, D., van den Berg, L. A., Lingsma, H. F., Yoo, A. J., Schonewille, W. J., Vos, J. A., Nederkoorn, P. J., Wermer, M. J. H., van Walderveen, M. A. A., Staals, J., Hofmeijer, J., van Oostayen, J. A., à Nijeholt, G. J. L., Boiten, J., Brouwer, P. A., Emmer, B. J., de Bruijn, S. F., ... Dippel, D. W. J. (2015). A randomized trial of intraarterial treatment for acute ischemic stroke. *New England Journal of Medicine, 372*(1), 11–20. https://doi.org/10.1056/NEJMoa1411587
7. Bonati, L. H., Kakkos, S., Berkefeld, J., de Borst, G. J., Bulbulia, R., Halliday, A., van Herzeele, I., Koncar, I., McCabe, D. J., Lal, A., Ricco, J.-B., Ringleb, P., Taylor-Rowan, M., & Eckstein, H.-H. (2021). European Stroke Organisation guideline on endarterectomy and stenting for carotid artery stenosis. *European Stroke Journal, 6*(2), I–XLVII. https://doi.org/10.1177/23969873211012121
8. Brott, T. G., Howard, G., Lal, B. K., Voeks, J. H., Turan, T. N., Roubin, G. S., Lazar, R. M., Brown, R. D., Huston, J., Edwards, L. J., Jones, M., Clark, W. M., Chamorro, Á., Llull, L., Mena-Hurtado, C., Heck, D., Marshall, R. S., Howard, V. J., Moore, W. S., ... Meschia, J. F. (2026). Medical management and revascularization for asymptomatic carotid stenosis. *New England Journal of Medicine, 394*(3), 219–231. https://doi.org/10.1056/NEJMoa2508800
9. Chongruksut, W., Vaniyapong, T., & Rerkasem, K. (2014). Routine or selective carotid artery shunting for carotid endarterectomy and different methods of monitoring in selective shunting. *Cochrane Database of Systematic Reviews, 2014*(6), Article CD000190. https://doi.org/10.1002/14651858.CD000190.pub3
10. Flaherty, M. L., Kissela, B., Khoury, J. C., Alwell, K., Moomaw, C. J., Woo, D., Khatri, P., Ferioli, S., Adeoye, O., Broderick, J. P., & Kleindorfer, D. (2013). Carotid artery stenosis as a cause of stroke. *Neuroepidemiology, 40*(1), 36–41. https://doi.org/10.1159/000341410
11. Gaba, K., Ringleb, P. A., & Halliday, A. (2018). Asymptomatic carotid stenosis: Intervention or best medical therapy? *Current Neurology and Neuroscience Reports, 18*(11), Article 80. https://doi.org/10.1007/s11910-018-0888-5
12. General anaesthesia versus local anaesthesia for carotid surgery (GALA): A multicentre, randomised controlled trial. (2008). *The Lancet, 372*(9656), 2132–2142. https://doi.org/10.1016/S0140-6736(08)61699-2
13. Hara, T., & Rai, Y. (2022). Carotid endarterectomy. *Advances and Technical Standards in Neurosurgery, 44*, 187–207. https://doi.org/10.1007/978-3-030-87649-4_10
14. Hill, M. D., Brooks, W., Mackey, A., Clark, W. M., Meschia, J. F., Morrish, W. F., Mohr, J. P., Rhodes, J. D., Popma, J. J., Lal, B. K., Longbottom, M. E., Voeks, J. H., Howard, G., & Brott, T. G. (2012). Stroke after carotid stenting and endarterectomy in the Carotid Revascularization Endarterectomy versus Stenting Trial (CREST). *Circulation, 126*(25), 3054–3061. https://doi.org/10.1161/CIRCULATIONAHA.112.120030
15. Jamilian, P., Bretfelean, L.-D., Rajagopalan, S., & Suttenwood, H. (2024). Current practices in carotid surgery. *British Journal of Hospital Medicine, 85*(9), 1–9. https://doi.org/10.12968/hmed.2024.0065
16. Kashyap, V. S., So, K. L., Schneider, P. A., Rathore, R., Pham, T., Motaganahalli, R. L., Massop, D. W., Foteh, M. I., Eckstein, H.-H., Jim, J., Leal Lorenzo, J. I., & Melton, J. G. (2022). One-year outcomes after transcarotid artery revascularization (TCAR) in the ROADSTER 2 trial. *Journal of Vascular Surgery, 76*(2), 466–473.e1. https://doi.org/10.1016/j.jvs.2022.03.872
17. Knappich, C., Kuehnl, A., Haller, B., Salvermoser, M., Algra, A., Becquemin, J.-P., Bonati, L. H., Bulbulia, R., Calvet, D., Fraedrich, G., Gregson, J., Halliday, A., Hendrikse, J., Howard, G., Jansen, O., Malas, M. B., Ringleb, P. A., Brown, M. M., Mas, J.-L., ... Lewis, S. C. (2019). Associations of perioperative variables with the 30-day risk of stroke or death in CEA for symptomatic carotid stenosis. *Stroke, 50*(12), 3439–3448. https://doi.org/10.1161/STROKEAHA.119.026320

18. Lal, B. K., Jordan, W., Kashyap, V. S., Kwolek, C. J., Moore, W. S., Mukherjee, D., & Schermerhorn, M. L. (2020). Clinical competence statement of the Society for Vascular Surgery on training and credentialing for transcarotid artery revascularization. *Journal of Vascular Surgery, 72*(3), 779–789. https://doi.org/10.1016/j.jvs.2020.05.053
19. Liang, P., & Schermerhorn, M. L. (2022). Transcarotid artery revascularization: Is it better than carotid endarterectomy? *Advances in Surgery, 56*(1), 111–127. https://doi.org/10.1016/j.yasu.2022.02.004
20. Morris, D. R., Ayabe, K., Inoue, T., Sakai, N., Bulbulia, R., Halliday, A., & Goto, S. (2017). Evidence-based carotid interventions for stroke prevention: State-of-the-art review. *Journal of Atherosclerosis and Thrombosis, 24*(4), 373–387. https://doi.org/10.5551/jat.38745
21. Müller, M. D., Lyrer, P., Brown, M. M., & Bonati, L. H. (2020). Carotid artery stenting versus endarterectomy for treatment of carotid artery stenosis. *Cochrane Database of Systematic Reviews, 2020*(2), Article CD000515. https://doi.org/10.1002/14651858.CD000515.pub5
22. Musialek, P., Bonati, L. H., Bulbulia, R., Halliday, A., Bock, B., Capoccia, L., Eckstein, H.-H., Grunwald, I. Q., Lip, P. L., Monteiro, A., Paraskevas, K. I., Podlasek, A., Rantner, B., Rosenfield, K., Siddiqui, A. H., Sillesen, H., Van Herzeele, I., Guzik, T. J., Mazzolai, L., ... Lip, G. Y. H. (2025). Stroke risk management in carotid atherosclerotic disease: A clinical consensus statement of the ESC Council on Stroke and the ESC Working Group on Aorta and Peripheral Vascular Diseases. *Cardiovascular Research, 121*(1), 13–43. https://doi.org/10.1093/cvr/cvad135
23. Musialek, P., Paraskevas, K. I., & Roubin, G. S. (2024). Improving carotid artery stenting to match carotid endarterectomy: A task accomplished. *EuroIntervention, 20*(7), e402–e404. https://doi.org/10.4244/EIJ-E-24-00012
24. Naylor, A. R., Ricco, J.-B., de Borst, G. J., Debus, S., de Haro, J., Halliday, A., Hamilton, G., Kakisis, J., Kakkos, S., Lepidi, S., Markus, H. S., McCabe, D. J., Roy, J., Sillesen, H., van den Berg, J. C., Vermassen, F., ESVS Guidelines Committee, Kolh, P., Chakfe, N., ... Venermo, M. (2018). Editor's choice: Management of atherosclerotic carotid and vertebral artery disease: 2017 clinical practice guidelines of the European Society for Vascular Surgery (ESVS). *European Journal of Vascular and Endovascular Surgery, 55*(1), 3–81. https://doi.org/10.1016/j.ejvs.2017.06.021
25. Naylor, R., Rantner, B., Ancetti, S., de Borst, G. J., Di Carlo, M., Halliday, A., Kakkos, S. K., Markus, H. S., McCabe, D. J. H., Sillesen, H., van den Berg, J. C., de Ceniga, M. V., Venermo, M. A., Vermassen, F. E. G., ESVS Guidelines Committee, Antoniou, G. A., Goncalves, F. B., Björck, M., Chakfe, N., ... Stone, D. H. (2023). Editor's choice: European Society for Vascular Surgery (ESVS) 2023 clinical practice guidelines on the management of atherosclerotic carotid and vertebral artery disease. *European Journal of Vascular and Endovascular Surgery, 65*(1), 7–111. https://doi.org/10.1016/j.ejvs.2022.04.011
26. Paraskevas, K. I., Mikhailidis, D. P., Veith, F. J., & Spence, J. D. (2016). Definition of best medical treatment in asymptomatic and symptomatic carotid artery stenosis. *Angiology, 67*(5), 411–419. https://doi.org/10.1177/0003319715624526
27. Randomised trial of endarterectomy for recently symptomatic carotid stenosis: Final results of the MRC European Carotid Surgery Trial (ECST). (1998). *The Lancet, 351*(9113), 1379–1387. https://doi.org/10.1016/S0140-6736(97)09292-1
28. Ren, S., Li, X., Wen, J., Zhang, W., & Liu, P. (2013). Systematic review of randomized controlled trials of different types of patch materials during carotid endarterectomy. *PLOS ONE, 8*(1), Article e55050. https://doi.org/10.1371/journal.pone.0055050
29. Rerkasem, K., & Rothwell, P. M. (2011). Systematic review of randomized controlled trials of patch angioplasty versus primary closure and different types of patch materials during carotid endarterectomy. *Asian Journal of Surgery, 34*(1), 32–40. https://doi.org/10.1016/S1015-9584(11)60016-X
30. Paraskevas, K. I., Malas, M. B., & Schermerhorn, M. L. (2024). Transcarotid artery revascularization versus carotid endarterectomy. *Angiology*. https://doi.org/10.1177/00033197241261453
31. Sutton-Tyrrell, K., Wolfson, S. K., & Kuller, L. H. (1994). Blood pressure treatment slows the progression of carotid stenosis in patients with isolated systolic hypertension. *Stroke, 25*(1), 44–50. https://doi.org/10.1161/01.STR.25.1.44
32. Transcarotid arterial revascularization of symptomatic internal carotid artery disease: A systematic review and study-level meta-analysis. (n.d.). *Stroke*. Retrieved May 31, 2026, from https://www.ahajournals.org/doi/10.1161/STROKEAHA.123.044246
33. Veunac, L., Saliou, G., Knebel, J.-F., Bartolini, B., Puccinelli, F., Michel, P., & Hajdu, S. D. (2022). Revascularization of carotid artery occlusion using stenting versus non stenting in endovascular management of tandem occlusion stroke. *Journal of Clinical Neuroscience, 98*, 15–20. https://doi.org/10.1016/j.jocn.2022.01.036
34. Wiske, C., Arhuidese, I., Malas, M., & Patterson, R. (2018). Comparing the efficacy of shunting approaches and cerebral monitoring during carotid endarterectomy using a national database. *Journal of Vascular Surgery, 68*(2), 416–425. https://doi.org/10.1016/j.jvs.2017.11.077
35. Wu, H., Wang, Z., Li, M., Sun, P., Wei, S., Xie, B., Zhang, C., Zhang, L., & Bai, H. (2024). Outcomes of transcarotid artery revascularization: A systematic review. *Interventional Neuroradiology, 30*(3), 396–403. https://doi.org/10.1177/15910199221123283