# CAROTID ARTERY STENTING (CAS): INDICATIONS AND EVIDENCE

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## I CURRENT INDICATIONS (ESC 2024 PAAD / ESVS 2023 GUIDELINES)

### A Symptomatic Patients (TIA, Amaurosis Fugax, or Non-Disabling Ischemic Stroke Within 6 Months)

- **Standard Revascularization Thresholds (NASCET Criteria):** Revascularization is **Class I recommended for 70% to 99% carotid stenosis** and **Class IIa for 50% to 69% stenosis**, provided the documented procedural 30-day risk of death or stroke is **less than 6 percent**. (Carotid Endarterectomy [CEA] is generally first-line, while Carotid Artery Stenting [CAS] may be considered [Class IIb] as an alternative in standard-risk patients <70 years.)
- **When CAS is Preferred Over CEA (Class IIa):** CAS is preferred over open surgery in symptomatic patients with **High Surgical Risk or Hostile Neck Anatomy**—specifically **prior cervical radiation therapy, radical neck dissection/tracheostomy, post-CEA restenosis, high carotid bifurcation or lesion extending above the C2 vertebral body (or low intrathoracic common carotid lesion), contralateral laryngeal/vocal cord paralysis, contralateral internal carotid occlusion**, or severe cardiopulmonary comorbidity (severe HFrEF, recent MI, unstable angina).

### B Asymptomatic Patients (No Ipsilateral Neurological Symptoms Within 6 Months)

- **Standard Threshold (60% to 99% NASCET Stenosis):** Routine revascularization is **not** recommended in unselected asymptomatic patients on modern medical therapy (statins, antiplatelets, BP control); revascularization (**CEA [Class IIa] or CAS [Class IIb]**) is considered **only** if **1 or more imaging/clinical features of increased ipsilateral stroke risk** are present, the 30-day procedural stroke/death rate is **less than 3 percent**, and patient **life expectancy exceeds 5 years**.
- **High-Risk Stroke Features Justifying Intervention in Asymptomatic 60–99% Stenosis:** Contralateral TIA/stroke, **silent ipsilateral infarction on brain CT/MRI**, **stenosis progression (>20%)**, **large plaque area (>40–80 mm2) or echolucent/juxtaluminal black area on ultrasound**, **intraplaque hemorrhage or lipid-rich necrotic core on MRI**, **spontaneous microemboli on Transcranial Doppler (TCD)**, or **impaired cerebrovascular reserve**.

## II CONTRAINDICATIONS TO CAROTID ARTERY STENTING

### A Absolute Contraindications

- **Anatomical Factors:** Visible **free-floating intraluminal thrombus** at the lesion site (extreme risk of fatal distal cerebral embolization during wiring/stenting), **chronic total occlusion (100%)** of the internal carotid artery, or inability to gain safe vascular access.
- **Clinical Factors:** Severe cognitive impairment/dementia, major disabling acute stroke (modified Rankin Scale >=3–4, or infarct involving >1/3 of the MCA territory due to high hemorrhagic transformation risk), intolerance to dual antiplatelet therapy, or life expectancy <1 year (or <5 years in asymptomatic stenosis).

### B Relative Contraindications (Anatomical High-Risk for Transfemoral CAS [TF-CAS] — Favoring CEA or TCAR)

- **Hostile Aortic Arch Anatomy: Type III aortic arch**, severely calcified ("shaggy/porcelain") aortic arch, or complex **bovine arch** requiring prolonged catheter manipulation across the arch.
- **Lesion and Target Vessel Characteristics: Heavy circumferential ("eggshell" >=270–360 degree) calcification** (prevents stent expansion), **severe proximal common carotid or distal internal carotid tortuosity (>90-degree angulation / kinking)** preventing embolic protection device placement, long multifocal tandem lesions, or **echolucent unstable lipid-rich plaque**.
- **Patient Age >= 70 to 75 Years:** Individual-patient meta-analyses of randomized trials (**Carotid Stenting Trialists' Collaboration**) prove that **transfemoral CAS carries approximately double the 30-day stroke risk of CEA in patients aged 70 years or older** (driven by aortic arch atheroma scraping and vessel tortuosity), whereas CAS and CEA have equivalent stroke rates in patients **under 70 years of age**.

| Clinical Trial | Target Population & Design | Primary Efficacy & Safety Findings | Clinical Impact |
|---|---|---|---|
| **SAPPHIRE (2004)** | **High-surgical-risk** patients (symptomatic >=50% or asymptomatic >=80%): **CAS + EPD vs. CEA** | 1-yr composite (death, stroke, MI): **12.2% CAS vs. 20.1% CEA** (non-inferior, p = 0.004) | Established **CAS with embolic protection** in high-surgical-risk patients |
| **CREST (2010 & 10-Yr)** | **2,502 Standard-risk** symptomatic & asymptomatic patients: **TF-CAS vs. CEA** | 4-yr & 10-yr primary composite (stroke, MI, death): **No difference (7.2% vs. 6.8%)**; 30-day **Stroke higher in CAS (4.1% vs. 2.3%)**, while **MI (2.3% vs. 1.1%) & cranial nerve palsy (4.7% vs. 0.3%) higher in CEA** | Proved long-term durability of both; established the **age <70 yr** equivalence rule and **MI vs. minor stroke trade-off** |
| **ACT-1 (2016)** | **1,453 Standard-risk asymptomatic** patients (<80 yr, 70–99% stenosis): **CAS vs. CEA** | 1-yr composite (death, stroke, MI): **3.8% CAS vs. 3.4% CEA** (non-inferior); 5-yr stroke-free survival identical (93.1% vs. 94.7%) | Validated CAS non-inferiority in standard-risk asymptomatic patients <80 years |
| **ACST-2 (2021)** | **3,625 Asymptomatic** patients (largest RCT): **CAS vs. CEA** | 30-day disabling stroke/death **1.0% in both** (more non-disabling stroke with CAS: 2.7% vs. 1.6%); **5-year fatal/disabling stroke identical (2.5% vs. 2.5%)** | Confirmed identical 5-year protection against disabling stroke |
| **ROADSTER 1 & 2** | **TCAR (Transcarotid Artery Revascularization)** with dynamic flow reversal | 30-day stroke rate **1.4% (ROADSTER 1)** and **0.6%–1.9% (ROADSTER 2)**; cranial nerve injury <1.5% | Bypassing the aortic arch via direct common carotid cutdown + flow reversal eliminates arch embolic stroke in elderly (>75 yr) patients |

## III MANAGEMENT OF PROCEDURAL COMPLICATIONS

- **Periprocedural Embolic Stroke:**
  - **Prevention (Class IIa):** Use of **Cerebral Embolic Protection Devices (EPDs)**—either **Distal Filter Wire devices** (e.g., FilterWire EZ, SpiderFX, Emboshield NAV6), **Proximal Balloon Occlusion with Flow Reversal/Stasis** (Mo.Ma Ultra—preferred in friable, thrombotic, or tight lesions), or **Direct Transcarotid Flow Reversal (TCAR — ENROUTE system)**, alongside **Dual-Layer Micromesh Stents** (Roadsaver, CGuard) to prevent plaque prolapse through stent struts.
  - **Acute Management:** Immediate cerebral angiography and **mechanical neuro-thrombectomy** (stent-retriever or aspiration) if acute large-vessel intracranial occlusion (M1/M2 MCA or terminal ICA) occurs on the table.
  - **Carotid Sinus Baroreceptor Reflex (Hemodynamic Depression — Bradycardia & Hypotension):**
  - **Mechanism:** Mechanical stretching of the **carotid sinus baroreceptors** during balloon predilation/postdilation stimulates the **Sinus Nerve of Hering (CN IX)** and nucleus tractus solitarius, triggering vagal bradycardia/asystole and sympathetic withdrawal hypotension (occurs in 10 to 40 percent).
  - **Management:** Hold morning antihypertensives on the day of CAS, administer prophylactic **Intravenous Atropine (0.5 to 1.0 mg IV)** or glycopyrrolate 1 minute prior to balloon inflation across the carotid bulb, avoid aggressive balloon oversizing, and treat persistent post-stent baroreceptor hypotension with **IV isotonic crystalloid boluses and IV Phenylephrine, Norepinephrine, or Dopamine** (or oral **Midodrine**; usually resolves within 12 to 24 hours as baroreceptors reset).
  - **Cerebral Hyperperfusion Syndrome (CHS — Occurs in 1% to 3% at 12 Hours to 7 Days Post-CAS/CEA):**
  - **Mechanism:** In patients with chronic critical (>80–90%) carotid stenosis and contralateral occlusion or poor collateral flow, downstream cerebral arterioles are **maximally chronically vasodilated with loss of pressure autoregulation**. Sudden restoration of high-pressure pulsatile perfusion overwhelms the blood-brain barrier, causing **ipsilateral hydrostatic vasogenic cerebral edema and fatal Intracerebral Hemorrhage (ICH)**.
  - **Clinical Triad: Severe ipsilateral throbbing frontotemporal headache**, **focal neurological deficits**, and **focal or generalized seizures** (without cerebral ischemia on imaging).
  - **Management: Aggressive, immediate strict Blood Pressure Control (target Systolic BP <120 to 130 mmHg)** using agents that do **not** cause cerebral vasodilation—specifically **Intravenous Labetalol or Nicardipine/Clevidipine** (**strictly avoid Sodium Nitroprusside, Nitroglycerin, and Hydralazine**, as direct cerebral venodilation/vasodilation increases intracranial pressure and worsens hyperperfusion).

## IV PRACTICAL PROTOCOLS AND THE INDIAN CLINICAL CONTEXT

- **Dual Antiplatelet Therapy (DAPT — Class I):** Load with **Aspirin (75–325 mg) + Clopidogrel (300–600 mg)** prior to CAS, maintain **DAPT (Aspirin 75–100 mg + Clopidogrel 75 mg daily) for at least 4 weeks (1 month)** post-stenting until endothelialization, and continue **lifelong single antiplatelet therapy (Clopidogrel or Aspirin) + High-Intensity Statin**.
- **The "14-Day Window" for Symptomatic Stenosis (Class I):** Because the risk of recurrent stroke after a carotid TIA or minor stroke is highest in the first two weeks, carotid revascularization must be performed **as early as possible—ideally within 14 days of symptom onset**. (Note: During the hyperacute first **2 to 7 days** after symptom onset, **CEA carries a significantly lower stroke risk than transfemoral CAS** because passing a wire/filter through a fresh, ruptured ulcerated plaque has a higher embolic hazard.)
- **Practical Considerations in the Indian Context (Takayasu Arteritis):** In young Indian patients (<40 years, predominantly female) with **Takayasu Arteritis (Type I aortoarteritis)** causing severe common or internal carotid stenosis, intervention must be deferred until **active inflammation is suppressed with corticosteroids/immunosuppressants** (normal ESR and hs-CRP). Because Takayasu lesions are dense, transmural, fibrotic pan-arteritic stenoses (unlike soft atherosclerotic plaques), they require high-pressure balloon angioplasty (preferring drug-coated/plain balloon angioplasty or selective stenting only for dissection/recoil, as routine stenting in Takayasu carries a higher rate of in-stent restenosis than in atherosclerosis).

### KEY REFERENCES


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