Medical Policy Manual

**Topic:** Extracranial Carotid Angioplasty/Stenting  
**Date of Origin:** July 2005

**Section:** Surgery  
**Last Reviewed Date:** December 2016

**Policy No:** 93  
**Effective Date:** January 1, 2017

**IMPORTANT REMINDER**

Medical Policies are developed to provide guidance for members and providers regarding coverage in accordance with contract terms. Benefit determinations are based in all cases on the applicable contract language. To the extent there may be any conflict between the Medical Policy and contract language, the contract language takes precedence.

PLEASE NOTE: Contracts exclude from coverage, among other things, services or procedures that are considered investigational or cosmetic. Providers may bill members for services or procedures that are considered investigational or cosmetic. Providers are encouraged to inform members before rendering such services that the members are likely to be financially responsible for the cost of these services.

**DESCRIPTION**

Carotid angioplasty with stenting (CAS) is a treatment for carotid stenosis that is intended to prevent future stroke. The procedure is proposed as an alternative to medical therapy and a less invasive alternative to carotid endarterectomy (CEA). CAS involves the insertion of a stent (wire-mesh tube) into a narrowed carotid artery. A catheter (a long hollow tube) is inserted into a groin or neck artery and guided through the arteries to the narrowing in the carotid artery. A balloon at the end of the catheter is inflated to push open the narrowed area, and a metal stent is inserted to keep this area from narrowing again. The procedure is performed with the patient fully awake and without sedation. At present, most practitioners also use a distally placed embolic protection (DEP) device that is designed to reduce the risk of stroke caused by thromboembolic material dislodged during CAS. Carotid angioplasty is rarely performed without stent placement.

**Regulatory Status**

The U.S. Food and Drug Administration (FDA) has approved several carotid artery stents and DEP devices from various manufacturers. The FDA has mandated postmarketing studies for these devices. Each FDA-approved carotid stent system is indicated for combined use with a DEP device.
**MEDICAL POLICY CRITERIA**

I. Carotid angioplasty with associated stenting and embolic protection may be considered **medically necessary** when all of the following criteria are met:

   A. Documented 50-99% stenosis; **AND**
   
   B. Symptoms with duration less than 24 hours of focal ischemia (transient ischemic attack or monocular blindness) in previous 120 days, or nondisabling stroke; **AND**
   
   C. One or more of the following anatomic contraindications for carotid endarterectomy (CEA) are present:
      
      1. Tissue changes from prior extensive ipsilateral neck radiation
      2. Prior ipsilateral radical neck resection
      3. Anatomical malformation that prevents collateral circulation to the brain during open carotid endarterectomy (CEA)
      4. Lesions surgically inaccessible (such as high internal carotid lesion that cannot be accessed from the neck)
      5. Spinal immobility preventing open carotid endarterectomy (CEA)
      6. Tracheostomy

II. Except as defined in I. A, B, and C above, carotid angioplasty with associated stenting and embolic protection, is considered **investigational.**

**SCIENTIFIC EVIDENCE**[^1]

Evidence from well-designed, well-conducted randomized controlled trials (RCTs) is necessary to establish the safety and efficacy of carotid angioplasty with stenting (CAS) compared with carotid endarterectomy (CEA) for treatment of carotid stenosis.

**Literature Appraisal**

**Systematic Reviews**

A 2012 updated Cochrane Review systematically reviewed all RCTs comparing carotid angioplasty and stenting with carotid endarterectomy or medical care[^2] The previous reviews found the data to be conflicting and difficult to interpret. However, since the last review, 2 large RCTs, 1 small RCT, and new long-term follow-up data from 3 previously identified trials have been published and the updated report considered the data sufficient to address the principal research questions.
The Cochrane Review found strong evidence that endovascular treatment in patients with symptomatic carotid stenosis is associated with a higher risk of death or stroke than CEA up to 30 days after the procedure. The evidence was also rated strong for an association between patient age and excess risk with endovascular treatment. There was insufficient evidence to determine whether the comparative risks of endovascular treatment versus CEA depended on the patient’s sex, vascular anatomy, or characteristics of atherosclerotic plaque. Little is known on the long-term durability of endovascular treatment beyond four years, especially with respect to restenosis and recurrent stroke rates. The combined results of two large\[3,4\] and three small trials showed no significant increase in severe restenosis after primary stenting compared with endarterectomy, but there was a wide confidence interval surrounding the effect measure and evidence of substantial heterogeneity ($I^2 = 58\%$). The available evidence does not rule out the possibility of a small increase in restenosis rates among patients receiving stent treatment compared with endarterectomy, and it is not known if restenosis increases the risk of recurrent stroke. The existing evidence does not allow any firm conclusions on the comparative safety and efficacy of endovascular treatment versus endarterectomy in patients with asymptomatic carotid stenosis.

The authors noted significant methodological limitations, including heterogeneity between trials (e.g. different patient populations, procedures, medication use, outcome measures, and follow-up) that limited the precision and interpretation of the estimates of effect. Some studies were stopped early due to recruitment, safety, or futility issues. The early termination may have led to an overestimate of the risk or the benefit of the treatment. In addition, no intention-to-treat (ITT) or partial ITT analyses were carried out, which may have biased the estimates of treatment effect.

The authors concluded that “symptomatic carotid stenosis should not be routinely treated with carotid stenting in patients above the age of 70, provided the patients are fit and willing to undergo surgery, and endarterectomy can be performed at standard risk.” For symptomatic patient who are not candidates for CEA, “randomised trial data are sparse and the optimal management is often unclear.” However, carotid stenting may be considered for these patients “so long as the risk of recurrent symptoms with optimized medical treatment alone is considered greater than the risk of the stenting procedure.” Carotid stenting may be offered as an alternative to CEA for symptomatic stenosis in patients younger than 70 years “at centres achieving peri-procedural stroke or death rates in this age group comparable to those with endarterectomy.” For patients with asymptomatic carotid stenosis, there is insufficient data to justify stenting as an alternative to CEA. More long-term follow-up data is needed for both symptomatic and asymptomatic patients to assess rates of restenosis following revascularization procedures.

In 2015, Vincent et al conducted a meta-analysis of 8 RCTs (total N=7091 patients).\[5] Studies were selected that compared CAS to CEA, enrolled more than 50 patients, and reported periprocedural or long-term outcomes. Included were the large randomized trials CREST, ICSS, SPACE, EVA-3S, CAVATAS, and SAPPHIRE. CAS was associated with an increased rate of any type of periprocedural stroke (relative risk [RR], 1.49; 95% CI, 1.11 to 2.01), a similar risk of a disabling or major stroke, and a decreased risk of periprocedural myocardial infarction (RR, 0.47; 95% CI, 0.29 to 0.78). However, in follow-up ranging from 2 to 10 years, stenting was associated with an increased risk of stroke (RR, 1.36; 95% CI, 1.16 to 1.61) and an increased risk of a composite end point of ipsilateral stroke, periprocedural stroke, or periprocedural death (RR, 1.45; 95% CI, 1.20 to 1.75). This analysis supports the conclusion that CEA remains the treatment of choice for most patients due to the increase in adverse events with CAS.

Paraskavas et al conducted a systematic review of studies comparing cognitive outcomes after CEA with those after CAS.\[6] Thirteen studies were included, with heterogeneity in the types of cognitive outcome...
measures reported. In qualitative analysis, the authors report that the majority of studies did not report a significant difference between CEA and CAS in terms of cognitive outcomes, but that the heterogeneity in outcomes reported precluded more definitive conclusions.

Galyfos et al reported results of a systematic review that included 9 trials (n=5959) with a focus on risk of periprocedural symptomatic or asymptomatic myocardial ischemia or infarction. Four studies did not report their definition used for myocardial ischemia, and other studies varied in their definitions. In pooled analysis, compared with CEA, CAS was associated with decreased risk for cardiac damage (pooled RR, 0.37; 95% CI, 0.22 to 0.61; P=0.0001). However, the study provides incomplete information about selection of studies for inclusion, which limits conclusions that can be drawn.

A 2012 Agency for Healthcare Research and Quality (AHRQ) report evaluated the evidence from 60 eligible studies of treatment strategies for patients with asymptomatic carotid artery stenosis. The report noted that the definitions of “asymptomatic” patients were heterogeneous across the evaluated studies (i.e., patients without symptoms, patients with symptoms present for > 6 months before their enrollment in the study but recently [within 6 months] asymptomatic, or patients with symptoms in a vascular territory other than ipsilateral carotid [e.g., vertebrobasilar territory]). The report focused on evidence for the following treatments:

- Medical therapy alone
- CEA and medical therapy compared with medical therapy alone
- CAS and medical therapy compared with medical therapy alone
- CAS and medical therapy compared with CEA and medical therapy.

For evidence on CAS and medical therapy compared with CEA and medical therapy, the review concluded that “one recent large trial (CREST) reported higher rates of postprocedural ipsilateral stroke (including any periprocedural stroke) and its composite primary endpoint in the CAS group, as compared with CEA, but this did not reach statistical significance in patients with asymptomatic carotid stenosis. The CREST and the SAPPHIRE trials randomized patients with symptomatic and asymptomatic carotid stenosis stratified according to symptom status. Therefore, the treatment assignment was randomized among the subgroup of patients with asymptomatic carotid stenosis. However, neither trial was powered to detect a significant difference in the primary composite endpoint among subgroups of patients with asymptomatic carotid stenosis. The failure to find a significant difference does not rule out the possibility that real difference exists between the intervention modalities tested.” The authors also stated that “future trials should focus not only on whether CAS is equivalent or superior to CEA, but also on whether an invasive interventional procedure is likely to translate into any significant benefit to the patient treated with current best medical therapy.”

The 2007 and the 2009 BlueCross BlueShield Association Technology Evaluation Center (TEC) assessments did not identify reliable evidence in support of CAS. Five major randomized trials of CAS vs. CEA were reviewed in the TEC Assessments (SPACE, EVA-3S, SAPPHIRE, ICSS, and CREST) and all had significant limitations, including early termination (SPACE and EVA-3S), small numbers of symptomatic vs. asymptomatic patients (SAPPHIRE), significant loss to follow-up (CREST), and lack of power to reliably detect differences between treatment arms overall as well as in the subanalyses (CREST).

In 2014, Khan and Qureshi published a systematic review with meta-analysis of risk factors associated with stroke and/or death in patients undergoing CAS. The following were reported to be independent risk factors for 30-day stroke and death following CAS:

- Symptomatic carotid stenosis compared with asymptomatic stenosis
• Age >80 years for 30-day stroke/death
• Age >70 years for 4-year stroke/death
• Lesion characteristics (e.g., ulceration, irregularity, calcification, length)
• Final residual stenosis >30%

No significantly increased risk of 30-day post-CAS stroke and/or death was found for gender, cardiac disease, or cardiovascular risk factors including hypertension, hyperlipidemia, chronic obstructive pulmonary disease, peripheral artery disease, cigarette smoking. Mixed and unclear associations with risk were found for chronic renal failure, diabetes mellitus, high C-reactive protein levels, timing of procedure relative to the index ischemic event. Pre- and postprocedural use of statin medications was reported to be associated with lower periprocedural stroke and/or death.

Several other meta-analyses of the studies that compare carotid angioplasty/stenting (CAS) with endarterectomy (CEA) have been published.[14-23] These analyses reported inconsistent findings, most of which favor CEA over CAS for symptomatic carotid stenosis. The reliability of the conclusions from these meta-analyses is limited by pooling results from unreliable, heterogenous primary studies (different patient samples, endovascular procedures, duration of follow-up and/or completion status of the trials).

Randomized Controlled Trials (RCTs)

The Asymptomatic Carotid Trial (ACT) I was a noninferiority trial of CAS versus CEA in asymptomatic individuals who were not at high risk for surgical complications.[24] Enrollment began in 2005 with a target of 1658 participants, but, because of slow enrollment the trial was halted in 2013 with 1453 participants. The primary composite end point of death, stroke, or MI within 30 days or ipsilateral stroke within 1 year was obtained in 3.8% of CAS and 3.4% of CEA patients, while the cumulative 5-year rate of stroke-free survival was 93.1% with CAS and 94.7% with CEA (p=0.44). This study does not answer the question of how best to treat asymptomatic patients, since it does not include a medical therapy arm. Patients who are treated with current best medical therapy may have an ipsilateral stroke rate of only 0.5% to 1% per year.[25]

In 2016, Brott et al reported long-term follow-up for CREST.[26] There were no significant differences in the primary composite outcome (any periprocedural stroke, MI, death or postprocedural ipsilateral stroke) between the CEA (9.9%) and CAS (11.8%; HR=1.10) groups when measured out to 10 years. The second primary end point of post procedural ipsilateral stroke rates were also not significantly different between CEA (5.6%) and CAS (6.9%; HR=0.99).

In 2014, Brooks et al published the long-term results of symptomatic and asymptomatic carotid stenosis patients randomly assigned to CEA or CAS, which were included in the systematic review by Vincent et al.[27] Minimum follow-up was 10 years. One the 173 patients with long-term follow-up data, 87 (50.2%) died within this period, most of nonvascular causes. No difference between the treatment groups was found for risk of ipsilateral stroke (p>0.05). Restenosis was assessed only in the CAS group (3.3%) and remained asymptomatic. The risk of heart attack was significantly higher in patients with baseline symptomatic versus asymptomatic carotid stenosis (p=0.005) and in all patients treated with CEA (p=0.002). Additional long-term data are needed to assess the validity and significance of these findings.

Also in 2014, Altinbas et al reported that periprocedural rates of hemodynamic instability in ICSS differed between CEA and CAS groups.[28] Hemodynamic depression occurred more commonly in CAS
patients (13.8% vs 7.2%; RR 1.9; 95% CI 1.4 to 2.6; P<0.0001), while hypertension requiring treatment occurred less commonly in CAS patients (RR 0.2; 95% CI 0.1 to 0.4; P<0.0001). Hemodynamic instability was not associated with the ICSS study’s primary composite outcome.

In 2016, Featherstone et al published a health technology assessment (HTA) on ICSS funded by the U.K.’s National Institute for Health Research Health Technology Assessment program.[29] The HTA reviewed all of the data from the study, concluding that “the functional outcome after stenting is similar to endarterectomy, but stenting is associated with a small increase in the risk of non-disabling stroke. The choice between stenting and endarterectomy should take into account the procedural risks related to individual patient characteristics.”

Several publications have analyzed data from the CREST trial to compare specific outcomes of CAS vs. CEA or investigate the safety of these procedures in different subgroups.[30-32] However, any findings based on the CREST data are unreliable due to the biases introduced by the loss to follow-up and inadequate statistical power. In a follow up analysis of the CREST trial data, Gonzalez et al reported no differences in outcomes for subjects treated in high-, medium-, or low-volume centers.[33]

Additional smaller trials have compared CEA with CAS. In 2014, Li et al published a study that reported to randomize 130 subjects at high risk of stroke due to angiographically confirmed carotid stenosis (≥50%) to CEA (n=65) or CAS (n=65).[34] The authors report a 3-month post-operative risk of mortality of 1.5% with CAS, compared with 9.2% with CEA. However, “existence of complete follow-up data” is an inclusion criterion, and insufficient details are provided about enrollment and randomization procedures to allow conclusions to be drawn about the study. In 2015, Kuliha et al published results of an RCT which randomized 150 subjects with at least 70% carotid stenosis to CEA (n=73) or CAS (n=77). New infarctions on MRI were found more frequently after CAS (49% vs 25%; P=0.002).[35] A randomized trial comparing CAS to CEA in 136 asymptomatic patients with >70% carotid stenosis was published in 2016 by Mannheim and Karmeli. After a mean follow-up time of 26 months, they found no difference in short- or long-term outcomes.[36]

Non-randomized Studies

Additional evidence has been published related to rates of periprocedural stroke/death following CAS, particularly related to subgroups defined by medical comorbidities. Spangler et al evaluated patients treated with isolated primary CEA (n=11,336) or primary CAS (n=544) at 29 centers between 2003 and 2013 to assess periprocedural mortality and stroke risks for patients considered medically high risk.[37] A Cox proportional hazards model was used to generate predicted 5-year mortality, and patients in the highest risk score quartile were considered high-risk. For asymptomatic patients, there were no significant differences between CEA and CAS for major periprocedural outcomes (major or minor stroke, myocardial infarction, death) for either high- or low-risk patients. Periprocedural death/stroke rates with CAS were 1.1% for low-risk patients and 1.6% for high-risk patients. For symptomatic patients, periprocedural death/stroke rates were higher with CAS than CEA for both low- and high-risk groups. For low-risk symptomatic patients, periprocedural death/stroke rates were 6.0% for CAS, compared with 2.2% for CEA (P<0.01). For high-risk symptomatic patients, periprocedural death/stroke rates were 9.3% for CAS, compared with 2.5% for CEA (P<0.01).

A number of other nonrandomized studies, case series, and registries on carotid angioplasty and stenting (CAS) have been published.[37-53] While these studies contribute to the body of knowledge by providing direction for future research, evidence from these studies does not permit conclusions due to methodological limitations such as nonrandom allocation of treatment and lack of appropriate
comparison groups. In addition, registry data may be unreliable due to incomplete reporting. Finally, the technology under investigation may change over time, further limiting the ability to carry out reliable comparisons based on the registry data.

Clinical Practice Guidelines

American Heart Association/American Stroke Association Council on Stroke (AHA/ASA) [54]

The 2011 update of the evidence-based guideline on stroke prevention from the AHA/ASA includes the following recommendations:

Asymptomatic Carotic Stenosis

Selection of asymptomatic patients for carotid revascularization should be guided by the following:
- An assessment of comorbid conditions and life expectancy
- Other individual factors
- A thorough discussion of the risks and benefits of the procedure with an understanding of patient preferences (Class I; Level of Evidence C defined as useful/effective based on consensus opinion, case studies, limited populations studied).

Prophylactic CEA performed with <3% morbidity and mortality can be useful in highly selected patients with an asymptomatic carotid stenosis (minimum 60% by angiography, 70% by validated Doppler ultrasound) (Class IIa; Level of Evidence A defined as reasonable based on data from multiple RCTs with conflicting evidence or meta-analyses; additional focused studies needed).
- Note: The benefit of surgery may now be lower than anticipated based on RCT results, and the cited 3% threshold for complication rates may be high because of interim advances in medical therapy.

Prophylactic CAS might be considered in highly selected patients with an asymptomatic carotid stenosis. The advantage of revascularization over current medical therapy alone is not well established (Class IIb; Level of Evidence B defined as may be considered, but efficacy is less well established and evidence is conflicting; additional broad studies needed).

Stenosis is defined as at least one of the following:
- >60% on angiography
- >70% on validated Doppler ultrasonography
- >80% on computed tomographic angiography or MRA if the stenosis on ultrasonography was 50% to 69%.

The usefulness of CAS as an alternative to CEA in asymptomatic patients at high risk for the surgical procedure is uncertain (Class IIb; Level of Evidence C defined as may be considered, but efficacy is less well established with only diverging expert opinion or case series; additional focused studies needed).

The 2014 updated AHA/ASA evidence-based guideline for patients with stroke or transient ischemic attack (TIA) includes the following recommendations:

Symptomatic Carotic Stenosis [55]
CEA is recommended for the following patients with recent (i.e., in the past 6 months) TIA or ischemic stroke if the perioperative morbidity and mortality risk is estimated to be less than 6%:
- With severe ipsilateral carotid stenosis (between 70% and 99% of the lumen diameter), (Class I; Level of Evidence A defined as a strong recommendation based on sufficient evidence from multiple RCTs or meta-analyses)
- With moderate carotid stenosis (50% to 69% of the vessel lumen), depending on patient-specific factors such as age, gender, and comorbidities. (Class I; Level of Evidence B defined as recommended based on evidence from a single RCT or non-randomized studies)
- When revascularization is indicated, CEA is reasonable within 2 weeks if there are no contraindications to early revascularization (Class IIa; Level of Evidence B defined as reasonable procedure; some conflicting evidence from single RCT or non-randomized studies)

CAS is indicated as an alternative to CEA for symptomatic patients at low risk of complications associated with endovascular intervention with severe stenosis defined as >70% by noninvasive imaging or >50% (Class I; Level of Evidence B defined as recommended based on evidence from a single RCT or non-randomized studies).

CAS may be considered for patients with symptomatic severe stenosis (>70%) when performed by operators with established periprocedural morbidity and mortality rates of <6% in the following circumstances:
- Patient age older than approximately 70 years, particularly when arterial anatomy is unfavorable (Class IIa; Level of Evidence B)
- Stenosis that is difficult to access surgically, or
- Anatomic or medical conditions that greatly increase the risk for surgery (Class IIa; Level of Evidence B), or
- Other specific circumstances exist (e.g., radiation-induced stenosis or restenosis after prior CEA) (Class IIa; Level of Evidence B)

When the degree of stenosis is <50%, CEA and CAS are not recommended (Class III; Level of Evidence A defined as not helpful based on sufficient evidence from multiple RCTs or meta-analyses)

ASA/ACCF/AHA/AANN/AANS/ACR/ASNR/CNS/SAIP/SCAI/SIR/SNIS/SVM/SVS

The 2011 Guideline on the Management of Patients with Extracranial Carotid and Vertebral Artery Disease[56] specifies the circumstances in which CAS may be indicated as an alternative to CEA, as well as the circumstances when it may be reasonable to choose CAS over CEA. However, the recommendations are based on B level of evidence, the lower level of evidence defined in the guideline as derived from a single randomized trial or non-randomized studies. Further, the specific randomized trials referenced for these determinations are the CREST and SAPPHIRE trials. The findings from these trials are considered unreliable due to significant study limitations as explained above.

Summary

Many studies have compared carotid artery angioplasty and stenting (CAS) with carotid endarterectomy (CEA) for the treatment of carotid artery stenosis. This research does not support CAS for patients at low or average risk, because CAS has a higher risk of harm than CEA in these patients and has not been shown to provide better long-term outcomes. However, certain higher risk patients with carotid artery stenosis should not have CEA, and in these patients, CAS may provide better health outcomes.
Therefore, except in a select group of patients identified in the policy criteria, CAS is considered investigational.

REFERENCES


CROSS REFERENCES

Percutaneous Angioplasty and Stenting of Veins, Surgery, Policy No. 109

Endovascular Angioplasty and/or Stenting for Intracranial Arterial Disease (Atherosclerotic and Aneurysms), Surgery, No. 141
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