

Screening for Carotid Artery Stenosis: U.S. Preventive Services Task Force Recommendation Statement

U.S. Preventive Services Task Force*

Description: Update of the 1996 U.S. Preventive Services Task Force statement about screening for asymptomatic carotid artery stenosis (CAS) in the general population.

Methods: The U.S. Preventive Services Task Force examined the evidence on the natural history of CAS; systematic reviews of the accuracy of screening tests; observational studies of the harms of screening and treatment of asymptomatic CAS; and randomized,

controlled trials of the benefits of treatment for CAS with carotid endarterectomy.

Recommendation: Do not screen for asymptomatic CAS in the general adult population. (Grade D recommendation)

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*For a list of members of the U.S. Preventive Services Task Force, see the **Appendix** (available at www.annals.org).

The U.S. Preventive Services Task Force (USPSTF) makes recommendations about preventive care services for patients without recognized signs or symptoms of the target condition.

It bases its recommendations on a systematic review of the evidence of the benefits and harms and an assessment of the net benefit of the service.

The USPSTF recognizes that clinical or policy decisions involve more considerations than this body of evidence alone. Clinicians and policymakers should understand the evidence but individualize decision making to the specific patient or situation.

Table 1 describes the USPSTF grades, and Table 2 describes the USPSTF classification of levels of certainty about net benefit. Both are also available online at www.annals.org.

Rationale

Importance

Good evidence indicates that although stroke is a leading cause of death and disability in the United States, a relatively small proportion of all disabling, unheralded strokes is due to CAS.

Detection

The most feasible screening test for severe CAS (for example, 60% to 99% stenosis) is duplex ultrasonography. Good evidence indicates that this test has moderate sensitivity and specificity and yields many false-positive results. A positive result on duplex ultrasonography is often confirmed by digital subtraction angiography, which is more accurate but can cause serious adverse events. Noninvasive confirmatory tests, such as magnetic resonance angiography, involve some inaccuracy. Given these facts, some people with false-positive test results may receive unnecessary invasive carotid endarterectomy surgery.

Benefits of Detection and Early Intervention

Good evidence indicates that in selected, high-risk trial participants with asymptomatic severe CAS, carotid endarterectomy by selected surgeons reduces the 5-year absolute incidence of all strokes or perioperative death by approximately 5%. These benefits would be less among asymptomatic people in the general population. For the general primary care population, the benefits are judged to be no greater than small.

SUMMARY OF RECOMMENDATIONS AND EVIDENCE

The USPSTF recommends against screening for asymptomatic carotid artery stenosis (CAS) in the general adult population (Figure). This is a grade D recommendation.

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Harms of Detection and Early Intervention

Good evidence indicates that both the testing strategy and the treatment with carotid endarterectomy can cause harms. A testing strategy that includes angiography will itself cause some strokes. A testing strategy that does not include angiography will cause some strokes by leading to carotid endarterectomy in people who do not have severe CAS. In excellent centers, carotid endarterectomy is associated with a 30-day stroke or mortality rate of about 3%; some areas have higher rates. These harms are judged to be no less than small.

USPSTF Assessment

The USPSTF concludes that, for individuals with asymptomatic CAS, there is moderate certainty that the benefits of screening do not outweigh the harms.

CLINICAL CONSIDERATIONS

Patient Population

This recommendation applies to adults without neurologic signs or symptoms, including a history of transient ischemic attacks or stroke. If otherwise eligible, an individual who has a carotid-area transient ischemic attack should be evaluated promptly for consideration of carotid endarterectomy.

Risk Assessment

In a setting of excellent surgical care and low complication rates, screening may benefit patients who have a very high risk for stroke. It is not clear, however, how to identify people whose risk for stroke is high enough to justify screening yet who do not also have a high risk for surgical complications. The major risk factors for CAS include older age, male sex, hypertension, smoking, hypercholesterolemia, and heart disease.

Screening Tests

Available screening and confirmatory tests (duplex ultrasonography, digital subtraction angiography, and magnetic resonance angiography) all have imperfect sensitivity and appreciable harms. Therefore, screening could lead to non-indicated surgeries that result in serious harms, including death, stroke, and myocardial infarction, in some patients.

Useful Resources

In other recommendations, the USPSTF notes that adults should be screened for hypertension, hyperlipidemia, and smoking. In addition, clinicians should discuss aspirin chemoprevention for patients who have an increased risk for cardiovascular disease. The evidence and recommendations on these conditions from the USPSTF are available on the Agency for Healthcare Research and Quality Web site at www.preventiveservices.ahrq.gov.

DISCUSSION

Burden of Disease

The contribution of CAS 60% to 99% to the morbidity and mortality associated with stroke, or to the natural progression of asymptomatic CAS in the general population, is not precisely known (1, 2). Based on population-based studies and the accuracy of carotid duplex ultrasonography, the estimated prevalence of CAS 60% to 99% in the general population older than age 65 years is about 1%. Studies have found that CAS is more prevalent in older adults, smokers, those with hypertension, and those with heart disease. Research has not found any single risk factor or clinically useful risk stratification tool that can reliably and accurately distinguish people who have clinically important CAS from those who do not.

Scope of Review

In 1996, the USPSTF concluded that evidence was insufficient to recommend for or against screening of asymptomatic patients for CAS by using a physical examination or carotid ultrasonography. To update its recommendation, the USPSTF examined high-quality evidence on the natural history of CAS; systematic reviews of the accuracy of screening tests; and randomized, controlled trials (RCTs) of the benefits of treatment of CAS with carotid endarterectomy. Because the magnitude of potential surgical harms is such an important consideration in the treatment of CAS, the USPSTF conducted a systematic review of this issue.

Accuracy of Screening Tests

Two meta-analyses provide information on the accuracy of carotid duplex ultrasonography in detecting clinically important stenosis. Recent systematic reviews of studies about the accuracy of carotid duplex ultrasonography, using digital subtraction angiography as the reference standard, estimated the sensitivity to be 86% to 90% and the specificity to be 87% to 94% for detecting CAS greater than 70% (3, 4). The estimated sensitivity and specificity of carotid duplex ultrasonography to detect CAS of 60% or more are approximately 94% and 92%, respectively (3). The reliability of carotid duplex ultrasonography is not established (3). One meta-analysis noted that the measurement properties used among various ultrasonography laboratories varied greatly and to a clinically important degree (3). In 1996, the USPSTF reviewed the evidence for screening for bruits on physical examination and found that the test had poor reliability and poor sensitivity (5).

Effectiveness of Early Detection and Treatment

Two good-quality RCTs, the ACAS (Asymptomatic Carotid Atherosclerosis Study) and the ACST (Asymptomatic Carotid Surgery Trial), compared carotid endarterectomy plus medical management to medical management alone in participants without symptoms attributable to the studied artery (6, 7). The ACAS projected a 5-year rate of ipsilateral stroke and any perioperative stroke or death that

was lower in the carotid endarterectomy group than in the medical group: 5.1% versus 11.0% (relative risk reduction, 0.53 [95% CI, 0.22% to 0.72%]). If strokes associated with angiography were included, the difference between the groups was 5.6% versus 11.0%, or an absolute difference of 5.4 percentage points over 5 years. The estimated relative risk reduction was greater for men than for women (0.66 and 0.17, respectively). The ACST projected a lower 5-year rate of any stroke or perioperative death in the carotid endarterectomy group than in the medical group: 6.4% versus 11.8% (absolute difference, 5.4 percentage points [CI 2.96 to 7.75 percentage points]). About half of the strokes prevented by carotid endarterectomy were disabling. The treatment groups did not statistically significantly differ in all-cause mortality in either study.

The RCTs on carotid endarterectomy for asymptomatic CAS have important limitations in their generalizability to the primary care population. The RCTs included highly selected participants and surgeons. The 30-day perioperative results of the RCTs were reported as a combined outcome that did not include acute nonfatal myocardial infarction, which is an important complication. The medical treatment group in the RCTs was poorly defined, was not kept constant over the course of the study, and would not have included treatments that are now considered to be optimal medical management, including aggressive management of blood pressure and lipids.

Potential Harms of Screening and Treatment

Tests done to confirm carotid duplex ultrasonography have associated harms. If all positive tests are followed by digital subtraction angiography, about 1% of people would experience a nonfatal stroke as a result of the angiography. If positive tests are not followed by confirmatory angiography but rather by magnetic resonance angiography or computed tomography angiography—tests with less than 100% accuracy—some patients will have unnecessary carotid endarterectomy, with consequent harms in the absence of proven benefit.

Fourteen good- or fair-quality observational studies that evaluated carotid endarterectomy complications in patients with asymptomatic CAS were identified for USPSTF review. Overall, 30-day perioperative stroke or death rates in asymptomatic patients ranged from 1.6% to 3.7% (2). Participants in ACAS had a perioperative rate of stroke or death of 2.7% overall (1.7% for men and 3.6% for women). In ACST, the perioperative rate of stroke or death was 3.1% overall but was higher for women (3.7%) than for men (2.4%). The observational studies reporting perioperative nonfatal myocardial infarctions showed a rate of approximately 0.7% to 1.1% (8–10). Patients with more comorbid conditions had a rate of nonfatal myocardial infarction up to 3.3% (9). The rate of nonfatal perioperative myocardial infarction reported for the surgical group in the RCTs varied from 0.6% to 1.9%. Two Medicare-based studies found variation in perioperative stroke

and death among 10 states (11, 12). In the first study, the statewide rates ranged from 2.3% to 6.7%; a follow-up study for the same 10 states found similar results as those in 2001, with rates ranging from 1.4% to 6.0%.

Estimate of the Magnitude of Net Benefit

In patients and surgeons similar to those in the RCTs, treatment with carotid endarterectomy for asymptomatic CAS can result in a net absolute reduction in stroke rates—approximately 5% over 5 to 6 years (about 2.5% absolute risk reduction for disabling strokes). The number needed to treat for 5 years to prevent 1 stroke is about 20 (number needed to treat to prevent 1 disabling stroke is about 40). This benefit has been shown in selected patients with selected surgeons, and it must be weighed against a small increase in nonfatal myocardial infarctions. The net benefit for carotid endarterectomy largely depends on people surviving the perioperative period without complications and living for 5 years. The 2 RCTs that found a benefit to surgery compared with medical management had 30-day perioperative rates of stroke and death of 2.7% to 3.1%, and some large observational studies have shown higher rates.

If ultrasonography screening were followed by magnetic resonance angiography confirmation, about 23 strokes would be prevented over 5 years by screening 100 000 people with a prevalence of CAS of 1%. Thus, about 4348 people would need to undergo screening to prevent 1 stroke (number needed to screen) after 5 years. Twice this number (8696 people) would need to be screened to prevent 1 disabling stroke.

How Does the Evidence Fit with Biological Understanding?

The medical treatment group in the RCTs was poorly defined and probably did not include intensive blood pressure and lipid control, which is standard practice today. It is difficult to determine what effect current standard medical therapy would have on overall benefit from carotid endarterectomy. The Kaplan–Meier curves in ACST cross from net harm to net benefit at about 1.5 years after carotid endarterectomy for men and at nearly 3 years after carotid endarterectomy for women (13–17). The average follow-up time in ACAS and ACST was 2.7 and 3.4 years, respectively; the estimated survival beyond the actual follow-up time may not be applicable in this situation. It is possible that the benefit from carotid endarterectomy is limited to a specific interval and does not continue unabated into the future. Thus, the actual (not projected) risk reduction for carotid endarterectomy over 5 to 10 years is still uncertain.

Although this report did not review the evidence on medical treatment, accepted medical strategies to prevent stroke are available. Until research addresses the gaps in the evidence that screening and treatment with carotid endarterectomy provides overall benefits to the general population, clinicians' efforts might be more practically focused

Figure. Screening for carotid artery stenosis: clinical summary of U.S. Preventive Services Task Force Recommendation

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Screening for Carotid Artery Stenosis

Population	Adult General Population *
Recommendation	<p>Do not screen with ultrasonography or other screening tests Grade: D</p>
Risk assessment	<p>The major risk factors for carotid artery stenosis include older age, male sex, hypertension, smoking, hypercholesterolemia, and heart disease. However, accurate, reliable risk assessment tools are not available.</p>
Balance of benefits and harms	<p>Harms outweigh benefits. In the general population, screening with carotid duplex ultrasonography would result in many false-positive results. This would lead either to surgeries that are not indicated or to confirmatory angiography. As the result of these procedures, some people would have serious harms (death, stroke, and myocardial infarction) that outweigh the potential benefit that surgical treatment may have in preventing stroke.</p>
Other relevant recommendations from the USPSTF	<p>Adults should be screened for hypertension, hyperlipidemia, and smoking. Clinicians should discuss aspirin chemoprevention with patients at increased risk for cardiovascular disease. These recommendations and related evidence are available at www.preventiveservices.ahrq.gov.</p>

For a summary of the evidence systematically reviewed in making these recommendations, the full recommendation statement, and supporting documents, please go to www.preventiveservices.ahrq.gov. USPSTF = U.S. Preventive Services Task Force. *This recommendation applies to adults without neurologic symptoms and without a history of transient ischemic attacks or stroke. If otherwise eligible, an individual who has a carotid-area transient ischemic attack should be evaluated promptly for consideration of carotid endarterectomy.

Table 1. What the U.S. Preventive Services Task Force Grades Mean and Suggestions for Practice*

Grade	Definition	Suggestions for Practice
A	The USPSTF recommends the service. There is high certainty that the net benefit is substantial.	Offer/provide this service.
B	The USPSTF recommends the service. There is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial.	Offer/provide this service.
C	The USPSTF recommends against routinely providing the service. There may be considerations that support providing the service in an individual patient. There is moderate or high certainty that the net benefit is small.	Offer/provide this service only if other considerations support offering or providing the service in an individual patient.
D	The USPSTF recommends against the service. There is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits.	Discourage the use of this service.
I statement	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of the service. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.	Read the clinical considerations section of USPSTF Recommendation Statement. If the service is offered, patients should understand the uncertainty about the balance of benefits and harms.

* USPSTF = U.S. Preventive Services Task Force.

Table 2. U.S. Preventive Services Task Force Levels of Certainty about Net Benefit

Level of Certainty*	Description
High	The available evidence usually includes consistent results from well-designed, well-conducted studies in representative primary care populations. These studies assess the effects of the preventive service on health outcomes. This conclusion is therefore unlikely to be strongly affected by the results of future studies.
Moderate	The available evidence is sufficient to determine the effects of the preventive service on health outcomes, but confidence in the estimate is constrained by such factors as: <ul style="list-style-type: none"> the number, size, or quality of individual studies inconsistency of findings across individual studies limited generalizability of findings to routine primary care practice lack of coherence in the chain of evidence. As more information becomes available, the magnitude or direction of the observed effect could change, and this change may be large enough to alter the conclusion.
Low	The available evidence is insufficient to assess effects on health outcomes. Evidence is insufficient because of: <ul style="list-style-type: none"> the limited number or size of studies important flaws in study design or methods inconsistency of findings across individual studies gaps in the chain of evidence findings that are not generalizable to routine primary care practice lack of information on important health outcomes. More information may allow an estimation of effects on health outcomes.

* The U.S. Preventive Services Task Force (USPSTF) defines *certainty* as “likelihood that the USPSTF assessment of the net benefit of a preventive service is correct.” The net benefit is defined as benefit minus harm of the preventive service as implemented in a general primary care population. The USPSTF assigns a certainty level based on the nature of the overall evidence available to assess the net benefit of a preventive service.

on optimizing medical management of risk factors of stroke.

Recommendations of Other Groups

In 2006, the American Heart Association/American Stroke Association did not recommend screening the general population for asymptomatic carotid stenosis (18). The American Society of Neuroimaging released recommendations in 2007 that also recommended against screening in unselected populations but advised that screening of adults age 65 years or older with 3 or more cardiovascular risk factors should be considered (19). In 2007, the Society for Vascular Surgery recommended ultrasonography screening for individuals age 55 years or older with cardiovascular risk factors, such as a history of hypertension, diabetes mellitus, smoking, hypercholesterolemia, or known cardiovascular disease (20).

From the U.S. Preventive Services Task Force, Agency for Healthcare Research and Quality, Rockville, Maryland.

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Requests for Single Reprints: Reprints are available from the USPSTF Web site (www.preventiveservices.ahrq.gov).

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Appendix: U.S. Preventive Services Task Force

Members of the U.S. Preventive Services Task Force† are Ned Calonge, MD, MPH, *Chair* (Colorado Department of Public Health and Environment, Denver, Colorado); Diana B. Petitti, MD, MPH, *Vice Chair* (Keck School of Medicine, University of Southern California, Sierra Madre, California); Thomas G. DeWitt, MD (Children's Hospital Medical Center, Cincinnati, Ohio); Leon Gordis, MD, MPH, DrPH (Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland); Kimberly D. Gregory, MD, MPH (Cedars-Sinai Medical Center, Los Angeles, California); Russell Harris, MD, MPH (University of North Carolina School of Medicine, Chapel Hill, North Carolina); Kenneth W. Kizer, MD, MPH (National Quality Forum, Washington, DC); Michael L. LeFevre, MD, MSPH (University of Missouri School of Medicine, Columbia, Missouri); Carol Loveland-Cherry, PhD, RN (University of

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†This list includes members of the Task Force at the time this recommendation was finalized. For a list of current Task Force members, go to www.ahrq.gov/clinic/uspstfab.htm.

‡Dr. Teutsch was recused from the discussion and vote on this issue.