Does This Patient Have a Clinically Important Carotid Bruit?

Jean-Stéphane Sauvé, MD; Andreas Laupacis, MD; Truls Østbye, MD; Brian Feagan, MD; David L. Sackett, MD

CLINICAL SCENARIOS

Case 1

A 50-year-old man undergoes a general physical examination for his insurance policy. A left-sided, focal, systolic carotid bruit is identified. There is no history of prior stroke or transient ischemic attack (TIA).

Case 2

A 50-year-old man undergoes a preoperative examination the evening before he is to undergo coronary bypass surgery. A bruit identical to that found in the first patient is heard. There is no history of cerebrovascular symptoms.

Case 3

A 50-year-old man presents to the emergency department with a history of a transient (less than 1 hour) slurring of speech and right-arm weakness. There is no history of prior cerebrovascular disease, and the physical examination reveals a focal, left-sided, systolic carotid bruit.

THE IMPORTANCE OF CLINICAL EXAMINATION

The clinical significance of the identical-sounding bruit is vastly different in these patients. In each of them, the coupling of a thoughtful history with a competent physical examination will lead to quite different prognostic predictions and differing courses of appropriate clinical action.

THE CAROTID ARTERY AS A CAUSE FOR BRUITS IN THE NECK

The right common carotid artery arises from the brachiocephalic artery (the first branch of the aortic arch) and the left arises directly from the aortic arch. The common carotid arteries run upward and backward through the neck, from the sternoclavicular joint to the upper border of the thyroid cartilage, where they divide into the external and internal carotid arteries (Figure). The external carotid artery terminates in the substance of the parotid gland, where it divides into the superficial temporal and mandibular arteries. The internal carotid artery ascends to the base of the skull and enters the cranium through the carotid canal in the temporal bone.

Although bruits of the carotid artery have been reported in approximately 20% of children less than 15 years of age, they occur in about 1% of healthy adults.[1] Carotid bruits can be heard in states of increased vascular flow such as thyrotoxicosis, anemia, and arteriovenous fistulas. A relatively common example of the latter occurs with the creation of a forearm fistula in patients receiving hemodialysis.[2] In a convenience sample of 15 long-term hemodialysis patients, Messert et al[2] found bilateral carotid bruits in five patients and a unilateral bruit in six. The bruit was usually louder on the side of the fistula and was often associated with a subclavian bruit (in 13 of 15 patients). Carotid artery stenosis, typically due to atherosclerosis, is the underlying condition to be considered when one hears a carotid bruit, and the accuracy of this sign is discussed below. However, a bruit may be heard over the bifurcation of the carotid artery when the associated angiogram shows either a normal or completely occluded internal carotid artery; in these cases the bruit may arise from a stenosed external carotid artery.[3]

HOW TO HEAR CAROTID BRUITS

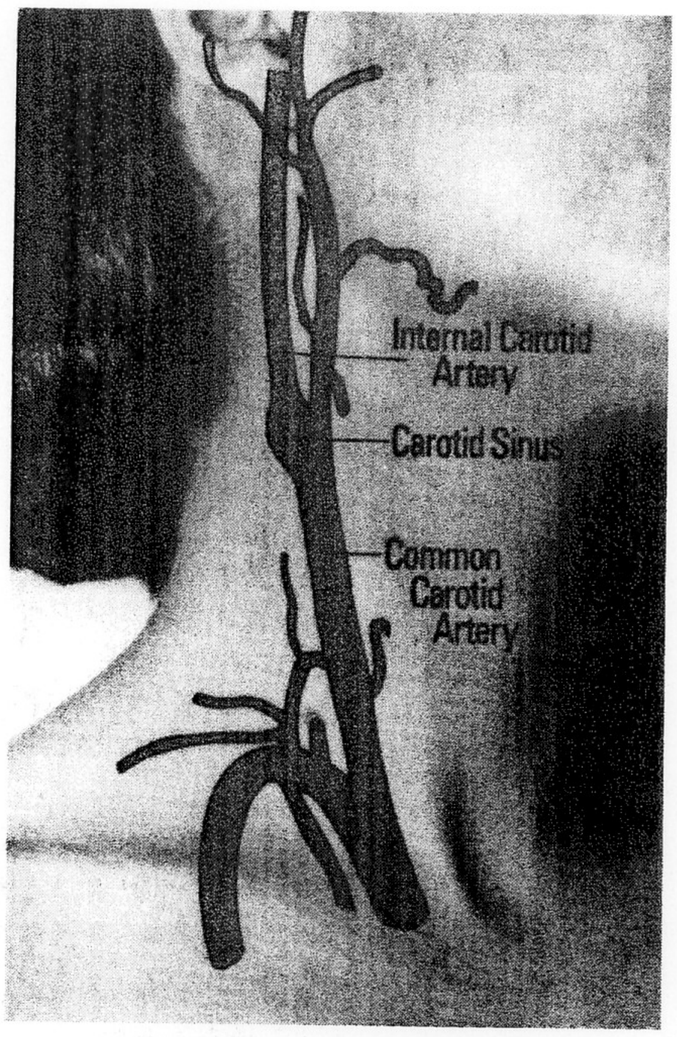
In a quiet room, with the patient relaxed, it is conventional to use the bell of the stethoscope and to listen for carotid bruits over an area beginning from just behind the upper end of the thyroid cartilage to just below the angle of the jaw.[4,5] No method of auscultation has been demonstrated to be superior to another. Most carotid bruits are heard only in systole, but some are heard in both systole and diastole, the significance of which is unclear, given the poor clinical agreement on the assessment of the duration of carotid bruits.[6]

Carotid bruits make up but a portion of all neck bruits. Systolic heart murmurs transmitted to the neck usually can be differentiated from carotid bruits because they are louder over the precordium than over the neck.

Venous hums, caused by flow in the internal jugular vein, have been reported to occur in approximately 25% of young adults.[7] They are easily distinguishable from carotid bruits, being most prominent in diastole, with the patient sitting and the head turned away from the side of auscultation. Venous hums are rarely heard with the patient lying down and are always abolished either by the compression of the ipsilateral internal jugu-

From the Departments of Medicine and Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario (Drs Sauvé and Sackett); the Departments of Medicine and Epidemiology and Community Medicine, University of Ottawa (Ontario) (Dr Laupacis); the Departments of Epidemiology and Biostatistics and Family Medicine, University of Western Ontario, London (Dr Østbye); and the Department of Medicine, University of Western Ontario, London (Dr Feagan).

Reprint requests to Division of General Internal Medicine, Henderson General Division, Room 408, McMaster Clinic, 711 Concession St, Hamilton, Ontario, Canada L8V 1C3 (Dr Sackett).



Surface anatomy of the right carotid artery.

lar vein cephalad to the stethoscope or by Valsalva's maneuver.[8,9]

PRECISION OF AUSCULTATION FOR CAROTID BRUITS

Among 55 patients examined independently by two neurologists (both of whom had normal audiograms), the agreement beyond chance for the presence of a bruit was substantial, with a κ of 0.67. However, agreement regarding the intensity, pitch, or duration of the bruit was only fair ($\kappa<0.40$).[6]

THE IMPORTANCE OF CAROTID BRUITS IN DIFFERENT CLINICAL PRESENTATIONS

Case 1: The Asymptomatic Ambulatory Bruit

How Often Should We Expect to Find an Asymptomatic Carotid Bruit?—In a community-based study, Heyman et al[10] found the prevalence of asymptomatic cervical bruits (bruits heard in the supraclavicular area or anterior to the sternocleidomastoid muscle) to increase with age, from 2.3% in the age group of 45 to 54 years to a high of 8.2% in the age group of 75 years or older. Bruits were more common in women and hypertensive patients.

If No Bruit Is Found at This Examination, What Are the Chances of Developing a Bruit de Novo Over the Following Years?—The incidence of de novo bruits also increases with age. Wolf et al[11] estimated that out of a cohort of 100 adults aged 65 years or older, just about 1% per year (seven over the next 8 years) will develop a new carotid bruit, a rate twice that of individuals aged 45 to 54 years.

What Are the Prognostic Implications of Discovering an Asymptomatic Carotid Bruit During a General Physical in a 50-Year-Old Man?—Asymptomatic carotid bruits are associated with increased incidence of both cerebrovascular and cardiac events in this age group. For example, Wiebers et al[12] conducted a 5-year prospective, population-based study of two unmatched but generally similar cohorts, one of which had carotid bruits (566 individuals) and the other did not (428 individuals). The average annual stroke rates were three times as high in patients with bruits (1.5%) compared with those without (0.5%), and similar ratios were also found for TIAs (0.9% vs 0.2%). The majority of strokes and TIAs occurred on the same side as the bruit. The prognosis was not different for the various types of carotid bruits (diffuse vs localized, isolated systolic vs systolic and diastolic). In a second prospective, population-based cohort, Heyman et al[10] followed up 1620 asymptomatic adults aged 45 years or older for 6 years and again found a higher incidence of strokes in patients with cervical bruits (odds ratio, 4.2). The association appeared stronger in men (odds ratio, 7.5) than women (odds ratio, 1.6). Heyman and colleagues also found a 3.4-fold higher risk of death from ischemic heart disease in men with asymptomatic cervical bruits (90% confidence interval [CI], 1.1 to 11), and a 1.9-fold risk in women (90% CI, 0.7 to 5).

Recently, a randomized trial of carotid endarterectomy in asymptomatic carotid stenoses of at least 50% reported a decrease in TIAs following surgery.[13] However, there was no decrease in disabling or fatal stroke following surgery, and most clinicians would not refer such patients for angiography.

It is important to note that in the elderly (those older than 75 years), there may not be an increased risk of stroke with asymptomatic carotid bruits. Among nursing home residents, the 3-year incidence of TIA or stroke was 10% when a bruit was present and 9% when it was absent, a relative risk of only 1.1 (95% CI, 0.45 to 2.7).[14]

Table 1.—Risk of Perioperative Stroke in Patients With Preoperative Carotid Bruits

Studies	Types of Patients	No. of Patients With Perioperative Stroke/ Total No. of Patients With Bruits (%)	No. of Patients With Perioperative Stroke/ Total No. of Patients Without Bruits (%)	*P**
Barnes et al[17]	Coronary artery bypass graft and vascular surgery	2/44 (4.5)	3/405 (0.7)	.022
Evans et al[16]	Major vascular surgery	0/92 (0)	4/496 (0.8)	.39
Ivey et al[15]	Cardiac surgeries	0/82 (0)	9/1339 (0.7)	.46
Ropper et al[18]	All elective surgeries for those aged greater than 55 y	0/82 (0)	4/592 (0.7)	.46

*Using the χ^2 test.

Case 2: The Asymptomatic Preoperative Bruit

How Often Should We Expect to Find an Asymptomatic Carotid Bruit on Routine Preoperative Assessment?—The prevalences reported in the four surgical cohort studies that assessed for the presence of bruits preoperatively range from a low of 6% (Ivey et al[15]) to a high of 16% (Evans et al[16]), with an overall average of about 10%. These figures are significantly higher than those in the general population (average, 4.4%), and this difference is probably because three of the four surgical series were patients undergoing major vascular procedures, in which the prevalence of "systemic atherosclerosis" is increased.

Are Patients With Asymptomatic Preoperative Bruits at Higher Risk of Perioperative Stroke?—As shown in Table 1, only one[17] of the four[15-18] studies found an increased incidence of permanent neurological complications following surgery among patients with preoperative asymptomatic carotid bruits. When combined with the other three studies, the difference becomes a nonsignificant trend favoring fewer strokes amidst patients with carotid bruits (pooled rate difference [DerSimonian and Laird[19]], −0.6% [95% CI, −1.6% to 0.4%]; pooled odds ratio [Peto and colleagues[20]], 0.94 [95% CI, 0.22 to 3.92]).

On the other hand, Ivey et al[15] found an increase (11% vs 2%; $P<.001$) in transient, nonfocal neurological abnormalities (such as intellectual and behavioral change) in patients with asymptomatic bruits who underwent cardiac procedures.

Case 3: The Symptomatic Bruit

Should Further Diagnostic or Therapeutic Procedures Be Carried Out in Patients With Symptomatic Carotid Bruits?—Two recent randomized controlled trials[21,22] have demonstrated that carotid endarterectomies markedly decrease mortality and stroke in patients with symptomatic, high-grade (70% to 99%) carotid stenosis. Accord-

Table 2.—Ability of Carotid Bruits to Indicate Various Degrees of Angiographic Carotid Stenosis in Patients With Symptoms

Studies	Types of Patients	Degree of Stenosis Predicted, %	Sensitivity	Specificity	Positive Likelihood Ratio	Pretest *P*	Posttest *P*
Ingall et al[23]	Various symptoms	50-99	0.37	0.94	5.7	.25	.65
Ziegler et al[24]	Transient ischemic attack	>50	0.29	0.88	2.4	.08	.17
Hankey et al[25]	Anterior-circulation transient ischemic attack	75-99	0.76	0.76	3.2	.16	.37
North American Symptomatic Carotid Endarterectomy Trial Collaborators[26]	Anterior-circulation transient ischemic attack	70-99	0.62	0.61	1.6	.52	.63

ingly, the onus is on the physician to rule in or rule out high-grade carotid stenosis in all patients with anterior-circulation TIAs or minor strokes, regardless of bruits.

Does the Presence or Absence of a Carotid Bruit Accurately Reflect the Degree of Underlying Carotid Artery Stenosis in Symptomatic Patients?—The relationship between carotid bruits in patients with cerebrovascular symptoms and angiographically determined carotid stenosis is summarized in Table 2.[23-26] The two studies that reported data specifically about high-grade stenosis found an association with carotid bruits.[25,26] The likelihood ratios for high-grade carotid stenosis were 3.2 and 1.6 when bruits were present and 0.3 and 0.6 when bruits were absent.

Unfortunately, however, this relation is not strong enough for the clinician to be able to use the presence of a bruit to rule in, or the absence of a bruit to rule out, high-grade carotid stenosis. For example, in the North American Symptomatic Carotid Endarterectomy Trial (NASCET), over a third of patients with high-grade stenoses had no detectable bruits, and the presence of a focal carotid bruit increased the probability of underlying high-grade (70% to 99%) carotid stenosis by only 11%, from a pre-examination probability of 52% to a post-examination probability of 63%. Furthermore, the NASCET also showed that no other bruits (supraclavicular, ophthalmic, or contralateral) added to the accuracy of the finding.

Thus, the evaluation of the patient with cerebrovascular disease whose symptoms are compatible with carotid artery stenosis cannot be limited to the physical examination, and at the present state of diagnostic imaging technology probably requires angiography.[26,27]

THE BOTTOM LINE

1. Asymptomatic carotid bruits are relatively common. Their prevalence increases with age. They are associated with a long-term increase in cerebrovascular and cardiac events, save perhaps in individuals greater than 75 years of age.

2. Asymptomatic preoperative bruits are not predictive of increased risk of perioperative stroke. However, they may be harbingers of transient postoperative cognitive and behavioral abnormalities.

3. Although the presence of a carotid bruit in a patient with carotid-territory cerebrovascular symptoms increases the probability that the underlying stenosis is high-grade (and therefore amenable to endarterectomy), the accuracy of this physical finding is low. Accordingly, the presence of a carotid bruit cannot be used to rule in, nor can its absence be used to rule out, surgically amenable carotid artery stenosis in symptomatic patients.

We thank Jeff Turnbull, MD, for his early contribution in developing this article.

References

1. Wadia NH, Monckton G. Intracranial bruits in health and disease. *Brain.* 1957;80:492-509.
2. Messert B, Marra TR, Zerofsky RA. Supraclavicular and carotid bruits in hemodialysis patients. *Ann Neurol.* 1977;2:535-536.
3. Matthews WB. Observations on the carotid bruit. *J Neurol Neurosurg Psychiatry.* 1961;24:161-166.
4. Ratcheson RA. Clinical diagnosis of atherosclerotic carotid artery disease. *Clin Neurosurg.* 1982; 29:464-481.
5. Harrison MJ. Cervical bruits and asymptomatic carotid stenosis. *Br J Hosp Med.* 1984;32:80-81.
6. Chambers BR, Norris JW. Clinical significance of asymptomatic neck bruits. *Neurology.* 1985;35: 742-745.
7. Jones FL. Frequency, characteristics and importance of the cervical venous hum in adults. *N Engl J Med.* 1962;267:658-660.
8. Hurst JW, Hopkins LC, Smith RB. Noises in the neck. *N Engl J Med.* 1980;302:862-863.
9. Fowler NO, Gause R. The cervical venous hum. *Am Heart J.* 1964;67:135-136.
10. Heyman A, Wilkinson WE, Heyden S, et al. Risk of stroke in asymptomatic persons with cervical arterial bruits: a population study in Evans County, Georgia. *N Engl J Med.* 1980;302:838-841.
11. Wolf PA, Kannel WB, Sorlie P, McNamara P. Asymptomatic carotid bruit and risk of stroke: the Framingham Study. *JAMA.* 1981;245:1442-1445.
12. Wiebers DO, Whisnant JP, Sandok BA, O'Fallon WN. Prospective comparison of a cohort with asymptomatic carotid bruit and a population-based cohort without carotid bruit. *Stroke.* 1990;21:984-988.
13. Hobson RW, Weiss DC, Fields WS, et al. Efficacy of carotid endarterectomy for asymptomatic carotid stenosis. *N Engl J Med.* 1993;328:221-227.
14. Van Ruiswyk J, Noble H, Sigmann P. The natural history of carotid bruits in elderly persons. *Ann Intern Med.* 1990;112:340-343.
15. Ivey TD, Strandness E, Williams DB, Langlois Y, Misbach GA, Kruse AP. Management of patients with carotid bruit undergoing cardiopulmonary bypass. *J Thorac Cardiovasc Surg.* 1984;87:183-189.
16. Evans WE, Cooperman M. The significance of asymptomatic unilateral carotid bruits in preoperative patients. *Surgery.* 1978;83:521-522.
17. Barnes RW, Liebman PR, Marszalek PB, Kirk CL, Goldman MH. The natural history of asymptomatic carotid disease in patients undergoing cardiovascular surgery. *Surgery.* 1981;90:1075-1081.
18. Ropper AH, Wechsler LR, Wilson LS. Carotid bruit and risk of stroke in elective surgery. *N Engl J Med.* 1982;307:1388-1390.
19. DerSimonian R, Laird N. Meta-analysis in clinical trials. *Controlled Clin Trials.* 1986;7:177-188.
20. Yusuf S, Peto R, Lewis J, Collins R, Sleight P. Beta blockade during and after myocardial infarction: and overview of the randomized trials. *Prog Cardiovasc Dis.* 1985;27:335-371.
21. North American Symptomatic Carotid Endarterectomy Trial Collaborators (NASCET). Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. *N Engl J Med.* 1991;325:445-453.
22. European Carotid Surgery Trialists' Collaborative Group. NRC European Carotid Surgery Trial: interim results for symptomatic patients with severe (70-99%) or mild (0-29%) carotid stenosis. *Lancet.* 1991;337:1235-1243.
23. Ingall TJ, Homer D, Whisnant JP, Baker HL, O'Fallon WN. Predictive value of carotid bruit for carotid atherosclerosis. *Arch Neurol.* 1989;46:418-422.
24. Ziegler DR, Zileli T, Dick A, Sebaugh JL. Correlation of bruits over the carotid artery with angiographically demonstrated lesions. *Neurology.* 1971;21:860-865.
25. Hankey GJ, Warlow CP. Symptomatic carotid ischaemic events: safest and most cost effective way of selecting patients for angiography, before carotid endarterectomy. *BMJ.* 1990;300:1485-1491.
26. Sauvé S, Sackett DL, Taylor DW, Barnett HJM, Haynes RB, Fox A, on behalf of the NASCET. Can bruits distinguish high-grade from moderate symptomatic carotid stenosis? *Clin Res.* 1992;40:304A. Abstract.
27. Haynes RB, Taylor DW, Sackett DL, Fox A, Rankin R, Barnett H. Poor performance of doppler in detecting high-grade carotid stenosis. *Clin Res.* 1992;40:184A. Abstract.