

that the WCD could be used as a feasible bridge to definitive implantation of an ICD in patients in whom risk stratification for sudden death is not completed.

1. Moss JA, Hall J, Cannom DS, Daubert JP, Higgins SL, Klein H, Levine JH, Saksena S, Waldo AL, Wilber D, Brown MW, Heo M, for the Multicenter Automatic Defibrillator Implantation trial Investigators. *N Engl J Med* 1996;335:1933-1940.
2. Cardiovascular News. NHLBI Stops Arrhythmia Study: implantable cardiac defibrillators reduce deaths. *Circulation* 1997;95:2465-2466.
3. Kerber RE, Kouba C, Martins J, Kelly K, Low R, Hoyt R, Ferguson D, Bailey L, Bennett P, Charbonnier F. Advance prediction of transthoracic impedance in human defibrillation and cardioversion: importance of impedance in determining the success of low-energy shocks. *Circulation* 1984;70:303-308.

4. Dalzell GWN, Adgey AAJ. Determinants of successful transthoracic defibrillation and outcome in ventricular fibrillation. *Br Heart J* 1991;65:311-316.
5. Kerber RE, Kienzle MG, Olshansky B, Waldo AL, Wilber D, Carlson MD, Aschoff AM, Birger S, Fugatt L, Walsh S, Rockwell M, Charbonnier F. Ventricular tachycardia rate and morphology determine energy and current requirements for transthoracic cardioversion. *Circulation* 1992;85:158-163.
6. Kerber RE, Kieso RA, Kienzle MG, Olshansky B, Waldo AL, Carlson MD, Wilber DJ, Schoff AM, Birger S, Charbonnier F. Current-based transthoracic defibrillation. *Am J Cardiol* 1996;78:1113-1118.
7. Klein H, Auricchio A, Huvell E, Nisam S. Initial experience with a new down-sized implantable cardioverter-defibrillator. *Am J Cardiol* 1996;78:9A-14A.
8. Kerber RE, Samat W. Factors influencing the success of ventricular defibrillation in man. *Circulation* 1979;60:226-230.
9. Gascho JA, Crampton RS, Cherwek ML, Sipes JN, Hunter FP, O'Brien W. Determinants of ventricular fibrillation in adults. *Circulation* 1979;60:231-240.

Frequency of Neurologic Complications Following Carotid Sinus Massage

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Carotid sinus (CS) massage is now recommended for the routine investigation of all older patients who experience syncope, dizziness, or unexplained falls.¹ Half of all adults attending the accident and emergency department do so because of a fall, 20% of these are unexplained falls and 23% of unexplained falls are attributed to CS hypersensitivity.² CS hypersensitivity is almost exclusively a disease of aging, increasing in prevalence when associated with comorbidity such as systemic hypertension, coronary heart disease, and peripheral vascular disease. CS hypersensitivity is an abnormal response to CS massage characterized either by significant heart rate slowing (>3 seconds asystole; cardioinhibitory type), a decrease in systolic blood pressure (>50 mm Hg vasodepressor type), or a combination of both types (mixed).³ A standard technique is used applying longitudinal digital pressure at the bifurcation of the internal and external carotid artery for 5 seconds. This procedure is applied to the right then left sides after 120 seconds. It is performed using the Akron tilt table, supine and tilted to 70°. All staff using the technique undergo training and are supervised until they are able to demonstrate competency. Both cardioinhibitory and mixed CS hypersensitivity benefit from physiologic cardiac pacing. However, treatment of vasodepressor responses generally remains unsatisfactory.⁴ Information on complication rates as a result of CS massage are available,^{5,6} but there are no large single-center studies. This information is important if physicians are to secure informed consent for the procedure.

We present incidence data of neurologic and cardiologic complications in a large series of consecutive older patients presenting with syncope or falls to a dedicated investigation facility.

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During a 5-year period, we investigated 4,000 patients (mean age 74 ± 14 years) for symptoms of syncope, dizziness, or falls in a secondary and tertiary referral facility. This represents 16,000 episodes of CS massage. All patients had supine and upright CS massage with continuous heart rate and blood pressure monitoring (surface electrocardiograph and digital photoplethysmography). Contraindications to CS massage were the presence of a carotid bruit, stroke, or myocardial infarction within the previous 6 months, and a history of serious cardiac arrhythmias, ventricular tachycardia, or ventricular fibrillation. During that time, 11 patients had neurologic complications; no patient had a cardiac complication (ventricular tachycardia, ventricular fibrillation, or prolonged cardiac asystole requiring intravenous drugs or cardiopulmonary resuscitation).

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The average age of these 11 patients was 80 ± 5 years: 6 were men. Underlying comorbid conditions included ischemic heart disease ($n = 5$), previous cerebrovascular accident beyond 6 months ($n = 2$), and treated hypertension ($n = 3$). Seven patients were taking aspirin at the time of CS massage. None had contraindications to CS massage. Ten developed hemiparesis, 3 expressive dysphasia, and 1 a hemianopia. Complications occurred within 5 minutes of massage in 5 patients, and at 10 minutes, 30 minutes, and 2 hours after massage in the remaining patients. Computerized tomographic head scan revealed new lesions in only 2 patients. Nine patients had carotid Doppler ultrasound after the procedure:

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2 patients had >70% and 2 patients >30% contralateral diameter stenosis. Otherwise Doppler findings were unremarkable. Blood pressure and heart rate responses to CS massage were not significantly different comparing right to left sides. There was no significant differences in blood pressure or heart rate change when comparing sides ipsilateral and contralateral to the affected hemisphere. Seven of the 11 patients had CS hypersensitivity. All had a significant vasodepressor response (-41.7 ± 27.0) and 1 had a cardioinhibitory response and subsequently underwent pacing. Nine patients made a full functional recovery: 7 within 24 hours. Two patients had fully recovered at 1 month and in 2 patients hemiparesis persisted.

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The incidence of neurologic complications following CS massage is low (0.28%), and most patients make a full functional recovery. Older patients who have a vasodepressor response may develop neurologic sequelae up to 2 hours after the procedure.

In summary, CS massage is a useful procedure in diagnosis and treatment. A standard technique with applied exclusion criteria causes infrequent neurologic complications (11 in 16,000), most of which are transient and result in full recovery.

1. McIntosh S, da Costa D, Kenny RA. Outcome of an integrated approach to the investigation of dizziness, falls and syncope in elderly patients referred to a syncope clinic. *Age Ageing* 1993;22:53–58.

2. Richardson DA, Bexton RS, Shaw FE, Bond J, Kenny RA. Prevalence of cardioinhibitory carotid sinus hypersensitivity (CICSH) in accident and emergency attendances with falls or syncope. *Pace* 1997;20:820–823.

3. Strasberg B, Sagie A, Erdman S, Kusniec J, Sclarovsky S, Agmon J. Carotid sinus hypersensitivity and the carotid sinus syndrome [review]. *Prog Cardiovasc Dis* 1989; 31:379–91.

4. Sutton R. Vasodepressor syncope. *Herz* 1993;18:155–62.

5. Munro NC, McIntosh S, Lawson J, Morley CA, Sutton R, Kenny RA. Incidence of complications after carotid sinus massage in older patients with syncope. *J Am Geriatr Soc* 1994;42:1248–1251.

6. Beal MF, Park TS, Fisher CM. Cerebral atheromatous embolism following carotid sinus pressure. *Arch Neuro* 1981;38:310.