Published in final edited form as:

Am J Prev Med. 2007 May ; 32(5): 408–412.

Cardiovascular Risk in Survivors of Stroke

Susan P. Kopunek, RN, BSN¹, Kathleen M. Michael, PhD, RN, CRRN¹, Marianne Shaughnessy, PhD, CRNP^{2,3}, Barbara Resnick, PhD, CRNP, FAAN, FAANP³, Eun-Shim Nahm, PhD, RN³, Jill Whitall, PhD⁴, Andrew Goldberg, MD^{2,5}, and Richard F. Macko, MD^{2,6}

¹Claude D. Pepper Older Americans Independence Center, University of Maryland School of Medicine, Baltimore, MD ²Baltimore Veterans Administration Medical Center, Geriatrics Research, Education and Clinical Center, Baltimore, MD ³University of Maryland School of Nursing, Baltimore, MD ⁴Department of Physical Therapy and Rehabilitation Science, University of Maryland School of Medicine, Baltimore, MD ⁵Division of Gerontology, Department of Medicine, University of Maryland ⁶Exercise and Robotics Center of Excellence, University of Maryland School of Medicine, Baltimore, MD

Abstract

Background—Stroke survivors are at significant risk for recurrent stroke and cardiovascular disease. Inadequately managed modifiable risk factors increase the threat of recurrent stroke, development of new co-morbidities, and double the risk of premature mortality. The purpose of this study was to determine the prevalence of modifiable cardiovascular risk factors in stroke survivors who completed a research screening evaluation for entry into exercise rehabilitation studies. The sample collected between January 2001 and June 2005 evaluated 364 community-dwelling men and women aged 34 to 88 years living in Baltimore, Maryland.

Methods—Each participant's risk profile was evaluated from data obtained during a medical history and physical examination and from laboratory analysis of a fasting blood sample. Current practice guidelines were used to define risk categories.

Results—Ninety-nine percent of participants had at least one sub-optimally controlled risk factor. Ninety-one percent had two or more concurrent risk factors inadequately treated. Eighty percent of the participants had pre-hypertension or hypertension, 67% were overweight or obese, 60% had sub-optimal LDL, 45% had impaired fasting glucose, 34% had low HDL, and 14 % were current smokers, while reportedly receiving routine medical care.

Conclusions—These findings confirm that cardiovascular risk factors remain inadequately managed in stroke survivors, increasing the chance for repeat stroke and cardiovascular event. Systematic assessment of this vulnerable population is imperative at every healthcare encounter.

INTRODUCTION

Stroke affects roughly 700,000 Americans each year, one third of which are recurrent events. It is the third leading cause of death in the United States and is a leading cause of disability.¹ The financial burden of repeat vascular events associated with under-managed cardiovascular risk factors exceeds \$13.6 billion.² The 2006 American Heart Association/American Stroke

Correspondence and reprint requests: Susan Kopunek, RN, 10 N. Greene St Baltimore BT/18/GR, Baltimore, MD 21201, Phone: 410.605.7000x5444; Fax 410.605.7913; Email: skopunek@grecc.umaryland.edu.

No financial conflict of interest was reported by the authors of this paper.

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Association (AHA/ASA) fundamental recommendation to secondary stroke prevention is control of hypertension, diabetes, dyslipidemia, smoking, obesity, and alcohol consumption, as well as increased physical activity.³ Few studies have systematically evaluated whether stroke survivors' modifiable risk factors are optimally managed.

The purpose of this study was to determine the prevalence of sub-optimally managed modifiable cardiovascular risk factors in stroke survivors who completed an entry screen for exercise rehabilitation studies.

METHODS

Three hundred sixty-four community-dwelling men and women with residual hemiparetic weakness from the greater Baltimore area were evaluated between January 2001 and June 2005 for participation in two exercise rehabilitation studies, involving either upper extremity exercise or progressive treadmill walking. The volunteers were aged 34 to 88 years, had mild-to-moderate hemiparetic weakness, and were at least 6-months post-ischemic stroke or 12-months post-hemorrhagic stroke. Entry into the exercise studies was not deemed safe until completion of the natural stroke recovery, requiring a longer duration from event in individuals with hemorrhagic stroke. Eighty-seven percent had ischemic stroke, and 13% had hemorrhagic stroke, with the average time since stroke of 3 years (range 6 months to 18 years). A telephone screen determined preliminary eligibility for participation in the exercise studies, excluding subjects if they reported a history of serious or unstable medical or psychiatric conditions, active and excessive alcohol use or active illicit drug use, or severe receptive aphasia. Given that the study was testing the effectiveness of specific exercise programs, respondents were excluded if they engaged in >20 minutes of aerobic exercise at least three times per week, or repetitive arm exercises greater than once weekly. Participants deemed eligible during the telephone screen were offered two subsequent appointments: one for informed consent, followed by a 2-hour health screening visit. All subjects provided informed consent prior to participation. The study was conducted under the supervision of the Institutional Review Board of the University of Maryland.

History and physical examination included resting blood pressure, heart rate, height, weight, temperature, respiration rate, and resting electrocardiogram. Fasting blood samples included blood count (CBC) and an 18-item blood chemistry and lipid panel including fasting plasma glucose (FPG), triglycerides, high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), and total cholesterol. The results were compared to Clinical Practice Guidelines established by the Joint Commission of the Prevention, Detection, and Treatment of High Blood Pressure-7 (JNC-7)⁴; the Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel or ATP III 2001)⁵; The Evidence Report-National Institutes of Health (NIH) 1998⁶; and the American Diabetes Association (ADA).⁷

All subjects were notified of study eligibility; abnormal health status findings, including but not limited to cardiovascular risk factors; and recommendations for follow up with their primary care provider. With participant consent, primary physicians received copies of the EKG and blood sample results. A research nurse coordinator followed the identified health issues for eligible participants until medical clearance was obtained.

Data were analyzed in 2006 using SPSS version 14.0 (SPSS Inc., Chicago IL, 2005).

RESULTS

Demographic characteristics are summarized in Table 1. Modifiable risk factors are identified in Table 2.

Cardiovascular Risk Factors

The screening assessments revealed sub-optimal control of hypertension, dyslipidemia, glucose metabolism, obesity, and/or smoking in nearly all of the participants (99%).

Hypertension

Of the total sample of 364, 80% had blood pressure readings consistent with pre-hypertension or hypertension Stage 1 or Stage 2. A large portion of the total sample (32%) reported no antihypertensive prescription use. Of the 152 subjects who met JNC-7 classification for Stage-1 or Stage-2 hypertension, 29% reported no use of antihypertensive agent, and 23% reported treatment with a single antihypertensive drug. Blood pressure categories and reported number of antihypertensive agents are listed in Table 2.

Dyslipidemia

Sixty percent had LDL-C cholesterol levels >100 mg/dL; the majority of these reported no lipid-lowering medication use. Eight percent not using anti-lipemic agents had LDL-C concentrations >160 mg/dL. Within the 49% taking lipid lowering medications, 17% had LDL-C between 100 and 129mg/dL, and 10% had LDL-C >130mg/dL. Thirty-four percent had HDL-C concentrations <40 mg/dL. Lipid categories according to ATP III and reported medicine use by the study sample are listed in Table 2.

Diabetes and Impaired Fasting Glucose

Forty-five percent had undiagnosed impaired FPG or undiagnosed diabetes; 20% reported a previous history of diabetes mellitus with a mean HbA1c of 7.11%. FPG results and reported medicine use are listed in Table 2.

Obesity

Body mass index (BMI; kg/m²) calculations showed that 36% were overweight, 24% were obese, and 8% were morbidly obese. Only 33% were of normal BMI. Weight measurements, categorized using The NIH Evidence Report,⁶ are listed in Table 2. Smoking status is also included in Table 2.

Concurrent Risk Factor Management

Ninety-nine percent of the participants had at least one inadequately managed risk factor. Ninety percent had multiple sub-optimally controlled risk factors. Concurrent risk factors are displayed in Table 3.

Significant Demographic Variables

Baseline comparisons confirm a cardiovascular risk factor profile congruent with previously reported epidemiologic studies of stroke survivors. Hypertension was more evident in black subjects and in older subjects, obesity was more frequent in females, and elevated FPG results were seen more often in the older population. The effect of age or time from stroke on the six risk factors found no statistically significant result in risk factor outcomes.

DISCUSSION

This study demonstrates the persistent, silent high risk for the progression of cardiovascular co-morbidities and recurrent stroke events. The substantial gap between recommended guidelines and clinical practice has important public health implications.

Elevated blood pressure, hyperglycemia, dyslipidemia, obesity, and smoking are co-morbidly associated with heart disease, stroke, and early mortality.⁸⁻¹⁶ Large epidemiologic trials and general expert consensus confirm positive health outcomes when elevated blood pressure is optimally managed,³ yet 80% of the subjects in this study had blood pressure findings above the recommended goals. The annual costs of under-managed risk factors, indicated by short-term hospitalization and first-year loss of productivity due to premature death, are estimated between \$3.2 and \$11.1 billion for previous stroke participants having one inadequately controlled risk factor, and \$4.1 to \$12.2 billion for 2 or more inadequately controlled risk factors.² In this study, 91% had two or more inadequately controlled risk factors.

Cardiovascular mortality in those with previous MI or stroke is doubled for those with two or more uncontrolled risk factors.² Lowering blood pressure by 9 mmHg systolic and 4 mmHg diastolic reduces the relative risk of recurrent stroke by 28%, with additional risk reduction through combination pharmacologic intervention.¹⁷ Health service strategies to systematically identify and achieve risk factor control could reduce recurrent stroke events and associated financial burden.

The AHA/ASA 2006 guidelines recommend statin use by all stroke survivors, including individuals with normal cholesterol levels.³ Fifty-one percent of the sample did not use any lipid-lowering medicine and 60% of the total sample had elevated levels, placing them at higher risk for vascular events. For individuals with known diabetes, the AHA/ASA recommends aggressive treatment of elevated blood pressure, hyperlipidemia, and hyperglycemia to near-normal glycemic levels.³ Microvascular and macrovascular complications exist silently for the 45% who had no previous diagnosis of hyperglycemia and/or elevated FPG. Prospective data from the Dutch TIA Trial⁸ found a 2- to 3-fold increased risk for recurrent stroke from impaired glucose tolerance and type 2 diabetes.

Weight reduction, smoking cessation, and increased physical activity are shown to improve cardiovascular factors and subsequent lowering of cardiovascular events.³ Sixty-seven percent of the sample were above normal weight and 13% continue to smoke.

The report findings are similar to the risk factor profile in the 2006 REACH¹⁸ international registry and Northern Manhattan Study (NOMAS).¹⁹ In the REACH subset of participants with cardiovascular disease, 83% had hypertension, 58% had hypercholesterolemia, 39% were overweight, and 16.5% were obese.¹⁸ In NOMAS, 78.2% had hypertension, 36% had LDL >130mg/dL, 43.4% had diabetes, and 21.3% currently smoked.¹⁹

Reasons for high rates of sub-optimal risk factor management are complex; multidisciplinary studies are needed to develop new strategies to bridge the evidence-practice gap. Mass media, especially television, is cited more often (32%) than primary physicians (20%) as a prime source of stroke information.²⁰ National and local public health policies can facilitate health promotion for stroke survivors through comprehensive health and prescription insurance, accessible health care, affordable transportation systems, and adequate accommodations for the disabled.

The study design may have led to an under-representation of the magnitude of the cardiovascular risk that persists in stroke survivors. Excluded subjects with unstable medical or psychiatric co-morbidities or who regularly exercise might have different risk profiles. Access to health care, socioeconomic and educational limitations, and other factors affecting the management of cardiovascular risk factors would be important to evaluate in future studies. The outcome of notification to primary practitioners in terms of interventions and effectiveness over time should be a key issue of further investigation.

Sub-optimal control of cardiovascular risk factors in stroke survivors is a serious and persistent problem that increases morbidity and mortality.

Acknowledgements

Appreciation is extended to the participants. This study was supported by University of Maryland Claude D. Pepper Older Americans Independence Center, National Institutes Of Health Grants from the National Institute on Aging (P60AG 12583); National Institute on Disability and Rehabilitation Research (H133G010111); the Baltimore Department of Veterans Affairs Geriatrics Research, Education and Clinical Center (GRECC) and the Baltimore Veteran's Affairs Medical Center Research Enhancement Award Program (REAP) entitled 'Stroke, Disability Reduction and Disease Prevention'

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Table 1

364 subjects screened for two exercise stroke studies conducted in Baltimore, Maryland

	Stroke survivors <i>n</i> (%)
Age $\pm$ SD (years)	64 $\pm$ 12.0
Race	
Black	171 (47 %)
Caucasian	174 (48 %)
Other	19 (5%)
Total	364
Marital status	
Married / co-habitate	
Divorced / separated / widowed	160 (44%)
Not disclosed	144 (39%)
Total	60 (17%)
Education status	364
Grade school	
Some/all high school	
Vocational	12 (3%)
Undergraduate	125 (34 %)
Graduate	10 (3%)
Not disclosed	100 (28%)
Total	37 (10%)
	80 (22%)
	364

SD, standard deviation

Table 2

Cardiovascular risk factor profile of 364 subjects screened for two exercise stroke studies conducted in Baltimore, Maryland between January 2001 and June 30, 2005

	Recommended goals	Stroke subjects	Med use	
BP (per JNC-7)	SBP / DBP mmHg		Yes	No
Normotensive	<120 and <80	71 (20%)	43 (12%)	28 (8%)
Prehypertension	120-139 or 80-89	141 (39%)	88 (23%)	53 (15%)
Hypertension, Stage 1	140-159 or 90-99	112 (30%)	83 (23%)	29 (8%)
Hypertension, Stage 2	≥160 or ≥100	40 (11%)	35 (10%)	5 (1%)
TOTAL		364	249(68 %)	115 (32%)
LDL-C (per ATP III)	mg/dL			
Optimal	<100	140 (40%)	81 (23%)	58 (17%)
Near optimal/above optimal	100-129	106 (29%)	58 (17%)	47 (13%)
Borderline high	130-159	68 (20%)	23 (7%)	45 (13%)
High	160-189	21 (6%)	6 (1%)	15 (4%)
Very High	≥190	17 (5%)	5 (1%)	12 (4%)
TOTAL		352	173 (49%)	177 (51%)
FPG (per ADA)	mg/dL			
Normoglycemia	≤ 99	170 (48%)	17 (5%)	153 (43%)
Impaired fasting glucose	100-125	118 (34%)	20 (6%)	98 (28%)
Diabetes mellitus	≥126	64 (18%)	35 (10%)	29 (8%)
TOTAL		352	72 (21%)	280 (79%)
HDL-C (per ATP III)	mg/dL			
High	≥60	44 (13%)	16 (5%)	28 (8%)
Normal	40-59	186 (53%)	88 (25%)	93 (27%)
Low	<40	122 (34%)	69 (20%)	53 (15%)
TOTAL		352	173 (50%)	174 (50%)
BMI (per NIH criteria)	kg/m²			
Underweight	<18.5	4 (1%)		
Normal	18.5-24.9	111 (32%)		
Overweight	25-29.9	129 (36%)		
Obesity I	30-34.9	56 (16%)		
Obesity II	35-39.9	27 (8%)		
Extreme obesity	≥40	27 (8%)		
TOTAL		354		
SMOKING				
Never		101 (28%)		
Former		197 (54%)		
Current		47 (13%)		
Not disclosed		19 (5%)		
TOTAL		364		

Table 3

Concurrent inadequately controlled cardiovascular risk factors in stroke survivors

Concurrent risk factors	<i>n</i> (%)
0	3 (1)
1	31 (9)
2	88 (24)
3	114 (31)
4	97 (26)
≥5	31 (9)