How Well Are Hypertension, Hyperlipidemia, Diabetes, and Smoking Managed After a Stroke or Transient Ischemic Attack?

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Background and Purpose—Stroke prevention clinics (SPCs) are not usually involved with the active management of hypertension, hyperlipidemia, diabetes, and smoking. The effect of consultations generated at SPCs on the adequacy of the management of these risk factors for stroke has not been well described, and few studies have long-term follow-up.

Methods—We performed a prospective study of 119 consecutive patients referred to an SPC for secondary prevention. One year after their baseline visit, patients were re-evaluated for the adequacy of the management of the above risk factors, and the proportion of improvement was assessed.

Results—One-hundred twelve patients returned for their 1-year follow-up visit. Sixty-six were male, and the average age was 65 years. Hypertension was present in 83 patients, hyperlipidemia in 92, diabetes in 26, and smoking in 38, and 80 had multiple risk factors. At baseline, 66% of patients with hypertension, 17% of patients with hyperlipidemia, and 23% of diabetics had adequate management of their respective risk factors. During 1 year of follow-up, hypertension management improved 20% (P<0.001) and lipid management improved 32% (P<0.001). There was no significant improvement in diabetes management or smoking cessation.

Conclusions—Although our understanding of the benefit of addressing hypertension, hyperlipidemia, diabetes, and smoking for secondary prevention of stroke is evolving, we found marked room for improvement in the management of these four risk factors. SPCs may need to be more actively involved in the management of these modifiable risk factors, if we are to significantly impact the risk of recurrent stroke. (Stroke. 2002;33:1656-1659.)

Key Words: secondary prevention ■ stroke prevention

Conventionally, stroke prevention clinics (SPCs) address issues regarding diagnosis, etiology, and secondary prevention. Most referrals to SPCs originate from primary care or emergency room physicians. Diagnostic workup and interventions for specific etiologies of stroke are initiated by SPCs. In addition, certain modifiable risk factors for stroke (MRF-S) such as hypertension (HTN), hyperlipidemia, diabetes, and smoking are discussed in consultations generated at SPCs, although the particulars of management are often left to primary care physicians.1

Strategies for secondary prevention of stroke in patients with atrial fibrillation2,3 and carotid artery stenosis are well established.4–6 There is much evidence from high-quality randomized clinical trials regarding the benefit of antithrombotic therapies for secondary prevention of stroke.7–11 Similarly, the recently published results of the PROGRESS trial demonstrate secondary prevention of stroke with even moderate reduction in blood pressure.12 However, completed randomized clinical trials addressing hyperlipidemia,13,14 diabetes, and smoking for secondary prevention of stroke are lacking. Recommendations for secondary prevention regarding these four MRF-S are derived from evidence in other clinical settings or from observational studies.

To date we are aware of only one other report from an SPC addressing MRF-S. This study highlighted the inadequate management of these risk factors in the community despite explicit management recommendations.15 That report represented fewer nonconsecutive patients; blood glucose and cholesterol were not followed consistently in every patient; the population was overwhelmingly male; and some patients were referred to specialty clinics for cholesterol and dietary management. Therefore, we undertook this study to describe the management of HTN, hyperlipidemia, diabetes, and smoking in patients with stroke or transient ischemic attack (TIA), before and 1 year after evaluation at an SPC.

Subjects and Methods

The University of Alberta Hospital is a tertiary care referral center in Western Canada. Our SPC receives referrals from primary care and emergency room physicians and serves a population of 1.5 million. The SPC consists of a stroke neurologist, clinical stroke fellows, specialist nurses, and an ultrasonography technician. From January 1999 to January 2000, 119 consecutive patients with ischemic stroke...
or TIA were evaluated. Our standardized evaluation included history, physical examination, laboratory testing and, where appropriate, diagnostic imaging.

The following definitions and measurements were used for each risk factor of interest. Hypertension: A self-reported history of HTN or the use of antihypertensive medications, or a measured blood pressure consistently $>140/90 \text{ mm Hg}$ constituted HTN. Four blood pressure readings were obtained at the SPC, and the most recent blood pressure measurements from the referring physician's office were collected. Patients with two blood pressure measurements (at least 1 week apart) of $>140/90 \text{ mm Hg}$ were considered inadequately managed. Hyperlipidemia: Abnormal fasting lipid profiles as defined by National Cholesterol Education Program (NCEP) criteria constituted hyperlipidemia. Fasting lipid profiles within the week of a visit to the SPC were obtained in every patient. Current medications for the management of hyperlipidemia were recorded. Adequate management of hyperlipidemia was defined according to the criteria suggested by the NCEP; in summary, the targets for low-density lipoprotein (LDL) cholesterol were $<2.6 \text{ mmol/L}$ (secondary prevention) or $<3.4 \text{ mmol/L}$ (primary prevention).16 Diabetes: Self-reported history of diabetes, or use of medications for diabetes, or an elevated fasting blood glucose (FBG) $>7.1 \text{ mmol/L}$ constituted diabetes. FBG within a week of SPC visit was obtained. In a patient with documented diabetes, inadequate diabetes management was defined as a FBG $>6.0 \text{ mmol/L}$. We also measured body mass index. Smoking: History of smoking was ascertained by patient self-report. In addition, a detailed history regarding physical activity, as well as sociodemographic variables, prior history of cardiovascular disease, stroke/TIA, and detailed family history were gathered.

During the clinical visit, MRF-S were explained to the patient, and the desired targets and their importance were discussed. Pamphlets on stroke and risk factors for stroke, and a telephone number for future counseling or questions were provided to every patient. Each visit also generated a consult letter to the referring physician, and included a separate section regarding MRF-S, but modifications in the medical management of these risk factors were left to the referring physician. However, diagnostic, therapeutic, and management issues specific to stroke or TIA were carried out by the SPC team. A follow-up visit was conducted at 12 months.

Patient evaluation was repeated in the same manner as the initial visit. We describe means and proportions as appropriate. We used McNemar tests to examine changes in risk factor status over time (before versus 1 year after the SPC visit). For each risk factor using logistic regression, we examined the association between change (improvement) and potential predictors, including age, gender, history of stroke or TIA, and history of coronary artery disease.

**Results**

Initially 119 consecutive patients were entered into the study, and we report the results from 112 patients with stroke or TIA who returned for their one-year follow-up. Repeated attempts were made to contact the seven patients lost to follow-up. Mean age was 65 years (range 40 to 82) and 45 patients (40%) were 70 years of age or older. Other patient characteristics are described in Table 1. With the exception of 2 patients with posterior circulation strokes, all others (110) had anterior circulation TIA or stroke. TIA was diagnosed in 76 patients (68%) and stroke in 36 (32%) patients. Other than the presenting event, 51 patients (46%) had already had a prior stroke or TIA. All patients had echocardiography, Holter monitoring, carotid duplex, transcranial Doppler, imaging studies, and/or surgical referrals as indicated, and 100% were started on antiplatelet treatment. Table 2 summarizes changes in MRF-S over one year of follow-up, and below are details with respect to each risk factor.

### Table 1. Patient Characteristics (n=112)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>Percentage</th>
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<tr>
<td>Age (mean, range)</td>
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<td>40–82</td>
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<tr>
<td>Male</td>
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<td>59%</td>
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<tr>
<td>Female</td>
<td>46</td>
<td>41%</td>
</tr>
<tr>
<td>Referred after TIA</td>
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<td>68%</td>
</tr>
<tr>
<td>Referred after stroke</td>
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<td>32%</td>
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<td>Previous stroke or TIA</td>
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<td>46%</td>
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<td>History of CAD</td>
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<td>21%</td>
</tr>
<tr>
<td>Family history of CAD</td>
<td>16</td>
<td>14%</td>
</tr>
<tr>
<td>One MRF-S</td>
<td>32</td>
<td>28%</td>
</tr>
<tr>
<td>Two MRF-S</td>
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<td>44%</td>
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<td>Hypertension</td>
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<td>74%</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
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<tr>
<td>Smoking</td>
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<td>34%</td>
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<tr>
<td>BMI &gt;27</td>
<td>19</td>
<td>17%</td>
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</table>

**TABLE 1.** Patient Characteristics (n=112)

TIA indicates transient ischemic attack; CAD, coronary artery disease; MRF-S, modifiable risk factors for stroke; and BMI, body mass index. (MRF-S—hypertension, hyperlipidemia, diabetes, and smoking).

**Hypertension**

At the time of first visit, 83 (74%) patients were treated for HTN. Of these 28 (34%) of 83 were inadequately managed; their mean blood pressure was 169/98 mm Hg. At follow-up, almost half (12/28, 43%) of those with poorly controlled blood pressure were still inadequately managed (mean blood pressure 176/97 mm Hg). In 55 (66%) of 83 patients, HTN was adequately managed at the time of first visit (mean blood pressure 129/72 mm Hg) and at 1-year of follow-up (mean blood pressure 132/74 mm Hg). Overall 66% of those with HTN were adequately managed at baseline and 86% at their follow-up visit (Table 2).

**Hyperlipidemia**

Using the NCEP criteria for secondary prevention, 92 (82%) patients had hyperlipidemia at the baseline visit that required treatment (mean LDL 3.68 mmol/L). Only 16 (17%) patients were adequately managed for hyperlipidemia at baseline (mean LDL 2.5 mmol/L) and at follow-up (mean LDL 2.45 mmol/L). After 1 year, only 45 (49%) of 92 had adequate management of their lipids (mean LDL 2.24 mmol/L). Even when we used the less stringent NCEP criteria for primary prevention, 56 (61%) patients were eligible for treatment at baseline (mean LDL 4.06 mmol/L). At 1 year of follow-up, only 31 (55%) of 56 were treated to recommended NCEP goals (mean LDL 2.69 mmol/L). Twenty-one patients had a history of coronary artery disease and hyperlipidemia, in addition to a recent stroke or TIA. Of those, 14 (67%) of 21 were inadequately managed with respect to hyperlipidemia. At 1-year of follow-up 3 (21%) of 14 of these patients were adequately managed.

**Diabetes**

Twenty-six patients were diabetic by our definition, and all were type II. In 20 (77%) of 26 patients, baseline management was considered inadequate (mean FBG: 8.0 mmol/L).
Only 3 (15%) of 20 had improved glycemic control (mean FBG: 5.3 mmol/L) during follow-up. Overall 23% of diabetics were adequately managed at baseline, and this proportion increased to 35% at the follow-up visit. One third (9/26) of diabetic patients also had HTN at their baseline visit, and at follow-up 5 (56%) of 9 remained hypertensive, using a conservative blood pressure target of <140/90 mm Hg.

**Smoking**

Thirty-eight patients (34%) were smoking at the time of their SPC evaluation. After 1 year, only 4 (11%) patients had quit smoking, and no patient started.

**Predictors for Improvement**

We identified several potential predictors of improvement, such as age, gender, history of stroke or TIA, and history of coronary artery disease. However, none were independently associated with improvements in HTN, hyperlipidemia, diabetes, or smoking in multivariate logistical regression analyses.

**Discussion**

Although the appropriate imaging studies, surgical referrals, and antiplatelet treatment were initiated at our SPC, we found much room for improvement in terms of the secondary prevention of stroke. In general, the four MRF-S we examined were not actively managed by the SPC staff. Arguably, these modifiable risk factors are as important to stroke prevention as the evaluation for possible surgery or the use of antiplatelet agents. Yet, we found relative undertreatment of these important risk factors for atherosclerosis and stroke.

One third of our patients had inadequately managed HTN at baseline, indicating suboptimal secondary prevention. Even after 1 year, only 57% (14/28) of these patients had improved blood pressure control. Even in the highest risk patients, those with HTN and diabetes, two thirds still had inadequate blood pressure control in the year after initial evaluation. Although at the time of this study the results of the PROGRESS trial were not available, there is a steep and continuous association between HTN and stroke.12,17–19 The results of the PROGRESS trial and other existing data offer reasonable evidence to treat HTN aggressively for secondary prevention of stroke.12,20,21

Most of our patients were inadequately managed for hyperlipidemia, but there was some improvement during 1 year of follow-up. Even in patients with hyperlipidemia and coronary artery disease (representing the subgroup most likely to benefit from aggressive treatment), there was inadequate management.22 3-Hydroxy-3-methylglutaryl coenzyme A reductase inhibitor trials in patients with coronary artery disease and hyperlipidemia consistently demonstrate a 25% to 50% risk reduction for stroke or TIA.23–25 The effect of cholesterol lowering on secondary prevention of stroke is currently being investigated in two randomized clinical trials,13,14 but until the results of these studies become available, adequate management of hyperlipidemia seems justified.26,27

The management of diabetes, both at baseline and at follow-up, was less than optimal. Although the current evidence regarding the association between hyperglycemia and macrovascular complications such as stroke is not strong, the current consensus is that adequate management of diabetes is reasonable, and there is certainly benefit in terms of microvascular complications.28

Finally, even a year after their strokes, most smokers continued to smoke. The population-attributable risk for stroke associated with smoking is about 12%.29 Moreover, our results are even more disappointing when we consider that observational studies demonstrate a decreased stroke risk within 2 to 5 years of smoking cessation.30–32

Although several predictors were positively associated with improvement in risk factors, none were statistically significant. However, a larger patient population may demonstrate significant predictors for improvement.

The strengths of our study include a consecutive sample of patients, prospective standardized data collection, and long-term follow-up. However, we had at least four limitations. First, we lost 7 (6%) patients to follow-up, introducing some bias. Second, we did not have full access to the primary care physicians’ records. Third, other than self-reporting, we did not have any measures of patient adherence to medications. Fourth, all of the patients we evaluated were from only one tertiary care referral clinic. Thus, our findings may have limited generalizability.

**Conclusion**

Our results indicate that the conventional approach of SPCs, in which a number of risk factors for stroke are not actively managed by the SPC staff, fails to produce marked improvement in the management of HTN, hyperlipidemia, diabetes, or smoking. Future work must determine whether more active involvement of SPCs in the handling of these MRF-S will contribute to their adequate management. It may be that neurologists working in the field of secondary stroke prevention will need additional training in the medical management of these risk factors or will need to ally themselves more closely with other clinicians involved in atherosclerosis risk reduction.
Acknowledgment
Dr Majumdar is a Population Health Investigator of the Alberta Heritage Foundation for Medical Research.

References
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Stroke. 2002;33:1656-1659
doi: 10.1161/01.STR.000017877.62543.14

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