Stroke Risk Management
Changes in Mainstream Practice

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Background—Research shows that identification and control of risk factors reduces ischemic stroke. The impact of this evidence and health initiatives on mainstream practice remains unknown.

Methods—The purpose of this observational study was to investigate prior management of risk factors (hypertension, atrial fibrillation, previous stroke/transient ischemic attacks) in patients with acute cerebral infarction. Data were collected on the frequency of known risk factors before the incident stroke and their management compared with predefined criteria for appropriateness. The proportion of patients receiving treatment for risk factors before the acute episode was studied over 3 years.

Results—One thousand seventy-four patients (median age, 76 years; 60% women) were included in the study over 3 years. The proportion of patients with known hypertension (41% to 46%), diabetes (12% to 13%), previous stroke or transient ischemic attack (TIA) (21% to 31%), and atrial fibrillation (16% to 21%) remained stable. Overall, approximately 45% patients with atrial fibrillation, 60% patients with hypertension, and 70% with cerebrovascular disease were being actively managed. Time trends analysis showed a significant increase in the proportion of patients being treated for risk due to known cerebrovascular disease (59% to 85%), atrial fibrillation (18% to 59%), ischemic heart disease (35% to 72%), and carotid disease (13% to 85%) between the first and third year. The proportion of patients receiving treatment for hypertension remained unchanged. Patients with preexisting symptomatic vascular disease were more likely to receive appropriate risk management compared with asymptomatic patients (72% versus 46%, P<.001).

Conclusions—Although a significant number of ischemic events remain potentially preventable, there appears to be a positive trend in improved control of stroke risk. (Stroke. 1998;29:53-57.)

Key Words: stroke prevention ■ risk factors ■ cerebral infarction

Several well-designed randomized controlled studies have shown that identification and treatment of vascular risk factors reduce the incidence of stroke.1-14 The most relevant risk factors in this context are control of hypertension,5-8 use of aspirin for primary and secondary prophylaxis in patients with moderate or high risk,9,10 and anticoagulation in patients with atrial fibrillation.11-14 There is now overwhelming research evidence to support aggressive management of these risk factors, which has been widely publicized in medical and nonmedical literature. In addition, management of vascular risk factors has been prioritized in the national health care program,15 and significant resources have been targeted towards health education, screening, and intervention in the last few years.

There are fears that research evidence or health initiatives may fail to change clinical practice and management of cardiovascular risk factors in mainstream care and that it may remain suboptimal.15 Several studies have shown that significant numbers of patients with hypertension, atrial fibrillation, and cerebrovascular disease who would benefit from treatment do not receive adequate investigation or intervention.17-23 It has been suggested that management of risk factors can be improved if there were more incentives for primary care physicians, improved access to investigations and specialist services, and better secondary care support.16,24-26

Cardiovascular risk management has been prioritized by the Health of the Nation program in Britain,16 and a common multidimensional approach to reducing cardiovascular disease has been recommended. The salient features of the preventive aspects of this program, applicable to all districts around the country, are targeting of risk factor management with predefined standards of control, regular audit to be undertaken of primary care physicians, and additional payments to primary care physicians linked to achieving targets for risk management. In the study district, a preventive strategy was developed, which was based on evidence in literature, assessment of population needs, and professional consensus between primary and secondary care physicians. The objective of the study was to investigate changes in prior management of risk factors in patients presenting with acute cerebral infarction after the implementation of the program to evaluate its impact on potentially preventable ischemic events.

Methods

This observational study included patients with acute cerebral infarction referred to in-patient or out-patient services of a district general
hospital serving a population of 310,000 residents between January 1994 and December 1996. The population in the district was stable and weighted toward the older age groups. There were an estimated 600 new strokes every year based on incidence rates from other major studies and adjusted for population characteristics.

Stroke and cardiovascular disease were identified as a priority area in strategic plans by the Health Service Purchasers in the district and new initiatives included: (1) Investment in health education and health lifestyles program for cardiovascular risk. (2) Targeting on risk identification and management in primary care with secondary support from hospitals. This included nationally agreed financial incentives to primary care physicians in achieving defined targets for hypertension, smoking, cholesterol levels, obesity, exercise, and alcohol. Although the criteria of appropriate management were discussed with primary care physicians in local seminars, a specific training program for risk management was not undertaken. (3) Development of specialist hospital-based services for stroke and ischemic heart disease, including rapid access clinics for investigations and interventions aimed at vascular risk management.

An incident stroke register was used to collect information on patients in the health district who were admitted to the hospital or referred to neurovascular clinics. Data on the stroke register were validated by regular cross-checks against hospital admissions databases in local and neighboring hospitals as well as databases in general practice, district nursing, and community therapy records. The WHO definition of stroke was used. Patients were assessed by a stroke physician to establish a clinical diagnosis of stroke and risk factors. Previous hospital and general practice records were reviewed for past clinical diagnoses and prior management of risk factors. A computed tomography (CT) scan was undertaken to confirm the diagnosis and pathology of stroke.

Patients with clinical features of stroke but normal CT scans were considered to have an ischemic infarct. Patients with intracerebral hemorrhage (but not hemorrhagic infaracts) were excluded from the study because of differences in the etiology and risk factor profile (except for hypertension) between cerebral infarction and hemorrhage. Patients with a presumptive diagnosis of stroke with equivocal neurological deficits but no lesion on CT scan, neurological deficits secondary to epilepsy, or an infective, metastatic, or metabolic etiology and those with preexisting severe physical or cognitive disability were also excluded.

Data were collected on patient demography, stroke type and severity, and the frequency of known risk factors. Risk factors of primary interest included hypertension, atrial fibrillation, and a past history of transient ischemic attack (TIA) or ischemic stroke because there is unequivocal evidence to show that aggressive management of these factors is associated with reduced stroke incidence. Other risk factors of interest were those in which appropriate management may reduce stroke incidence and included diabetes mellitus, ischemic heart disease, peripheral vascular disease, hypercholesterolemia, smoking, and, possibly, asymptomatic carotid bruits. The identification and management of these risk factors before the acute event was reviewed by two independent observers (L.K. and I.P.) and compared with predefined standards for appropriate management based on recommendations in the literature.

**Hypertension**

Hypertension management included lifestyle advice and/or pharmacological intervention and optimum control of hypertension defined as systolic blood pressure <160 mm Hg and diastolic blood pressure <90 mm Hg measured at least two times in the year before the stroke.

**Atrial Fibrillation**

Management of atrial fibrillation included the use of anticoagulants in suitable patients and use of aspirin in patients with low risk or in whom anticoagulation would be contraindicated. As all anticoagulation was coordinated by the Anticoagulation Clinic, good control was defined as INR values in the therapeutic range on 80% or more recordings in patients' anticoagulation charts. The frequency of monitoring was variable, depending on the Anticoagulation Clinic assessments.

**Previous Stroke or TIA**

The management of previous stroke or TIA included the use of single or combination antiplatelet therapy and investigation for significant carotid artery disease, including carotid duplex scans and carotid endarterectomy, if appropriate.

**Smoking**

Smoking management included lifestyle and smoking advice given by a doctor or other health professionals in the 6 months after the acute episode.

**Diabetes Mellitus**

The management of diabetes mellitus included diet and lifestyle advice, use of oral hypoglycemic agents or insulin, and evidence of good control on home or biochemical monitoring. Optimum control was defined as fasting blood glucose <10 mmol/L or HbA1c <7% measured on at least two occasions in the year before the stroke.

**Ischemic Heart Disease and Peripheral Vascular Disease**

Ischemic heart disease and peripheral vascular disease were managed with the use of antiplatelet or anticoagulation agents.

Criteria for asymptomatic carotid bruits and for hypercholesterolemia were similar to guidelines in the literature. Data were analyzed for the entire patient group. As there may have been differences in practice over the period of the study, time trends were analyzed on a year-by-year basis for 3 years (1994 to 1996). Group homogeneity was analyzed with the \( \chi^2 \) test for multigroup comparisons of sex, stroke type, mortality, and destination of discharge. Data were compared with the \( \chi^2 \) test, \( t \) test, or ANOVA as appropriate. Interobserver agreement for appropriateness of risk factor management was evaluated with the \( k \) statistic.

**Results**

Ischemic stroke was seen in 1174 (87%) of the 1345 patients included in the stroke register over 3 years (Table 1). The mean age of patients with ischemic stroke was 75.7 ± 10.5 years (range, 26 to 100 years); 61% were women. Approximately 76% of these patients were admitted to the hospital for in-patient care.

Prestroke hypertension was seen in 507 (43%) patients, atrial fibrillation in 214 (18%) patients, and a past history of ischemic stroke or TIA in 306 (26%) patients (Table 2). Two hundred eighty-seven (57%) of the 507 patients known to have hypertension were receiving treatment before the stroke (Table 3). Of these, only 155 (54%) patients had documented diastolic blood pressures of <90 mm Hg before the acute event. Anticoagulation would have been inappropriate in 47 (22%) patients with established atrial fibrillation because of contraindications. Anticoagulation was being undertaken in 75 (45%) of the remaining 167 patients with atrial fibrillation, and there was evidence of good control in 64 (85%) patients. Aspirin or another antiplatelet treatment was being prescribed for 215 (70%) of the 306 patients known to have cerebrovascular disease. Symptomatic vascular disease before the presenting stroke was seen in 683 (58%) patients, whereas the incident stroke was the first presenting symptom of vascular disease in 491 (42%) patients. Appropriate prior management of risk factors was seen in 494 (72%) of the patients with symptomatic vascular disease before the stroke and in 225 (46%) of the patients in whom stroke was the first presenting symptom of vascular disease (\( P < .001 \)). There was a high level of agreement between the two observers on the presence of risk factors and...
their appropriate management (κ, 0.88 to 0.94; percentage exact agreement, 70% to 86%).

Year-by-year analysis showed that there were no significant differences between patient demography or stroke characteristics in patients with ischemic stroke over the 3-year period of observation (Table 1). There was a rise in the proportion of patients known to have atrial fibrillation, ischemic heart disease, and hypercholesterolemia, which may have been a result of increasing awareness of their importance as risk factors and better screening procedures over the period of observation (Table 2). On the other hand, the number of patients with a history of previous strokes or TIAs declined significantly. There was a significant increase in the proportion of patients receiving active management for risk due to previous strokes or TIAs, atrial fibrillation, and carotid disease (Table 3). Only 50% to 60% of patients with hypertension were being managed actively, and their proportion remained unchanged over the years. Although the proportion of patients being treated for hypercholesterolemia increased considerably, it failed to achieve significance because of small numbers.

**Discussion**

Results of this study suggest that despite considerable evidence published in recent literature and prioritization by health care planners, control of vascular risk factors remains suboptimal in mainstream practice, and there continues to be ischemic events, which are potentially preventable. On the other hand, there is encouraging evidence to suggest that there have been significant improvements in the management of some risk factors, especially atrial fibrillation and known carotid disease, over the last 3 years, which may be cause for optimism. Interestingly, there was a significant decrease in the proportion of patients who had a stroke or TIA before the presenting episode (Table 2), which may partly be due to improved secondary prevention measures.

There may be several factors contributing to the observed changes in mainstream practice over the last 3 years. The prevention of stroke and ischemic heart disease has been given a high profile in recent medical literature, with publication of several important studies, which have presented unequivocal evidence and guidelines for reducing vascular risks.9,13,31,32 Cardiovascular risk prevention has been prioritized in national and international strategies for health care,15,37 resulting in defined and time-limited targets to reduce the incidence stroke and other vascular events.15,37 These measures have helped to increase physician interest and resource investment by health purchasers in this area. In addition, local factors such as

**TABLE 1. Demography and Stroke Characteristics of Patients With Ischemic Strokes Included in the Study**

<table>
<thead>
<tr>
<th></th>
<th>1994 (n=436)</th>
<th>1995 (n=487)</th>
<th>1996 (n=422)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of stroke patients</td>
<td>436</td>
<td>487</td>
<td>422</td>
<td></td>
</tr>
<tr>
<td>No. of hemorrhages</td>
<td>60 (14%)</td>
<td>36 (8%)</td>
<td>75 (18%)</td>
<td></td>
</tr>
<tr>
<td>No. of ischemic strokes</td>
<td>376</td>
<td>451</td>
<td>347</td>
<td></td>
</tr>
<tr>
<td>Mean Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>73.4±11.2 (44-89)</td>
<td>71.8±13.7 (26-92)</td>
<td>74.6±9.3 (53-96)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>77.8±13.4 (17-94)</td>
<td>78.2±9.6 (50-100)</td>
<td>76.4±11.7 (44-92)</td>
<td></td>
</tr>
<tr>
<td>No. of females</td>
<td>226 (60%)</td>
<td>279 (62%)</td>
<td>214 (62%)</td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>116 (31%)</td>
<td>149 (33%)</td>
<td>101 (29%)</td>
<td></td>
</tr>
<tr>
<td>Discharge home</td>
<td>237 (63%)</td>
<td>271 (60%)</td>
<td>218 (63%)</td>
<td></td>
</tr>
<tr>
<td>Institutional care</td>
<td>23 (6%)</td>
<td>31 (7%)</td>
<td>28 (8%)</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 2. Known Risk Factor Profile of Patients With Ischemic Strokes Included in the Study**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>1994 (n=376)</th>
<th>1995 (n=451)</th>
<th>1996 (n=347)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>162 (43%)</td>
<td>185 (41%)</td>
<td>160 (46%)</td>
<td>NS</td>
</tr>
<tr>
<td>Diabetes</td>
<td>45 (12%)</td>
<td>59 (13%)</td>
<td>42 (12%)</td>
<td>NS</td>
</tr>
<tr>
<td>Smoker</td>
<td>68 (18%)</td>
<td>99 (21%)</td>
<td>83 (24%)</td>
<td>NS</td>
</tr>
<tr>
<td>Previous strokes/TIA</td>
<td>116 (31%)</td>
<td>117 (26%)</td>
<td>73 (21%)</td>
<td>.01</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>60 (16%)</td>
<td>81 (18%)</td>
<td>73 (21%)</td>
<td>NS</td>
</tr>
<tr>
<td>Ischemic heart disease*</td>
<td>112 (30%)</td>
<td>150 (33%)</td>
<td>115 (33%)</td>
<td>NS</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>45 (12%)</td>
<td>41 (9%)</td>
<td>34 (10%)</td>
<td>NS</td>
</tr>
<tr>
<td>Asymptomatic carotid bruit</td>
<td>15 (4%)</td>
<td>13 (3%)</td>
<td>13 (4%)</td>
<td>NS</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>8 (2%)</td>
<td>18 (4%)</td>
<td>28 (8%)</td>
<td>.001</td>
</tr>
</tbody>
</table>

n indicates number of ischemic strokes.

*Includes patients with a history of angina, acute myocardial infarction, coronary vascular reconstruction, or chronic nonvalvular heart failure.
TABLE 3. Year-by-Year Analysis of Prior Treatment of Known Risk Factors in Patients With Ischemic Stroke

<table>
<thead>
<tr>
<th>Known Risk Factor</th>
<th>1994</th>
<th>1995</th>
<th>1996</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>87/162 (54%)</td>
<td>109/185 (59%)</td>
<td>91/160 (57%)</td>
<td>NS</td>
</tr>
<tr>
<td>Diabetes</td>
<td>43/45 (96%)</td>
<td>54/59 (92%)</td>
<td>41/42 (98%)</td>
<td>NS</td>
</tr>
<tr>
<td>Smokers (advice given)*</td>
<td>46/68 (68%)</td>
<td>66/99 (66%)</td>
<td>58/83 (70%)</td>
<td>NS</td>
</tr>
<tr>
<td>Previous strokes/TIA</td>
<td>69/116 (59%)</td>
<td>84/117 (72%)</td>
<td>62/73 (85%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>8/47 (17%)</td>
<td>31/63 (49%)</td>
<td>35/57 (61%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Asymptomatic bruit†</td>
<td>2/15 (13%)</td>
<td>8/13 (62%)</td>
<td>11/13 (85%)</td>
<td>0.005</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>39/112 (35%)</td>
<td>72/150 (48%)</td>
<td>83/115 (72%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>2/8 (25%)</td>
<td>8/18 (44%)</td>
<td>10/28 (46%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Patients who were aware that smoking was injurious to health and had been advised to stop smoking by a doctor or other health professionals in the 6 months preceding the stroke.

†Appropriate treatment consisted of investigations for severity of carotid stenosis using a duplex carotid ultrasound and carotid endarterectomy in eligible patients.

The prioritization of cardiovascular risk prevention in health commissioning, financial incentives for primary care physicians, improved access to specialist investigations, and a seamless interface between primary and secondary–tertiary care services may have made significant contributions. The effect of increasing public awareness of cardiovascular risk factors and the public’s willingness to participate in risk reduction programs should not be underestimated and may have been another contributing factor.

The study suggests that there is a greater likelihood of appropriate risk management being undertaken in patients with preexisting symptomatic vascular disease compared with patients in whom the incident stroke was the first presentation of vascular disease (72% versus 46%). This may be because vascular symptoms may have alerted physicians about risk factors or because the benefits of appropriate risk management were perceived as being greater in this group of patients. Whatever the reason, it may be possible to improve implementation of preventive strategies by prioritizing secondary prevention in its broadest sense over primary prevention in the general population. The data presented in this study are not appropriate to comment on the overall health benefit of such a policy, which needs to be investigated in further studies.

Interesting patterns were observed in the management of individual risk factors. Despite the evidence and incentives associated with reductions in hypertension and smoking, there was little change over 3 years, probably because of physician and patient perceptions as well as the known problems of management of these factors. On the other hand, significant increases were seen in the management of risk associated with previous strokes and TIAs (59% to 85%), atrial fibrillation (17% to 61%), previously asymptomatic carotid artery disease (13% to 85%), and ischemic heart disease (35% to 72%), despite the lack of incentives and possible extra resource use in their management. These may be due to the availability of definitive investigations and effective (or simple) treatment regimens or because of increased secondary care involvement in these areas. The reasons for these differences must remain speculative at present, and further studies are needed to investigate effective targeting of initiatives directed at prevention, early identification, and appropriate referrals.

The limitations of retrospective assessment of risk factor control based on incident stroke need to be acknowledged. The study sample can be considered representative, as it includes >80% of stroke patients in the health district identified by the stroke register, which was validated against physician and nursing records as described. The study shows the number of strokes that may have been potentially preventable but does not provide information on strokes that may have been prevented as a result of appropriate management of risk factors. There is a possibility that there may be a higher (or lower) proportion of patients at risk being appropriately managed in the community than shown by the sample based on those who have had an ischemic event. It is also not possible to judge whether improved management of risk factors over the years may have resulted in a reduction in the incidence of vascular events.

These questions can only be answered by the reliable collection of longitudinal data in a large number of patients from several primary and secondary care sources. Efforts to collect such data as a part of health monitoring by service purchasers across Great Britain have been unsuccessful despite being a part of the primary care contract for the last 3 years. The other alternative is to undertake large scale prospective primary care studies, which are logistically difficult and expensive because of the number of patients, primary care physicians, and the length of follow-up involved. In the absence of such studies and the lack of information currently available, the present study identifies areas of progress as well as areas in which more effort may be needed, which will help in better planning of prevention strategies.

There appears to be a change for the better in the management of cardiovascular risk factors, which probably is being driven by a combination of scientific evidence, health prioritization, and increasing physician and public awareness. Despite the positive trends described in this study, there continue to be potentially preventable strokes, suggesting that there is no room for complacency in efforts to reduce the incidence of vascular disease. Several studies have shown that these efforts need to be sustained to maintain the momentum of vascular risk prevention; success will depend on close collaboration...
among the public, the physicians, and health-purchasing organizations.

References
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