Comparison of Hypertension Management After Stroke and Myocardial Infarction
Results From ECLAT1—A French Nationwide Study

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Background and Purpose—Hypertension control is a cornerstone of preventive treatment in patients at risk for cerebral attack. The aim of this study was to analyze hypertension management in secondary prevention of stroke as compared with patients in secondary prevention of myocardial infarction (MI).

Methods—The ECLAT1 study was a cross-sectional study conducted in all French regions in a random sample of 3009 practitioners. Patients with a documented history of atherothrombotic disease were included. Risk factors and the last measurement of blood pressure (BP) available in the medical record were noted. In the current study, patients with treated hypertension and a unique manifestation of atherothrombotic disease, ischemic stroke or MI, were analyzed.

Results—Among the 4346 patients included in the ECLAT1 study, 1416 patients with treated hypertension and stroke or MI were analyzed. Hypertension control was poorer in patients with stroke as compared with patients with MI (24.56% versus 34.16% P<0.01). Compared with patients with MI, systolic BP (140.61±14.14 versus 144.21±14.99; P<0.0001), pulse pressure (59.91±11.94 versus 62.48±12.49; P<0.001), and, to a lesser extent, diastolic BP (80.69±8.39 versus 81.72±8.85; P<0.05) were higher in stroke patients. Moreover, antihypertensive monotherapy was more frequently used in stroke than in MI patients (43.16% versus 31.44% P<0.0001).

Conclusion—With respect to the beneficial influence of tight BP control in secondary prevention of stroke, our results highlight the need for information provided to practitioners to recall the importance of hypertension control in this situation and to increase the use of combination therapy. (Stroke. 2004;35:1579-1583.)

Key Words: stroke ■ secondary prevention ■ hypertension

Approximately 0.2% of the population of most Western countries have a stroke each year. Among survivors, 7% have a recurrent event each year. For these reasons, stroke is expected to remain the second leading cause of death globally for the next few decades. Applying the best available evidence-based secondary prevention strategies to reduce the burden of stroke in the population is an important public health issue. In this respect, the continuous relationship between blood pressure and stroke and the positive influence of strict blood pressure (BP) control in stroke prevention demonstrate that hypertension control is a cornerstone of preventive treatment in patients at risk for stroke. In a recent observational study conducted in tertiary care in a stroke prevention clinic in Canada, 66% of treated hypertensive subjects in secondary stroke prevention were controlled at 140/90 mm Hg threshold, and this percentage increased at 86% after 1-year follow-up. However, data are lacking on BP control in patients in secondary prevention of stroke in primary care. The aim of this study was to analyze hypertension management in patients with previous history of ischemic stroke in primary care as compared with patients in secondary prevention of myocardial infarction.

Subjects and Methods

Study Design
The ECLAT1 study was a cross-sectional study conducted in all French regions in geographic-stratified random sample of 3009 general practitioners (GP). The number of GP by region was closely related to the distribution of GP in France. The GP performed their own surveys. The surveys were completed in an anonymous fashion. All the patients examined at office on December 7, 2000, were eligible. Patients with a documented history of ischemic stroke, myocardial infarction (MI), or peripheral artery disease were included. Gender, age, smoking habits, diabetes mellitus, drug regimens, and cardiovascular history were duly reported. Height and weight were measured. The last measurement of BP available in the medical record was noted. Smokers were defined as patients who currently smoked (cigarettes smoked >1/day) or who stopped
TABLE 1. Characteristics of the Study Population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>History of MI (n=846)</th>
<th>History of Stroke (n=570)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>70.42±10.55</td>
<td>73.44±10.42‡</td>
</tr>
<tr>
<td>Male</td>
<td>587 (69.39)</td>
<td>248 (43.51)†</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>27.00±4.30</td>
<td>26.46±4.22*</td>
</tr>
<tr>
<td>Overweight (BMI &gt;30 kg/m²)</td>
<td>182 (21.51)</td>
<td>108 (18.94)</td>
</tr>
<tr>
<td>Treated dyslipidemia</td>
<td>550 (65.01)</td>
<td>237 (41.58)‡</td>
</tr>
<tr>
<td>Treated diabetes</td>
<td>151 (17.85)</td>
<td>78 (13.68)*</td>
</tr>
<tr>
<td>Current smoking</td>
<td>86 (10.17)</td>
<td>41 (7.19)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>82 (9.69)</td>
<td>91 (15.96)‡</td>
</tr>
<tr>
<td>Heart failure</td>
<td>96 (11.35)</td>
<td>41 (7.19)†</td>
</tr>
<tr>
<td>Associated diseases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>76 (8.96)</td>
<td>36 (6.31)</td>
</tr>
<tr>
<td>Dementia</td>
<td>7 (0.82)</td>
<td>22 (3.85)‡</td>
</tr>
<tr>
<td>Others diseases</td>
<td>71 (8.39)</td>
<td>36 (6.32)</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antiplatelet agents</td>
<td>697 (82.39)</td>
<td>426 (74.74)‡</td>
</tr>
<tr>
<td>Antivitamin K</td>
<td>116 (13.71)</td>
<td>95 (16.67)</td>
</tr>
<tr>
<td>Statins</td>
<td>451 (53.31)</td>
<td>182 (31.93)‡</td>
</tr>
<tr>
<td>Fibrates</td>
<td>103 (12.17)</td>
<td>56 (9.82)</td>
</tr>
</tbody>
</table>

MI indicates myocardial infarction; BMI, body mass index.
Percentage are in parentheses.
*P<0.05.
†P<0.01.
‡P<0.001.

smoking <1 year ago. With respect to the aim of the study among patients included in the ECLAT1 study, we analyzed treated hypertensive patients who presented with a unique manifestation of atherothrombotic disease: MI or ischemic stroke.

Hypertension Criteria
Controlled hypertension was defined as BP <140/90 mm Hg. Uncontrolled hypertension was defined as BP ≥140/90 mm Hg. Isolated systolic hypertension was defined as systolic BP ≥140 mm Hg and diastolic BP <90 mm Hg. Borderline isolated systolic hypertension was defined as 140 ≤ systolic BP ≤ 160 mm Hg and diastolic BP <90 mm Hg.

Data Analysis
Patients were categorized according to the localization of their atherothrombotic disease (MI or ischemic stroke) and according to BP control. The analysis of antihypertensive treatment was conducted with respect to the World Health Organization (WHO) guidelines.11 We differentiated monotherapy and combination therapy as treatments comprising 2, 3, or more drugs. The comparisons were performed with χ² test or with Student t test. The relations between clinical characteristics, cardiovascular risk factors, and hypertension control were assessed first in bivariate analysis and then using a multivariate logistic regression. All the variables found to be associated with hypertension control (P<0.10) in bivariate analysis were entered in the model. Also, the model was systematically adjusted for age. Statistical analysis was performed on SAS statistical software (SAS/STAT user’s guide, release 6.12; SAS Institute Inc).

Results
Among the 5039 GP asked to participate in the survey, 875 (17.36%) declined and 1155 (22.92%) failed to satisfactorily complete the questionnaire. Finally, 3009 GP participated in the survey (participation rate: 59.71%).

Baseline Characteristics
Among the 4346 patients included in the ECLAT1 study, 2614 (60.15%) patients had previous history of hypertension, of whom 129 (2.97%) were not using antihypertensive drug treatment and 1033 (23.76%) had peripheral artery disease or had both stroke and MI. These patients were excluded from the analysis. Data concerning all variables were available for 1416 (32.58%) treated hypertensive patients with a unique manifestation of atherothrombotic disease: 986 with previous history of MI and 670 with previous history of ischemic stroke. These patients formed the basis of this report (Tables 1 and 2).

BP Control
In the sample, hypertension control was achieved in a lower percentage of patients with stroke than in patients with MI (24.56% versus 34.16% P<0.01) (Table 2). Systolic BP, pulse pressures, and, to a lesser extent, diastolic BP were higher in patients with a previous history of stroke than in patients with MI (Table 2). To take into account the potential influence of age and associated diseases on BP level, we performed subgroup analyses. The difference in BP control
between stroke and MI patients remained of similar magnitude in patients above and beyond the median value of age (72 years) and in patients free of heart failure, atrial fibrillation, dementia, cancer, or other severe nonvascular diseases, except in women (Table 3). In bivariate analysis, sex (P=0.0006), heart failure (P=0.008), body mass index (P=0.06), and history of stroke (P=0.0001) were associated with hypertension control whereas atrial fibrillation, treated dyslipidemia, diabetes, associated diseases, antihypertensive strategy, and type of antihypertensive treatment were not (P>0.10). In multivariate logistic regression analysis, stroke was independently associated with a higher risk of uncontrolled hypertension (odds ratio, 1.44; 95% CI, 1.13 to 1.85) (Table 4).

Analysis of Hypertension Management

β-Blockers, angiotensin-converting enzyme (ACE) inhibitors, diuretics, and calcium channel blockers were the most prescribed drugs in MI and stroke patients, respectively. Compared with MI patients, more patients with stroke were receiving monotherapy (stroke 43.16% versus MI 31.44%; P<0.001) (Table 2). When focused on uncontrolled hypertension, a quite similar difference was observed: 182/430 (42.33%) of stroke patients were receiving monotherapy versus 183/557 (32.85%) of MI patients (P<0.01). Also, one fifth of MI patients [19.21% (107/557)] and one sixth of stroke patients [16.28% (70/430)] with uncontrolled hypertension were receiving a combination of at least 3 drugs, including a diuretic.

Discussion

The main finding of this study is that BP control in patients with treated hypertension is poorer after stroke than after MI. It seems even poorer than previously reported in primary prevention. In this respect, a large body of evidence has shown the beneficial effect of strict BP control in stroke prevention. First, the relation between stroke and BP is steeper than the relation between coronary heart disease and BP: in a landmark analysis of 9 prospective observational studies, differences in diastolic BP of 5, 7.5, and 10 mm Hg were, respectively, associated with a reduction in stroke of at least 34%, 46%, and 56%, and there was a 21%, 29%, and 37% reduction in coronary heart disease. Second, in 1997, a meta-analysis of 9 randomized trials was conducted to assess the effect of antihypertensive drugs on clinical outcomes in patients with previous stroke; a 28% reduction in the recurrence of stroke was reported. In agreement with this finding, a large-scale randomized trial in 2001 showed a similar result: a mean reduction of 9 mm Hg in systolic BP and 4 mm Hg in diastolic BP with perindopril–indapamide-based therapy lowered the risk of stroke by 28%. Lastly, a recent meta-analysis has suggested that reduction in stroke risk is related to the magnitude of BP reduction. Unfortunately, although all these data reinforce the importance of strict BP control in secondary stroke prevention, we found that in general practice, only 1 of 4 patients with stroke had controlled BP at the 140/90 mm Hg threshold.

Patient Characteristics

Because the relationship between stroke and BP is steeper than the relationship between MI and BP, it is likely that before the occurrence of stroke, uncontrolled hypertension is more prevalent than in MI patients.

Table 3. Blood Pressure Control in Various Subgroups

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Controlled Hypertension</th>
<th>Stroke (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men, n=835</td>
<td>36.63 (215/587)</td>
<td>27.02 (67/248)†</td>
</tr>
<tr>
<td>Women, n=581</td>
<td>28.57 (74/259)</td>
<td>22.67 (73/322)</td>
</tr>
<tr>
<td>Patients 72y, n=720</td>
<td>36.02 (170/472)</td>
<td>24.19 (60/248)†</td>
</tr>
<tr>
<td>Patients &gt;72y, n=696</td>
<td>31.82 (119/374)</td>
<td>24.84 (80/322)*</td>
</tr>
<tr>
<td>Patients free of dementia, n=1387</td>
<td>34.21 (287/839)</td>
<td>24.64 (135/548)‡</td>
</tr>
<tr>
<td>Patients free of dementia or cancer, n=1278</td>
<td>33.81 (258/763)</td>
<td>24.66 (127/515)‡</td>
</tr>
<tr>
<td>Patients free of associated noncardiovascular diseases, n=1176</td>
<td>33.19 (231/696)</td>
<td>25.00 (120/480)†</td>
</tr>
<tr>
<td>Patients free of heart failure, n=1279</td>
<td>32.80 (246/750)</td>
<td>24.20 (128/529)‡</td>
</tr>
<tr>
<td>Patients free of atrial fibrillation, n=1243</td>
<td>34.29 (262/764)</td>
<td>25.47 (122/479)†</td>
</tr>
</tbody>
</table>

*P<0.05. †P<0.01. ‡P<0.001. §P<0.0001. ¶P<0.00001.

Table 4. Multivariate Logistic Regression Analysis With Uncontrolled Hypertension as Dependent Variable

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (1-y increase)</td>
<td>1.00</td>
<td>0.99–1.01</td>
<td>NS</td>
</tr>
<tr>
<td>Stroke vs MI</td>
<td>1.44</td>
<td>1.13–1.85</td>
<td>†</td>
</tr>
<tr>
<td>Heart failure, yes vs no</td>
<td>0.61</td>
<td>0.42–0.89</td>
<td>*</td>
</tr>
<tr>
<td>Sex (male vs female)</td>
<td>0.73</td>
<td>0.57–0.94</td>
<td>*</td>
</tr>
<tr>
<td>BMI (1-kg/m² increase)</td>
<td>1.03</td>
<td>1.00–1.06</td>
<td>*</td>
</tr>
</tbody>
</table>

*P<0.05. †P<0.01. BMI indicates body mass index; NS, not significant.
was more prevalent than before the occurrence of MI. In this respect, BP may be poorly controlled in stroke patients because their hypertension is more refractory to treatment. However, this hypothesis cannot be assessed with respect to the cross-sectional design of the study. However, patients with stroke were older and more frequently had a previous history of dementia or atrial fibrillation than MI patients, whereas heart failure, diabetes, and male sex were more prevalent in MI patients. The deleterious influence of age and associated risk factors on BP control has been repeatedly shown.\textsuperscript{15–17} Also, it is likely that heart failure results in a decrease in BP level and helps control hypertension. Lastly, because strict BP control may not be considered as a suitable goal by the GP for patients with short life expectancies, the difference in the prevalence of associated diseases may have contributed to explain the difference in hypertension control between stroke patients and MI patients. To test these hypotheses, we analyzed the differences in BP control between MI patients and stroke patients in various subgroups. In such a condition, the difference in BP control remained significant between MI patients and stroke patients in all subgroups but women. Moreover, in multivariate analysis, after adjustment for sex and other confounders, the probability of being controlled for hypertension remained significantly higher in MI patients as compared with stroke patients. In summary, all these data suggest that patient’s characteristics in terms of demographic characteristics, associated risk factors, or associated diseases do not fully account for the poorer BP control observed in stroke patients.

**Hypertension Management**

The second finding of the study is that compared with patients with MI, hypertensive patients with stroke were more frequently treated with a monotherapy. BP level could not explain this difference in the intensity of antihypertensive treatment. Conversely, because hypertensive patients with a history of stroke had higher systolic BP and pulse pressure than hypertensives with a history of MI, one could expect an increase in the intensity of antihypertensive therapy in the former group with respect to the deleterious influence of these parameters on cardiovascular prognosis.\textsuperscript{18,19} It is likely that the beneficial effects of $\beta$-blockers beyond BP reduction both on outcome\textsuperscript{20,21} and on relief of angina symptoms\textsuperscript{22} contribute to the larger use of combination therapy in MI patients. Because of the cross-sectional design of the study, it could not be established to what extent this larger use of combination therapy has accounted for in the better BP control observed in patients with MI. However, international\textsuperscript{41} and national guidelines\textsuperscript{23,24} recommend combining drugs when monotherapy fails to control hypertension. Also, it is of interest to note that in a prospective study conducted in primary care older patients, Berlowitz et al.\textsuperscript{25} have shown that patients who received more intensive medical therapy had better hypertension control. Thus, in light of these data, it would be highly relevant to understand the reasons for the lack of more intensive drug therapy in uncontrolled hypertensives with stroke. Interestingly, in a US cross-sectional study on hypertension management,\textsuperscript{26} conducted in primary care, the most frequently cited reason for no initiation or change in therapy in patients with uncontrolled hypertension was related to the primary care physicians being satisfied with BP. On average, physicians reported that 150 mm Hg was the lowest systolic BP at which they would recommend pharmacologic treatment to patients, compared with 91 mm Hg for diastolic BP. In accordance with this finding, we showed that the majority of patients with uncontrolled hypertension with stroke had isolated systolic hypertension. Therefore, as in primary prevention,\textsuperscript{27} our data suggest that obtaining strict systolic BP control in stroke patients is not a realistic nor a desirable target in the GP opinion. Concerns about an excessive decrease in BP in patients with severe supra-aortic atherosclerotic lesions\textsuperscript{28} may explain this attitude. Obviously, this point of view represents a major obstacle to the control of hypertension in stroke secondary prevention. In this respect, it would be useful to provide information to GP to improve the use of combination therapy.

**Conclusion**

This study provides for the first time to our knowledge data on hypertension management in secondary prevention of stroke in a large and representative sample of GP in a Western country. BP control was poorer and use of combination antihypertensive therapy was less frequent in patients with a previous history of stroke as compared with patients with MI. Demographic characteristics or associated diseases of patients with stroke do not account for these results. An underestimation of the risk related to systolic BP and of the benefit drawn from strict BP control in patients with stroke may explain these findings. Our results suggest that information should be provided to GP on hypertension management in secondary stroke prevention to help improve the prognosis of this population at high risk.

**Acknowledgments**

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**References**


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