Background and Purpose—High blood pressure (BP) in acute stroke has been associated with a poor outcome; however, this has not been evaluated in young adults.

Methods—The relationship between BP and long-term outcome was assessed in 1004 consecutive young, first-ever ischemic stroke patients aged 15 to 49 years enrolled in the Helsinki Young Stroke Registry. BP parameters included systolic (SBP) and diastolic BP, pulse pressure, and mean arterial pressure at admission and 24 hours. The primary outcome measure was recurrent stroke in the long-term follow-up. Adjusted for demographics and preexisting comorbidities, Cox regression models were used to assess independent BP parameters associated with outcome.

Results—Of our patients (63% male), 393 patients (39%) had prestroke hypertension and 358 (36%) used antihypertensive treatment. The median follow-up period was 8.9 years (interquartile range 5.7–13.2). Patients with a recurrent stroke (n=142, 14%) had significantly higher admission SBP, diastolic BP, pulse pressure, and mean arterial pressure (P<0.001) and 24-h SBP, diastolic BP, and mean arterial pressure compared with patients without the recurrent stroke. Patients with SBP ≥160 mm Hg compared with those with SBP <160 mm Hg had significantly more recurrent strokes (hazard ratio 3.3 [95% confidence interval, 2.05–4.55]; P<0.001) occurring earlier (13.9 years [13.0–14.6] versus 16.2 [15.8–16.6]; P<0.001) within the follow-up period. In multivariable analyses, higher admission SBP, diastolic BP, pulse pressure, and mean arterial pressure were independently associated with the risk of recurrent stroke, while the 24-hour BP levels were not.

Conclusions—In young ischemic stroke patients, high acute phase BP levels are independently associated with a high risk of recurrent strokes. (Stroke. 2016;47:1593-1598. DOI: 10.1161/STROKEAHA.116.012944.)

Key Words: blood pressure ■ hypertension ■ prognosis ■ stroke ■ stroke in the young

Strokes occur because of rare causes, such as arterial dissections.11,12 The overall prevalence of hypertension in the young has already more than doubled in the past 2 decades, as has the amount of untreated hypertension.13 Diagnosed hypertension in the family is a highly significant predictor of stroke,14 and unhealthy lifestyles, such as obesity, high salt intake, and poor physical activities increase the prevalence of mild hypertension, found increasingly even in the young.

Although there are some limited epidemiological data on the association of hypertension in the young and stroke mortality,15 the BP levels in the acute stroke phase and their impact on the long-term outcome have not been evaluated in the young. We therefore studied the relationship between the admission and 24-hour BP values in the young patients, with...
a first-ever ischemic stroke and the risk of a recurrent stroke, cardiac events, or death from any cause.

Materials and Methods
This retrospective study was approved by the relevant authorities and performed at the Department of Neurology, Helsinki University Hospital. Our hospital has the only comprehensive stroke center with a neurological emergency room in the Helsinki region serving a population of 1.5 million. Patients included in the study belong to the Helsinki Young Stroke Registry (n=1008) and had a first-ever acute ischemic stroke diagnosed and treated at our department from 1994 to 2007.14 The BP medication information was gathered from patient records and prescriptions data at 3 months time point to exclude patients using the medication only at the acute stroke phase.

All patients included in the study had admission and 24-hour BP values and data on long-term follow-up. BP measurements were performed with fully automatic arm BP monitors and reading lying in a supine position. Systolic BP (SBP) and diastolic BP (DBP) were recorded at admission in the emergency room and again at 24 hours after stroke onset. When >1 BP measurements were available, the first recording was taken into account for the analysis. Pulse pressure (PP) was calculated as SBP−DBP. Mean arterial pressure was calculated as DBP+1/3 PP. The difference between the admission and 24-hour BP values was calculated as delta (Δ) SBP, DBP, PP, and mean arterial pressure.

Demographic factors analyzed included age and sex. Comorbidities considered were diagnosed hypertension, obesity defined as a body mass index ≥30 kg/m², or patient clearly stated as heavily obese if body mass index data were not available, smoking, dyslipidemia, previous transient ischemic attack, known atrial fibrillation, type 1 or type 2 diabetes mellitus, and cardiovascular disease, including congestive heart failure, coronary artery disease, prior myocardial infarction, or peripheral arterial disease. Classification of the cause of stroke was based on medical and radiological data and was assessed by stroke neurologists according to the Trial of Org 10172 in Acute Ischemic Stroke Treatment criteria. Hypertension was defined according to World Health Organization criteria: SBP ≥ 140 mm Hg, DBP ≥ 90 mm Hg, or patient being on antihypertensive treatment.15

Follow-up data until the end of 2011 were obtained from the Care Register for Healthcare, maintained by the National Institute for Health and Welfare in Finland. This register is mandatory and regulated by legislation and includes data on all in-hospital stays. All hospitalizations because of International Statistical Classification of Diseases-9 codes 391–398, 402, 404, 410–417, 420–437, 440–444, 446–447, 449, 451–453, 459, and 798, as well as International Statistical Classification of Diseases-10 codes I01, I02, I05–I09, I11, 113, 120–128, 130–152, 160–168, and I70–I79 were screened and diagnoses verified from original patient records when possible. Dates and causes of death came from Statistics Finland. The reliability and quality of these registries have previously been validated.17,18

The primary outcome measure was recurrent stroke, defined as any hemorrhagic or ischemic cerebrovascular event corresponding to the aforementioned diagnosis codes, with an exception for transient ischemic attack, which was not included. Secondary outcome measures were death from any cause and composite of cardiac events, defined as an acute myocardial infarction, unstable angina pectoris, coronary revascularization procedure, hospitalization because of other cardiac disease, such as arrhythmia, cardiomyopathy, or congestive heart failure, or death because of cardiac causes, whichever occurred first.

Statistical Analyses
To characterize the patient population, BP parameters were studied in subgroups defined by age and sex. Because we had only few young patients and the number of patients increased with age, we used age percentiles to have an almost equal number of patients in each group. Median and interquartile range were reported for normally distributed parameters. Chi-square tests were used to compare categorical variables. Student’s t and Mann–Whitney U tests allowed comparisons of normally distributed continuous and non-normally distributed or noncontinuous variables, respectively. With each patient, the median differences between admission and 24-hour values were tested with Wilcoxon signed-rank test.

The cutoff SBP and DBP levels were visually estimated from the Cox regression cumulative survival curve in both patients with or without antihypertensive medication. Multivariable Cox regression analysis was used to identify the independent BP parameters associated with the outcomes. For each BP parameter, a separate multivariable analysis was performed after adjustment for age, sex, previous transient ischemic attack, dyslipidemia, type 1 and type 2 diabetes mellitus, cardiovascular disease, obesity, and current smoking; selection was based on their univariate significance (P<0.10). Cumulative distribution of the Kolmogorov–Smirnov test was analyzed on patients with and without recurrent stroke and admission SBP and DBP decentiles.

A 2-sided P value <0.05 was considered statistically significant. All statistical analyses were done on IBM SPSS 19.0.

Results
A total of 1004 eligible patients were included in the study (44 [37–47] years). Median delay to the first imaging was 0 days (interquartile range 0–2). Most patients were men (63%) having hypertension significantly more often than women (44% versus 31%; P<0.001).

Increased SBP levels ≥140 mm Hg at admission were found in 57% (n=549) of the patients. Male preponderance, BP levels, and cardiovascular risk factors, such as hypertension (n=393, 39%), increased significantly with age (Table I in the online-only Data Supplement). Patients with a recurrent stroke had higher BP levels both at admission and at 24 hours; the BP levels decreasing significantly within 24 hours (Table 1).

One in 3 used antihypertensive medication (n=358, 36%) within 3 months: β-blockers (57%), angiotensin-converting enzyme inhibitors (26%), diuretics (25%), calcium-channel blockers (18%), and angiotensin-receptor blockers (14%).

Table 1. Admission and 24-Hour Blood Pressure Parameters in mm Hg Stratified by the Occurrence of Recurrent Stroke

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>All (n=962)</th>
<th>Recurrent Stroke (n=393)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP (mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>141 (125–160)</td>
<td>140 (124–160)</td>
<td>151 (131–170)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>865 (78–97)</td>
<td>85 (76–92)</td>
<td>90 (80–104)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PP (mm Hg)</td>
<td>58 (24)</td>
<td>57 (17)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MAP (mm Hg)</td>
<td>107 (23)</td>
<td>105 (18)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>24-hour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP (mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>134 (120–150)</td>
<td>132 (120–150)</td>
<td>140 (121–160)</td>
<td>0.006</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 (72–90)</td>
<td>80 (70–90)</td>
<td>85 (76–95)</td>
<td>0.014</td>
</tr>
<tr>
<td>PP (mm Hg)</td>
<td>53 (21)</td>
<td>53 (16)</td>
<td>0.104</td>
</tr>
<tr>
<td>MAP (mm Hg)</td>
<td>100 (22)</td>
<td>99 (16)</td>
<td>0.014</td>
</tr>
<tr>
<td>Δ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔSBP (mm Hg)</td>
<td>8 (4–21)</td>
<td>7 (4–20)</td>
<td>0.074</td>
</tr>
<tr>
<td>ΔDBP (mm Hg)</td>
<td>5 (3–14)</td>
<td>5 (1–15)</td>
<td>0.234</td>
</tr>
<tr>
<td>ΔPP (mm Hg)</td>
<td>2.5 (7–15)</td>
<td>2 (7–14)</td>
<td>0.072</td>
</tr>
<tr>
<td>ΔMAP (mm Hg)</td>
<td>5.3 (3–16)</td>
<td>5 (3–15)</td>
<td>0.129</td>
</tr>
</tbody>
</table>

Data are shown as median=interquartile range or mean (SD). Δ indicates BP change from admission to 24-hour. BP, blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; PP, pulse pressure; and SBP, systolic blood pressure.
enzyme inhibitors (39%), diuretics (24%), and calcium channel blockers (23%).

The follow-up period extended ≤18 years (median 8.91 [interquartile range 5.66–13.2]; Figure 1). A recurrent stroke during follow-up occurred in 142 patients (14%; 65% male); most recurrent strokes being ischemic (n=123, 12%) and only few (n=19, 1.9%) hemorrhagic. Composite of cardiac events were seen in 149 patients (15%), and AMI occurred in 37 patients (3.7%; 89% male). Vascular death was seen in 42 patients (4.2%; 78% male) out of all the 178 deaths (18%) from any cause.

Patients with an admission SBP ≥160 mmHg compared with patients with an SBP <160 mmHg had significantly more recurrent strokes in all the patients; in both patients with and without antihypertensive treatment (Figure 1). The recurrent strokes also occurred earlier (13.9 [13.0–14.6] versus 16.2 [15.8–16.6]; P=0.001) with the higher BP levels. Patients with an admission DBP≥100 mm Hg compared with patients with a DBP <100 mm Hg had also significantly more recurrent strokes (hazard ratio 3.2 [95% confidence interval, 2.36–4.09]; P<0.001). The cumulative distribution of patients with higher admission SBP and DBP decentiles

![Figure 1](http://stroke.ahajournals.org/)

Figure 1. Cumulative event risk of the relationship between admission systolic blood pressure (SBP) below or ≥160 mmHg and recurrent stroke in all patients (A), patients with (B) and without antihypertensive medication (C) at the end of follow-up. CI indicates confidence interval; and HR, hazard ratio.
associated with a significantly higher recurrent stroke risk is seen in Figure 2.

In multivariable Cox regression analyses, higher admission SBP, DBP, PP, mean arterial pressure, and ΔSBP levels were independently associated with an increased recurrent stroke risk (Table 2) after adjusting for age, sex, previous transient ischemic attack, type 1 and type 2 diabetes mellitus, obesity, hyperlipidemia, and current smoking. No association was found for ΔDBP, ΔPP, Δmean arterial pressure, or 24-hour BP levels and recurrent stroke or for any BP levels and death from any cause or any cardiac event (data not shown).

Discussion

High admission BP levels were found in more than half of our young patients with acute stroke. These high BP levels were independently associated with a higher risk of recurrent strokes in the long-term follow-up, being in line with earlier reports with older stroke patients.6 There was a cutoff level of BP >160/100 mm Hg on admission, which lead to significantly more recurrent strokes than the lower BP levels. Hypertension was a relatively rare diagnosis before stroke, and the diagnosed patients had few hypertensive years behind; in addition, the elevated BP levels decreased within 24 hours close to normal being no more associated with recurrent strokes. Low admission BP, on the other hand, was found in only 4.5% of our young patients, probably because of few patients having impaired cardiac output, secondary to cardiac failure, AMI, or arrhythmias, found more in older stroke patients.19

The underlying mechanisms of elevated BP in ischemic stroke are not yet well understood, although several mechanisms have been suggested, such as preexisting hypertension, oxidative stress, activation of the sympathetic renin–angiotensin–aldosterone, cortisol, and natriuretic peptide neuroendocrine systems, and the Cushing reflex, that is, raised BP secondary to raised intracranial pressure.19 In acute stroke, cerebral blood flow depends on systemic arterial pressure when cerebral autoregulation is impaired because of regional hypoxia and acidosis, resulting in reduced penumbral perfusion. Transcranial Doppler has been used to study impaired cerebral autoregulation20; however, not all studies using other methods have found evidence of the impaired cerebral autoregulation.21

The management of BP in the acute stroke phase is, consequently, still unclear,22,23 with limited evidence to evaluate the effect of altering BP.19 Ischemic stroke patients have been shown to have their acute postevent SBP closer to premorbid levels, with no BP level rise before the event, unlike patients with hemorrhagic stroke.24 Most recommendations, therefore, avoid routine BP lowering in the acute phase of ischemic stroke23 because it could be harmful25 because of an inadequate supply of blood in the brain. Initiation of antihypertensive therapy has mostly been associated with a favorable outcome in case of intraventricular thrombolysis.26

In a meta-analysis, lowering the BP reduced the stroke rate in everyone >60 years of age, no matter what the baseline BP level.5 In a post analysis of a subacute stroke prevention trial, only one third of the patients had controlled BP ≥75% of the time, which was linked to reduction in recurrent stroke.6 In our study, there was no difference found between patients with or without antihypertensive medication at 3 months in predicting recurrent stroke during the 18-year follow-up. There might be several explanations for this result. The lack of association of BP variability during the acute phase may relate to bed rest and acute therapy. Our patients might have had uncontrolled BP like most patients in the stroke prevention trial, or the young patients getting older might instead have been using more antihypertensive medication later on, after the 3 months. The patients in the stroke prevention trial having controlled BP most of the time were younger, had lower body mass index

Figure 2. Cumulative distribution of the Kolmogorov–Smirnov test on patients with and without recurrent stroke and admission systolic (A; P<0.001) and diastolic (B; P<0.01) blood pressure decentiles. DBP indicates diastolic blood pressure; and SBP, systolic blood pressure.
and cholesterol levels, and had less history of diabetes mellitus. It, thus, seems to be important in the young to emphasize also on the lifestyle modifications, such as obesity, diabetes mellitus, hyperlipidemia, and smoking in preventing recurrent strokes.

Our study has limitations because it was conducted in a retrospective manner without predefined study protocol for the BP measurements, and pre-event BP levels were not available. The cohort also represents a solely white population, and thus, the results may not be directly generalizable to other ethnic populations with a different profile of BP.

The strengths of the study include the large number of patients enrolled and the ability to stratify the impact of the antihypertensive use. The patients were prospectively assessed with standardized measures over a 13-year period. Given the wide catchment area for our stroke unit, the registry has likely captured most young stroke patients, and because of the surveillance system for medication, recurrent events and deaths have likely been near complete over the median of a 9-year follow-up, with limited referral or outcome assessment bias.

The study highlights the prognostic importance of hypertension at the time of the initial stroke, in terms of a relationship with recurrent events, with only 30% of patients on antihypertensive therapy within 3 months. Given the near linear association of BP levels and the risk of recurrent vascular events, this study highlights an unmet need where all young patients with acute stroke should take BP-lowering medication irrespective of initial BP levels. Although the young have stroke risk factors differing from the elderly, this article reemphasizes the importance of BP control in the long-term, and that hypertension in the acute stroke phase highlights a need for intensive BP-lowering therapy because of its prognostic prediction in terms of major recurrent cardiovascular events. In our cohort with a mean age of 44 years, 1 in 7 had a recurrent stroke, and 1 in 5 died, over the subsequent several years.

Conclusions
This study brings new clinically useful information about the impact on outcome of admission BP levels in young adults having acute, first-ever ischemic stroke. In the young ischemic stroke patients, high acute-phase BP levels were independently associated with a high risk of recurrent strokes. There was a cutoff level of BP >160/100 mm Hg at admission, leading to significantly more recurrent strokes than with lower levels.

Sources of Funding
This work was supported by the Helsinki University Hospital District Research Funds, Academy of Finland and Finnish Medical Foundation.

Disclosures
None.

References
Acute-Phase Blood Pressure Levels Correlate With a High Risk of Recurrent Strokes in Young-Onset Ischemic Stroke

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http://stroke.ahajournals.org/content/suppl/2017/07/10/STROKEAHA.116.012944.DC2

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SUPPLEMENTAL MATERIAL.

Supplemental Table I. Baseline characteristics in four age percentiles.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Age Groups, year range (n)</th>
<th>15-37 (257)</th>
<th>38-44 (284)</th>
<th>45-47 (248)</th>
<th>48-49 (215)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, male</td>
<td></td>
<td>133 (52)</td>
<td>175 (62)</td>
<td>172 (69)</td>
<td>147 (68)</td>
<td>&lt;0.001</td>
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<td>NIHSS</td>
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<td>3 (2-7)</td>
<td>3 (1-6)</td>
<td>3 (2-8)</td>
<td>3 (2-9)</td>
<td>0.096</td>
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<tr>
<td>BP, admission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SBP, mmHg</td>
<td></td>
<td>130 (120-146)</td>
<td>140 (123-158)</td>
<td>151 (135-170)</td>
<td>150 (130-170)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DBP, mmHg</td>
<td></td>
<td>80 (70-90)</td>
<td>86 (76-97)</td>
<td>90 (80-101)</td>
<td>89 (80-100)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PP</td>
<td></td>
<td>53 (20)</td>
<td>56 (22)</td>
<td>61 (24)</td>
<td>63 (27)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MAP</td>
<td></td>
<td>98 (20)</td>
<td>106 (23)</td>
<td>112 (24)</td>
<td>112 (23)</td>
<td>&lt;0.001</td>
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<tr>
<td>BP, 24 hours</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP, mmHg</td>
<td></td>
<td>123 (116-135)</td>
<td>134 (120-150)</td>
<td>140 (124-160)</td>
<td>140 (126-160)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DBP, mmHg</td>
<td></td>
<td>75 (70-90)</td>
<td>80 (75-96)</td>
<td>86 (80-100)</td>
<td>89 (80-100)</td>
<td>&lt;0.001</td>
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<tr>
<td>PP</td>
<td></td>
<td>50 (19)</td>
<td>53 (17)</td>
<td>57 (21)</td>
<td>59 (24)</td>
<td>&lt;0.001</td>
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<tr>
<td>MAP</td>
<td></td>
<td>93 (17)</td>
<td>100 (23)</td>
<td>104 (20)</td>
<td>106 (20)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ΔBP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔSBP</td>
<td></td>
<td>6 (5-19)</td>
<td>5 (4-20)</td>
<td>13 (2-23)</td>
<td>6 (6-23)</td>
<td>0.475</td>
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<tr>
<td>ΔDBP</td>
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<td>5 (3-10)</td>
<td>5 (5-15)</td>
<td>6 (3.7-17)</td>
<td>2 (2-13)</td>
<td>0.110</td>
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<tr>
<td>ΔPP</td>
<td></td>
<td>3 (6-13)</td>
<td>1 (7-12)</td>
<td>4 (6-16)</td>
<td>3 (8.5-16)</td>
<td>0.068</td>
</tr>
<tr>
<td>ΔMAP</td>
<td></td>
<td>4.6 (2.3-12)</td>
<td>4.2 (3.3-16)</td>
<td>7.3 (1.6-17)</td>
<td>5.3 (3-16)</td>
<td>0.228</td>
</tr>
</tbody>
</table>

NIHSS, National Institutes of Health Stroke Scale; SBP, systolic blood pressure; DBP, diastolic blood pressure; PP, Pulse pressure; MAP, mean arterial pressure. Data are shown as mean (SD), median±IQR or n (%).
青年缺血性卒中急性期血压水平与高复发风险相关

**Acute-Phase Blood Pressure Levels Correlate With a High Risk of Recurrent Strokes in Young-Onset Ischemic Stroke**

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**背景和目的：**卒中急性期血压升高与不良预后相关，然而，血压水平对青年卒中影响尚未得到评估。

**方法：**选取赫尔辛基城市国立医院连续入组的1004例首次缺血性卒中患者，年龄15～49岁，评估血压与长期预后的关系。血压参数包括入院和24 h血压，舒张压、脉压和平均动脉压。在长期随访中以复发性卒中为主要终点事件。调整人口特征和存在的合并症，采用Cox回归模型评估与预后相关的独立血压参数。

**结果：**1004例患者中（63%男性），393例（39%）卒中前即有高血压，358例（36%）应用了降压治疗。平均随访时间为8.9年（四分位距5.7～13.2），卒中复发患者n=142例，14%入院时的收缩压、舒张压、脉压、平均动脉压（P<0.001）和24 h收缩压、舒张压、脉压和平均动脉压明显高于无复发卒中患者。收缩压≥160 mmHg的患者较收缩压<160 mmHg的患者随访期间卒中复发更多（风险比（hazard ratio，HR）为3.3（95%CI，2.05~4.55）；P<0.001），且复发时间更早（13.9年（13.0~14.6）比16.2年（15.8~16.6）；P<0.001）。在多变量分析中，入院时更高的收缩压、舒张压、脉压和平均动脉压是卒中复发的独立危险因素，而24 h血压水平则不是。

**结论：**急性期血压升高是青年缺血性卒中患者卒中复发的独立危险因素。

**关键词：**血压；高血压；预后；卒中；青年卒中

所有纳入的研究患者均具备入院时、24 h血压和长期随访数据。应用全自动手臂血压仪测量患者仰卧位血压。分别于急诊室和卒中后24 h测量患者收缩压（systolic blood pressuer, SBP）和舒张压（diastolic blood pressure, DBP）。脉压（pulse pressure, PP）为SBP减去DBP。平均动脉压为DBP加1/3 PP。入院时和24 h血压的差别用（Δ）SBP、DBP、PP和平均动脉压表示。

**人口统计因素包括年龄和性别。合并症包括确诊的高血压、肥胖（定义为体质指数≥30 kg/m²，或没有体质指数数据但严重肥胖者）、吸烟、血吸虫病、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作、心房颤动、血脂异常、既往有短暂性脑缺血发作。卒中的病因分类基于医学和影像学资料，由神经科专家依据Org10172急性卒中治疗标准进行评估。依据世界卫生组织的标准将高血压定义为：SBP≥140 mmHg，DBP≥90 mmHg，或正在接受降压治疗。

**随访数据截止到2011年底，所有数据来源于医疗保健注册登记处，并由芬兰国家健康和福利研究所维护。依据国际疾病分类—9版和—10版的编码进行筛选和诊断确认，死亡日期和原因源于芬兰统计局，数据记录的可靠性和质量已得到验证。**

**研究的主要终点事件为卒中复发，除了短暂性脑缺血发作之外的任何出血性或缺血性脑血管事件。次要终点为死亡和心脏事件，包括急性心肌梗死、不稳定型心绞痛、冠状动脉血管重建术以及因其他心脏疾病住院，如心律失常、心肌病、充血性心力衰竭或起因于心肌的死亡。**
统计分析

血压参数根据人口特征在不同年龄和性别的亚组中进行统计分析。中位数和四分位数间距用来描述非正态分布参数。卡方检验比较分类变量。t检验和Mann-Whitney U检验分别用来比较连续正态分布和非正态分布或非连续变量。对每例患者入院时和24 h的血压差值进行Wilcoxon秩和检验。

通过Cox回归生存曲线评估降压或未降压治疗患者SBP和DBP的临界值。应用多变量Cox回归分析确定独立的血压参数与预后相关性。对每个血压参数分别进行多变量分析校正年龄、性别、既往短暂性脑缺血发作、1型和2型糖尿病、心血管疾病、肥胖和吸烟等因素，并基于上述的单变量意义进行选择（P<0.10）。

Kolmogorov-Smirnov检验的累积分布用于分析患者有或无卒中复发与入院时的SBP和DBP分布密度的关系。

所有统计分析采用IBM SPSS 19.0软件进行，P值<0.05为差异有显著性。

结果

共有1004例符合入选标准的患者纳入本研究（44 (37-47)岁）。首次完成影像学检查的中位时间为0 d（四分位距0~2 d）。多数患者为男性（63%），且患有高血压比例明显高于女性（44% vs 31%; P<0.001）。

入院时SBP水平升高的患者占57%（n=549）。男性比例、血压水平和心血管危险因素如高血压（n=393, 39%）均随年龄增长显著增加（在线补充数据表I）。

卒中复发的患者入院时和24 h的血压水平更高；所有患者血压在24 h内显著下降（表1）。

入院时和卒中24 h内血压下降的患者中，血压差值（ΔBP）≥10 mmHg的卒中复发率较高（图1）。

通过Cox回归生存曲线评估降压或未降压治疗患者SBP和DBP的临界值。应用多变量Cox回归分析确定独立的血压参数与预后相关性。对每个血压参数分别进行多变量分析校正年龄、性别、既往短暂性脑缺血发作、1型和2型糖尿病、肥胖和吸烟等因素，并基于上述的单变量意义进行选择（P<0.10）。

Kolmogorov-Smirnov检验的累积分布用于分析患者有或无卒中复发与入院时的SBP和DBP分布密度的关系。

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表1根据卒中复发与否对入院及24 h BP参数（mmHg）进行分层

<table>
<thead>
<tr>
<th>预测因素</th>
<th>HR (95%CI)</th>
<th>P值</th>
</tr>
</thead>
<tbody>
<tr>
<td>入院时SBP</td>
<td>1.11 (1.04~1.18)</td>
<td>0.001</td>
</tr>
<tr>
<td>入院时DBP</td>
<td>1.16 (1.04~1.29)</td>
<td>0.005</td>
</tr>
<tr>
<td>入院时PP</td>
<td>1.11 (1.01~1.21)</td>
<td>0.017</td>
</tr>
<tr>
<td>入院时MAP</td>
<td>1.01 (1.00~1.02)</td>
<td>0.001</td>
</tr>
<tr>
<td>ΔSBP</td>
<td>0.99 (0.98~1.00)</td>
<td>0.043</td>
</tr>
<tr>
<td>ΔDBP</td>
<td>0.99 (0.98~1.00)</td>
<td>0.212</td>
</tr>
<tr>
<td>ΔPP</td>
<td>0.99 (0.98~1.00)</td>
<td>0.157</td>
</tr>
<tr>
<td>ΔMAP</td>
<td>0.99 (0.98~1.00)</td>
<td>0.077</td>
</tr>
</tbody>
</table>

注：每个分析调整了年龄、性别、既往短暂性脑缺血发作、1型和2型糖尿病、肥胖、高脂血症和吸烟等因素。校正基线因素后，对每个血压变量和结局之间的关系分别进行检验。Δ表示入院时血压与卒中24 h之间的血压差值；BP：血压；DBP：舒张压；MAP：平均动脉压；PP：脉压。
能障碍的研究20，而应用其他方法的研究尚未发现此方面的证据21。

由于评估血压改变对卒中影响的证据有限19，目前对卒中急性期血压的管理目标尚不明确22, 23。与出血性卒中不同，缺血性卒中发病前血压无明显升高，发病后亦无明显变化24。考虑到脑灌注减少的不利影响25，一般不推荐在卒中急性期进行常规降压治疗26。但是，降压治疗与静脉溶栓的良好预后相关26。

在一项meta分析中，不论基础血压如何，对年龄大于60岁的人群，降低血压能够降低卒中的发生率5。另一项亚急性卒中预防试验的结果显示，1/3患者的血压在≥75%的时间得到控制，降低了卒中复发的风险5。而本研究的结果发现，卒中发生后3个月内是否应用降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。这一结果可能有几种解释：首先，本研究未对卒中急性期的患者卧床和治疗与血压变异性的关系进行分析。其次，与上述卒中预防试验的多数患者相同，本研究中患者应用的降压药物与卒中复发无明显相关性。