Ethanol Intoxication: A Risk Factor for Ischemic Brain Infarction in Adolescents and Young Adults

Matti Hillbom, M.D. and Markku Kaste, M.D.

SUMMARY  Between January 1978 and December 1979 23 consecutive patients aged under 40 years with acute ischemic brain infarction were admitted to the department of neurology, Meilahti University Hospital in Helsinki. In 10 patients (43%) the onset of symptoms was preceded within 24 hours by ethanol intoxication, and all but one symptom occurred at weekends when most liquor is consumed in Finland. Ethanol intoxication preceding the stroke was 4 times as common in female and 5 times as common in male patients as ethanol intoxication in the general Finnish population of the same age and sex. The present results support those of our previous study and suggest that occasional ethanol intoxication increases the risk of ischemic brain infarction both in adolescents and young adults.

Our previous study suggested that occasional ethanol intoxication increases the risk of ischemic brain infarction in adolescents and young adults. In that study we reviewed only the available charts of patients admitted because of ischemic brain infarction, and, therefore, probably some ethanol-related cases remained undiscovered. Earlier authors have not regarded ethanol intoxication as a risk factor of brain infarction in adolescents or young adults, although some studies suggest a relationship between ethanol abuse and stroke. In order to clarify the role of occasional ethanol intoxication as a risk factor of ischemic brain infarction we started a new study in early 1978.

Patients and Methods

All consecutive patients aged 15-40 years who were admitted to the department of neurology, University of Helsinki, beginning in January, 1978, for an ischemic brain infarction verified by computed tomography and/or cerebral angiography and/or serial brain scanning were included. Patients with cerebral arteritis and transient ischemic attacks, i.e., with symptoms and signs lasting less than 24 h, were excluded. The ischemic area was located by computed tomography in 17 patients, and 6 of these were also verified by serial brain scanning. In 5 the clinical diagnosis was confirmed by serial brain scanning and in 1 by carotid angiography only. Angiographic examinations (mainly aortic arch angiography) were performed in 11 patients, none of whom had a total occlusion of the internal carotid artery. The ischemic area was situated in the vertebrobasilar territory in 5 patients and in the brain supplied by the middle cerebral arteries in 18. None of the patients died during the acute stage of brain infarction, but 1 died with a second brain infarction several months after the first attack. All patients had clinical localizing signs, such as unilateral motor and/or sensory disturbances, visual-field defects or aphasia.

The authors asked the patients about their drinking and smoking habits, use of oral contraceptives, pregnancy and puerperium, recent head trauma, migraine attacks, surgical operations and infections. Previous diseases such as cerebrovascular disorders, cardiac disease (including attacks of cardiac arrhythmia), arterial hypertension, diabetes and migraine were also recorded. Detailed information about drinking preceding the ischemic brain infarction was obtained from the patients themselves or from their relatives or friends. The term "ethanol-related infarction" is reserved here for patients where the first symptoms of ischemic brain infarction were preceded within 24 hours by ethanol intoxication. All patients who were considered as having been intoxicated had consumed the equivalent of at least 80 g of absolute ethanol within a few hours. A heavy drinker means a person who takes more than 5 drinks per day almost daily. The daily ethanol intoxication rates in different age groups of our patients were compared to the equivalent figures for the general Finnish population, and the percentages of brain infarction occurring on different weekdays were compared to the weekly rhythm of ethanol consumption in Finland.

Laboratory examinations included hemoglobin, hematocrit, and total and differential white-cell counts, thrombocytes, erythrocyte-sedimentation rate, serum electrolytes, cholesterol and triglycerides, fasting blood sugar, creatinine and transaminases. The results were compared with the findings of Finnish population studies. For statistical analysis Student's t-test and the Fisher exact probability test were used.

Results

During 1978-1979 we studied 23 consecutive patients aged 15-40 years (11 women and 12 men) with ischemic brain infarction verified by computed tomography and/or cerebral angiography and/or
serial brain scanning. In 10 of them (43%), including 2 women and 8 men, ethanol intoxication immediately preceded the brain infarction. Men were significantly overrepresented among the ethanol-related patients (Fisher's exact test, $p < 0.05$). One man was known to be a heavy drinker. One patient had the symptoms of brain infarction while he was still heavily drunk, but most of the patients reported that they drank in the evening and, after waking in bed the following morning, they noted that they were stricken. These observations suggest the involvement of intoxication rather than that of withdrawal effects.

The ethanol-related strokes involved 67% of the male and 18% of the female patients (fig. 1). The daily ethanol intoxication rate in the Finnish population of the same age is 12% for men and 4% for women. Accordingly, ethanol intoxication appears related to an increased risk of ischemic brain infarction about 5 times in our male and 4 times in our female patients.

The percentage distribution of onset of brain infarction on different days of the week was compared with the weekly rhythm of ethanol consumption in Finland (fig. 2). Ethanol consumption on Fridays is almost double and on Saturdays treble that on any other day of the week. Occurrence of ischemic brain infarction is concentrated on weekends, especially on Sundays. Fisher's exact test was used in evaluating day of admission, assuming that admissions on Saturday and Sunday should have been only 2/7 of the total. In 9 of the 10 ethanol-related patients the first symptoms occurred during these days (Fisher's exact test, $p < 0.01$), while the ethanol-unrelated patients were distributed fairly evenly throughout the week (fig. 3).

The table shows the frequency of various risk factors for brain infarction in our patients. Fifty-eight% of male patients and 55% of female patients were current smokers. Among the male patients with ethanol-related infarction there were 3 non-smokers.

### Table: The Incidence of Risk Factors in 23 Patients

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>13</td>
</tr>
<tr>
<td>Ethanol intoxication</td>
<td>10</td>
</tr>
<tr>
<td>Migraine</td>
<td>7</td>
</tr>
<tr>
<td>Arterial hypertension</td>
<td>4</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>4</td>
</tr>
<tr>
<td>Transient cardiac arrest</td>
<td>3</td>
</tr>
<tr>
<td>Oral contraceptive medication</td>
<td>3</td>
</tr>
<tr>
<td>Pregnancy and puerperium</td>
<td>2</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2</td>
</tr>
<tr>
<td>Heavy drinking</td>
<td>1</td>
</tr>
<tr>
<td>Recent head trauma</td>
<td>1</td>
</tr>
<tr>
<td>Recent respiratory infection</td>
<td>1</td>
</tr>
<tr>
<td>Pheochromocytoma</td>
<td>1</td>
</tr>
</tbody>
</table>

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**Figure 1.** Percentage distribution of patients by sex.
In the Finnish population studies there were about 50% men and 17% women smokers. Arterial hypertension was diagnosed in only 4 male patients (17%). According to a Finnish population study the prevalence of arterial hypertension among men aged 25–39 years is between 14 and 23%. Three of our 11 female patients (27%) had used oral contraceptives within 6 months before the stroke. In the Health Security Area of South Finland 16% of women are reported to use oral contraceptives. Seven of the 11 female patients (64%) had migraine in their past history. In a Finnish population study migraine was discovered in 34% of women. In 4 ethanol-unrelated female patients, brain infarction was preceded by a migraine attack. The 2 patients with cardiac disease both had coronary heart disease, one with earlier myocardial infarction. None of the patients had rheumatic heart disease or mitral valve prolapse. Cardiac arrhythmias were not observed on admission but 3 patients reported them in their past history. None of the patients had polycythemia, severe anemia or macroglobulinemia, but the one who died later had hypertension, diabetes and pheochromocytoma. Several patients had slightly raised serum levels of cholesterol and triglycerides. However, the mean values of serum cholesterol and triglycerides in our patients were similar to those of the general Finnish population of the same age and sex.

**Discussion**

In 43% of our young patients with ischemic brain infarction the onset of symptoms was preceded by ethanol intoxication. The results confirm our earlier observation that occasional ethanol intoxication is a risk factor for ischemic brain infarction. In the previous study only the charts of patients were reviewed, and, therefore, the risk seemed to be lower.

Ethanol intoxication seems also to carry a risk for adolescents. If both sets of our material are combined they include 8 patients with brain infarction in the age group 15–19 years, and 4 of them (50%) are clearly ethanol-related.

Reported drinking to intoxication in Finland occurs in 39% of women and 65% of men for all drinking occasions. Occasional heavy drinking, especially among adolescents and young adults, concentrates on weekends. Drinking to intoxication refers only to that situation where alcohol has been consumed and the estimated blood ethanol concentration exceeded one part per thousand.

We compared the weekly rhythm of ethanol consumption in Finland with the percentage distribution of brain infarctions by days of the week. In young adults, drinking to intoxication and brain infarction both concentrate on weekends. All but one of the ethanol-related strokes occurred during weekends.

Men were over-represented among the ethanol-related cases (80% of them) probably because they consume 4/5 of all alcoholic beverages in Finland. The male preponderance and the weekly distribution of the ethanol-related strokes both implicate the role of ethanol.

The nearly balanced sex distribution of strokes in the present study is not easily explained. The restriction of the material to include only adolescents and young adults may help explain this. Women have additional stroke risk factors such as pregnancy, puerperium, and the use of oral contraceptive medication compared to men. Women also have a high frequency of migraine. The female-associated stroke risk factors may in part balance the ethanol-induced risk in males.

Both ischemic and hemorrhagic strokes seem to be common among alcohol abusers, but only 2 previous studies have suggested that occasional or acute ethanol intoxication may promote brain infarction. Since no alcoholics were included and only 1 patient was known to be a heavy drinker, the present data point out that occasional ethanol intoxication may precipitate brain infarction.

Early occurrence of brain infarction may be a sign of premature atherosclerosis. However, our patients did not show other signs of atherosclerosis.

About half of our patients had some condition predisposing to brain infarction in their previous history. None, however, had rheumatic heart disease, although it is frequently encountered among young adults with embolic infarction of cardiac origin. None had mitral valve prolapse. Of the other pos-
possible risk factors the prevalence of arterial hypertension, smoking, and use of oral contraceptive medication were not clearly higher than those found in Finnish population studies.10-13 Migraine, however, showed higher prevalence among our female patients.

Ethanol intoxication may promote brain infarction by several mechanisms.1 The effects of ethanol on hemocoagulation and cerebral blood flow should be considered.13 An increase in hematocrit and blood viscosity provides susceptibility for thrombosis, and hematocrit is increased by acute ethanol intoxication. Ethanol-induced sludging of blood, demonstrated 25 years ago,14 may play some role in the pathogenesis of ethanol-related brain infarction. Increased plasma osmolality due to a high blood ethanol level may be responsible for disturbed platelet function19 and reduced erythrocyte flexibility.20

Some experimental observations suggest that cerebral blood flow may fall during ethanol intoxication.21 In addition, the autoregulation of cerebral circulation has been shown to be disturbed by ethanol both in rhesus monkeys and dogs.22 Alcoholic stupor or sleeping while heavily drunk may cause extracranial vessel compression from unusual posture and may further disturb cerebral blood flow and thus promote brain infarction. Neck trauma could be a contributing factor, but in only one of our ethanol-related strokes did even minor head trauma precede the onset of symptoms of brain infarction.

These results support our previous observation that occasional ethanol intoxication is associated with an increased risk for ischemic brain infarction both in adolescents and young adults. Whether this holds for older age-groups as well remains to be proved. It is unclear why ethanol intoxication increases the risk. In our patients the risk caused by ethanol was higher than that caused by arterial hypertension or other classical risk factors.

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References

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