SUMMARY A gastroendoscopic study was performed on 177 patients with acute stroke. Gastric changes were found in 92 among them (52%), including ten with acute ulcer. A high frequency of gastric changes was found in patients with serious stroke and/or in patients whose cerebral lesions were located close to the hypothalamus or its centrifugal tract. The mortality in patients with gastric changes was high, especially in patients with acute ulcers, multiple erosions and petechiae. The frequency of brown gastric juice and coffee grounds at gastroendoscopic examination (gastric hemorrhage) was three times as high as that of melena and/or hematoeemia. On the other hand, the mortality of patients with gastric hemorrhage differed little from that of patients with melena and/or hematoeemia.

ACUTE GASTROINTESTINAL CHANGES are seen after major trauma, post-surgically and in patients with myocardial infarction, burn, central nervous lesions and so forth. Acute gastrointestinal changes also are found occasionally in stroke patients.

Since the first observations of the relationships between certain cerebral lesions and acute gastrointestinal changes in the nineteenth century, considerable clinical and experimental evidence has been accumulated to support the existence of the relationships. Cushing reviewed the evidence in 1932. That report stimulated a number of other clinical studies on patients with various pathological conditions of the brain and concomitant gastrointestinal changes. Recently autopsy studies have revealed a high incidence of gastroduodenal changes. This has also been confirmed by experimental studies in animals.

In the present study, gastroendoscopic examinations were performed on 177 patients with acute stroke, thereby offering an approach to the clinical importance of the problem.

Methods

One hundred seventy-seven patients admitted into the Research Institute of Brain and Blood Vessels, Akita, Japan, from February 1973 to October 1974, were studied; these included 75 with cerebral hemorrhage, 54 with cerebral infarction, and 48 with subarachnoid hemorrhage. There were 126 men and 51 women, age 29 to 81 (mean age, 56.3 ± 10.6 years). Most patients were admitted within three days (78%) after the onset of stroke, and all within 16 days. In the majority of patients, the first gastroendoscopic examination (Olympus GTF S-2) was done within one week after the onset, and in all patients within two to three weeks.

The gastroendoscopic examination was performed in 88 patients once and in the other 89 patients several times. Patients who had examinations more than once were classified according to the angiographically determined location of the hematoma: hematoma located in the thalamus and/or hypothalamus (medial type), hematoma located in the putamen and/or capsular interna (lateral type), hematoma extending into both thalamus and putamen (combined type), and infratentorial hemorrhage including pontine hemorrhage and cerebellar hemorrhage.

Cerebral infarction was classified into five types according to the angiographical findings: internal carotid artery occlusion, anterior cerebral artery occlusion, middle cerebral artery occlusion, vertebrobasilar artery occlusion and occlusions of multiple arteries.

Subarachnoid hemorrhage was classified into five types according to the location of the ruptured aneurysm: internal carotid artery, anterior cerebral artery, anterior communicating artery, middle cerebral artery and basilar artery. Subarachnoid hemorrhage without aneurysm was excluded.

Gastroendoscopic findings were classified into five categories as follows.

1. Acute ulcers: multiple ulcers were found in the majority of the patients of this group.
2. Multiple erosions: numerous petechial hemorrhages, echymosis, fibrin nets and reddened granulose were found at the same time.
3. Petechiae: numerous petechiae alone were found.
4. Erosion showing fibrin nets: localized superficial mucosal defect showing fibrin nets alone was found.
5. No acute gastric change: acute ulcers, erosions and other acute gastric changes were not found in the stomach.

Gastrointestinal hemorrhage was observed macroscopically and with a gastroendoscope. The macroscopic observation revealed melena and/or hematoeemia. The gastroendoscopic examination revealed gastric hemorrhage, observed as bleeding, coffee grounds or brown gastric juice.

In the present study no remarkable complication has occurred from the gastroendoscopic techniques.

Results

Gastroendoscopic Findings

Gastroendoscopic Findings and Type of Stroke (Table 1)

Gastric changes were found in 92 patients (52%), including ten with acute ulcers, nine with multiple erosions, 63

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with petechiae, and ten with acute erosion showing fibrin nets.

Of 75 patients with cerebral hemorrhage, gastric changes were found in 42 patients (56%), including four with acute ulcers, five with multiple erosions, 30 with petechiae and three with erosion showing fibrin nets. The frequency of gastric changes in the patients with cerebral hemorrhage of combined type was high (87%). It was significantly higher than in patients with cerebral hemorrhage of the lateral type (p < 0.025) and in patients with cerebral hemorrhage of the medial type (p < 0.025).

Of 54 patients with cerebral infarction, gastric changes were found in 23 patients (43%), including two with acute ulcers, two with multiple erosions, 17 with petechiae and two with erosion showing fibrin nets. A high frequency (78%) of gastric changes was found in patients with internal carotid artery occlusion. This was higher than in patients with middle cerebral artery occlusion (p < 0.025).

Of 48 patients with subarachnoid hemorrhage, gastric changes were found in 27 patients (56%), including four with acute ulcers, two with multiple erosions, 16 with petechiae and five with erosion showing fibrin nets. A high frequency (76%) of gastric changes was found in patients with aneurysm of the internal carotid artery. This was higher than in patients with aneurysm of the middle cerebral artery (p < 0.025).

The groups of infratentorial hemorrhage, anterior cerebral artery occlusion, ruptured aneurysm of anterior cerebral artery and ruptured aneurysm of vertebrobasilar artery were too few to be statistically useful.

### Table 2 Gastroendoscopic Findings and Level of Consciousness

<table>
<thead>
<tr>
<th>Level of Consciousness</th>
<th>Acute Ulcers</th>
<th>Multiple Erosions</th>
<th>Petechiae</th>
<th>Erosion Showing Fibrin Nets</th>
<th>No Acute Gastric Change</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Clear and Awake</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>22</td>
<td>35</td>
</tr>
<tr>
<td>Somnolent to Stuporous</td>
<td>7</td>
<td>3</td>
<td>36</td>
<td>7</td>
<td>52</td>
<td>105</td>
</tr>
<tr>
<td>Semicomatose to Comatose</td>
<td>2</td>
<td>4</td>
<td>20</td>
<td>0</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>9</td>
<td>63</td>
<td>10</td>
<td>85</td>
<td>177</td>
</tr>
</tbody>
</table>

### Table 3 Dosage of Steroid Hormone and Gastroendoscopic Findings

<table>
<thead>
<tr>
<th>Dosage (mg)</th>
<th>Acute Ulcers</th>
<th>Multiple Erosions</th>
<th>Petechiae</th>
<th>Erosion Showing Fibrin Nets</th>
<th>No Acute Gastric Change</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>2</td>
<td>26</td>
<td>5</td>
<td>43</td>
<td>76</td>
</tr>
<tr>
<td>&lt;99</td>
<td>9</td>
<td>4</td>
<td>30</td>
<td>1</td>
<td>34</td>
<td>78</td>
</tr>
<tr>
<td>100 or &gt;</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>8</td>
<td>23</td>
</tr>
</tbody>
</table>

*Deamethasone.
Steroid Hormone Medication and Gastroendoscopic Findings (Table 2)

Sex, Age and Gastroendoscopic Findings

Sex and age had no significant effect on the occurrence of gastric changes. Gastric changes were found in 66 of the 126 men (53%) and in 26 of the 51 women (51%).

Level of Consciousness and Gastroendoscopic Findings (Table 2)

According to the level of consciousness, the patients were divided into three groups: (1) fully clear and awake, (2) somnolent to stuporous (blurred consciousness, but reacting to speaking), and (3) semicomatose to comatose (unconscious, with or without reaction to pain). Acute gastric changes were found in 13 of 35 patients in the fully awake group, in 53 of 105 patients in the somnolent to stuporous group, and in 26 of 37 patients in the semicomatose to comatose group. The incidence of gastric changes was conversely correlated with the level of consciousness (p < 0.025).

Steroid Hormone Medication and Gastroendoscopic Findings (Table 3)

Steroid hormone was given to many of the patients, mainly because of high intracranial pressure or in relation to the neurosurgical procedure. The administration of steroid hormone was finished in most patients within one week. According to the total dosage of steroid given, the patients were divided into three groups: none, small dosage (less than 100 mg dexamethasone) and high dosage (100 mg or more of dexamethasone). Gastric changes were found in 33 (43.4%) of 76 patients who did not receive steroid hormone, in 44 (56.4%) of 78 patients in the small dosage group and in 23 (65.2%) of 37 patients in the high dosage group. However, the correlation of frequency of the gastric changes to the dosage of steroid hormone was insignificant.

Mortality and Gastroendoscopic Findings (Table 4)

It is often difficult to determine the direct cause of death following an acute stroke. In this study, 38 patients died because of the stroke and its complications: 18 due to brain death, five due to gastrointestinal bleeding and 15 due to other complications.

The mortality of patients with acute ulcers and multiple erosions was highest; four of ten patients with acute ulcers died, as did four of nine patients with multiple erosions. A higher mortality was found in patients with petechiae, also. On the other hand, the mortality of patients with erosion showing fibrin nets and no acute gastric change was low.

Gastrointestinal Bleeding

Frequency of Melena and/or Hematoemesis and Gastric Hemorrhage (Table 5)

Melena and/or hematoemesis were found in 33 patients, i.e., in 15 of 75 patients with cerebral hemorrhage, in seven of 54 patients with cerebral infarction, and in 11 of 48 patients with subarachnoid hemorrhage. The highest frequency of melena and/or hematoemesis was observed in patients with cerebral hemorrhage of the combined type (47%). Acute gastric changes were found in 28 of 33 patients with melena and/or hematoemesis. Five patients with no acute gastric changes exhibited melena and/or hematoemesis.

Gastric Hemorrhage at Gastroendoscopic Examination (Table 5)

Gastric hemorrhage was found in 64 patients at gastroendoscopic examination, including 26 of 75 patients with cerebral hemorrhage, 15 of 54 patients with cerebral infarction, and 23 of 48 patients with subarachnoid hemorrhage. Eight of ten patients with acute ulcers had associated gastric hemorrhage. On the other hand, gastric hemorrhage was found in five of nine patients with multiple erosions, in 39 of 63 patients with petechiae, in two of ten patients with erosion showing fibrin nets, and in ten of 85 patients with no acute gastric change.

Mortality of Patients With Gastrointestinal Bleeding (Table 6)

Sixteen of 33 patients with melena and/or hematoemesis (48%) and 25 of 64 patients with gastric hemorrhage (39%) died. However, only 13 of 113 patients without gastric hemorrhage died. Therefore, the mortality of patients with gastric hemorrhage was significantly higher than that of patients without gastric hemorrhage (p < 0.005).

Discussion

Gastroendoscopic Findings

Clinicopathological studies have revealed a high frequency of gastrointestinal changes in association with cerebral lesions. However, acute gastrointestinal changes found at the time of autopsy are not always induced by the cerebral lesions, because these changes may be produced by shock, infectious diseases, allergic reaction, excessive use of drugs and other factors in the agonal stage.

The highest frequency of gastric changes was found in pa-
patients with cerebral hemorrhage and with subarachnoid hemorrhage. On the other hand, the frequency of gastric changes in patients with cerebral infarction was low.

The frequency of gastric changes was more than 70% in patients with cerebral hemorrhage of the combined type, cerebral infarction due to internal carotid occlusion, and subarachnoid hemorrhage due to ruptured aneurysm of the internal carotid artery. Since cerebral lesions induced with cerebral hemorrhage of the combined type and cerebral infarction of internal carotid artery occlusion might be extensive, the influence of these lesions upon the hypothalamus and its centrifugal tract would be serious. Therefore, the frequency of gastric changes might be high in these patients. On the other hand, patients with subarachnoid hemorrhage due to aneurysm of the internal carotid artery. Since cerebral lesions induced with cerebral hemorrhage of the combined type and cerebral infarction of internal carotid artery occlusion might be extensive, the influence of these lesions upon the hypothalamus and its centrifugal tract would be serious. Therefore, the frequency of gastric changes might be high in these patients. On the other hand, patients with subarachnoid hemorrhage due to aneurysm of the internal carotid artery also often had associated gastric changes. The cause of this complication might be due not only to the influence upon the hypothalamus by hematoma from ruptured aneurysm, but also to the circulatory disturbance to the hypothalamus because of spasm of the posterior communicating artery and/or anterior choroidal artery and/or most distal part of the internal carotid artery.

The incidence of gastric changes was conversely correlated with the level of consciousness. While some patients in the clear and awake group showed gastric changes, 11 of 37 patients in the semicomatose to comatose group did not show gastric changes. In general, the location of these cerebral lesions was far from the hypothalamus, and the influence upon the hypothalamus might be mild. On the other hand, gastric changes were found in four of five patients in the clear group of subarachnoid hemorrhage of internal carotid artery aneurysm. The causes of this finding were described above.

It was concluded that a high frequency of gastric changes was found in patients with serious stroke and/or in patients whose cerebral lesions were located close to the hypothalamus or its centrifugal tract. That is, gastric change could be induced by the stimulation upon the hypothalamus and/or its centrifugal tract as Cushing. French et al., Porter et al., Feldman et al. and others reported.

In the present study, the frequency of gastric changes was not correlated to the dosage of steroid hormone. Tellez and Bauer also reported that the use of steroids in cerebrovascular patients did not cause gastrointestinal bleeding.

### Gastrointestinal Bleeding

The high mortality of stroke patients with gastrointestinal bleeding is well known. In the present study, the frequency of melena and/or hematoemesis was 19%, and the frequency of gastric hemorrhage was 36%. However, the mortality of patients with gastric hemorrhage (39%) differed little from that of patients with melena and/or hematoemesis (48%). On the other hand, the mortality of patients without gastric hemorrhage was low (12%). Therefore, for reliable prediction of the prognosis of patients with acute stroke, it is important to observe gastric juice by gastroendoscopic examination and/or by suction of gastric juice.

### Acknowledgment

We wish to thank all research workers in our Institute for valuable suggestions and Miss T. Abe for her assistance.

### References


### Table 6 Mortality and Type of Gastrointestinal Bleeding

<table>
<thead>
<tr>
<th>Type of Gastrointestinal Bleeding</th>
<th>Mortality</th>
<th>Type of Gastrointestinal Bleeding</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melena and/or hematoemesis</td>
<td>33</td>
<td>Gastric hemorrhage</td>
<td>64</td>
</tr>
<tr>
<td>No gastric hemorrhage</td>
<td>113</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>16</td>
<td>Total</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>(48%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td></td>
<td>(39%)</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td></td>
<td>(12%)</td>
</tr>
</tbody>
</table>
T Kitamura and K Ito

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