Effects of Direct-interrupting Surgery on Gastric Mucosal Congestion in Patients with Esophageal Varices

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Summary. The purpose of this study is to clarify the effect of direct-interrupting surgery on gastric mucosal congestion in patients with esophageal varices. Fifteen such patients underwent endoscopy in the preoperative, early postoperative and late postoperative periods. The index of local blood volume (IHb) and that of oxygen saturation (ISO2) were endoscopically measured using a tissue reflectance spectrophotometer at the antrum, the angle, and the corpus of the stomach. The congestion index (CI) was calculated by dividing IHb by ISO2. At the antrum and the angle, none of the mean values of IHb, ISO2, CI, or the incidence of mucosal redness changed significantly. At the corpus, the mean values of IHb and CI in the early postoperative period were significantly lower than those in the preoperative period (p<0.01 and p<0.05, respectively), but those in the late postoperative period showed no significant difference from preoperative and early postoperative values. Also at the corpus, the mean value of ISO2 and the incidence of mucosal redness showed no significant change in the early and late postoperative periods. These results suggest that gastric mucosal congestion of the corpus of the stomach in patients with esophageal varices can be relieved in the early postoperative period although it may recur in the late postoperative period.

Key words—congestive gastropathy, direct-interrupting surgery, reflectance spectrophotometry.

INTRODUCTION

Bleeding from the gastric mucosa is one serious complication in patients with esophageal varices, in addition to variceal bleeding itself. In a previous study, we reported that there was mucosal congestion at the upper corpus of the stomach in such patients. Change in the mucosal congestion after medical or surgical treatment for esophageal varices is a further issue for investigation, although the latter has been left largely unstudied. The current study was undertaken to clarify the effect of direct-interrupting surgery on the gastric mucosal congestion using reflectance spectrophotometry.

PATIENTS AND METHODS

Fifteen patients with esophageal varices (6 men and 9 women) aged 35-71 years (53±11, mean±SD) considered appropriate for elective direct-interrupting surgery, were studied. Their primary disease, determined by means of a wedge biopsy of the liver at the time of surgery, consisted of 8 cases of liver cirrhosis, 5 of idiopathic portal hypertension, and 2 of primary biliary cirrhosis. Twelve of them belonged to Child's Group A, 2 to Group B, and 1 to Group C. The postoperative follow-up period ranged from 8 to 53 months (19±11). Our direct-interrupting surgery consisted of esophageal transection, esophago-gastric devascularization and splenectomy.

After an overnight fast, all patients were premedicated with an intramuscular injection of butropin bromide (4 mg) before endoscopy. Following endoscopic observation of gastric mucosal redness, measurements of the index of local mucosal blood volume (IHb) and that of local oxygen saturation (ISO2) were carried out, using a tissue reflectance spectrophotometer (TS-200, Sumitomo-denko, Osaka). The congestion index (CI) was calculated by dividing IHb by ISO2. We hypothesized that the severe the congestion, the higher the IHb and the lower the ISO2, and that CI could thereby show the degree of congestion in one parameter.

Three sites of the stomach were selected for these
endoscopic measurements and observations: the greater curvature of the antrum (antrum), the lesser curvature of the angle (angle), and the greater curvature of the upper corpus (corpus).

These endoscopic examinations were performed three times per each patient in the preoperative period (Phase 0), early postoperative period within three months after surgery (Phase 1), and late postoperative period more than six months after surgery (Phase 2). Seven patients failed to undergo endoscopy in the early postoperative period because of anastomotic stenosis (n=4) or they did not come to the clinic for follow-up evaluation (n=3).

The mean values of blood hemoglobin in the three phases were compared to check the presence of significant changes. Also, the incidence of mucosal redness was compared.

The TS-200 is a tissue spectrum analyzer which calculates IHb and IS02 every 0.5 sec, showing a positive correlation with local mucosal blood volume and local oxygen saturation, respectively. The depth of measured spectra is 0.3-0.4 mm from the surface of the mucosa, the uppermost layer of the mucosa still containing capillary loops.\(^3,4\) A light probe with a 3 mm diameter was passed along the biopsy channel of the endoscope and contacted the mucosa as much “en face” as possible while applying minimal pressure. Measurements were made five times at each site to obtain mean values. Red spots were avoided as measuring sites, and nearby tissue was alternatively selected.

### Statistical analysis

The results were expressed as the mean±SD. Statistical comparison between the preoperative and postoperative mean values of blood hemoglobin, IHb, IS02, and CI were made with Student’s paired \(t\)-test. Comparison of the incidence of mucosal redness was performed with an \(x^2\)-test. Differences, recognized at a probability of less than 0.05 were considered statistically significant.

### RESULTS

1) Blood hemoglobin (Table 1)

The mean values of blood hemoglobin Phases 0, 1, 2 were respectively 11.9±2.0, 12.6±1.4, and 12.4±1.7, showing no significant change.

<table>
<thead>
<tr>
<th>Phase</th>
<th>0</th>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td>Hemoglobin (g/dl)</td>
<td>11.9±2.0</td>
<td>12.6±1.4</td>
<td>12.4±1.7</td>
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Phase 0: preoperative, Phase 1: within three months after surgery, Phase 2: more than six months after surgery.
Fig. 2. Changes in the index of local gastric mucosal oxygen saturation (ISO₂) after the direct-interrupting surgery. At the antrum, the angle, and at the corpus, ISO₂ shows no significant change. See Table 1 for the phase numbers.

Fig. 3. Changes in the index of local gastric mucosal congestion (Cl) after the direct-interrupting surgery. At the corpus, Cl decreases significantly in Phase 1 but returns to preoperative values in Phase 2. See Table 1 for the phase numbers.
2) IHb (Fig. 1)

The mean values of IHb in Phases 0, 1, 2 were respectively 130±19, 131±25, 138±16 at the antrum, 119±19, 124±19, 125±18 at the angle, and 143±21, 116±12, 131±14 at the corpus.

The mean value of IHb at the antrum and at the angle showed no significant change through the three phases. At the corpus, they decreased significantly in Phase 1 (p<0.01) and increased again in Phase 2, showing no significant difference from those in Phase 0 or 1.

3) ISO2 (Fig. 2)

The mean values of ISO2 in Phases 0, 1, 2 were respectively 49±3, 46±3, 47±3 at the antrum, 48±4, 45±2, 46±5 at the angle, and 42±3, 42±3, 44±3 at the corpus.

At the three sites of the stomach, no significant change in the mean values of ISO2 was observed through the three phases.

4) CI (Fig. 3)

The mean values of CI in Phases 0, 1, 2 were respectively 2.7±0.5, 1.9±1.2, 3.4±0.6, at the antrum, 2.5±0.4, 1.8±1.0, 2.9±0.4 at the angle, and 3.4±0.6, 1.8±0.9, 2.7±0.6 at the corpus.

The mean value of CI at the antrum and at the angle showed no significant change through the three phases. At the corpus, they decreased significantly in Phase 1 (p<0.05) and increased again in Phase 2, showing no significant difference from those in Phase 0 or 1.

5) Incidence of gastric mucosal redness (Fig. 4)

The incidence of mucosal redness in Phases 0, 1, 2 were respectively 33%, 38%, 47% at the antrum, 27%, 0%, 20% at the angle, and 53%, 25%, 47% at the corpus.

At the antrum, where the surgical procedure of the direct-interrupting surgery seems to have little effect, the incidence of gastric mucosal redness increased as the phase proceeded, showing no significant difference. At the angle and at the corpus, where the surgical procedures have greater effect, the incidence of the mucosal redness was lower in Phase 1 than that in Phase 0, and higher in Phase 2 than that in Phase 1, returning to approximate values in Phase 0. No significant difference was observed among these values, however.

DISCUSSION

Gastric mucosal bleeding in patients with esophageal varies is sometimes massive and life-threatening, accounting for 10-50% of all bleeding in such patients.5-7 Gastric mucosal red spots, most frequently observed at the fundus and the corpus,1,5,9-13 are considered to be a subclinical condition for this mucosal bleeding.8 This mucosal appearance was originally mistakenly named as "hemorrhagic gastritis," but has been lately renamed "congestive gastropathy"9)
or "portal hypertensive gastropathy" based on its histological findings as characterized by the ectasia of mucosal and submucosal veins with little or no evidence of inflammation.

In our previous study, this mucosal congestion was expressed in terms of increased local blood volume and congestion index (higher IHb and CI), and decreased oxygen saturation (lower ISO2) by reflectance spectrophotometry. By gas clearance technique, some investigators have reported a decreased blood flow of the upper corpus of the stomach. However, the use of gas clearance technique does not permit investigators to distinguish congestion from ischemia, because it can express both of these states as the same "decreased blood flow." More recently developed laser velocimetry has the same disadvantage. In contrast to these methods, reflectance spectrophotometry has the advantage of being able to distinguish congestion from ischemia, showing higher IHb with lower ISO2 when congestion is present, and lower IHb with normal or lower ISO2 when ischemia is present.

The incidences of variceal bleeding and gastric bleeding after selective shunting surgery are 7.5% and 5.5%, respectively, and after direct-interrupting surgery are 6.8% and 3.8%, respectively. The question arises as to how the mucosal congestion of the upper stomach changes after the variceal eradication, and there have been very few reports on the role of surgical procedures in this milieu. Mitarai, using gas clearance technique, reported a gastric mucosal blood flow reduced by 20% at four weeks after direct-interrupting surgery, and mucosal injury was observed in most cases that showed over 20% reduction. On the other hand, Satani, also using gas clearance technique, observed moderate reduction and early recovery of gastric mucosal blood flow within one week after surgery, with almost no mucosal hemorrhage and only mild atrophic changes at the corpus at four weeks after the operation. These two papers reported different results on gastric mucosal blood flow and mucosal redness after direct-interrupting surgery. Our endoscopic observation showed a lower incidence of gastric mucosal redness at the corpus in Phase 1 than in Phase 0, which seems to be in agreement with Satani's results at four weeks after surgery.

From the viewpoint of mucosal microcirculation, some new aspects have been revealed by the current results with the use of reflectance spectrophotometry. At the corpus, the values of IHb and CI decreased significantly in Phase 1, and appeared to return to preoperative levels in Phase 2, although the blood hemoglobin did not change significantly. Also, the values of ISO2 and the incidence of mucosal redness at the corpus did not show any significant change through the three phases, but the incidence of mucosal redness decreased from 53% in Phase 0 to 25% in Phase 1. These results suggest that, after direct-interrupting surgery, the mucosal congestion of the corpus is relieved in Phase 1 and recurs in Phase 2, whereas at the angle, and at the antrum, none of the mean values of IHb, ISO2, CI, nor the incidence of mucosal redness changes significantly.

The mechanism of improvement of gastric mucosal congestion in Phase 1 needs further investigation. Devascularization probably plays an important role; it blocks not only collateral veins but also inflowing arteries of the corpus, thereby interrupting the regional hyperdynamic state. Portosystemic shunting operations are known to stop bleeding from portal hypertensive gastric mucosa. If a direct-interrupting operation also accompanies portal decompression, as Kawasaki reported, it could also contribute to relieving gastric mucosal congestion.

The mechanism of the recurrence of mucosal congestion of the corpus in the late postoperative period is another question to be answered. The same mechanism of recurrence of esophageal varices might be attributed to it; firstly, incomplete interruption of the local circulation from the portal vein and secondly, increased blood supply from the non-devascularized part of the stomach or the esophagus.

The risk of gastric mucosal bleeding may increase after successful endoscopic injection sclerotherapy (EIS) for esophageal varices. Some investigators have reported, using gas clearance technique, that the gastric mucosal blood flow is reduced after EIS with exacerbation of gastric mucosal redness. Although their follow-up intervals differ, EIS may have an adverse effect on congestive gastrohypertensive gastric mucosa, at least temporarily after the procedure.

Our results suggest that gastric mucosal congestion of the corpus in patients with esophageal varices is relieved in the early postoperative period, although this beneficial effect may diminish in the late postoperative period.

REFERENCES


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