continuous wave carbon dioxide laser has been described for haemostasis, and early experimental results are promising. Cryosurgical techniques and tissue adhesives may also fulfill a role in this respect in the future. Adequate drainage of the cut surface is mandatory. In addition, T-tube drainage of the common bile duct has received almost universal acceptance although recently doubt has been cast on the necessity for this. This has, however, proved useful in allowing operative cholangiography and methylene blue injection to detect unsuspected biliary leaks from the cut surface.

A significant advance has been the better understanding and correction of the frequently encountered coagulation disorders associated with massive hepatic resection. These disorders are multifactorial and involve deficiencies in many of the liver-produced coagulation factors, activation of the fibrinolytic system, consumptive coagulopathy, thrombocytopenia and additional coagulation disturbances associated with massive blood transfusion.

A great deal has been learnt regarding the disordered hepatic function following massive resections of up to 80% of the liver, and which, if uncorrected, can prove fatal. In particular, postoperative hypoglycaemia and a precipitous fall in the serum albumin require intensive replacement therapy in the first postoperative week. Studies of hepatic regeneration have stressed the remarkable regenerative powers of the human liver, and that up to 90% resection can be accomplished with morphological and functional regeneration within 6 months.

Thus there seems little doubt that the future will see an increased application of resectional hepatic surgery with a steady improvement on the results already being achieved.

REFERENCES


The Effect of a Boots Preparation and Pure Natural Secretin and Pancreozymin on Pancreatic and Gastric Function in Man

SIMMY BANK, M.B., CH.B., M.R.C.P., Head, Gastro-Intestinal Clinic, I. N. MARKS, M.B., F.R.C.P. (EDIN.), Senior Physician, AND B. NOVIS, M.B., CH.B., M.R.C.P., Senior Registrar, Gastro-Intestinal Clinic and Department of Medicine, Groote Schuur Hospital and University of Cape Town

SUMMARY

Secretin was found to be a powerful inhibitor of basal gastric acid secretion in man. Pure natural secretin was more effective and more rapid in its action on gastric secretion than Boots secretin. Pancreozymin and Swedish CCK (cholecystokinin) had a variable effect on basal gastric acid secretion and all the changes were modest and unimpressive.

Structurally, gastrin and pancreozymin share the same terminal amino-acid linkage and secretin and glucagon have a similar molecular configuration. The present study reports our finding on the effect of various types of secretin and pancreozymin on basal gastric acid secretion in man.

**MATERIAL AND METHOD**

Pure natural secretin and pancreozymin (Jorpes and Mutt, Sweden) as well as a preparation by Boots (England) were used in this study. To assess the effects of these hormones on gastric function, it was necessary to establish the relative potency of the 2 secretin and pancreozymin preparations on pancreatic volume, bicarbonate and enzyme secretion at various dose levels.

After duodenal and gastric intubation under fluoroscopic control, dose response curves with 1, 2 and 4 intravenous units/kg body-weight of Boots secretin (Crick, Harper and Raper units) and 0·25, 0·5 and 1 intravenous units/kg body-weight of pure natural secretin (clinical units) were carried out in 4 subjects free of pancreatic disease and 1 with proved pancreatitis. Similar dose-response curves with pancreozymin were carried out in 2 patients using 1, 2 and 4 intravenous units of Boots pancreozymin/kg body-weight (Crick, Harper and Raper units) and 0·25, 0·5 and 1 units of Jorpes pancreozymin—cholecystokinin (CCK—Ivy dog units).

Collections from the duodenal tube were made under ice at 10-minute intervals for 90 minutes and the volume, bicarbonate, trypsin, chymotrypsin, lipase and amylase determined in each sample. After basal collections, gastric juice was aspirated through the gastric tube at 10-minute intervals for 60 minutes and the volume, acid concentration and acid output in each sample were measured.

**RESULTS**

**Effect of the Secretin and Pancreozymin Preparation on Pancreatic Secretion**

The mean volume output and bicarbonate concentrations at the various dosage levels of the 2 secretin preparations were tested in the 4 control patients. It was found that a dose level of 4 units of Boots secretin was equivalent in its effect to 0·25 - 0·5 units of pure natural secretin. The fit was best for volume and bicarbonate, the enzyme concentration being somewhat less amenable to this type of investigation. Fig. 1 shows the effect of 0·25 units of pure natural secretin and 4 units of Boots secretin on volume output, and bicarbonate and enzyme concentration in the individual subjects. With a few exceptions, the responses in all 6 parameters were similar in the 5 subjects tested, i.e. 1 unit of pure natural secretin was equal in potency to 10 - 16 units of Boots secretin.

Similar studies carried out with pancreozymin showed that 1 Ivy-dog unit of pure natural pancreozymin (CCK) was equal to 4 Crick, Harper and Raper units of Boots pancreozymin on pancreatic enzyme concentration and output.

**Effect of the Secretin and Pancreozymin Preparations on Basal Gastric Acid Secretion**

Fig. 2 shows the results of the total acid output per 10 minutes in 5 subjects given pure natural secretin in a...
dose of 0·25 clinical units/kg body-weight and these are compared with 7 control subjects in whom the secretin was omitted, i.e. the basal collections were continued for 60 minutes. In the control subjects, basal acid output fluctuated at the 10-minute intervals and only 1 patient had a reduction to achlorhydric level at the 50-60-minute collection. In the 5 subjects who received secretin a reduction in acid output was recorded in all cases. A comparison between the control group and the subjects who were given 0·25 units/kg pure natural secretin and 4 units/kg of Boots secretin is shown in Table I. Most of the patients who received either secretin preparations showed a reduction in acid output, not infrequently to the level of basal anacidity. The reduction was more rapid after injecting pure natural secretin (Table I) and both secretin preparations appeared to reduce acid concentration more than the volume output.

<table>
<thead>
<tr>
<th>Subjects tested</th>
<th>Basal acid output</th>
<th>Achlorhydria</th>
<th>Onset of reduction (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td>7</td>
<td>Reduced</td>
<td>1</td>
</tr>
<tr>
<td>Boots secretin</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Pure natural secretin</td>
<td>5</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>0·25 units/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Eight similar tests carried out with 1 unit/kg pancreozymin-cholecystokinin (CCK) and 4 units/kg Boots pancreozymin showed varying results. A moderate increase in acid output occurred in 2 patients with basal achlorhydria before the injection; a reduction in acid output occurred in 3 patients with initial acid secretion and the results were virtually unchanged in the remaining 2. All the effects were modest.

**DISCUSSION**

This study has confirmed the findings of Wormsley that secretin is an inhibitor of basal gastric acid secretion in man. Further, secretin was able to reduce acid secretion to achlorhydric levels in patients with relatively low initial basal secretion and pure natural secretin was a more effective inhibitor than Boots secretin when doses of equal potency, as judged by their effect on pancreatic secretion, were administered. Although studies on the effect of secretin on stimulated gastric secretion were not carried out, it has been shown that secretin is a weak inhibitor of gastrin or pentagastrin-stimulated secretion in man and has a lesser effect on histamine-stimulated secretion. Johnson and Grossman have shown that secretin acts as a non-competitive inhibitor of gastrin in dogs. Whether secretin production accounts for the whole inhibitory phase of gastric acid secretion after duodenal acidification or after free fatty acids in the duodenum is uncertain but it is possible that secretin is in fact the only true enterogastrone.

We have been unable to confirm previous work by other authors that pancreozymin stimulates gastric acid secretion. However, Wormsley used much larger doses of pancreozymin which were not truly physiological. The present study suggests that pancreozymin has a variable and minor effect on gastric acid secretion, producing slight stimulation in some patients, mild inhibition in others and no effect in the majority of cases. Brooks and Grossman found that pancreozymin (CCK) inhibited the pentagastrin-stimulated acid secretion by a mean value of 33% but even their individual results were variable. There was little difference between the Boots preparation and CCK in their relative effects on the basal acid secretion.

**REFERENCES**


**Liver Storage**

HAROLD SPILG, F.C.S. (S.A.), Registrar, and JOHN TERBLANCHE, CH.M., F.R.C.S., F.C.S. (S.A.), Senior Lecturer, Department of Surgery, University of Cape Town

**SUMMARY**

A brief history of the development of methods of organ storage with special emphasis on liver storage is presented. The current status of experimental liver storage is reviewed, emphasizing that hypothermia is at present the principal protective factor in all successful methods of liver storage.