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Total Gastrectomy with Preservation of the Hepatic and Celiac Vagi

by

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Introduction

Total gastrectomy is usually accompanied with bilateral abdominal vagotomy and followed frequently by such late complications, as diarrhea, reflux esophagitis, dumping syndrome, agastric anemia, decreased fat absorption and furthermore, nutritional deficiencies, etc. It is probable that these undesirable sequelae attendant on total gastrectomy might be partially caused by vagal denervation of abdominal viscera other than the stomach, such as the biliary tract, pancreas, intestine, etc. Impressed by Ex-professor Chuji Kimura's suggestion, we invented a new method of operation, total gastrectomy with preservation of the hepatic and celiac vagi as a countermeasure against postoperative sequelae following total gastrectomy. The clinical and experimental investigations were performed to evaluate the effect of the application of this new method of operation.

Anatomy[9)10)18)29)]

Both vagus nerves emerge from their pulmonary plexuses behind the right and left lung roots, respectively, divide into several branches, and become arranged along the anterior and posterior surfaces of the esophagus as the complicated nets of the esophageal plexus. These numerous nerve fibers joined again to form the single, double, or rarely tripple trunks of the anterior and posterior vagus nerves, respectively, two to six cm above the diaphragm. Usually, the left vagal trunks pass anterier, and the right posterior to the esophagus. They enter the abdomen through the esophageal hiatus and after supplying several filaments to the cardiac orifice, they divide into two or four groups of branches. The anterior vagal trunk divides into hepatic, anterior celiac, and anterior gastric branches of relatively equal size, and the posterior vagal trunk divides into a large posterior celiac and a smaller posterior gastric branches.

The anterior and posterior gastric branches radiate to the lesser curvature and innervate respectively, the anterior and posterior walls of the stomach. It is reported that both groups of gastric branches anastomose to each other at the lesser curvature. The hepatic branches are two or four in number and run within the lesser omentum to the hepatic plexus at the

porta hepatis. The small pyloric branches consisting of some hepatic vagal fibers are usually two in number. One arises from the hepatic branches high up near the cardiac end of the lesser curvature, and the other about half way along the lesser curvature, and they run almost horizontally to the right between the layers of the lesser omentum, and turn downwards in the gastrohepatic ligament on the left side of the hepatic artery to reach the pyloric antrum, pylorus, and proximal part of the duodenum. Therefore, the hepatic branches innervate the biliary tract, liver and proximal part of the duodenum. The anterior and posterior celiac branches get together and run downwards just craniodorsal to the left gastric artery within the gastropancreatic peritoneal fold to the celiac and superior mesenteric autonomic plexuses, and then accompany the branches of the abdominal aorta to innervate the majority of the abdominal viscera, the stomach, the duodenum, the small intestine, the large intestine nearly oral to the splenic flexure, the liver, pancreas, spleen, kidney, etc. The posterior celiac branches comprise 75 to 80 per cent of all celiac vagal fibers and innervate the entire small intestine and the oral half of the large intestine, but the anterior celiac branches innervate only the duodenum. The exact distribution of the hepatic and celiac vagi to the pancreas is unknown, but it is probable that the hepatic vagi innervate the ventral pancreas and the celiac vagi the dorsal pancreas. There are some vagal pancreatic nerves originating from the gastric branches of the anterior and posterior vagal trunks.[18]

The gastric branches comprise about 65 per cent of vagal fibers passing through the esophageal hiatus. The hepatic branches comprise 10 per cent of all vagal fibers and the remaining 25 per cent of vagal fibers make up the celiac branches. Each cervical vagus contains about 30,000 fibers. About half the fibers in each are distributed in the abdominal vagal nerves and there are about 30,000 fibers to the abdominal viscera. Only about 10 to 20 per cent of these are efferent or motor, the remaining 80 to 90 per cent being afferent or sensory.[29] Judging mainly from the positional relationship to the left gastric artery, JACKSON classified the course of the posterior vagal trunk into six types. In Types 1 and 2, which are found at the rate of 40 and 28 per cent, respectively, the posterior celiac branches run downwards craniodorsal and relatively close to the left gastric artery.[13]

Effects of extragastric vagotomy[2)4)7)8)9)10)17)20)24)27)29)30]

Following truncal or abdominal total vagotomy, various undesirable sequelae are produced in consequence of vagal denervation of abdominal viscera besides the stomach; that is, with the gallbladder, 1) loss of contractile response to vagal stimulation, 2) flaccidity and dilatation, 3) delayed or increased emptying, 4) possible increased incidence of gallstone; with the pancreas, 1) loss of insulin response, 2) decrease in feeding response and in 24-hour output of pancreatic juice, 3) decreased response to secretin ; with the intestine, 1) dilatation and pooling, 2) decreased number of villi, 3) loss of contractile response to electrical stimulation, and in the integrated functions, 1) episodic diarrhea, 2) decreased fat absorption, etc.

Method of operation[5)12)13]

A midline incision is made between the xiphoid and umbilicus. A transverse incision

extending across the left rectus muscle at the level of the umbilicus is added on the left side. After the whole stomach is mobilized except for the upper portion of the lesser curvature and the cardiac end of the greater curvature, the duodenum is divided at the first part and its stump is closed. If it is necessary, the resection of such adjacent organs, as the spleen, the body and tail of the pancreas, is performed. Then, exerting firm traction on the greater curvature of the stomach, caudally, anteriorly and to the right, the cardiac end of the greater curvature is mobilized and the visceral peritoneum anterior to the abdominal esophagus is incised transversely just above the cardia. The anterior vagal trunk is identified anterior to the esophagus. Then, exerting firm traction on the stomach, caudally, anteriorly and to the left, the hepatic vagal branches can easily be seen passing to the right a little cranial to the cardia. The hepatic branches are dissected distally from their origins in the anterior vagal trunk, after dividing the anterior gastric and anterior celiac branches at their constant beginning portions just beneath the peritoneum adjacent to the cardia and lesser curvature. During these procedures, the cardiac lymph nodes on both sides are cleansed. With downward traction on the stomach, the posterior trunk or its celiac branch is palpated and identified as a taut cord by a finger directed either alongside the right posterior surface of the abdominal esophagus and cardia, and the whole course of the celiac branch is dissected down to the trunk of the left gastric artery or to the celiac plexus. Then, the lesser curvature of the stomach is dissected from the pylorus toward the cardia, and the left gastric vessels are divided near the origin of the artery from the celiac artery; cleansing the lymph nodes along the left gastric artery and at its root. After visualization of the whole course of the celiac branches situated craniodorsal to these vessels, the posterior gastric branches are divided just near the origin from the posterior trunk. In this manner, the stomach is completely dissected preserving the hepatic and the posterior celiac branches of the vagi. Then,
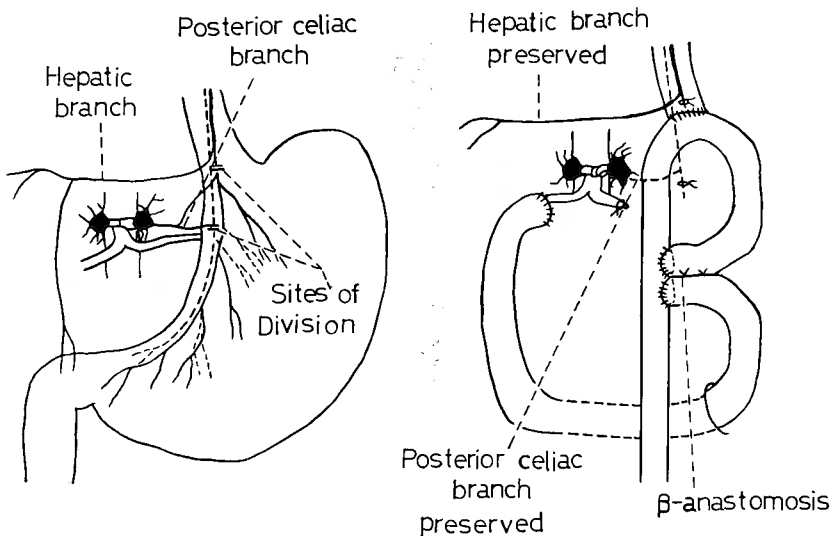

Fig. 1. Total gastrectomy with preservation of the hepatic and posterior celiac vagi (KIMURA & ISHIGAMI)

in the relatively curative operation, the distal divided end of the esophagus is anastomosed to the jejunum, 60 to 70 cm aboral to Treitz's ligament, in end-to-side fashion. After the jejunum, 20 to 30 cm aboral to Treitz's ligament, is transected partially, the end-to-side jejunojejunostomy of β type (NAKAYAMA) is performed. With preservation of the hepatic and posterior celiac vagi, the operative procedure of esophagojejunostomy does not meet with any difficulty due to the limited pullout of the divided esophageal stump. In the absolutely curative operation, we had better interpose the right half of the colon including the terminal ileum or various types of the pedunculated jejunal segments between the esophagus and the duodenum (Fig. 1).

Indication of the new method of operation

Hitherto, 54 cases of gastric carcinoma, two cases of gastric ulcer with probable malignancy in the cardia and one case of reticulum cell sarcoma of the stomach have undergone this new method of operation. In 45 cases both the hepatic and posterior celiac vagi were preserved. In 10 cases only the posterior celiac branch was preserved. In three cases the posterior celiac branch was preserved, but it was uncertain that whether the hepatic branch was preserved or not. In 36 cases splenectomy was combined, and in 11 cases both splenectomy and distal pancreatectomy were combined. In two cases, the pedunculated right half of the colon or the jejunal loop were interpose respectively between the distal esophageal and the proximal duodenal stumps. This new method of operation is indicated for the cases in which no invasion of cancer upward into the esophageal wall or outside the capsules of cardiac, lesser curvature and left gastric artery lymph nodes, etc., was observed. It is favorable to the preservation of these vagal branches that the course of these branches is quite different from those of blood vessels and lymphatics, which supply the proximal portion of the stomach. The preservation of the posterior celiac branch sometimes meets with some difficulties at the site, one to two cm in length, where this branch runs in close proximity and craniodorsal to the left gastric vessels, as seen in Types 1 and 2 of the above-mentioned JACKSON's classification. However, keeping in mind the anatomical structure of the concerned portion, this operative procedure is rather easy to perform on the cases in which no cancer invasion was observed outside the capsule of lymph node.

We investigated the influence of the preservation of the posterior celiac branch on the curability of operation in the cases of gastric cancer, in which this branch was

Table 1. Cancer infiltration into the posterior celiac branch and cancer dissemination onto the lesser omentum in gastric cancer patients

Cancer infiltration into the posterior celiac branch

	$\begin{array}{c}n(-)\\ n_1(+)\end{array}$	$n_2(+)$	$n_3(+)$	Total
m~pm	0/5	0/1		0/6
ss	0/2	0/1		0/3
s(+)	0/4	1/7	1/2	2/13
Total	0/11	1/9	1/2	2/22

Cancer dissemination onto the lesser omentum

	$\begin{array}{c}n(-)\\ n_1(+)\end{array}$	$n_2(+)$	$n_3(+)$	Total
m~pm	0/5	1/1		1/6
ss	0/2	1/1		1/3
s(+)	3/4	7/7	2/2	12/13
Total	3/11	9/9	2/2	14/22

resected together with the cancerous stomach. It was shown that cancer cells were quite rarely found in the posterior celiac branch, especially in its perineural space, but disseminated metastases to the lesser omentum adjacent to the lesser curvature were frequently observed. Therefore, in the procedure to preserve the posterior celiac branch, it is necessary to dissect it along with this nerve (Table 1).

Effect of the preservation of the hepatic and posterior celiac vagi in total gastrectomy

1) Postoperative complaints

The incidence of postoperative side effects, such as diarrhea, reflux esophagitis, dumping syndrome, anorexia, weightloss, etc. in the group of total gastrectomy with preservation of the hepatic and posterior celiac vagi was investigated as compared with that in the group of total gastrectomy with truncal vagotomy. In regard to anorexia, weightloss, etc., no remarkable difference was observed between these two groups, one to two months postoperatively. However, three to nine months postoperatively, the occurrence of postoperative side effects, especially diarrhea, weightloss, reflux esophagitis, etc., was lower in the group with preservation as compared with the group of truncal vagotomy. While the weightloss following total gastrectomy with truncal vagotomy amounted to a 15 per cent decrease on an average, it was only an 11 per cent decrease in the group of preservation. On the other hand, the occurrence of dumping syndrome was higher in the cases in which the posterior celiac branch was preserved. It was also verified in the dumping test in clinical cases and in the experimental results (Fig. 2). Selective gastric vagotomy was first introduced independently by JACKSON and by FRANKSSON both in 1947.[8][10] It is designed as a treatment for duodenal ulcer to accomplish the following objectives: anatomically, assurance of complete vagal de-
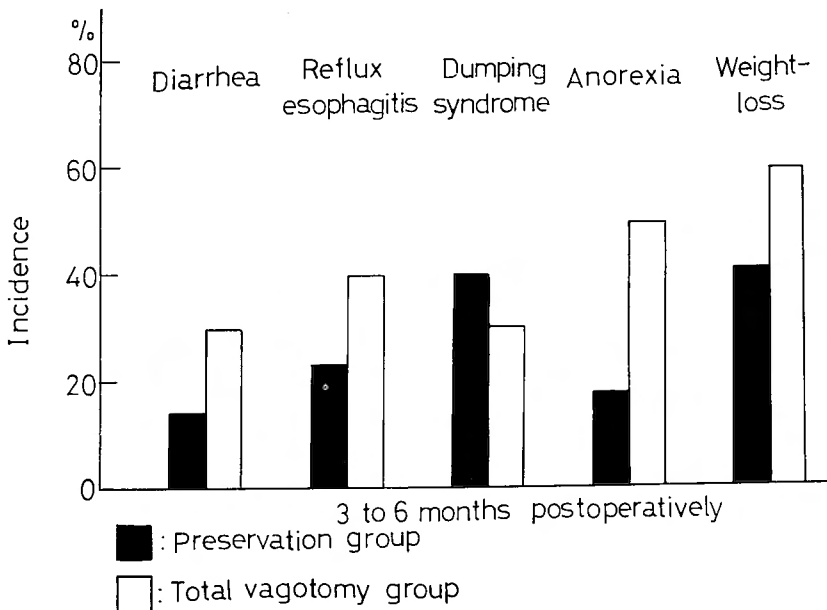

Fig. 2. Postoperative complaints after total gastrectomy

nervation of the stomach ; physiologically, preservation of the hepatic and celiac branches, thus retaining vagal innervation to the pancreas, biliary tract and intestine ; and clinically, avoidance of certain undesirable sequelae attendant on vagal denervation of abdominal viscera other than the stomach.

According to HARKINS et al.[10], the incidence of diarrhea with dumping, diarrhea only or dumping only in the groups with total vagotomy and antrectomy were 30 %, 38% and 8%, respectively, those in the groups of selective vagotomy and antrectomy were 27%, 2% and 19%, respectively. As similar evidence was reported by BURGE et al., KRAFT et al., FARRIS & SMITH, WILLIAMS & IRVINE, HEDENSTEDT & LANDQUIST, etc., the incidence of diarrhea not associated with dumping is markedly decreased in the group of selective vagotomy. In the group of selective vagotomy, vague abdominal discomfort, gas, bloating and diarrhea have been notably absent ; however, the incidence and severity of dumping and diarrhea associated with dumping have remained the same as with truncal vagotomy. Such differences in postoperative side effects extremely resemble those between two groups of total gastrectomy with truncal vagotomy or with preservation of the hepatic and posterior celiac vagi.

The reason why the incidence of dumping syndrome was higher after preserving the posterior celiac branch was investigated. SILVER et al.[26] evaluated that division of the mesenteric nerves to the challenged jejunum will completely prevent the dumping syndrome. Division of nerves at more proximal sites alters the time of onset of the dumping syndrome and reduces the number of signs of dumping per challenge as the denervation becomes more complete. Frequent occurrence of dumping syndrome in the group with preservation of the posterior celiac vagi may be attributable to the interruption of the vasomotor reflex, inhibition of production, release and local clearance of serotonine.

WAKABAYASHI[28] of our clinic investigated the effect of the preservation of the posterior celiac branch on the occurrence of dumping syndrome. In our cases of total gastrectomy with preservation of the posterior celiac branch, the incidence of dumping syndrome was higher, as compared with the cases of total vagotomy. In these cases, general syndromes, such as cold sweating, palpitation, flushing, etc., occurred much more frequently, but intestinal syndrome, such as diarrhea, borborygmus, etc., occurred less frequently (Fig. 3). In the dumping test following ingestion of 150 ml of 50 per cent glucose solution, our clinical cases in the group of preservation showed 13.0 ± 1.61 per cent elevation of maximal blood pressure and $2.5 \pm 2.51°C$ elevation of body temperature, while our clinical cases in the group of total vagotomy showed 8.2 ± 2.70 per cent and $1.3 \pm 0.08°C$ elevation, respectively (Fig. 4). In the dumping test following intrajejunal administration of hypertonic glucose solution in dogs, the rates of decrease in pulse pressure, circulating plasma volume and femoral artery pressure amounted to 35.5 ± 5.30, 14.1 ± 2.42, 20.1 ± 3.34 per cent, respectively, in the group of preservation of the posterior celiac branch, while they were 21.0 ± 1.31, 5.5 ± 0.76, 13.2 ± 2.34 per cent, respectively, in the group of division. In dogs with preservation of the posterior celiac branch, change of general circulation and stasis in the mesenteric vein tended to occur more markedly. On the other hand, serotonine release from the argentaffin cell mass of
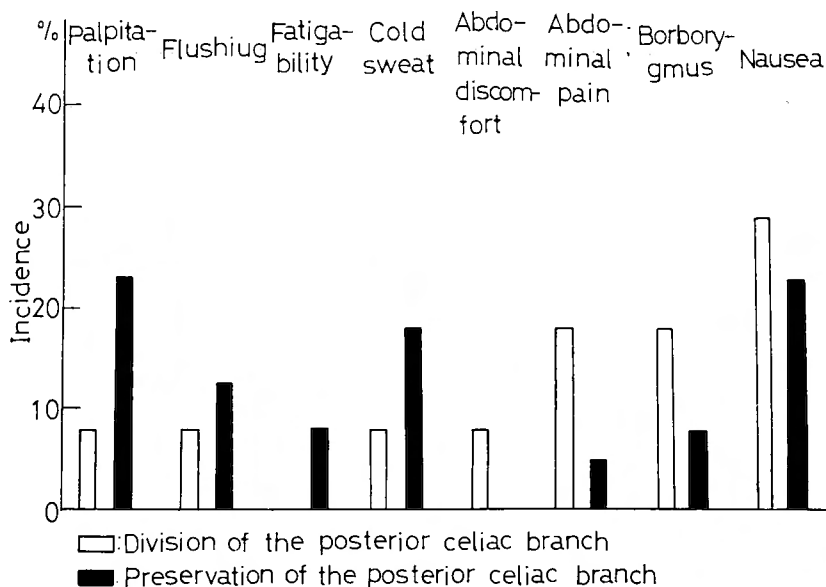
Fig. 3. Subjective complaints in dumping syndrome after total gastrectomy
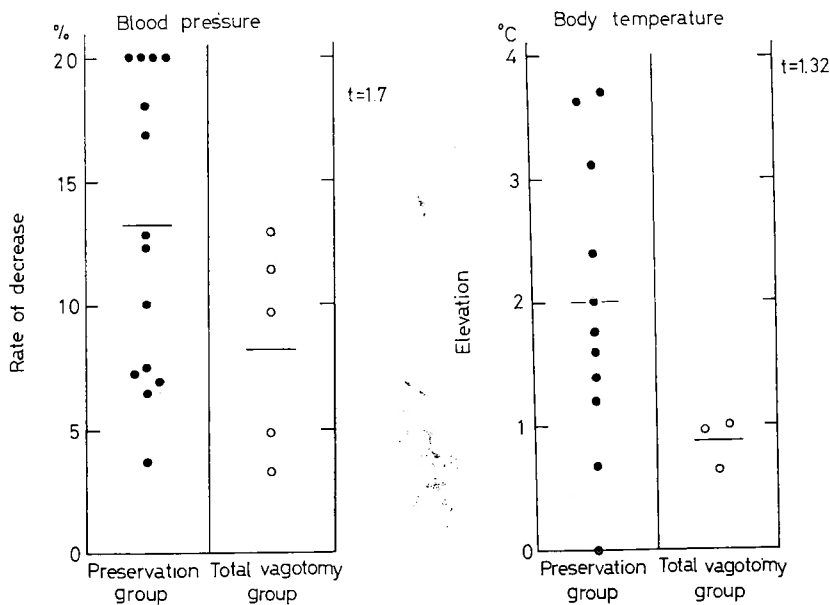

Fig. 4. Changes in maximal blood pressure and body temperature during the
postoperative dumping test after total gastrectomy

the upper jejunum following dumping challenge were inhibited by division of the posterior celiac branch in fluorohistochemical study according to the FALCK-FUJIWARA method. In the group of preservation of the posterior celiac branch the amount of serotonine in the argent-affin cells of the upper jejunum decreased markedly following the instillation of hypertonic

glucose solution, while in the group of division it decreased slightly.[28]

2) Carbohydrate metabolism, especially the glucose tolerance curves

Blood sugar levels in the patients who had undergone total gastrectomy were character-istically high immediately and 90 minutes after the glucose tolerance test.[19] And they show-ed that the insulin released from the pancreas was abnormal in these patients. We inves-tigated the glucose tolerance curves in our clinical cases of total gastrectomy, one to three months postoperatively, who showed the normal pattern of this curve preoperatively. Four out of eight cases in the group of total vagotomy showed the curve of diabetes mellitus type, in which the blood sugar level was more than 180 mg/dl one hour after the ingestion, and more than 140mg/dl two hours after the ingestion. On the other hand, a large majority of cases in the group of preservation showed the normal pattern of glucose tolerance curve, and in only two out of 14 cases it was a little more than 180mg/dl one hour after the ingestion. No difference was observed between two groups with and without resection of the pancreatic tail (Fig. 5).
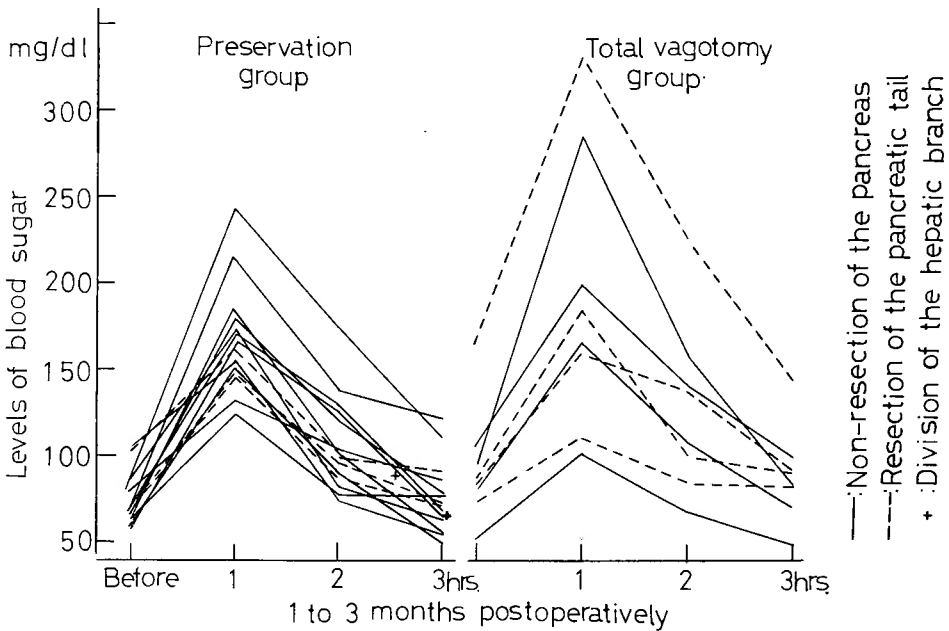

Fig. 5. Glucose tolerance curves after total gastrectomy

WILLIAMS & IRVINE found abnormal lactose tolerance in nine per cent of patients with total vagotomy and 12 per cent of those with selective vagotomy. GOLDING et al. detected no change from normal after vagotomy alone, although there was enhanced absorption of xylose during the late post-prandial period-90, 120 and 180 minutes.[29] This might be explained as the results of more rapid exposure of the sugar to the intestine following the accompanying drainage operation. According to BALLINGER et al.[1], subtotal gastrectomy or division of the gastric branches of the vagi produced mucosal damage in the small intestine presumably

related to the rise in bacteria ; and division of the hepatic or celiac branches produced mucosal damage in the small intestine as a pure denervation phenomenon without a rise in bacteria. Total abdominal vagotomy produced mucosal damage in the small intestine due to both causes. They also studied the effect of parasympathetic denervation of the abdominal viscera upon mesenteric blood flow.[2] Total subdiaphragmatic vagotomy resulted in an average reduction of 42 per cent in blood flow through the common mesenteric vein. Division of the celiac and hepatic branches caused a reduction in flow of 17 and 18 per cent, respectively. Division of the anterior and posterior gastric branches caused a reduction in flow of 0.6 and 5.1 per cent, respectively. Glucose is mainly absorbed by active transport. MITSUNO et al.[19] clarified that ATP ase and glucose-6-phosphate dehydrogenase activities decreased in the upper alimentary tract of totally vagotomized dogs. We observed that the atrophy of the mucosa of the small intestine, electron-microscopically, club-like shortening of the microvilli, and histochemically, decrease of ATP ase, acid phosphatase and succinic dehydrogenase activities, three to four weeks after total vagotomy. Therefore, the preservation of the hepatic and posterior celiac vagi at the time of total gastrectomy may contribute to reduce the atrophy of the mucosa of the small intestine which is partly caused by decreased blood flow or short-circuit of blood through the patent A-V shunt, and further abnormal release of insulin from the pancreas, and to improve the carbohydrate metabolism following total gastrectomy.

3) Digestion and absorption of fat

After total gastrectomy, digestion and absorption of fat are impaired and the mean absorption rate of fat amounts to 81.7 per cent of the whole uptake, while the normal rate amounts to more than 92 per cent. Such impairment is said to be hardly improved. MITSUNO et al.[19] measured the amount of serum lipids after ingestion of acetate-C^{14} in clinical cases who had undergone total gastrectomy, and showed that the amount of esterified fatty acid and triglyceride decreased, while there was no significant change in the amounts of cholesterol and esterified cholesterol, as compared with normal subjects. Vagotomy also exerts influence on digestion and absorption of fat. Using ^{14}C-labeled sodium octanoate, GOLDING et al. found less absorption of this fatty acid after vagotomy alone, but once more the difference was not significant. When pyloroplasty was added, however, absorption was further reduced and was then significantly less than normal.[29] WASTELL found that total, posterior selective and anterior selective vagotomy had no effect on fat excretion ; indeed, the only consistent rise in fat excretion was obtained when pyloroplasty, especially both pyloroplasty and anterior selective vagotomy were performed, and this occurred both with and without vagotomy. OKUBO et al.[22] measured faecal fat excretion by means of ^{131}I-Triolein, and observed steatorrhea more frequently in the patients with total vagotomy, as compared with in those with selective vagotomy.

Digestion and absorption of fat in our clinical cases were investigated after ingestion of 50 to 100μci of ^{131}I-Triolein capsules together with a cold meal one to three months post-operatively. The rate of faecal excretion, which amounts to about one per cent in a healthy person, came to more than 15 per cent in three out of four cases in the group of total vago-
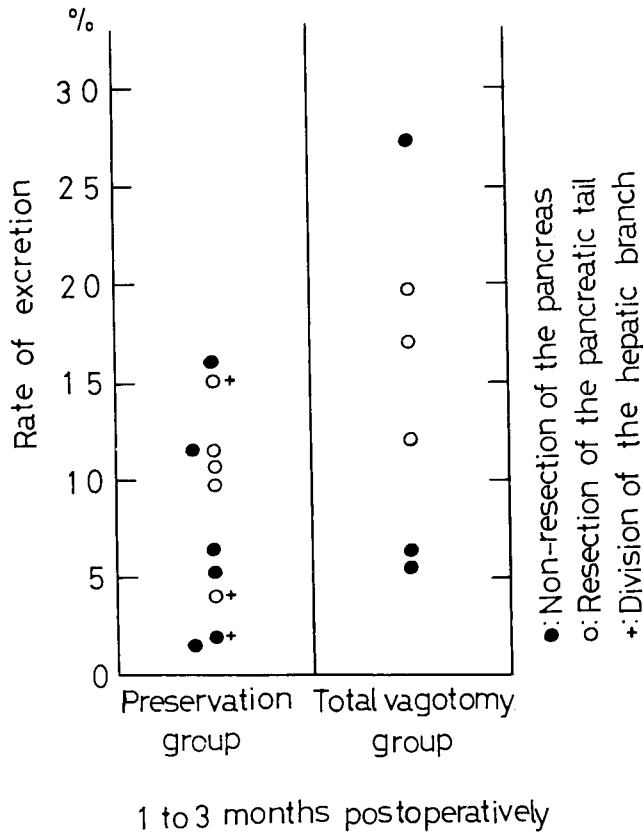
Fig. 6. The rate of faecal excretion of ingested ^{131}I-Triolein after total gastrectomy

tomy, while it was less than 10 per cent in a large majority of 14 cases in the group of pre-servation (Fig. 6). On the other hand, the absorption rate into the blood, which reach to the highest level, about 13 per cent, four hours after ingestion, showed a rapid elevation in the group of preservation, as compared with the group of total vagotomy. And the maximum concentration in the blood was more than 10 per cent in six out of 14 cases, and less than eight per cent in only six cases, in the group of preservation, while it was less than eight per cent in all five cases in the group of total vagotomy (Fig. 7). These results seemed to be unrelated with the performance of resection of the pancreatic tail. According to WILLIAMS & IRVINE, the increased faecal fat after gastric operation is partly due to increased endogenous fat excretion rather than to decreased dietary fat absorption. Therefore, the measurement of serum lipids after ingestion of a fatty meal is an adequate test for abnormal fat absorption. Normally, fat in a meal is almost completely absorbed in the uppermost jejunum, 100cm in length. It is reasonable to postulate that after total vagotomy rapid emptying into the small intestine could lead to an adequate rise in serum lipid even though steatorrhea was present.[16] Be that as it may, digestion and absorption of fat remain in good condition in the group of preservation. A decrease in the fat absorption could be due to : 1) drainage
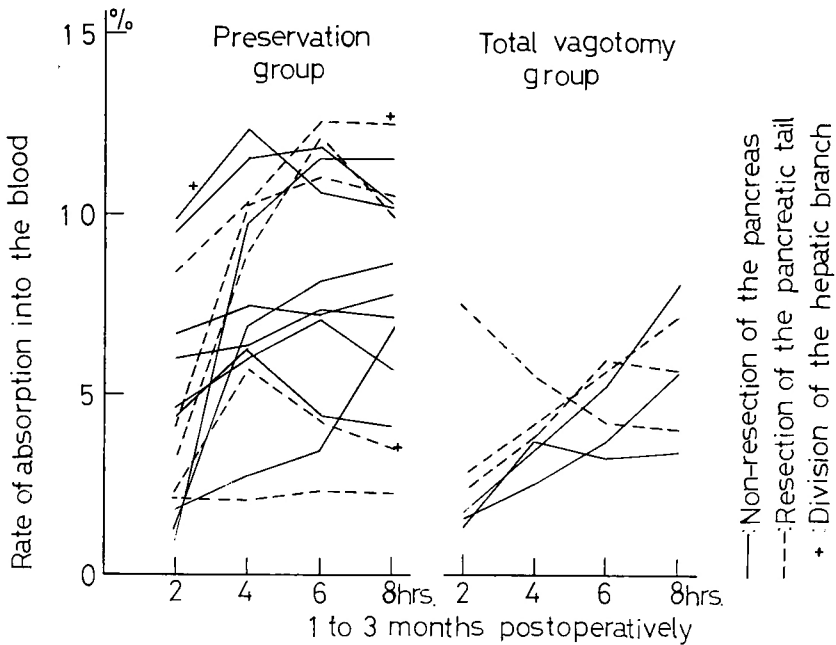
Fig. 7. The rate of absorption of ingested ¹³¹I-Triolein into the blood after total gastrectomy

operation, 2) an alteration in the intestinal mucosa, 3) intestinal hypermotility, 4) blind loop syndrome, 5) an alteration in the functions of the biliary tract and pancreas ; delay in time in which concentration of lipase and bile acids reach to their maximal values, and change in the composition of bile or pancreatic secretion, etc.[11]

The impairment of liver function occurs inevitably following total gastrectomy. In the group of preservation, the decrease in choline esterase and the increase in alkaline phosphatase were slight and the abnormalities in the values of GPT, CCFT, LDH and icteric index were observed only in a few cases, postoperatively, as compared with the group of total vagotomy.[6]

In our clinical cases of total gastrectomy, postoperative gallbladder functions were investigated by calculating the volume of the gallbladder in pre- and postoperative cholangiograms. In five out of seven cases in the group of division of the hepatic branch, the volume of the gallbladder showed more than 30 per cent dilatation, as compared with the preoperative one, while eight out of 11 cases in the group of preservation of the hepatic branch showed more than −15 per cent dilatation and reduced in size postoperatively. In the former group, the volume of the gallbladder showed a 33.1 ±6.65 per cent dilatation, while in the latter group, it showed a −16.2 ±10.70 per cent dilatation (Fig. 8). In all 10 cases in the group of division of the hepatic branch, the volume of the gallbladder showed less than 20 per cent contraction 30 minutes after ingestion of the yolk, while 13 out of 14 cases in the group of preservation of the hepatic branch showed more than 20 per cent contraction, and in only one case it showed less than 20 per cent contraction. In the former group, the
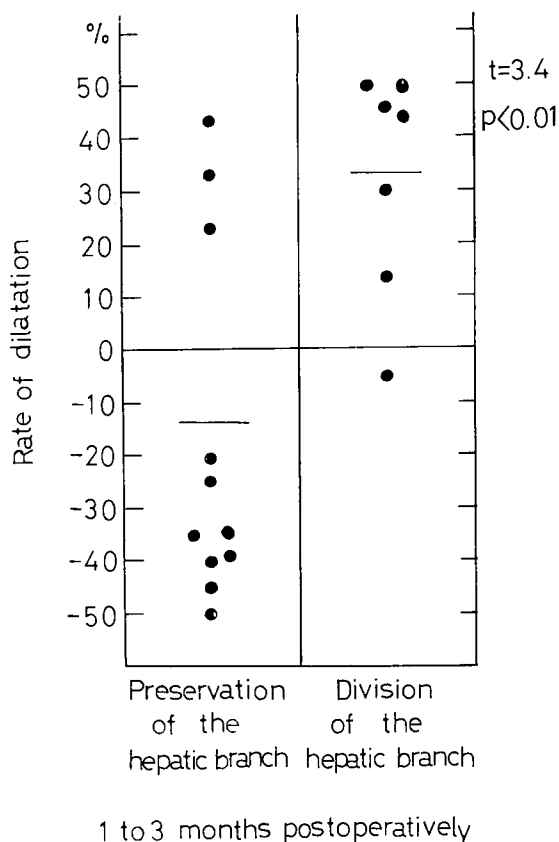
Fig. 8. The rate of dilatation of the gallbladder in the cholecystogram after total gastrectomy

volume of the gallbladder showed a 12.2 ± 2.40 per cent contraction, while in the latter group, it showed a 40.1 ± 5.47 per cent contraction (Fig. 9). Therefore, in the group of preservation of the hepatic branch, dilatation of the gallbladder was slight and its contraction was better. In dogs, total vagotomy and division of the hepatic branch increased intraluminal pressure of the gallbladder from the second postoperative day, and it showed a two to three times increase in pressure value on the fourth postoperative day[25)30)]. WAKABAYASHI[28)] of our clinic has demonstrated the same experimental results. It is thought to be due to the spasm of the sphincter of Oddi. And it plays a role in dilatation of the gallbladder in clinical cases who had undergone total vagotomy or division of the hepatic branch and to cause insufficient postcibal mixing of food with bile and pancreatic juice after total gastrectomy.[25)30)]

FAGERBERG et al.[4)] and TOMPKINS et al.[27)] showed that the levels of calcium, bilirubin, and chlesterol, the ratio of phospholipid/cholesterol and pH value in gallbladder bile increased among vagotomized animals, as compared with intact controls.

FUCHIMOTO & WAKABAYASHI[28)] of our clinic also clarified that the levels of cholesterol, phospholipid and the ratio of phospholipid/cholesterol in gallbladder bile increased, and the level of choleric acid and the ratio of choleric acid/cholesterol decreased. The level of cholesterol
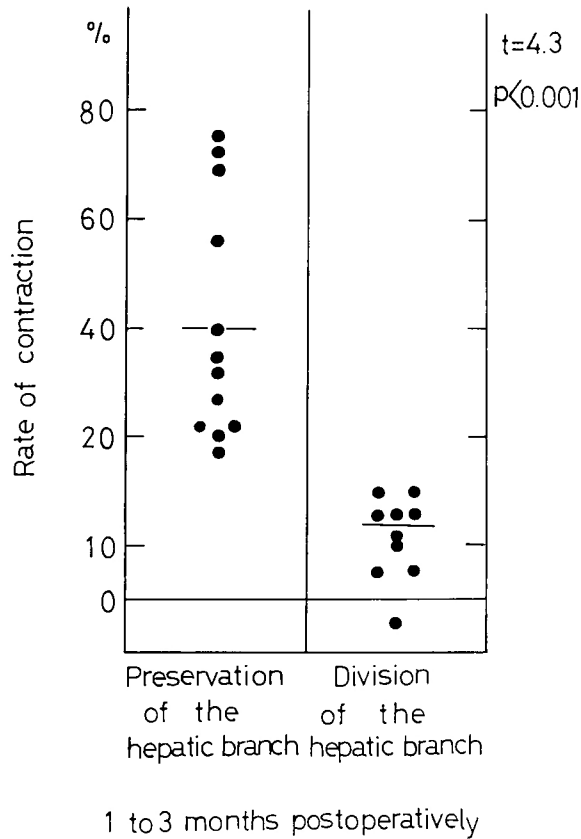
Fig. 9. The rate of contraction of the gallbladder in the cholecystogram after total gastrectomy

in gallbladder bile, which shows a mean value of 0.96mg/ml in the normal group, amounted to 1.30 and 0.59mg/ml on the average in the group of division of the hepatic branch and its preservation, respectively. Recently, the role of the mucosa of the alimentary tract in synthesis of fat is calling our attention. As shown in the above-mentioned clinical and experimental results, the preservation of the hepatic and posterior celiac vagi during the operative procedure of total gastrectomy should contribute to reduce the atrophy of the mucosa of the small intestine, the impairment of emptying of bile and pancreatic secretion, especially the change in the compositions of bile acids and pancreatic secretion, after total vagotomy, and further, to reduce the impairment of digestion and absorption of fat after total gastrectomy.

4) Digestion and absorption of protein

After total gastrectomy digestion and absorption of protein are also markedly impaired. MITSUNO et al.[19] clarified that postcibal levels of amino nitrogen in clinical cases who had undergone total gastrectomy reached to their peaks one hour after the meal, then decreased gradually and returned to the normal value at the time of hunger two hours later, while those in healthy persons showed a low level once about one hour after meal, thereafter, increased again and reached to peak levels two to 2.5 hours later. BALDWIN et al. and CROW et al.[3]
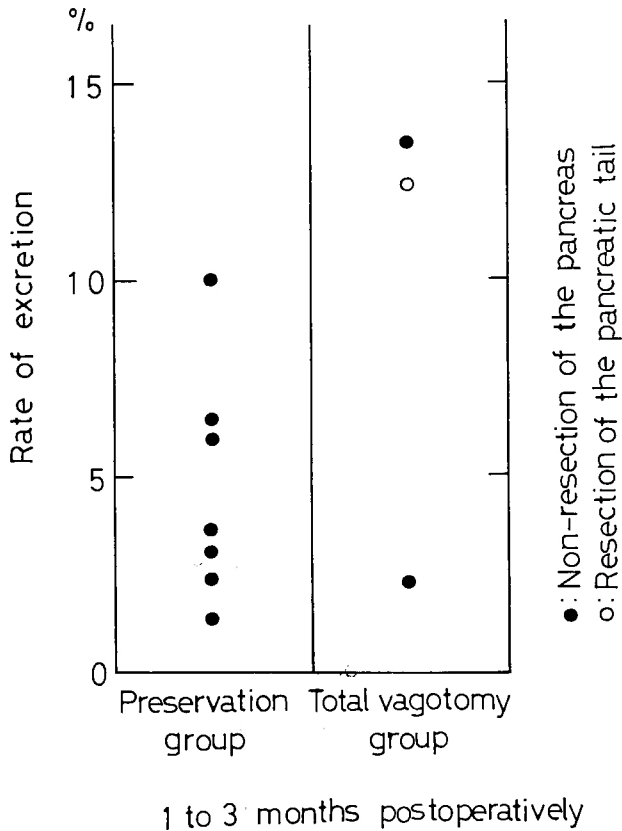
Fig. 10. The rate of faecal excretion of ingested RISA after total gastrectomy

measured faecal nitrogen in 72-hour-collections from dogs eating a standard laboratory diet. Whereas there was no change from normal in the animals with selective vagotomy, those with total vagotomy excreted a significantly increased amount of nitrogen in their stool.

Digestion and absorption of protein in our clinical cases of total gastrectomy were investigated by feeding them a meal containing ^{131}I-labeled protein (RISA) and measuring radioactivities in peripheral blood and faeces samples. In the group of preservation, the faecal loss of protein was slight and peripheral blood radioactivity showed a higher level, as compard with the group of total vagotomy (Figs. 10, 11). However, at present we can not yet draw a decisive conclusion, as the number of our cases are very small.

Summary

Total gastrectomy is usually accompanied with bilateral abdominal vagotomy and followed frequently by side effects, agastric syndromes. Some of these postoperative sequelae seem to be caused by lack of extragastric vagal innervation. To cope with these sequelae we invented a new method of operation, total gastrectomy with preservation of the hepatic and posterior celiac vagi. We investigated the effect of the performance of this new
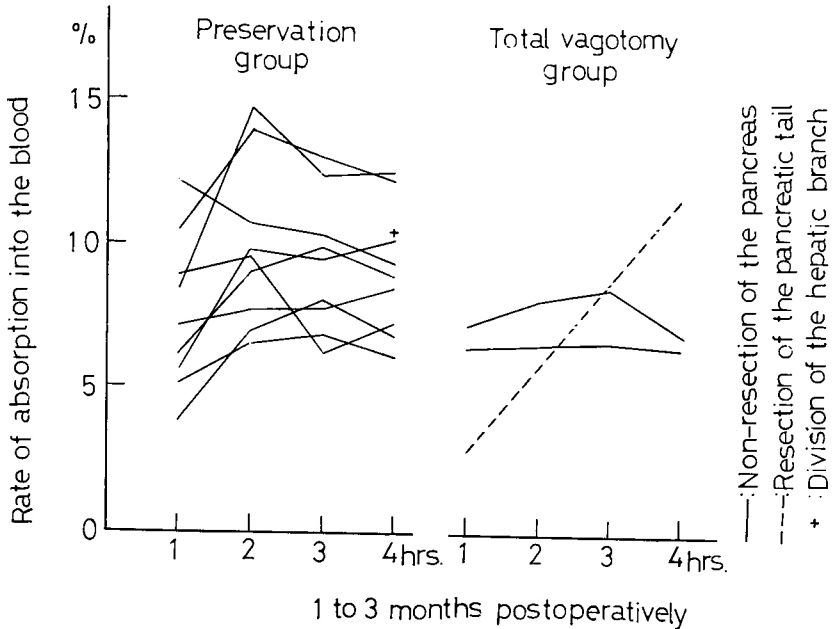
Fig. 11. The rate of absorption of ingested RISA into the blood after total gastrectomy

method of operation clinically and experimentally. The preservation of the hepatic and posterior celiac vagi during the operative procedure of total gastrectomy may contribute to reduce the occurrence of postoperative complaints, such as diarrhea, weightloss, reflux esophagitis, etc., to keep in good condition the digestion and absorption of fat and protein, carbohydrate metabolism, function of gallbladder, etc., and to improve the postoperative nutritional status.

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迷 走 神 経 部 分 的 保 存 胃 全 摘 術

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胃全摘術においては食道下端において両側迷走神経が完全に切断されるが，術後しばしば下痢，逆流性食道炎，ダンピング症候群，無胃性貧血，脂肪吸収障害，さらに栄養障害などが発生する．これらの術後障害の一部は胆道系，膵，腸管などに対する迷走神経支配の脱落に基ずくものと思われる．われわれは胃全摘後の後遺症に対する対策として，迷走神経肝枝および後腹腔枝を保存して胃を全摘する新術式，すなわち迷走神経部分的保存胃全摘術（木村・石上）を案出し，この術式を施行したさいの効果について検討を加えた．

まず迷走神経肝枝および後腹腔枝を保存して，胃を全摘する手術術式とその適応について述べ，さらにこの術式の施行が癌根治性に及ぼす影響について検討した．

次にこの術式を施行した臨床例について，全迷切を伴う胃全摘施行例を対照として，以下の諸点を比較・検討した．

1）術後愁訴，とくに下痢，体重減少，逆流性食道炎症状，さらに食思不振は保存群の方に発生頻度が小であったが，ダンピング症候群のみは保存群に多発した．しかも後腹腔枝保存群では動悸，冷汗，熱感などの全身症状が多く，腹鳴などの腹部症状が少なかったのに反して，切断群では腹部症状が多く，全身症状は少なかった．高張糖液によるダンピング試験の成績も以上と一致した．

2）術後の糖負荷試験では保存群では大多数が正常の耐糖曲線を示したのに反して，全迷切群では約半数が糖尿病型の異常曲線を示した．

3）^{131}I-Triolein による脂肪の消化吸収試験では，糞便中排泄率は保存群の多くが10％以下の値を示したのに反して，全迷切群では15％以上の値を示すものが多かった．また血中吸収率は保存群では約半数が10％以上の値を示したのに反して，全迷切群では全例が8％以下の値を示した．

4）術後肝機能では保存群の方が Ch.E. の低下やアルカリ性フオスフアターゼの上昇が軽度で，G PT，CCFT，LDH，黄疸指数の異常を示すのが少なかった．

5）術前後の胆のう造影所見を比較すると，術後拡張率は肝枝保存群では−16.2％であったのに対して，肝枝切断群では33.1％であり，また術後卵黄服用後の収縮率は肝枝保存群では40.1％であったのに対して，肝枝切断群では12.2％であった．

6）^{131}I-RISA による蛋白の消化吸収試験では糞便中排泄率，血中吸収率ともに保存群の方が良好な値を示した．

一方イヌにおける実験的検討においては，肝枝切断後，胆のう内圧は術後2日から上昇し，4日後には2〜3倍に上昇し，また胆のう胆汁の組成ではコレステロールおよび燐脂質の増加，胆汁酸および胆汁酸／コレステロール比の減少をきたした．さらに後腹腔枝保存群では，切断群に比して，高張糖液負荷による脈圧および循環血漿量の減少および上部空腸におけるセロトニンの減少が高度であった．これらは以上の臨床的検索成績ともよく一致している．

したがって迷走神経肝枝および後腹腔枝を保存して胃を全摘すると，腹部全迷切を伴う従来の胃全摘術を施行した場合に比べて，術後愁訴を軽減し，脂肪や蛋白質の消化吸収，糖代謝，胆のう機能などを良好に保ち，術後の栄養状態を改善しうるものと思われる．