

Clinical and Radionuclide Evaluation of Bile Diversion by Braun Enteroenterostomy: Prevention and Treatment of Alkaline Reflux Gastritis

An Alternative to Roux-en-Y Diversion

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Objective and Summary Background

Symptomatic, medically resistant postgastrectomy patients with alkaline reflux gastritis (ARG) have increased enterogastric reflux (EGR) documented by quantitative radionuclide biliary scanning. Even asymptomatic patients after gastrectomy have increased EGR compared with nonoperated control patients. Roux-en-Y biliary diversion, although successfully treats the clinical syndrome of ARG, has a high incidence of early and late postoperative severe gastroparesis, Roux limb retention (the Roux syndrome), or both, which often requires further remedial surgery. As an alternative to Roux-en-Y diversion, this review evaluates the efficacy of the Braun enteroenterostomy (BEE) in diverting bile away from the stomach in patients having gastric operations. Based on previous pilot studies, the BEE is positioned 30 cm from the gastroenterostomy.

Methods

Thirty patients had the following operations and were evaluated: standard pancreatoduodenectomy (8), vagotomy and Billroth II (BII) gastrectomy (6), BII gastrectomy only (10), and palliative gastroenterostomy to an intact stomach (6). All anastomoses were antecolic BII with a long afferent limb and a 30-cm BEE. Four symptomatic patients with medically intractable ARG and chronic gastroparesis had subtotal BII gastric resection with BEE rather than Roux-en-Y diversion. Eight control symptomatic patients and six asymptomatic patients with previous BII gastrectomy and no BEE were evaluated. Radionuclide biliary scanning was performed within 30 days in all patients and at 4 to 6 months in 14 patients. Bile reflux was expressed as an EGR index (%).

Results

After operation, 18 of 34 patients (53%) had no demonstrable EGR while in the fasting state for as long as 90 minutes. The range of demonstrable bile reflux (EGR) in the remaining 16 patients was from 2% to 17% (mean, 4.5%). Enterogastric reflux in the 14 control patients (with no BEE) ranged from 5% to 82% (mean, 42%). The four patients with ARG and chronic gastroparesis treated by subtotal gastrectomy and BEE had postoperative EGR of 0%, 2%, 2%, and 4%, respectively.

They are asymptomatic with no evidence of bile reflux gastritis. In the 14 patients who had late evaluation, EGR ranged from 0% to 16% (mean, 5.5%). No patient had signs or symptoms of ARG after operation.

Conclusions

Braun enteroenterostomy successfully diverts a substantial amount of bile from the stomach. The ARG syndrome might be prevented by performing BEE during gastric resection or bypass in a variety of operations. Conversion to a Bill with BEE may be an alternative to Roux-en-Y diversion in treating medically resistant ARG and subsequent may avoid the Roux syndrome.

During the 1970s and early 1980s, use of Roux-en-Y gastrojejunostomy increased dramatically to treat alkaline reflux gastritis (ARG).¹⁻⁵ The early series reported nearly universal success after Roux diversion, and Roux-en-Y gastrojejunostomy was even suggested as a method of primary reconstruction after gastrectomy.⁶ The initial successful results were soon replaced by reports of prolonged hospitalization, severe early gastric atony or vomiting, and late failures due to chronic gastric atony, pain, intermittent vomiting, and bezoar formation.⁷⁻¹⁰ The Roux-en-Y stasis syndrome is probably due to transection of the jejunum and bypass of the duodenal pacemaker which causes alterations in motility, electrical activity, and stasis in the stomach, Roux limb, or both.¹¹⁻¹⁸ Further remedial gastric surgery, including subtotal, near-total, or completion gastrectomy has been performed to alleviate symptoms of chronic Roux-en-Y gastroparesis.¹⁹⁻²² Although medical therapy has been directed toward gastroparesis, chronic Roux limb stasis has no specific treatment. Other procedures have been suggested as alternatives to treat patients with ARG but have not achieved wide acceptance among surgeons.^{23,24} Prevention may be the best treatment for both ARG and the Roux syndrome.

The advent of radionuclide biliary scanning and its ability to visualize and quantify duodenogastric reflux has allowed adequate evaluation of symptomatic and asymptomatic postgastrectomy patients.^{25,26} Extensive bile reflux has been documented in patients who had vagotomy and drainage or resection and subtotal gastrectomy, although the direct relation of symptoms, amount of reflux, and predictions of surgical success is controversial.²⁶

One hundred years ago, Braun²⁷ introduced an enteroenterostomy anastomosis between the afferent and

efferent limbs just distal to a gastroenterostomy in an attempt to divert food from the afferent limb, decrease the "vicious circle" syndrome, and decrease bile vomiting. Although bilious vomiting resolved in some of his patients, he abandoned the procedure when more physiologic operations replaced gastroenterostomy to treat ulcer disease.

This review evaluates a more distal modification of the Braun enteroenterostomy (BEE) to divert bile from the stomach and prevent ARG. This modification is an alternative to Roux-en-Y diversion that prevents complications of the Roux syndrome.

METHODS

Pilot studies at our institution were performed initially with patients who had pancreatic cancer who received a palliative gastroenterostomy or a standard Whipple procedure. The stimulus for this study was our attempt to alter the massive bilious output from the nasogastric tube or gastrostomy in the 25% to 40% of patients who had postoperative gastroparesis. In the early studies, a 15- to 20-cm enteroenterostomy was performed between the afferent and efferent limbs of the gastroenterostomy. Postoperative biliary scanning showed a fair amount of bile diversion away from the stomach and decreased output from the nasogastric or gastric tube. After what appeared to be early successful results, the enteroenterostomy was moved downstream to approximately 30 cm from the gastroenterostomy.

Patients who had surgical procedures that included a Billroth II (BII) resection or a gastroenterostomy were included in this study. All anastomoses were performed using the gastrointestinal anastomosis stapling device. A BEE was created approximately 30 cm from the gastroenterostomy or Billroth II resection. The gastroenterostomy was performed in a "Polya fashion" with two firings of the stapling device (10 to 12 cm in length). The enteroenterostomy was performed with one firing of the stapling device. The following groups of patients were operated on, studied, and evaluated using technetium-99m (Tc99m) DISIDA (di-isopropyl imino diacetic acid)

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biliary scanning. Group A included 30 patients who had the following procedures: standard pancreatoduodenectomy (Whipple procedure) (8); vagotomy, antrectomy, and BII anastomosis (6); BII gastrectomy only for gastric ulcer or carcinoma (10); and palliative gastroenterostomy for unresectable cancer of the pancreas or duodenum (6). The BII anastomosis and gastroenterostomy were formed as described above, usually in an antecolic manner and with the distal Braun enteroenterostomy between the afferent and efferent limbs. Group B included 14 patients who had previous vagotomy and BII gastric resection for ulcer disease 3 months to 5 years before this study. This group had no enteroenterostomy performed and consisted of 6 asymptomatic patients and 8 patients with moderate to severe symptoms of ARG. All 14 served as controls to evaluate enterogastric reflux (EGR) in patients without BEE. Group C included 4 patients with clinical and radionuclide documentation of medically resistant ARG and some degree of documented gastroparesis. Two patients had previous vagotomy and pyloroplasty: one had a previous vagotomy and antrectomy and BI and the other had a previous vagotomy and antrectomy and BII gastric resection. Rather than Roux-en-Y biliary diversion, these patients had subtotal BII resection with a BEE. All patients in groups A and C had postoperative radionuclide biliary scanning within 30 days of surgery. Group D included 14 of the 34 patients in groups A and C. After early postoperative biliary scanning, these patients were re-evaluated in 4 to 6 months with a second biliary scanning procedure. Because enteroenterostomy resulted in a diminished volume of gastric output in our pilot studies, we studied 12 patients (group E) and compared their postoperative gastric output with and without BEE. Six patients from group A who had either palliative gastroenterostomy or a standard Whipple procedure with BEE were evaluated. Six additional patients who had palliative gastroenterostomy for an unresectable carcinoma did not have BEE and were evaluated for postoperative gastric output.

Previously we reported our technique for Tc99m biliary scanning and the modification of the method of Tolin to quantify EGR.²⁸ After an overnight fast, patients were scanned after receiving a bolus injection of Tc99m DISIDA. Patients were scanned for 90 to 120 minutes. After 60 minutes, most patients received an injection of sincalide (the active octapeptide of cholecystinin) to stimulate gallbladder contraction. The patients were scanned for another 30 minutes after this injection. At either 90 or 120 minutes, most patients were given water spiked with Tc99m sulfur colloid to mark the stomach and delineate gastric reflux from overlapping structures such as the left lobe of the liver. Although accurately quantifying enterogastric reflux is difficult, vi-

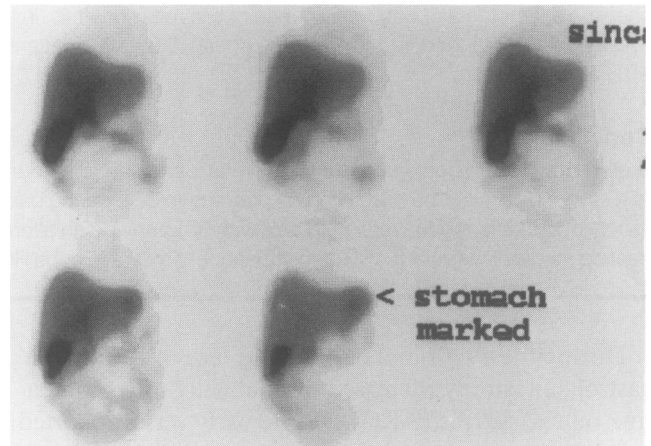


Figure 1. Biliary scanning in a patient with Braun enteroenterostomy. Radiolabeled bile is slowly released into the small intestine with minimal reflux into the stomach. At 90 minutes the stomach is marked with Tc99m sulfur colloid to delineate its position.

sual evidence of either reflux or no reflux, especially when the stomach is marked, is fairly easy. After marking of the stomach, computer analysis detected the amount of enterogastric reflux in the area where the stomach was positioned.

RESULTS

Group A

Of the 30 patients who had BEE with a variety of surgical procedures, postoperative radionuclide biliary scanning showed no EGR in 16. Figure 1 is the biliary scan of one of these patients, which shows slow release of bile from the liver into the small intestine. There is only a slight amount of reflux into the stomach, and the stomach, which is marked with Tc99m sulfur colloid, overlaps the left lateral segment of the liver. Of the remaining 14 patients, EGR ranged from 2% to 17%, with a mean of 5.5%.

Group B

These patients served as a control group, with 14 patients having previous vagotomy and BII resection with no enteroenterostomy. Figure 2 shows the range of EGR in all 14 patients. The asymptomatic patients had a mean EGR of 21%, with a range of 5% to 38%. The mean EGR in the group of 8 patients with symptoms of ARG was 57% (range, 32% to 82%). Figure 3 shows extensive EGR in 1 patient. Bile remained in the stomach throughout most of the examination and for as long as 4 hours. This patient had symptoms of ARG.

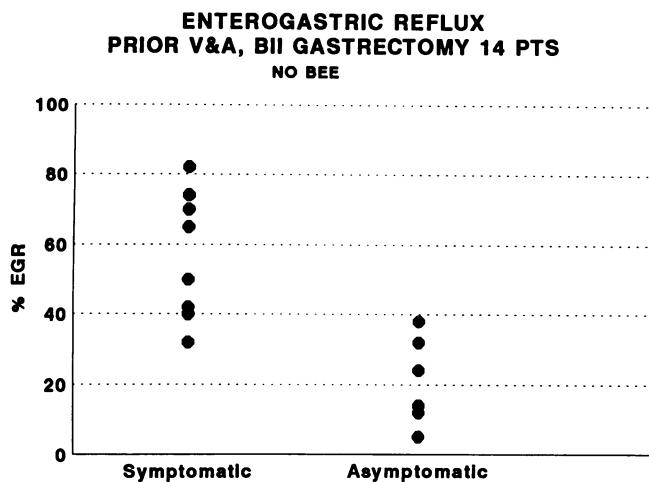


Figure 2. Enterogastric reflux in symptomatic and asymptomatic patients who had previous vagotomy and antrectomy and the Billroth II procedure. Patients with symptoms of alkaline reflux gastritis have more enterogastric reflux of duodenal contents.

Group C

Preoperative EGR in the 4 patients with documented ARG and gastroparesis who had BII resection with BEE was 38%, 18%, 34%, and 52%. After surgery, radionuclide scanning showed a markedly diminished EGR of 0%, 2%, 4%, and 2%. Figure 4 is the nuclear scan in one of these patients. After subtotal BII with BEE, no EGR occurred for as long as 90 minutes. At 100 minutes, Tc99m sulfur colloid adequately delineated the area of the stomach and confirmed that the BEE had diverted all of the bile for as long as 90 minutes. The area of the BEE is visualized in the 90-minute segment.

Group D

Fourteen patients from group A were re-evaluated 4 to 6 months after surgery. Six of the 16 patients who had

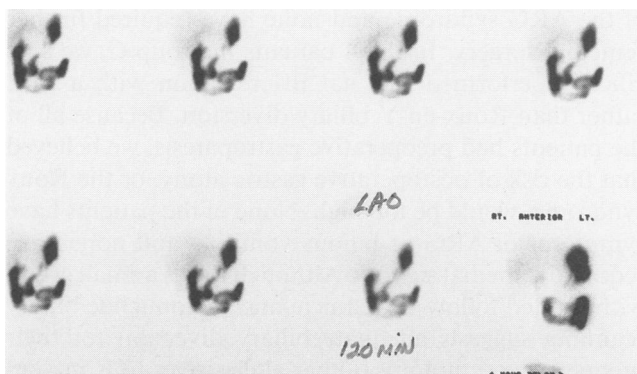


Figure 3. Biliary scan shows extensive accumulation of radiolabeled bile in the stomach at 120 minutes and at the 4-hour delay image.

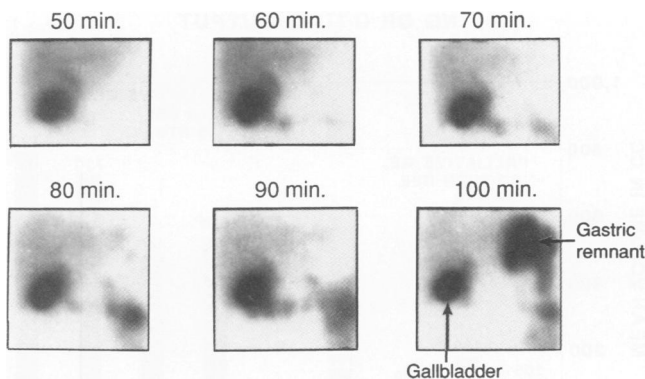


Figure 4. This patient had a previous vagotomy and entrectomy and the Billroth II procedure with no enteroenterostomy. Biliary scan after subtotal resection with enteroenterostomy for alkaline reflux gastritis and gastroparesis. Essentially no uptake into the stomach is seen at 90 minutes. The area of the gastric remnant is marked with Tc99m sulfur colloid at 100 minutes.

0% EGR were tested. In addition, 8 of the 14 patients with mild to moderate EGR were re-evaluated during this late period. The early and late EGR results are listed in (Table 1). Of the 6 patients who had no EGR in the early postoperative period, 3 of them had 3%, 5%, and 8% EGR after late evaluation. Of the 8 patients who had some degree of reflux after surgery, late evaluation showed essentially similar results for EGR. At 4 to 6 months, the BEE continues to divert bile from the stomach.

Figure 5 shows the mean nasogastric or gastrostomy output in 6 patients after palliative gastroenterostomy or Whipple procedure with BEE compared with 6 patients

Table 1. RESULTS OF GROUP A PATIENTS (PD, GE, BII, V & BII)

No. of Patients	Early EGR		Late EGR
6/16	0%		0%, 0%, 0%, 3%, 5%, 8%
8/14	4%	↓	0%
	9%	↓	6%
	7%	↓	0%
	17%	↓	16%
	12%	↑	13%
	5%	↑	9%
	2%	↑	5%
	4%	↑	8%
14	0-17%		0-16%
	M-4.3%		M-5.4%

N = 30.
 PD = pancreaticoduodenectomy; GE = gastroenterostomy; BII = Billroth II resection; V & BII = vagotomy and Billroth II resection.

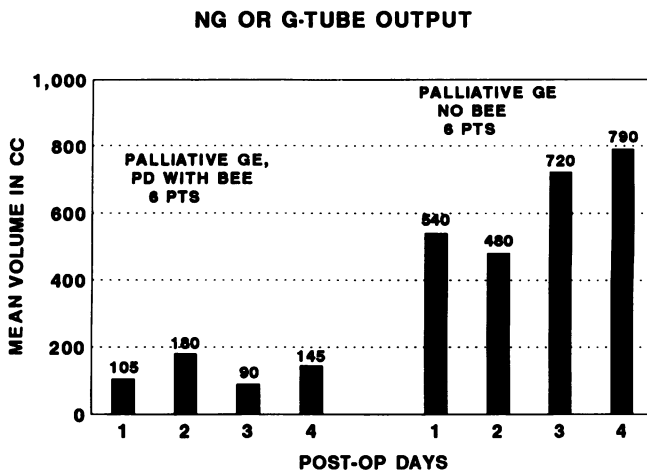


Figure 5. The mean nasogastric or gastric tube output in six patients with Braun enteroenterostomy and six patients without Braun enteroenterostomy who had palliative gastroenterostomy or a Whipple procedure.

without an enteroenterostomy. During 4 postoperative days, the patients with the BEE had a mean gastric output from 90 mL to 180 mL/24 hours. In a similar period, the 6 patients without BEE had 24-hour gastric output ranging from 480 mL to 790 mL/24 hours. All patients received prophylactic H₂ antagonists and routine post-surgical narcotics.

DISCUSSION

Although the first successful gastric operation was a limited distal gastrectomy with gastroduodenostomy, the first gastric operation to be widely used was gastroenterostomy.²⁹ Wolfler performed the first gastroenterostomy in 1881; 4 days later, Billroth performed the second such procedure.^{29,30} Unfortunately Wolfler's patient had "massive bilious vomiting" and died 10 days after operation. This complication occurred frequently after gastroenterostomy. This was attributed to food preferentially entering the afferent rather than the efferent limb and refluxing back through the duodenum into the stomach. Mikulicz coined the term "vicious circle" to describe this syndrome.³¹ Many attempts were made to prevent the vicious circle, including narrowing of the gastroenterostomy stoma, narrowing of the afferent limb, and changing the configuration of the gastroenterostomy.²⁹ One of these innovations was a technique described by Wolfler in 1883. Fourteen years before Roux's introduction of posterior gastrojejunostomy "en-Y," Wolfler proposed an antecolic Y-shaped configuration for gastroenterostomy with the afferent loop divided and anastomosed to the efferent limb downstream.²⁹ This procedure would prevent vicious circle and massive bil-

ious vomiting. In 1893, Braun devised a different approach to solve this problem, creating an enteroenterostomy between the afferent and efferent limbs to divert food to the efferent limb.²⁷ Although his primary goal was not to decrease bilious vomiting, he did note that this problem seemed resolved in several of his patients. This procedure apparently was abandoned when the short loop or "no loop" retrocolic gastrojejunostomy became popular in the early 1900s.

Although duodenogastric reflux and gastritis was described in the 1940s, it was not until 1962 that Duplessis³² used the term "reflux gastritis" to describe a syndrome of abdominal pain, vomiting, and weight loss. The term "alkaline reflux gastritis" was coined by Van Heerden and associates in 1969,³³ and throughout the 1970s interest in the diagnosis of this syndrome increased explosively. The topic of reflux gastritis has always been controversial, with varying opinions expressed about the importance of duodenogastric reflux after peptic ulcer surgery or even in healthy persons.³⁴⁻³⁶ Many surgical procedures were used to treat ARG, including closure of the pyloroplasty, takedown of the gastroenterostomy, conversion of a BII gastroenterostomy to a BI gastroenterostomy, BEE, Henley loop, and Roux-en-Y gastrojejunostomy. Few of these procedures resulted in successful treatment, except for a 50-cm Roux-en-Y limb. In 1984 we coined the term "Roux syndrome" to describe the early and late symptoms of post-Roux-en-Y gastroparesis.¹¹ It is interesting to note that most patients with chronic Roux limb stasis or the Roux syndrome have almost complete relief from the burning abdominal pain caused by the ARG syndrome before Roux-en-Y diversion. In this study, we found that BEE adequately diverts a substantial amount of bile from the stomach in patients having a variety of operations in which a gastroenterostomy or a BII resection was performed. Although many of the patients in group A had cancer, thereby ensuring only a short follow-up, none of the other patients have had signs or symptoms of the ARG syndrome and none have required further remedial surgery. In the 4 patients in group C, we specifically performed subtotal BII resection with a BEE rather than Roux-en-Y biliary diversion. Because all of the patients had preoperative gastroparesis, we believed that the risk of postoperative gastric atony, or the Roux syndrome, would be too high. None of the patients have symptoms of ARG or bilious vomiting and none have required remedial surgery. Although this is a small group with limited follow-up, clinical and radionuclide biliary scanning suggests adequate biliary diversion for their preoperative symptoms. Other alternatives to Roux-en-Y diversion have been proposed, such as exclusion jejunoduodenostomy as reported by Stiegmann and Goff,²³

and the “duodenal switch” procedure reported by Deemster and coworkers²⁴ and others.³⁷ Wilson and associates³⁷ reported a good clinical outcome in 33 or 42 patients who had the duodenal switch operation, with minimal complications and side effects.

Radionuclide biliary scanning using Tc99m DISIDA has become a standard noninvasive technique to quantify bile reflux. Normal EGR ranges from 0% to 5%, with asymptomatic BII gastrectomy patients having reflux from 4% to 46% and symptomatic patients having reflux from 60% to 95%.²⁶ An important correlation between the amount of Tc99m DISIDA and bile acid concentration in gastric juice has also been reported.²⁵

In this study, the control group (B) of patients who had previous vagotomy and BII gastric resection had moderate enterogastric reflux documented by biliary scanning. Our results corroborate those reported by others who documented a higher percentage of EGR in symptomatic patients with the ARG syndrome. It is too early to determine if BEE can be used definitively as an alternative to Roux-en-Y diversion or other procedures to prevent or treat ARG, but we remain cautiously optimistic. Although biliary scanning shows substantial biliary diversion from the stomach, the tests have some disadvantages when used to predict future clinical and surgical success. Nuclear imaging is only performed during a 90- to 120-minute period and the patient is usually in a supine position. Because bile reflux occurs intermittently 24 hours a day, other methods to quantify duodenogastric reflux may need to be used. Our early assumption was that previous attempts at enteroenterostomy placed the anastomosis near the gastroenterostomy. Griffiths and colleagues³⁸ reported the results of bile vomiting after surgery for peptic ulcer disease. They found that despite satisfactory improvement initially, the late results of enteroenterostomy were very poor, with only one of six patients remaining free of symptoms during a follow-up period of 5 to 9 years. Unfortunately we do not know whether the enteroenterostomy was close to the gastroenterostomy or even if this could account for differing results. In a 1904 article on duodenal ulcer, Mayo described a “clinical review of 58 operated cases, with some remarks on gastrojejunostomy.”³⁹ He described his technique of placing an enteroanastomosis 4 inches below the completed gastroenterostomy. Considering the early observations reviewed in this paper, we believe that the most prophetic observation of Mayo was his statement concerning the procedure: “When finished, it has all of the advantages of the ‘Y’ operation of Roux.” Perhaps by creating the anastomosis approximately 30 cm from the gastroenterostomy, less downstream resistance allows more afferent secretions to bypass the stomach. In carefully observing the computer-generated frames of

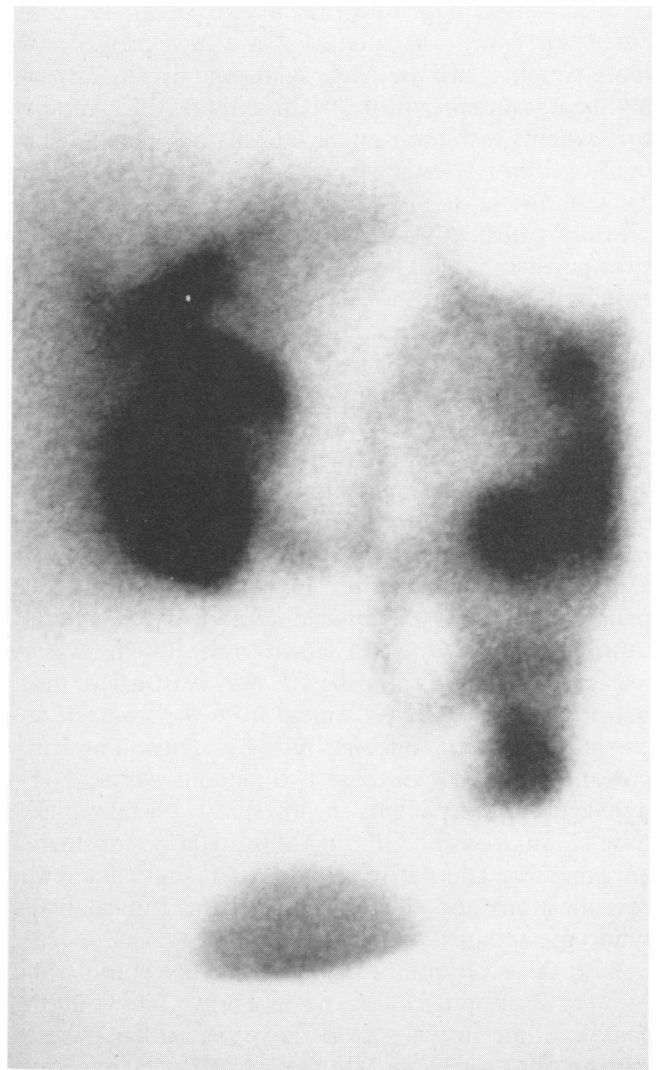


Figure 6. Biliary scan showing the gallbladder (*left*), accumulation in the small intestine (*right*), and no reflux through the gastroenterostomy into the stomach area.

our biliary scans, we observed radiolabeled bile above the enteroenterostomy but often with only small “wisps” of bile refluxing into the stomach and then rapidly clearing. This can also be observed by computer-generated dynamic views that follow the bile from the liver into the small intestine. Figure 6 shows what appear to be radiolabeling above an accumulation that might be the enteroenterostomy and near the area of the gastric remnant. In these patients, no substantial accumulation appears in the stomach, and the small bowel rapidly accumulates the radiolabeled bile. Whether this can occur on 24 hours a day in a nonfasting state must be determined. It is our belief, however, that the substantial side effects of Roux-en-Y diversion and the fact that 25% to 40% of patients may require further remedial surgery may make this pro-

cedure obsolete in the future if alternatives can be found. Since this paper was submitted, we have treated two more patients with the ARG syndrome by reconstructing their gastroenterostomy with a distal BEE. Another two patients with the Roux syndrome had takedown of the Roux limb, re-establishment of small bowel continuity with an end-to-end anastomosis, resection of the previous gastroenterostomy, and creation of a new gastroenterostomy with a distal enteroenterostomy. Although it is early in the postoperative period, these patients are eating a normal diet and have no evidence of bile vomiting or burning abdominal pain.

During this study, marginal ulceration developed in two patients. One had a Whipple procedure for islet cell tumor of the head of the pancreas and the second patient had palliative gastroenterostomy for an unresectable duodenal carcinoma. Both patients have been treated successfully with H₂ antagonists but neither had vagotomy as part of their procedure. This appears to be the one major objection to this procedure and may have been caused by moving the BEE down to the 30-cm level. A reasonable distance from the GE may exist where most but not all of the bile is diverted from the stomach but enough to prevent ongoing reflux gastritis. The early postoperative EGR in these two patients was 0%. The nonvagotomized patients in our study still take nighttime H₂ antagonists. Although this might be considered an expensive alternative, it appears to have far fewer complications and side effects than the clinical Roux syndrome and further remedial surgery.

With the exception of highly selective vagotomy and primary Roux procedures, postoperative bile vomiting early and late in the postoperative period has plagued patients for more than 100 years. Although it successfully treats ARG, the disadvantages of Roux-en-Y biliary diversion far outweigh its utility. Roux-en-Y reconstruction is used appropriately after total or near-total gastrectomy (usually for malignancy) to keep bile from the esophagus. We hope its use as a primary procedure for ulcer disease or as a remedial operation for postgastrectomy complications will decrease with time.

References

1. Bartlett MK, Burrington JD. Bilious vomiting after gastric surgery. *Arch Surg* 1968; 97:34-39.
2. Van Heerden JA, Priestly JR, Farrour GN, et al. Postoperative alkaline reflux gastritis. *Am J Surg* 1969; 118:427-433.
3. Van Heerden JA, Phillips SF, Adson MA. Postoperative reflux gastritis. *Am J Surg* 1975; 129:82-88.
4. Bushkin FL, Woodward ER. Alkaline reflux gastritis. In Ibrir PA, ed. *Major Problems in Clinical Surgery*. Vol. 20. Philadelphia: WB Saunders, 1976, pp 49-63.
5. Kennedy T, Green R: Roux diversion for bile reflux following gastric surgery. *Br J Surg* 1978; 65:323-325.
6. Herrington JL. Roux-en-y diversion as an alternative method of reconstruction of the alimentary tract after primary resection of the stomach. *Surg Gynecol Obstet* 1976; 143:92-93.
7. Davidson ED, Hersh T. Bile reflux gastritis. *Am J Surg* 1975; 130: 514-518.
8. Davidson ED, Hersh T. The surgical treatment of bile reflux gastritis: a study of 59 patients. *Ann Surg* 1980; 192:175-178.
9. Boren CH, Way LW. Alkaline reflux gastritis: a reevaluation. *Am J Surg* 1980; 140:40-46.
10. Malagelada JR, Phillips SF, Shorter RG, et al. Postoperative reflux gastritis: pathophysiology and long-term outcome after roux-en-y diversion. *Ann Intern Med* 1985; 103:178-183.
11. Vogel SB. Roux-y biliary diversion for alkaline gastritis: a cure or a new disease? In Najarian JS, Delaney JP, eds. *Gastrointestinal Surgery*. Chicago: Year Book Medical Publishers, 1984, pp 221-225.
12. Gustavson S, Ilstrup DM, Morrison P, et al. Roux-y stasis syndrome after gastrectomy. *Am J Surg* 1988; 155:490.
13. Vogel SB, Vair DB, Woodward ER. Alterations in gastrointestinal emptying of 99m-Technetium-labeled solids following sequential antrectomy, truncal vagotomy and roux-y gastroenterostomy. *Ann Surg* 1983; 198:506.
14. Mathias JR, Fernandez A, Sninsky CA, et al. Nausea, vomiting and abdominal pain after roux-en-y anastomosis: motility of the jejunal limb. *Gastroenterology* 1985; 88:101.
15. Karlstrom LH, Soper NJ, Kelly KA, et al. Ectopic jejunal pacemakers and enterogastric reflux after roux gastrectomy: effect of intestinal pacing. *Surgery* 1989; 106:486.
16. Perino LE, Adcock KA, Goff JS. Gastrointestinal symptoms, motility and transit after the roux-en-y operation. *Am J Gastroenterol* 1988; 83:380.
17. Harrison WD, Hocking MP, Vogel SB. Gastric emptying and myoelectric activity following Roux-en-y gastrojejunostomy. *J Surg Res* 1990; 49:385.
18. Vogel SB, Hocking MP. Etiology and treatment of the roux syndrome. In Larson GM, Nyhus LM, Judge C, eds. *Problems in General Surgery* 1993; 10(2):308-320.
19. Karlstrom L, Kelly K. Roux-y gastrectomy for chronic gastric atony. *Am J Surg* 1989; 157:44.
20. Eckhauser FE, Know JA, Raper SA, et al. Completion gastrectomy for postsurgical gastroparesis syndrome: preliminary results with 15 patients. *Ann Surg* 1988; 208:345.
21. Hinder RA, Esser J, DeMeester TR. Management of gastric emptying disorders following the roux-en-y procedure. *Surgery* 1988; 104:765.
22. Vogel SB, Woodward ER. The surgical treatment of chronic gastric atony following roux-y diversion for alkaline reflux gastritis. *Ann Surg* 1989; 209:756.
23. Stiegmann GV, Goff JS. An alternative to roux-en-y treatment of bile reflux gastritis. *Surg Gynecol Obstet* 1988; 166:69.
24. DeMeester TR, Fuchs KH, Ball CS, et al. Experimental and clinical results with proximal end-to-end duodenojejunostomy for pathologic duodenogastric reflux. *Ann Surg* 1987; 206:414.
25. Mompean JAL, Campos RR, Paricio PP, et al. Quantification of duodenogastric reflux in the operated stomach using 99m Tc-HIDA administered by continuous intravenous infusion as a duodenal marker. *Dig Surg* 1990; 7:131-137.
26. Wickremesinghe PC, Dayrit PQ, Manfredi OL, et al. Quantitative evaluation of bile diversion surgery utilizing 99m Tc HIDA scintigraphy. *Gastroenterology* 1983; 84:354-363.
27. Braun H. Ueber die Gastro-enterostomie and Gleichzeitige Ausgefuehrte. *Arch Klin Chir* 1893; 45:361.
28. Drane WE, Karvelis K, Johnson DA, Silverman ED. Scintigraphic

- evaluation of duodenogastric reflux: problems, pitfalls, and technical review. *Clin Nuc Med* 1987; 12:377–384.
29. McNealy RW, Lichtenstein ME. Evolution and present technique of gastrojejunostomy. *Surg Gynecol Obstet* 1935; 60:1003–1015.
 30. Wolfler A. Gastro-enterostomie. *Zentralbl F Chir* 1881; 8:705–708.
 31. Spivack JL. *The Surgical Technique of Abdominal Operations*. Chicago: SB Debour, 1939, pp 365–417.
 32. DuPlessis DJ. Gastric mucosal changes after operations on the stomach. *S African Med J* 1962; 36:471–478.
 33. Van Heerden JA, Priestley JT, Farrow GM, et al. Postoperative alkaline reflux gastritis: surgical implications. *Am J Surg* 1969; 118:427–433.
 34. Meyer JH. Reflections on reflux gastritis. *Gastroenterology* 1979; 77:1143–1145.
 35. Ritchie WP. Alkaline reflux gastritis: a critical reappraisal. *Gut* 1984; 25:975–987.
 36. Mackie C, Hulks G, Cuschieri A. Enterogastric reflux and gastric clearance of refluxate in normal subjects and in patients with and without bile vomiting following peptic ulcer surgery. *Ann Surg* 1986; 204:537–542.
 37. Wilson P, Anselmino M, Hinder RA. The duodenal switch operation for duodenogastric reflux. *In* Larson GM, Nyhus LM, Judge C, eds. *Problems in General Surgery* 1993; 10(2):242–252.
 38. Griffiths JMT, Smith AN, Small WP, Falconer CWA. The results of reoperation for bile vomiting following surgery for peptic ulcer. *Br J Surg* 1974; 61:838–843.
 39. Mayo WJ. Duodenal ulcer. A clinical review of fifty-eight operated cases, with some remarks on gastrojejunostomy. *Surg Gynecol Obstet* 1904; 900–908.

Discussion

DR. WALLACE P. RITCHIE, JR. (Philadelphia, Pennsylvania): Dr. Vogel and his colleagues at Florida deserve great credit, I think, because they were among the first to draw our attention to the existence of the Roux syndrome and convince us of its importance as an untoward clinical sequel to Roux diversion of upper intestinal content away from the stomach. Today, they're trying to convince us that the creation of a Braun enteroenterostomy is an effective way, perhaps as effective as the Roux, to accomplish that end. Even if we're inclined to accept that assertion as true, which it may be, it's important to point out—as I'm sure they would readily admit—that they haven't shown us that the Braun is superior to the Roux in terms of preventing the other end point: that is, postoperative early satiety, bloating, and vomiting. There are theoretical reasons to suggest that this could be the case, but it hasn't been demonstrated today, and that certainly is the heart of the case. I would point out, of course, that other proposed remediations, including the Tanner 19 and the uncut Roux, suffer exactly from the same debit. So my first question, Dr. Vogel, would be, do you have any date to indicate the Braun is in fact superior to the Roux with respect to the symptoms alluded to that are a consequence of delayed gastric emptying? I'd be particularly interested in the group of patients with primary gastroparesis in whom you created this, because all of us would agree that the creation of a Roux under these circumstances is a certain prescription for disaster. I have some questions about methodol-

ogy. I think the scintigraphic assessment of reflux magnitude has the advantage over other methods of being non-invasive. But it does have its problems, and a principal one in our experience has been the large inter and inpatient variability on repeated testing. We've always felt it important to use the patients as their own controls, something that wasn't done here. Perhaps Dr. Vogel could tell us about the reproducibility of his methods so we could have some idea of its accuracy. A second related problem methodologically has been that reflux isn't always constant over time. It's greatest in the early morning hours and of a lesser magnitude as the day wears on. Did you control for the time of day in which you performed the study, or did it make any difference that you were using an analog of CCK? Third, I would sound a note of caution about using the technique in patients who've undergone a standard pancreatoduodenectomy because, in the absence of a gallbladder, it's been very difficult in our hands to achieve accurate and reproducible quantitation of the amount of isotope in the hepatobiliary tree initially. This, of course, is the critical baseline measurement upon which the quantitation of reflux into the stomach is predicated. This is a particular problem, incidentally, when the agent is injected as a bolus. Methodological problems aside, I think it would be very important if you could tell us whether or not any of the differences you observed between groups achieved statistical significance. Finally, I'm glad that you point out that, in concert with the Roux and a simple gastroenterostomy, the Braun enteroenterostomy has the potential of being an ulcerogenic procedure. One needs to protect against that. Now a final sort of parenthetical and historic comment. The 34 patients reported upon, even though they are a very heterogeneous group, which has the potential of being a weakness in the study—but they must represent the largest modern series of Braun enteroenterostomies ever reported, certainly in this country. This would undoubtedly please Professor Heinrich Braun very much indeed. But sad to say, Braun, who was apparently well known and highly esteemed in his time, unfortunately, the details of his life have been largely forgotten by almost everybody. In my case, that wasn't true because I didn't know them in the first place. It is of some interest though that, as Dr. Woodward has pointed out, 1993 is the one hundredth anniversary of his first reported case. So, in summary, I think this is a good beginning if we can believe in the methodology. What ultimately needs to be done is to demonstrate the superiority of the Braun versus the Roux with respect to gastric stasis. I enjoyed the paper very much. I congratulate Dr. Vogel for his usual provocative and stimulating presentation.

DR. ROBB H. RUTLEDGE (Forth Worth, Texas): I congratulate Dr. Woodward on an excellent study. And I would like to ask if he has any similar data with isoperistaltic jejunal segments used between the stomach and duodenum to prevent reflux. The early work with Henley in the 1950s was all done with short segments just 10 cm long, and they certainly did not prevent the reflux. However, if you use the segment that's 25 to 30 centimeters long between the gastric remnant and the duodenum, you might be able to prevent the reflux. I've been satisfied with this in my clinical cases that I've done this. I think it