

Long-term Results of Roux-en-Y Hepaticojejunostomy and Hepaticojejunoduodenostomy

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The results of the long-term follow-up of 202 patients with Roux-en-Y hepaticojejunostomy (Roux-en-Y HJ) and 19 with hepaticojejunoduodenostomy (HJD) are reported. The mortality, morbidity, and the incidence of postoperative anastomotic stenosis were comparable in both groups. One hundred forty patients with Roux-en-Y HJ and 19 with HJD were followed with barium meal and endoscopy. An incidence of 5% postoperative duodenal ulcer was noted in the first group, while no ulcer was seen in the patients with HJD. Preoperative and postoperative gastric acid secretion (basal acid secretion and maximal acid secretion) and serum gastrin levels (basal and after protein meal) were measured in 25 cases with Roux-en-Y HJ and 19 with HJD. The serum gastrin levels were similar initially and remained unchanged after surgery in both groups. However, the mean levels of basal and maximal acid output, which was similar before surgery in both groups, increased significantly only in patients who had Roux-en-Y HJ ($p < 0.001$). In conclusion, HJD should be adopted as the preferred type of anastomosis in patients with benign pathology and long-life expectancy.

THE LONG-TERM FOLLOW-UPS of cases with Roux-en-Y hepatico- or choledoco-jejunostomy (HJ) have shown considerable advantage for prevention of reflux of intestinal content into the bile duct and, therefore, prevention of anastomotic stenosis as compared to other operations such as hepatico- or choledoco-duodenostomy. Although Roux-en-Y HJ has become the favored approach by a majority of surgeons, especially in those cases with nonmalignant pathology of bile ducts, this type of operation has the major drawback of completely excluding the bile from duodenum, thereby creating the conditions for possible formation of ulcer and also fat malabsorption.

The incidence of peptic ulcer following Roux-en-Y HJ has been reported to be from 1.7 to 22%^{1,2} by various authors, while in animal studies (dogs) the incidence is around 52%.³

There is significant controversy among the various investigators as to the mechanisms of postoperative ulcer formation. Indeed, two explanations have been of-

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ferred: (1) decreased neutralization of gastric acid secretion in the duodenum by the bile⁴ and (2) increased gastric acid secretion after surgery.⁵ To explain the latter hypothesis three different factors have been mentioned: (1) decreased hormonal inhibition of gastric secretion because of the exclusion of the duodenum from the bile transit⁴; (2) reduced metabolism of the gastrin or other stimulatory hormones due to possible concurrent hepatic damage⁶; and (3) increased vagal stimulation secondary to a condition of hypoglycemia because of hyperplasia of pancreatic beta cells.⁷

Because of the significant incidence of postoperative ulcer after Roux-en-Y HJ, some surgeons tried to solve this problem by interposing a loop of jejunum between the main bile duct and the duodenum in order to maintain a normal bile transit through the duodenum while preventing the reflux. This operation, which was first reported by Lopez Gibert⁸ in 1963 and largely followed in Italy by Grassi⁹ since 1969, has become in recent years the preferred technique in the authors' institution as well as in several others.¹⁰⁻¹³

This study evaluates the long-term results of Roux-en-Y HJ as compared to those obtained after hepaticojejunoduodenostomy (HJD), and especially studies the effect of such operations on gastric acid secretion.

Subjects and Methods

Two hundred twenty-one patients were studied. Of these, 202 (mean age \pm SD 49 ± 14 and a range of 17-79 years) had Roux-en-Y HJ in the last two decades (1960-1980), and 19 (with a mean age \pm SD 51 ± 4 and a range of 32-69) had HJD.

Table 1 demonstrates the various surgical indications in the 221 cases. During the operation for HJD, a loop of jejunum, which had been removed at the level of the third or fourth vascular arch and excluded from the intestinal transit, was repositioned in the suprameso-

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TABLE 1. Indications for Surgery in 221 Patients

	Roux-en-Y HJ		HJD	
Postoperative stenosis	87	(43%)	8	(42%)
Bile duct stones	70	(35%)	9	(47.5%)
Postoperative stenosis & fistulae	21	(10%)	2	(10.5%)
Cancer of head of pancreas	8	(4%)	—	—
Chronic pancreatitis	7	(3.5%)	—	—
Common bile duct stones & fistulae	6	(3%)	—	—
Congenital common bile duct cysts	3	(1.5%)	—	—
Total	202		19	

colic area in order to be interposed between the bile duct and the duodenum. The terminolateral hepaticojejunal anastomosis was carried on with a double-layer technique at the junction of the bile ducts, and the left hepatic duct was incised for a few centimeters according to Hepp's technique. In 15 cases a circular transanastomotic drainage (according to Warren or Praderi) was left in site for 2 to 8 months. In four cases no transanastomotic drainage was used. Following the reported experience by Lopez Gibert, a jejunal loop of the length of 20 to 25 cms was used initially. Unfortunately, very early follow-ups of the four cases in which this technique was used demonstrated that a loop of such a length was unable to prevent the reflux of the intestinal content into the bile duct. Therefore, in the other subsequent 15 cases a 40- to 50-cm long loop was used.

Results

Roux-en-Y Hepaticojejunostomy

In 202 cases with Roux-en-Y HJ, there was a postoperative mortality of 4.6% and a postoperative morbidity of 13% (27 cases). The mean postoperative recovery period was 15 days.

One hundred forty patients (69%) were followed for a minimum of 3 months to a maximum of 18 years.

TABLE 2. Follow-up of Roux-en-Y HJ and HJD

	Roux-en-Y HJ (202 Patients)		HJD (19 Patients)	
Mortality rate	9	(4.5%)	—	
Morbidity rate	27	(13%)	3	(16%)
Postoperative recovery days	15		16	
Anastomotic stenosis	13*	(9%)	short loop 1/4 long loop 1/15	(25%) (6.5%)
Postoperative duodenal ulcer	7*	(5%)	—	

* Of 140 Patients.

The incidence of anastomotic stenosis was 9%. All these patients were followed by radiologic examinations of the upper gastrointestinal tract, and in seven of them (5%) duodenal ulcers that did not exist prior to surgery were revealed and were confirmed by endoscopy. Two of these cases developed massive upper gastrointestinal bleeding that was fatal in one case (Table 2).

Hepaticojejunoduodenostomy

In 19 cases with HJD there was no postoperative mortality. Major postoperative complications were noted in three cases (16%). The average postoperative recovery period was 16 days.

All these patients were followed for a minimum of 6 months to a maximum of 6 years. The incidence of anastomotic stenosis was 25% (1 of 4) in those four patients with a short jejunal loop and only 6.6% (1 in 15) in those cases with a long jejunal loop.

From 1975 all the patients who were candidates for either type of the above mentioned anastomosis were studied by measuring before operation their gastric acid secretion (basal acid secretion and maximum acid output after histamine stimulation), blood gastrin levels (basal and after protein meal) (measured by radioimmunoassay),¹⁴ glucose tolerance curve, and blood insulin levels.

These tests were done 1 year after the operation. Of these patients 25 had Roux-en-Y HJ and 19 had HJD. Each patient was followed also by annual clinical and radiologic examinations in order to evaluate the status of the anastomosis.

Two (8%) of 25 patients with Roux-en-Y HJ who were studied developed abnormal glucose tolerance tests after surgery with mild hypoglycemia and abnormal insulin curves. None of the patients with HJD developed such abnormalities. Tables 3 and 4 demonstrate respectively the gastric acid secretion and serum gastrin levels before and after surgery in these two groups of patients.

Table 3 demonstrates that the mean values of basal acid output (BAO), maximal acid output (MAO), and peak acid output (PAO) are comparable in both groups before surgery, and there are no statistical differences. However, after surgery the mean values of BAO, MAO, and PAO of the patients who had Roux-en-Y HJ increased significantly ($p < 0.001$) as compared to those who had HJD.

The mean values of basal and postprandial serum level of gastrin in both groups were similar initially and did not change after surgery.

Discussion

The early and late results obtained in these two groups of patients are not statistically comparable be-

TABLE 3. Comparison of BAO, MAO, and PAO Before and After Surgery in Patients with Roux-en-Y HJ vs. Those with HJD

Type of Surgery	Basal Acid Output (BAO)		Maximum Acid Output (MAO)		Peak Acid Output (PAO)	
	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery
Roux-en-Y HJ 25 cases	4.4 ± 2.2	5.3 ± 2.4	28 ± 11.3	32 ± 12.2	36.8 ± 11.6	41.2 ± 12.9
HJD 19 cases	4.15 ± 2.3	3.12 ± 1.48	24.6 ± 10.9	22.0 ± 8.9	33.3 ± 11.4	30.4 ± 9.6
p	NS	p < 0.001	NS	p < 0.001	NS	p < 0.001

p values calculated with Student's t-test.

cause of significant numerical differences between the Roux-en-Y HJ group (202 cases) and the HJD group (19 cases) and also because of different lengths of follow-up periods.

The different duration of follow-up of these two groups also creates a limiting factor for an exact comparative evaluation of the incidence of stenosis. Even though the highest incidence of stenosis occurs in the first few years after operation, late stenosis after 20 years has been reported.^{2,15-17}

The authors' present impression is that these two types of surgical techniques could be considered similar as far as the risk of surgery and early results are concerned. The incidence of stenosis does not look different if one is able to perform an adequate antireflux anastomosis. For this reason it is very important in cases with HJD to prepare a jejunal loop of a length of 40 to 50 cm rather than one with 20 to 25 cm as reported by others. Indeed, in one of the four patients with a short jejunal loop, frequent episodes of cholangitis a few months after surgery and radiologic evidence of reflux and subsequent stenosis were noticed. One should be aware that the intraluminal pressure in the duodenum is much higher than the one in the bile ducts or jejunum. For this reason, in order to eliminate such a pressure gradient, a loop of jejunum 40 to 50 cm long seems essential.

None of the patients with a long loop developed radiologic evidence of reflux; only one patient developed anastomotic stenosis, which may have been secondary

to other factors. A loop longer than 50 cm does not offer further advantages, in fact it could bend easily or develop problems of vascularization and difficulties in transit.

In performing the anastomosis, the authors would like to point out some important technical aspects. In the last few years, the anastomosis was performed at the level of the junction of the bile ducts and opening of the left hepatic duct according to Hepp. In this way the widest possible anastomosis was obtained and was in many cases, over healthy tissues, which, according to the authors' experience, is very important for prevention of stenosis. In addition, the use of transanastomotic drainage should be considered according to the conditions of each case. In those cases with chronic cholangitis and sclerosis, a prolonged drainage is essential and a transanastomotic drainage according to Warren is used. However, in cases of dilated bile ducts with moderate inflammation a transanastomotic drainage does not appear to be indicated.

The result of gastric acid study is very interesting because it shows a significant difference among the two groups after surgery. It appears that in those with Roux-en-Y HJ the mean values of BAO, MAO, and PAO increase after operation, while in patients with HJD they remain stable. Indeed three patients who had normal BAO, MAO, and PAO before Roux-en-Y HJ became hypersecretors after surgery without a concomitant change in their serum gastrin level.

One patient who had bile duct stenosis and external

TABLE 4. Serum Gastrin Levels in 25 Patients with Roux-en-Y HJ and 19 with HJD

Type of Surgery	Basal		Postprandial	
	Before Surgery	After Surgery	Before Surgery	After Surgery
Roux-en-Y HJ 25 cases	83 ± 16	84 ± 18	122.5 ± 33	137 ± 50
HJD 19 cases	87 ± 18	83 ± 10.5	137 ± 35	137 ± 26
p	NS	NS	NS	NS

p values calculated with Student's t-test.

biliary fistula prior to HJD surgery had gastric acid hypersecretion; however, after surgery he demonstrated normal acid secretion.

The study of serum gastrin levels in both groups shows no differences.

Conclusion

According to the findings presented herein, Roux-en-Y HJ and HJD are comparable as to postoperative mortality or morbidity. The incidence of anastomotic stenosis appears to be the same in both methods, when an antireflux anastomosis is performed. For this purpose it is important, in all HJDs, to interpose a 40-to 50-cm long loop, because a shorter one could not guarantee the prevention of reflux.

Roux-en-Y induced gastric acid hypersecretion in some patients, and 5% of the patients developed postoperative peptic ulcer. The increase in gastric acid secretion in patients with Roux-en-Y HJ does not appear to be secondary to concurrent increase of serum gastrin levels.

The exclusion of bile from duodenum and subsequent gastric acid hypersecretion has been demonstrated previously in animals. The authors believe the same mechanism is working in those patients with Roux-en-Y HJ. Further studies of other gastrointestinal hormones, especially those that act as gastric acid inhibitors, are indicated in these patients. HJDs with 40- to 50-cm long loops have demonstrated to be very effective in allowing normal bile transit. After this surgery, there is no evidence of significant variations in the acid secretion. For these reasons, the authors believe that HJD should be adopted as a most effective type of anastomosis in patients with benign pathology and long-life expectancy, especially when investigative preoperative procedures (upper gastrointestinal x-rays, gastroduodenoscopy, gastric acid study, and blood level of gastrin) show a high risk of postoperative peptic ulcer formation.

For such patients, HJD appears to be a simpler and more physiological approach than adding a vagotomy to the Roux-en-Y as suggested by some authors.⁵

References

1. Bismuth H, Franco D, Corlette MB, Hepp J. Long term results of Roux-en-Y hepaticojejunostomy. *Surg Gynecol Obstet* 1978; 146:161-167.
2. Lane CE, Sawyers JL, Riddell DH, Scott HW. Long term results of Roux-en-Y hepatocholechojejunostomy. *Ann Surg* 1973; 177:714-722.
3. Kehne JH, Campbell RE. Choledochojejunostomy Roux-en-Y. An experimental study. *Arch Surg* 1964; 73:12-20.
4. Breen JJ, Molina E, Ritchie WP. Effect of common bile duct transplantation on gastric acid secretion in the dog. *Br J Surg* 1968; 55:282-284.
5. McArthur MS, Longmire WP. Peptic ulcer disease after choledochojejunostomy. *Am J Surg* 1971; 122:155-158.
6. Menguy RB. Mechanism of hypersecretion in dogs with exclusion of bile or pancreatic juice from small intestine. *Surg Forum* 1962; 13:300-303.
7. Ermini M, Carboni M. Il comportamento del pancreas nella fistola biliare interna sperimentale. *Chir Gen* 1963; 12:209-213.
8. Lopez Gibert J. Interposicion de una ansa yeyunal excluida entro coledoco y duodeno para tratamiento de una estenosis biliar post-gastrectomia. *Cir Ginec Urol* 1964; 18:128-131.
9. Grassi G, Broglia S, Dell'Osso A. Epaticodigiunoduodenoplastica nei reinterventi sulle vie biliari. *Chir Gastroent* 1969; 3:258-261.
10. Castrini G, Pappalardo G. Empleo de la hepaticoyeyunoduodenostomia en la terapia quirurgica de las estenosis iatrogenicas de la via biliar. *Quiron* 1980; 11:5-10.
11. Grassi G, Broglia S, Dell'Osso A. La tecnica della epaticodigiunoduodenoplastica. *Atti Soc Ital Chir* 1978; 1:226-236.
12. Moreno-Gonzalez E, Hebrero Sanmartin J, Moreno Azcota M, Belda Serna A. Reconstruction of the biliary tract using biliary duodenal interposition of a defunzionalized jejunal limb. *Surg Gynecol Obstet* 1980; 150:678-682.
13. Wheeler ES, Longmire WP Jr. Repair of benign stricture of the common bile duct by jejunal interposition choledochoduodenostomy. *Surg Gynecol Obstet* 1978; 146:260-262.
14. Data on file at Becton Dickinson Immunodiagnosics, Orangeburg, New York.
15. Way LW, Dunphy JE. Biliary stricture. *Am J Surg* 1972; 124:287-294.
16. Bowers RM. Morbid conditions following choledochojejunostomy. *Ann Surg* 1964; 159:424-427.
17. Stefanini P, Carboni M, Patrassi N, et al. Roux-en-Y hepaticojejunostomy. A reappraisal of its indications and results. *Ann Surg* 1975; 181:213-219.