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Choledochoenterostomy with an anti-reflux mechanism

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Abstract. A new technique of choledochoenterostomy was devised to solve some of the problems of enterobiliary anastomosis with a normal calibre. The distal extremity of the common bile duct is completely surrounded by the bowel mucosa to a length of 3 cm after seromyectomy of a bowel wall rectangle of 4 × 1 cm. Experimental studies in rats and dogs demonstrated that this procedure prevents the risks of anastomotic disruption and functions like a mechanical unidirectional valve, which has great efficacy in stopping enterobiliary reflux. Studies in ten patients with obstructive jaundice with an extrahepatic biliary dilation less than 1.2 cm diameter submitted to this procedure confirmed the experimental results. All patients were asymptomatic, without jaundice and with normalization of the liver enzymes after 2 months. The permeability of the valvular anastomosis studied by cholangiography, the HIDA ^{99m}Tc test and manometry was quite similar to other classical biliary–enteric anastomosis. In contrast, anti-reflux efficacy was only demonstrated in patients with a valvular anastomosis.

Key words: Choledochoenterostomy – Biliary reconstruction – Liver transplantation

A new technique of choledochoenterostomy was devised in which a unidirectional mechanical valve was created to prevent ascending cholangitis and to protect the anastomosis. This valve was devised to solve the well – known problems of enterobiliary sutures on extrahepatic biliary trees with a normal calibre, as happens in liver transplantation.

Surgical technique

The technique is based on two main steps: a mucomucosal biliary–jejunal anastomosis and complete protection of the distal common bile duct by the external layer of the intestinal mucosa (Fig. 1).

The bowel is prepared by stripping away a 4-cm long rectangle of the seromuscular wall with the width equal to the diameter of the common bile duct (1 cm or less). The separation of the seromuscular layer from the mucosa is facilitated by injecting small amounts of saline solution into the seromuscular plane. The hypervascularized and surplus mucosa bulging through this uncovered rectangle will accept 4–6 cm of the distal biliary tree. The anastomosis between the common bile duct and the bowel is performed 1–2 cm away from the shorter distal side of the rectangle, using three or four interrupted stitches of absorbable material. The longitudinal edges of the seromuscular rectangle are sutured over the common bile duct, which finally remains completely covered by the external layer of the bowel mucosa.

Materials and methods

The surgical technique was first performed on rats which were sacrified 1–2 months after surgery. The morphology of the area involving the biliary enteric anastomosis and the liver was checked and recorded. Samples were collected for microscopic examination.

Surgery was also performed on six dogs which were sacrified between the first and fourth month after surgery. Specimens were collected for histology. Special studies of microcirculation were performed by injecting a blue methylene dye or micropaque material through the common hepatic artery and the superior mesenteric artery. Blood samples were obtained twice a week for bilirubin, alkaline phosphatase, gamma-glutamyl transpeptidase, SGOT, and SGPT, until complete normalization of all parameters was found.

The continent choledochoenterostomy was then performed on ten patients with obstructive jaundice of various causes: five patients with pancreatic adenocarcinoma, one with adenocarcinoma of the Oddi, one with chronic pancreatitis, and three with lithiasis of the main biliary tree. The common bile duct was less than 1.2 cm in diameter in all the patients. A choledochojejunostomy was performed in six of the patients, choledochoduodenostomy in three and cysticjejunostomy in one.

The permeability and functioning of the common bile duct were studied by cholangiography, the HIDA ^{99m}Tc test and manometry, making use of the T tube positioned above the anastomosis. The

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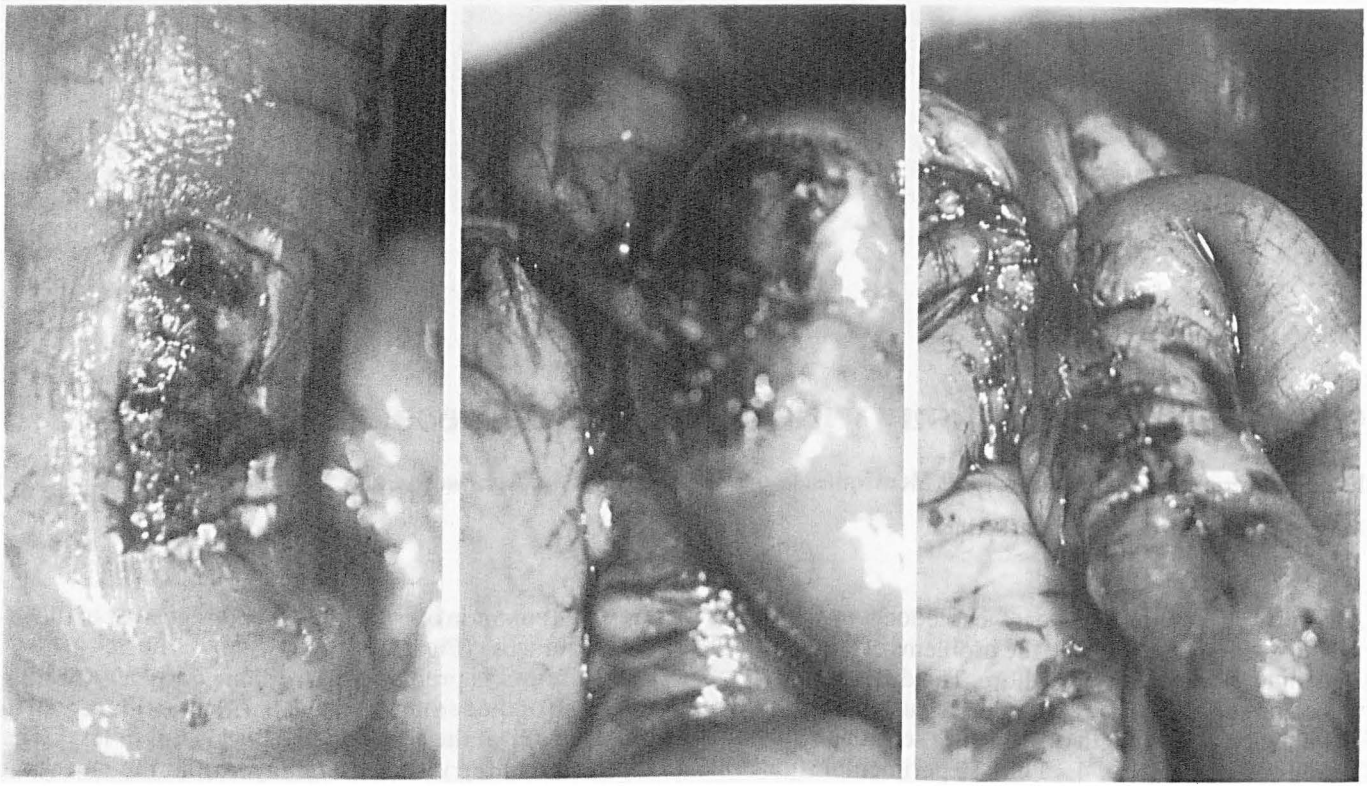

Fig. 1. The main phases of the surgical technique

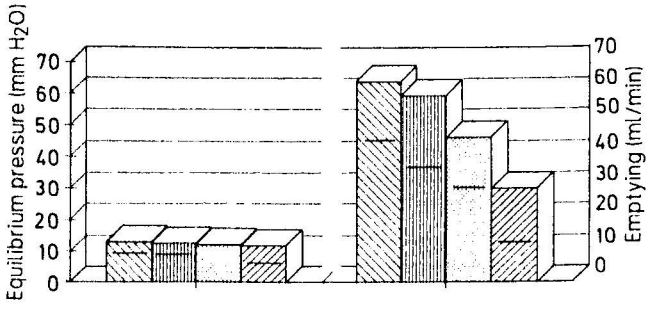

Fig. 2. Values of manometry (equilibrium pressure) and biliary flow of a saline solution in ml/min. Comparison between the valvular anastomosis and other classical types of biliary surgery. ▨, Valvular anastomosis; ▥, Choledochojejunostomy; ⬚, Choledochoduodenostomy; ▨ Common duct T tube

anti-reflux capacity of the mechanical valve was tested in the immediate postoperative period using a gamma camera and a sulphur colloid solution of technetium introduced into the Roux-en-Y loop (seven patients) or into the stomach with a liquid meal in three patients with a choledochoduodenostomy. Results were compared with six classical choledochoduodenostomies, six end-to-end choledochojejunostomies and nine cholecystectomized patients with common bile duct exploration (T tube).

Results

Experimental studies

Experimental studies on rats and dogs demonstrated that at 3 months, the common bile duct had adopted a morphology similar to the normal distal choledochus at the intraduodenal portion, ending in the lumen of the gut with a prominence identical to a normal Vater's papilla. Not one case of choledochoenterostomy disruption was detected. Values of alkaline phosphatase and gamma-glutamyl transpeptidase returned to normal 1–3 weeks after surgery.

Histopathological studies reveal a good parietal vascularization of the common bile duct, with minimum inflammatory cell infiltration, without signs of fibrosis and with a discrete atrophy of the mucosa.

Clinical studies

All patients were asymptomatic, without jaundice and with normalization of liver enzymes (SGOT, SGPT and alkaline phosphatase) 1 month after removal of the T tube.

The basal manometric pressure (equilibrium pressure for the valvular anastomosis, 12.8 ± 2.9 mm) was identical to the values obtained in patients who had undergone different types of biliary surgery (Fig. 2). The emptying of ^{99m}Tc through the common bile duct, and the flow of a saline solution measured in mililiters per minute, with the reservoir positioned 30 cm above the level of the biliary tree $T^1/_2$ = 63.4 ± 19.3 ml/min), were not significantly different from the same parameters measured after classical choledochoduodenostomy ($T^1/_2$ = 44.2 ± 15.1 ml/min, $P > 0.1$) or choledochojejunostomy ($T^1/_2$ = 56.7 ± 22.4 ml/min, $P > 0.1$), but were slightly higher than those obtained in common bile ducts with a T tube $P < 0.05$).

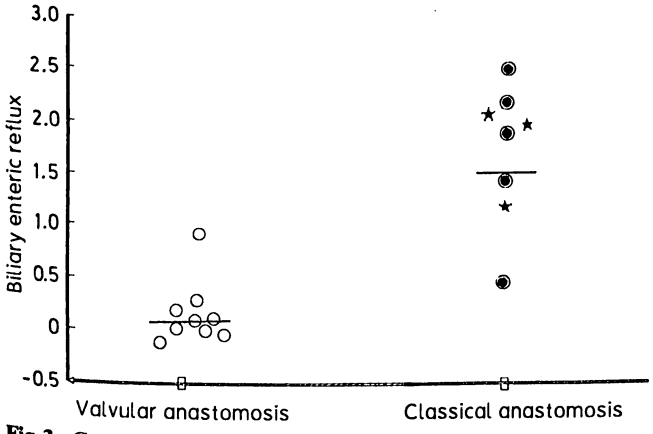

Fig. 3. Comparative values of biliary enteric reflux index between the valvular anastomosis (○) and the classical choledochojejunostomy (five patients, ●) and choledochoduodenostomy (three patients, * $P = 0.001$

An anti-reflux efficacy was demonstrated in more than 85% of the patients, which contrasted with classical biliary-enteric anastomosis patients (Fig. 3).

Discussion and conclusions

Direct duct-to-duct biliary anastomosis over a T tube, or Roux-en-Y choledochojejunostomy over an internal stent are the most common types of biliary reconstruction in liver transplantation. A significant percentage of postoperative morbidity and mortality has been related to these types of solution. Biliary tract complications have been considered responsible for technical complications in between 2% and 35% of all cases [1–3]. The main causes of biliary reconstruction failures are immediate disruption of the anastomosis and late stenosis of the extrahepatic biliary duct. To obviate some of these problems a new technique of choledochoenterostomy was devised based on the same principles adopted to obtain other kinds of organic mechanical anti-reflux valves.

Experimental studies on rats and dogs demonstrated that the new technique had the following advantages: (1) it prevented the common tendency of biliary anastomotic disruption involving common bile ducts of normal calibre; and (2) the hypervascularized mucosa avoided the risk of fibrotic stricture of the distal choledochus and inhibited the dilation of the proximal biliary tree. The intraluminal passage of the choledochus through the bowel wall caused a very effective enterobiliary anti-reflux effect without biliary obstruction, as was demonstrated in human studies. The choledochoenterostomy surrounded by the mucosa of the bowel functioned as an unobstructed and efficient Nissen fundoplication or a continent ureterocystostomy.

The fundoplication of the mucosa around the common bile duct protected the biliary tree against ascending infection due to the biliary enteric reflux and simultaneously reduced the risk of dehiscence and stricture of the enterobiliary anastomosis. In our opinion, this solution should be recommended in liver transplantation to solve the problems connected with anastomosis performed on common bile ducts of normal calibre.

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