

# Vascularized Venous Grafts in the Experimental Reconstruction of the Common Bile Duct\*

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THE RECONSTRUCTION OF the common bile duct can be one of the most technically difficult and challenging problems facing a surgeon today. The multiplicity of procedures and technics proposed, and the formidable nature of some of these, suggests that the ideal solution has not been reached.<sup>3</sup> The use of vascularized vein grafts in the experimental reconstruction of the common duct is worth consideration. In over four years of experiments, this method has given the most satisfactory long-term results.<sup>4</sup>

## MATERIALS AND METHODS

Ten fasting mongrel dogs weighing from 10 to 18 kilos were anesthetized with intraperitoneal and/or intravenous veterinary sodium nembutal.<sup>®</sup> The upper abdomen and neck were prepared and draped in the usual manner. A longitudinal incision was made in the lateral aspect of the right side of the neck along the course of the external jugular vein. The wound was developed down through skin and subcutaneous tissues. The external jugular vein, which is superficially located in the dog, was identified and separated from surrounding tissues from just below the angle of the mandible to the clavicle. All tributaries were doubly clamped, severed and ligated close to the vein. A segment 8 to 10 cm. in length was excised and threaded onto a polyethylene tube (size 190). The neck wound was then closed in layers with interrupted #4-0 and #2-0 cot-

ton sutures after all bleeding points were carefully controlled. Next, the abdomen was opened by means of an upper abdominal midline incision. The omentum was brought out through the wound. The jugular vein segment and polyethylene tube was placed near the right lateral border of the omentum. The edge of the omentum was folded over the vein, and tacked with several Champion #1 black silk sutures whose ends were left long for identification purposes. The omentum was returned to its normal position within the peritoneal cavity, and the wound was closed in layers with interrupted cotton sutures.

After six weeks to three months the second stage was performed. As in the first stage, no preoperative preparation was used other than withholding food for 12 hours; the anesthesia was administered as before. The right thoracic approach was used. In this technic a pneophor respirator was utilized in a semi-closed system. The incision was placed along the eighth interspace, extending from the erector spinous muscle group to the costochondral junction anteriorly. The wound was developed down through the chest wall between the eighth and ninth ribs. The lungs were allowed to partially collapse, and the diaphragm was incised. The lobes of the liver were easily allowed to fall back into the chest, exposing the *porta hepatis*. The common duct was isolated from surrounding tissue and a segment, approximating 2 to 5 cm. in length, was excised. In the dog, this represented most of the common duct from the junction of retro-duodenal

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TABLE I. Summary of Results.

Dog #	Length of Time P. O.	Result	Condition of Graft	Other Necropsy Findings
1	9 months	Sacrificed	Excellent	None
4	4½ months	Sacrificed	Partial stricture	Cholangitis
6	10 months	Sacrificed	Partial stricture	Cholangitis and perforated duodenal ulcer
9	1 month	Sacrificed	Partial stricture	Liver abscess, duodenal ulcer
8	8 months	Sacrificed	Partial stricture	Liver abscess, perforated duodenal ulcer
10	5 months	Died	Slight stricture	Perforated duodenal ulcer
12	3 months	Died	Partial stricture	Multiple hepatic abscess and subhepatic abscess
15	6 months	Sacrificed	Excellent	None

with the intra-duodenal duct to the point of junction of the last (or most distal) hepatic duct. The omentum was brought up into the mouth of the wound, and the transplanted vein was identified. The ends of the vein were excised, and viability assured by free bleeding. The viable vein graft with its omental pedicle then was swung up into position in the area of the *porta hepatis*. By means of interrupted sutures of #5-0 chromic gut the vein was anastomosed to the severed ends of the common duct over a (fresh) polyethylene tube. The tube was led through the sphincter of Oddi into the duodenum. The omental pedicle, with the intact blood supply to the transplanted vein, was allowed to fall into place over the region of the newly reconstituted common duct. The diaphragm and chest wall were closed in layers with interrupted sutures of cotton.

Postoperative care consisted of parenteral fluids for one or two days until oral fluids were tolerated in adequate amounts. Then solid foods were given. Penicillin, 300,000 units daily, was given for two or three days. The polyethylene stents were noted to pass spontaneously, and were usually found in the stools one week to ten days postoperatively.

#### RESULTS

Ten mongrel dogs were subjected to the above two-stage procedure. One animal died of shock and anesthesia less than eight hours after the operation. A second died on the seventh postoperative day of bowel obstruction from a loop of jejunum, which herniated

underneath the omental pedicle. The remaining eight dogs were followed from one to ten months. Six dogs were sacrificed at one month, four and one-half months, six, eight, nine and ten months respectively. Two dogs died at three and five months, respectively. Intact grafts were demonstrated in all animals, although partial stricture of the graft segment was found in most cases. In two cases, the results were clinically and anatomically excellent. Table I summarizes the results.

Of the two animals which died, one had an ascending cholangitis and multiple abscesses throughout the lobes of the liver, and a subhepatic abscess. The other animal died five months after operation of an incidental perforated duodenal ulcer and peritonitis. The graft was 2.5 cm. in length, and only slightly constricted to  $\frac{2}{3}$  of the circumference of the common duct proximally (1.2 cm. graft, 1.8 cm. of common duct), as shown in Figure 1. The common duct was not dilated proximally, and thick, greenish bile was easily expressed into the duodenum. Two other animals were sacrificed terminally, and were found to have perforated duodenal ulcers.

Of the sacrificed animals, four had partial stricture of the graft. These grafts shrunk as much as  $\frac{1}{2}$  to  $\frac{1}{3}$  the diameter of the common duct. In three of these animals the stricture was associated with an ascending cholangitis, and in two animals the stricture caused dilation of the proximal common duct. It was noteworthy that one minor variation in technic was added at the end of the



FIG. 1. Necropsy specimen of dog No. 10. Upper arrow points to fundus of gallbladder; middle arrow points to the graft; lower arrow points to the papilla of Vater.

series after it had become apparent that late follow-up studies revealed a large number of strictures. A #8 soft rubber "T" tube was used in place of the polyethylene stent; the long end of the "T" tube was ligated with silk and buried subcutaneously. This was well tolerated by the animal, and was allowed to remain in site for several months. The animal in which it was used was considered to have an excellent result.

Even in the grafts with excellent gross and functional results the histologic appearance of the graft was disappointing. In every instance studied, the graft showed some fibrosis and infiltration with chronic inflammatory cells. We were not able to demonstrate significant biliary epithelial over-

growth in the graft. In dog #1, the lining of the graft was composed of healthy endothelium.

#### DISCUSSION

The use of free vein grafts transplanted into the common bile duct has been attended by poor results.<sup>2</sup> We have found uniformly successful takes, however, when the vein was delayed by implantation in the omentum and allowed to develop a secondary blood supply before transplantation into the common duct. Nevertheless, late follow-up studies revealed partial stricture of the graft in over half of the cases. As this factor became apparent, the technic was altered to include an indwelling "T" tube.<sup>1</sup> We felt

that this, in itself, improved the end result.

It seems to us that there has evolved some worthwhile technical advances which might have clinical application. First, whatever tissue is used to bridge a defect in the bile duct must be viable, and have an adequate blood supply. Secondly, we had less stricture and better results when the repaired duct was protected for several weeks by an indwelling "T" tube or tubular polyethylene stent. Finally, the approach to the porta hepatis through the lower chest is excellent. This is particularly true in the case with previous abdominal surgery.

#### SUMMARY

1. A new technic for the reconstruction of the common bile duct in the experimental animal is described.

2. Eight mongrel dogs survived this procedure in the immediate postoperative peri-

od. They were followed up to ten months. Intact viable grafts were demonstrable in all animals, with excellent results in two.

3. The problem of delayed stricture has been encountered and, we believe, has not been fully overcome.

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