Combined Hepatic and Pancreaticoduodenal Procurement for Transplantation

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Several institutions are becoming involved with liver and pancreas transplantation. This involvement has increased the possibility of one or more institutions desiring both the pancreas and liver from the same donor. Combined whole-pancreas and liver procurement has been used at some institutions (1,2,3) but not at others, because the procurement surgeons have preferred to include the entire celiac axis for either the liver or whole-pancreas allograft at the expense of the other. We have utilized a method that allows combined liver–whole-pancreas procurement. A careful search is conducted for aberrant hepatic vessels, which may preclude combined liver–whole-pancreas procurement. The inferior border of the superior mesenteric artery (SMA) is cleared at its origin from the aorta. After the body and tail of the pancreas have been mobilized and the pancreas retracted medially, the celiac trunk and lateral and superior aspects of the aorta are exposed. The splenic artery is mobilized at its origin from the celiac axis. During the dissection of the hepatoduodenal ligament, the common and proper hepatic arteries are completely mobilized, and the gastroduodenal artery is ligated at its origin from the hepatic artery. The remainder of the common hepatic artery is mobilized to its origin from the celiac axis, and the celiac axis is isolated at its origin from the aorta. The portal vein is mobilized from its midportion to a point 2 cm from the head of the pancreas, which is left undisturbed. After in situ perfusion, the SMA distal to the inferior pancreaticoduodenal artery and the superior mesenteric vein (SMV) are clamped distally, ligated, and divided proximally. The portal vein 2 cm from the head of the pancreas is partially transected, allowing insertion of the portal cannula. The cannula is secured, portal perfusion is instituted, and the vein is completely transected to allow continuous drainage and to prevent venous hypertension in the pancreas. The splenic artery is divided just distal to its origin, leaving a cuff to oversew on the celiac axis. The aorta is divided between the celiac axis and the SMA, leaving a Carrel patch with each artery. The liver is procured with the celiac axis with an aortic cuff and portal vein. The whole-pancreas graft includes the splenic artery off the celiac axis, SMA artery with an aortic cuff, and portal vein (Fig. 1). The vessels are modified or elongated (or both), as deemed necessary, with the donor iliac vessels (Fig. 2). Twelve combined procurements have provided 11 livers and 12 pancreases for transplantation. One liver was not used due to ischemia introduced from early ligation of the distal SMA and SMV, which supplies blood flow to the liver via the bowel. One pancreas required reoperation due to disruption of the splenic artery to SMA anastomosis. Combined hepatic and pancreaticoduodenal procurement is possible. Liver and pancreas transplantation programs can coexist at a single institution, and institutional sharing of organs is greatly improved.

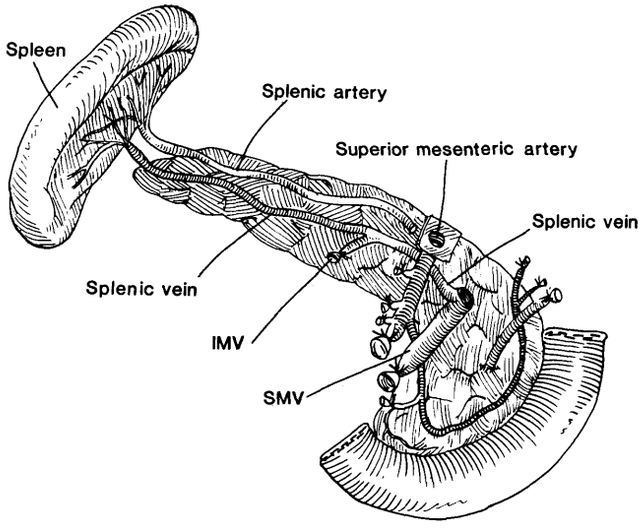

FIG. 1. Dorsal view of pancreaticoduodenal graft.

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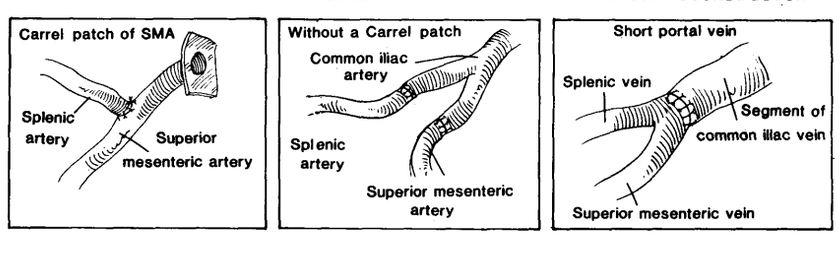

FIG. 2. Method of arterial and/or venous reconstruction required for pancreaticoduodenal graft.

Whole-Pancreas and Liver Procurement From Single-Cadaver Organ Donor: Where Should Shared Vascular Structures Be Divided?

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During a 12-mo period, 71 liver transplants (patient survival 79%) and 8 whole-pancreas transplants (patient survival 100%, graft survival 75%) were performed. Because of the size of the liver-transplant program and because priority was given to liver transplants at other centers, the few pancreas grafts available from cadaver donors limited the growth of the pancreas-transplant program. To continue to perform whole-pancreas transplants, we have begun to procure the liver and the whole pancreas (with a duodenal segment) from the same donor. Dual procurement of the liver and pancreas has been performed only when hepatic artery anatomy was normal, i.e., when there was no hepatic artery branch from the superior mesenteric artery or the left gastric artery. The arterial supply of the grafted liver was based on the common hepatic artery at its origin from the celiac, and that of the pancreas graft was based on an aortic patch including the celiac and superior mesenteric arteries, with the gastroduodenal artery being sacrificed. Justification for division of the arterial structures at this level was the desire to avoid an interposition arterial graft to the pancreas because the incidence of vascular thrombosis of this organ (12%) has been much higher than that for the adult liver (3%). The portal vein was divided 1.5–2.0 cm above the head of the pancreas, providing adequate length for both the pancreas and liver graft. Table 1 shows the initial and subsequent function of grafts procured in this manner. Two of three livers obtained from dual-procurement procedures remained functional; the recipient of the third succumbed 2 mo posttransplant after rejection and sepsis. Recipients of all three pancreas grafts remained normoglycemic and off insulin. Although other liver-transplant programs are reluctant to accept a dual-procurement procedure for the liver and pancreas that does not provide the full length of the celiac with the liver, we feel this procedure is the optimal one for obtaining both organs from a single donor.

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TABLE 1

	Liver recipient			Pancreas recipient	
Postoperative day	Bilirubin (mg/dl)	SGOT (mg/dl)	Prothrombin time (S)	Glucose (mg/dl)	Urine amylase (IU/h)
1	10.9 ± 4.1	721 ± 131	15.2 ± 0.9	89 ± 8	3370 ± 2340
2	8.3 ± 2.8	377 ± 114	14.1 ± 0.4	115 ± 8	2460 ± 1390
3	5.9 ± 2.4	194 ± 71	12.6 ± 0.4	108 ± 14	3110 ± 590
Current	1.9 ± 0.4	16 ± 2	11.9 ± 0.5	85 ± 1	9650 ± 160

SGOT, serum glutamic oxaloacetic transaminase.

Combined Liver and Pancreas Harvesting From Cadaveric Donors: Techniques According to Blood Supply

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Due to the increasing number of liver and pancreas grafts, combined harvesting of these organs has become necessary. The main purpose of the technique presented here is to obtain a single arterial anastomosis on the liver side and a Carrel patch for the pancreas. Segmental-pancreas harvesting may be realized in cases of hepatic arterial supply, but a right hepatic artery prevents a whole-pancreas removal. In segmental-pancreas harvesting the left part of the pancreas and spleen are dissected first, and the splenic artery and vein are skeletonized; the liver is then prepared as usual. A portal cannula is inserted through a mesenteric branch farther than the splenic vein; the portal flush does not impair the pancreatic outflow. The pancreas is removed first; the arterial supply may be the splenic or celiac, according to the arterial distribution and the needs of the liver team. The splenic vein is cut with a portal patch. In whole-pancreas harvesting the left pancreas is dissected first, the porta hepatis is prepared, and the gastroduodenal artery is divided close to its origin to maintain the revascularization through the superior pancreaticoduodenal arcade;

after Kocher maneuver and skeletonization of the mesenteric vessels, a portal cannula is inserted up to the middle of the porta hepatis through a mesenteric branch. To remove the whole pancreas the second duodenum is divided. After clamping and flushing the duodenum, the pancreas is removed first with an aortic patch including the origin of celiac and mesenteric, the portal vein is divided low in the porta hepatis, and the liver side is recannulated. According to the presence of a left hepatic artery or the needs of the liver team, the splenic artery is divided, and the celiac trunk is kept for the liver. One set of iliac vessels is removed for the pancreatic bench surgery on the artery. To reconstruct an arterial supply for the pancreas with a Carrel patch, two techniques may be used: in a segmental-pancreas graft the splenic artery is prolonged by an external iliac graft anastomosed end to end, and the patch on the other extremity is cut from the iliac bifurcation; in a whole-pancreas graft with a patch around the mesenteric origin and a divided splenic artery, an external iliac bypass is anastomosed end to end from the distal extremity of the superior mesenteric to the proximal end of the splenic. This technique allows a single arterial anastomosis in any case. A Carrel patch obtained from these reconstruction procedures is mandatory in the diabetic recipient with poor-quality vessels who receives these techniques without impairment of the vascularization of the liver.

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En Bloc Kidney and Pancreas Harvesting and Preparation of Pancreas Graft

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To minimize tissue damage from warm ischemia, we have developed hypothermic techniques for harvesting the pancreas and preparing the allograft for transplantation. In the en bloc bilateral nephrectomy and pancreaticoduodenectomy procedure, the kidneys were dissected first, then the distal aorta and inferior vena cava were dissected free. The visible lumbar vessels were controlled. The common bile duct, hepatic artery, and left gastric artery were divided, and the lesser sac was entered. The spleen and inferior surface of the pancreatic tail and body were mobilized. The superior mesenteric vessels were ligated, and the duodenum was divided with a GIA stapler. The aorta proximal to the celiac axis was dissected. The distal aorta and vena cava were divided, and then the proximal aorta, vena cava, and portal vein were divided. The en bloc specimen was then flushed with either a modified Eurocollins or a silica gel–based colloid solution and preserved. Just before transplantation, the organs were prepared while hypothermic conditions were maintained on a saline ice unit. The pancreas was separated from the kidneys, and a patch of the aorta, containing the origins of the celiac axis and the superior mesenteric artery, was taken. The splenic artery and vein, at the tail of the pancreas, small lymphatics, and the common bile duct were ligated. A duodenal loop was created when a duodenocystostomy technique was to be used for ductal drainage. Occasionally, to achieve sufficient arterial length for anastomosis, the celiac axis was anastomosed to the proximal end of the superior mesenteric artery of the donor. The distal superior mesenteric artery was then anastomosed to the recipient's external iliac artery. Venous reconstruction was also possible under hypothermia, with anastomosis of a segment of external iliac vein of the donor to the portal vein of the allograft. Immediate function was obtained in 21 of 22 (95.4%) whole-pancreas allografts with these techniques.

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