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Pancreas procurement from multiorgan donors for islet trasplantation

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Abstract

The outcome of human islet isolation procedures can be significantly effected by the technique used for pancreas procurement. In fact, the final step of islet purification using discontinuous density gradients requires a significant difference between the density of the islets and the density of the non-endocrine component of the gland. Therefore, any procedure during multi-organ procurement that will result in edema or degranulation of the acinar tissue will result in failure of the islet purification step. In this report a technique for combined harvesting of liver and pancreas is presented. The use of this procedure can be of assistance to avoid damage to the pancreas that could result in a compromised islet purification for improper handling of the gland even before it arrives to the isolation facility.

INTRODUCTION

Due to the increasing number of liver and pancreas grafts used for clinical transplantation, the combined harvesting of both these organs has become a common surgical practice (1-6).

The liver and the pancreas own a very related vascular anatomy that has to be shared at the time of their combined retrieval (1-7). Besides that, the procurement of each organ requires quite different ideal conditions. For instance both portal and arterial flush, although not mandatory, are advisable for the liver harvest (8), while the portal vein should be transected during the pancreas procurement to allow continuous drainage and to prevent venous hypertension in the gland (2).

The volume of the two organs is 10-fold different (about 2% and 0.2% of the adult body weight for liver and pancreas, respectively) (7) and consequently discordant is the amount of perfusate necessary to cool down the core temperature of each graft. In fact the overperfusion of the pancreas can be one of the responsible factors for the acute pancreatitis that often occur after the reperfusion of the organ (9,10), while the liver safely allows larger volumes of perfusate for cooling and preservation purposes.

Procurement of liver and pancreas “en bloc” with the duodenum and the hilar structures has been described as a part of the organ cluster procedure used in the treatment of upper abdominal malignancies (11). In the present paper a combined technique of procurement of the liver and the pancreas as separate organs is reported. The method is designed to meet the ideal conditions of procurement required for each graft and has been proven successful whether for the liver or the pancreas in a consecutive series of 17 cases. In fact each pancreas harvested with such technique was unconcernedly used either for the whole gland or clinical islets transplantation.

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Surgical procedure

A median sternotomy with a midline abdominal incision are performed and large retractors are placed avoiding in doing so bilateral cruciate incisions. While the cardiac team performs the preliminary mobilization of the heart we dissect in the usual fashion the infrarenal and supraceliac aorta (8). The kidneys do not need to be mobilized until the other organs have been removed.

After taking down the falciform and the left triangular ligaments the gastrohepatic ligament is approached and the gastroduodenal artery is divided between ties. The blood supply to the liver is then carefully assessed, and a general plan for the division of shared vascular structures between liver and pancreas is made following the general recommendations indicated in Table 1. After flushing of the gallbladder with saline the bile duct is also divided and ligated distally. The portal vein is dissected free and a vascular tape is placed around it, about 2 cm above the confluence. A Kocher maneuver is also performed with mobilization of the duodenum and the head of the pancreas. The gastrocolic omentum is divided up to the splenic flexure, and the whole stomach is dissected free. A decontamination of the duodenum is performed by means of antibiotic irrigation (amphotericin B, nystatin, diluted povidone-iodine) passed through the nasogastric tube placed at the level of the pylorus. The stomach is then totally removed after placing of GIA (pylorus) and TA55 (cardias) staple lines. This fact allows a larger exposure of the pancreas, spleen, celiac axis and aorta.

Subsequently the posterior attachments of the pancreas are bluntly taken down, the IMV is tied and the left renal vein is visualized as a marker of the lower and posterior margin of the resection. After division of the middle colic vessels and distal mobilization of the transversus colon, the attention is turned to the mesenteric axis where the SMA distal to the inferior pancreatico-duodenal artery, the ileocolic vein and the SMV are identified and looped.

Once the dissection is completed and heparin is given to the patient, a large cannula is placed into the aorta in the usual fashion. A second cannula is introduced into the SMV through the ileocolic vein and is advanced up to the portal vein about 2 cm above the confluence. Both cannulas are connected to separate infusion sets of UW-preservation solution. The SMA and all the remaining arterial and venous branches of the mesenteric axis are ligated or clamped. Subsequently the subdiaphragmatic aorta is cross-clamped, the vessel loop is tied over the portal cannula and the portal vein is divided immediately underneath at about 1 cm above the pancreatic margin.

Approximately 1000 ml of UW-solution is delivered through the aorta and 1500-2000 ml through the portal vein. Once the organs are cooled down and the cardiothoracic team has completed the heart/heart-lung procurement the liver and the pancreas are removed either “en bloc” or separately, dividing the arterial supply according to the recommendations indicated in Table 1. Care must be taken in avoiding any injury to the renal arteries during the detachment of the aortic patch around the SMA and the celiac axis. The preservation of the aortic origin of the SMA as well as of any arterial supply to the pancreas can be avoided in case of harvest of the gland for islets preparation. In our experience the final dissection of the origin of the SMA and celiac axis is delayed to the last step of the procurement, since any injury or vasospasm of the arterial supply to the pancreas and the liver would be dreadful before aortic cross-clamp. In fact, with an the organs well perfused and cooled down, it is easy to identity the SMA inside the mesenteric axis, dissect it and follow it proximally towards the aorta. During this maneuver the celiac-mesenteric plexus is divided on the left side of the SMA (the assistant side) where a possible branch for the liver or the pancreas is never encountered. After fashioning the aortic patch, all the organs but the

kidneys come from left to right into the surgeons hands. Unless the organs are removed “en bloc” with their arterial supply, the liver is always removed first, followed by the pancreas and the kidneys.

Once the organs are removed and placed in a basin, an additional 1000 ml of UW are infused into the liver (700 ml through the portal vein and 300 ml through the hepatic artery). No additional preservation solution is infused into the pancreas, which is simply stored in UW and prepared for shipping to the recipient hospital.

A total of 17 liver and pancreas procurements were performed with this technique in a group of stable donors whose median age was 36 years old (range 7-52). All the livers were clinically used for transplant and none of them experienced primary non function. In 10 out of 17 cases the post reperfusion biopsy, however, showed the presence of moderate ischemic injury, and the peak in the postoperative ALT level was always between 900 and 1200 U/I.

Eight pancreas were used for whole gland transplantation (WGTx) and 9 for islets purification (ITx). Seven out of 8 WGTx were referred to other centers. All the islets preparations were performed in Pittsburgh, employing the automated method previously described (12); in the last three cases the islets were in fact injected into the portal vein of three patients who underwent upper abdominal exenteration with only liver replacement (13).

In the group of WGTx, 2 out of 8 grafts (25%) experienced a severe post-reperfusion pancreatitis (with in 48 hr); but only one of them (13%) was eventually removed because of sepsis and abscess formation into the gland. The quality of the pancreatic grafts was excellent in the cases used for islets preparation. In fact an average of 534,880 islets were obtained from each graft, representing a mean of 10.072 islets per gram of pancreas.

Since the number of suitable multigram donors is limited, combined liver-pancreas procurement is performed more and more often.

In our experience this kind of procurement is better performed by a single team with good experience in handling and transplanting both these organs.

Because of the life-saving nature of liver transplantation, the procurement of the liver should have priority over the pancreas in case of emergency (severe hemodynamic instability of the donor). In stable donors the described technique or combined harvest was responsible for an ischemic injury on the liver that was only slightly worse than in less extensive procurements; in fact all the liver grafts of this series showed good function and rapid postoperative recovery. The procurement of the pancreas has been standardized in our group in a way that allows a flexible use of the graft whether for the whole gland or islets transplantation. Key points in the proposed technique are: careful dissection of both organs with respect of shared vascular structures (Table 1), good decompression of the venous drainage of the pancreas by transection of the portal vein, prevention of pancreas overperfusion and *in situ* UW-perfusion of the liver with both arterial and portal flush. The combined approach for harvesting “en bloc” the arterial supply of liver and pancreas makes possible a safer dissection of an aberrant right hepatic artery on the backtable or a preparation of the celiac axis for the liver graft when that becomes mandatory (i.e., aberrant left hepatic from the left gastric artery, pediatric use of the graft).

In our experience it is proven that the approach to the procurement of the pancreas for islets preparation should not be less accurate than that one used for the whole gland transplantation. Besides the method employed for islets purification the better is the quality of the harvest, the higher are the chances to purify good islets. Multiorgan procurement of

liver and pancreas from the same donor is feasible and should be pursued in most of the cases. We believe that the present technique will have a substantial impact in the search for a better standard in combined liver and pancreas procurement.

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