

A Modified Technique and Clinical Application of Combined Liver and Kidney Extraction from Non-Heart-beating Donors

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Abstract

Objectives: Discussing a modified technique and its application effect of quick combined liver and kidney extraction. **Method:** We used a modified method to conduct 60 cases of quick combined liver and kidney extraction. The key parts modified include the combination of in situ perfusion and surface cooling, incision and drainage of the inferior vena cava in a timely manner and en bloc resection of liver, gallbladder, pancreas, spleen and kidney after in situ bowel resection. **Results:** We obtained 60 donor livers and 120 donor kidneys. The mutated blood vessel of donor livers and kidneys were remained intact. There was no function loss of primary graft after liver transplantation surgery. The Serum Creatinine values of kidney transplant recipients in the fourth day after the surgery between Combined Liver and Kidney Extraction Group and Kidney-Only Extraction Group had no significant difference (157 μ mol/L vs 165 μ mol/L $P>0.05$). **Conclusion:** A modified technique of quick combined liver and kidney extraction can effectively protects the quality of liver and kidney.

Key Words: Combined Liver and kidney Extraction● Liver Transplantation● Kidney Transplantation

With the gradual increase of liver transplantation amount in recent years in China, combined liver and kidney extraction has become the most common way of multi-organ extraction. In recent years our hospital had 1/4 donor kidneys coming from combined liver and kidney extraction, and we found the function recovery of transplanted kidney was significantly affected. So we modified the technique of combined liver and kidney extraction and have achieved remarkable results, which is reported as follow:

1. Clinical Data

1.1 Donor

Donors all were the one without heartbeat, they are 20-30 years old, liver function test were normal and the test of HBsAg, HBeAg, HBeAb, HCV -Ab, HEV -Ab, RPR and TPPA were all negative. Before organ extraction the donors were given intramuscular injection of 10mg Phentolamine and intravenous injection of 400mg heparin.

1.2 Kidney Transplantation Recipients

We chose 350 kidney transplantation recipients who had transplantation surgery from August 2002 to August 2005 to observe the recovery condition of kidney function. Selection criteria were as follows:

- 1) 16-60 years old
- 2) No Coronary Heart Disease and severe Iliac Arteriosclerosis
- 3) No surgical complications after surgery
- 4) No heart failure during perioperative
- 5) Panel Reactive Antibody being negative and no acute rejection within 7 days after surgery

Among them 90 kidney transplantation recipients came from Combined Liver and kidney Extraction Group, and 260 recipients came from Kidney-Only Extraction Group.

1.3 A Modified Technique for Quick Combined Liver and kidney Extraction

The key parts modified: In Situ Perfusion Combined with Surface Cooling, Timely IVC Intubation for Drainage and En Bloc Resection of Liver, Gallbladder, Pancreas, Spleen and kidney After In Situ Bowel Resection. The steps were as follows:

- 1) Using big cross incision into abdomen to check and evaluate liver quality and then covering with sterile ice crumbs on the surface of the liver
- 2) abdominal aorta perfusion: dissecting the distal end of abdominal aorta to insert modified Foley catheter sized 22F with insertion depth of 15cm, inflating 30ml to block the proximal end of abdominal aorta, ligating the distal end of abdominal aorta, perfusing HCA solution of 3000ml.

- 3) Interior vena cava intubation
- 4) Mesenteric intravenous perfusion with UW solution of 2000ml
- 5) Isolating two kidneys and ureter and covering with lots of ice crumbs on the surface of liver and kidneys
- 6) Make bowel resection; cutting off hepatogastric ligament in the site close to the stomach; cutting off Duodenum along pancreas; cutting off mesentery and Treitz ligament at the distal end of portal vein perfusion tube and temporarily retaining the perfusion tube; moving intestine out of the abdominal cavity and only liver, gallbladder, pancreas, spleen and two kidneys left in the abdominal cavity.
- 7) Isolating liver
- 8) En bloc resection of liver, gallbladder, pancreas, spleen and two kidneys, and immersing them in the ice salt solution
- 9) Rinsing gallbladder and biliary tract
- 10) Isolating liver and kidneys
- 11) Continuing perfusion: continuing portal vein perfusion of 1000ml UW solution and the flowing out perfusate being used for liver preservation. if renal perfusion is not ideal, continue the perfusion of HCA solution through renal artery
- 12) Resection of iliac vessels of both sides

1.4 Statistical Analysis

We applied software of SPSS10.0. The comparison of two sample means used independent samples to test. Fisher's exact test was used to compare the rate of two sample.

2. Result

We performed 60 cases of quick combined liver and kidney extraction. Kidney warm ischemia time was 2-3 minutes, liver warm ischemia time was 3-6 minutes. The entire procedure took 10-15 minutes. There were no primary non-function after 60 donor kidneys were transplanted. The mutated blood vessel of donor livers and kidneys were remained intact. The Serum Creatinine values of kidney transplant recipients in the fourth day after the surgery from Quick Combined Liver and Kidney Extraction Group were $157 \pm 81 \mu\text{mol/L}$ and those from Kidney-Only Extraction Group were $165 \pm 68 \mu\text{mol/L}$. The two groups had no significant difference ($P > 0.05$). The incidence of acute tubular necrosis of recipients of the two groups had no significant difference as well (2.2% vs 1.5%, $P > 0.05$).

3 Discussion

3.1 Selection of Perfusion Order

In the surgery of donor liver extraction some authors believe that we should give the priority to portal vein perfusion because portal vein supplies 70% blood of entire liver. And also some authors believe that we should give the priority to abdominal aorta perfusion, or the both

perfusion take place in the same time. Among overseas donors with brain death, the priority of portal vein perfusion was practicable because at that time the blood supply of other organs didn't stop. But as to domestic donors with non-heart-beating, multi-organs extraction should give the priority to abdominal aorta perfusion in order to shorten the warm ischemia time of every organ. Clinical research shows that the perfusion being only given to abdominal aorta instead of portal vein can achieve the same liver quality as the one of abdominal aorta perfusion and portal vein perfusion being done in the same time. Because the perfusate in stomach, intestine, pancreas and spleen flow back to portal vein and the liver will be filled with perfusate too.

3.2 Selection of Perfusate

UW solution or other types of organ preservation solutions were used in abdominal aorta perfusion. Pirenne reported that comparing with UW solution abdominal aorta perfusion with Marshall solution can significantly reduce the incidence of biliary stricture after liver transplantation surgery, and can achieve the same one year survival rate of liver graft. The possible reason may be because the high viscosity of UW solution results in poor perfusion of capillary plexus around the bile duct and ischemic-type biliary lesions (ITBLs) occurred after liver transplantation. Such speculations have also been confirmed by other studies. Moench reported that using pressurized perfusion of abdominal aorta with UW solution can significantly reduce ITBLs. Adam reported that comparing with UW solution abdominal aorta perfusion with Eurocollins solution can also achieve the same survival rate of liver graft. HCA solution and Marshall solution all belong to hypertonic citrate organ preservation solutions. Abdominal aorta perfusion using HCA solution is practicable and safe, and usually there is no need to use UW solution perfusion through abdominal aorta after finishing the HCA solution perfusion.

3.3 Surface Cooling Effect

Abdominal aorta-portal vein in situ perfusion can make liver reach the minimum temperature of $11.0 \pm 3.0^{\circ}\text{C}$ (it takes 9.3 ± 3.4 minutes). But the optimum temperature for hepatic preservation is $0-1^{\circ}\text{C}$, and it needs 75-90 minutes to drop its core temperature to 5°C after liver cold-storage preservation (post processing). It needs 195 ± 75 minutes to drop its core temperature to 1°C after liver cold-storage preservation. Another author reported that during the combined liver-pancreas-kidney extraction ice crumb was put into abdominal cavity to prevent pancreas re-warming. In using-ice-crumb group the center temperature of pancreas was 4°C or so, but in non-ice-crumb group the center temperature of pancreas went up to 18.2°C . Cooling surface by ice crumb can improve the separation amount of pancreatic islet and better its activities. Therefore the cooling method of the combination of in situ perfusion and surface cooling should be promoted. When performing abdominal aorta perfusion and portal vein perfusion lots of ice crumb was simultaneously covered on the surface of liver, which accelerated the speed of decreasing temperature of liver graft and kidney graft and prevented two kidney re-warming. Pouring ice-water mixture into abdominal cavity after isolating two kidneys didn't affect the surgical procedures.

3.4 Order of Organ Extraction

Usually there was a problem that liver and kidney extraction were respectively performed by different hospitals. If liver extraction is done first, we usually perform pancreas transection in the middle of pancreas, cut off Treitz ligament and superior mesenteric artery, cut off abdominal aorta along the latter's opening. This process may damage accessory right hepatic artery coming from superior mesenteric artery and it is easy to cause renal vascular injury and prolonging renal ischemia time. The en bloc extraction of liver and kidney should be encouraged, which can guarantee that abdominal aorta perfusion and portal vein perfusion can be done in the same time during the entire operation process. After en bloc extraction was done, the organs were put into ice-water mixture, cut and open the posterior wall of abdominal aorta to identify the anatomical relationship between celiac artery, superior mesenteric artery and renal artery. Note abnormal blood vessels that may exist. Cutting off renal artery with a piece of abdominal aorta will be good for artery anastomosis of kidney graft and is also good for artery reconstruction of liver graft.

3.5 The Effect of Incision and Drainage of the Inferior Vena Cava in a Timely Manner

After the intubation of abdominal aorta, the incision of the inferior vena cava should be done immediately to drain blood and perfusate and to avoid high pressure of hepatic vein and renal vein that leads to flow disorders and tissue edema. In the same time we can keep a clear vision and reduce the chance of accidental injury of organs. If we cut diaphragm and inferior vena cava of liver to drain blood and perfusate into thoracic cavity, it will result in liver sagging and organs in abdominal cavity will lose normal anatomical relationship and the blood will flow to abdominal cavity, the clear vision will be affected, this will cause anatomical difficulties.

References: