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Is portal venous outflow better than systemic venous outflow in small bowel transplantation? Experimental study in syngeneic rats

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Abstract

Background/Purpose: Blood drainage of the graft into the recipient portal vein reestablishes the physiological venous outflow after small bowel transplantation (SBT). However, although this approach is likely beneficial for the host, it may be technically more demanding making portocaval venous drainage the preferred arrangement during human SBT. The aim of this study was to examine in a syngeneic model of SBT the possible benefits of portoportal anastomosis (PPA) vs portocaval anastomosis (PCA) in terms of body and organ weights and bacterial translocation.

Methods: Syngeneic SBT was carried out in 25 Brown-Norway male rats weighing 249 ± 17.5 g using either PPA (n = 13) or PCA (n = 12). Half the animals in each group were killed, respectively, on postoperative day 2 or 7. Liver, spleen, and lungs were weighed and under sterile conditions the regional lymph nodes were excised. The nodes and venous samples from the cava and portal veins were cultured for aerobes and anaerobes. Bacterial components were detected in blood by polymerase chain reaction. The findings in both groups were compared by χ^2 or Mann-Whitney U tests.

Results: Mean postoperative body weight change was −3.6% ± 1.5% in PPA and −6.0% ± 1.2% in PCA animals (ns) on day 2 and −6.5% ± 2.6% and −8.0% ± 5.0% (ns) on day 7. Liver, spleen, and lung weights were not significantly different between both groups on either end point. Gram-negative enteric bacteria were found in 3 of 7 PCA animals and 2 of 6 PPA animals at day 2 (ns) and in 1 of 6 and 4 of 6 on day 7 (ns). Aerobic gram-positive bacteria were found in 1 of 7 and 1 of 6 (ns), 3 of 6 and 3 of 6 (ns), respectively, in the 4 groups. Most positive cultures corresponded to portal blood and lymph node samples. There were no anaerobic growths.

Conclusions:

-No body or organ weight change suggesting significant functional advantages of one technical alternative over the other could be demonstrated.

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-Bacterial translocation in the absence of rejection was frequent after SBT independently of the variety of venous outflow used. No difference in bacterial translocation between both anastomosis could be demonstrated.

-Orthotopic venous drainage did not seem to be advantageous in the present experimental setting.

Blood drainage of the graft into the recipient portal vein reestablishes the physiological venous outflow after small bowel transplantation (SBT). This approach is likely beneficial for the host in terms of metabolism, immunology, and liver function when compared with portosystemic drainage that creates a partial mesocaval shunt, but these benefits are still to be demonstrated [1-4]. However, portoportal anastomosis (PPA) may be technically more demanding specially in children with short bowel syndrome, the most frequent indication for SBT. Therefore, portocaval anastomosis (PCA) is the preferred arrangement for most human SBT. Our aim was to examine in a syngeneic model of SBT the possible benefits of PPA vs PCA in terms of body and organ weights and bacterial translocation (BT).

1. Materials and methods

1.1. Animals

Brown-Norway rats (Janvier, Madrid, Spain) weighing 249 ± 17.5 g were used as donors and recipients (syngeneic model). The animals were housed in our animal care facilities that are accredited by regional animal health authorities in compliance with the current European Union regulations. All animals were given standard chow until the night before surgery and tap water ad libitum from then on.

1.2. Operative procedures

Orthotopic SBTs were performed according to the technique described before [5]. Each graft consisted of the entire small bowel from 3 cm of the duodenojejunal junction to 5 cm of the ileocecal valve. The vascular pedicle consisted of the superior mesenteric artery with a cuff of aorta and the portal vein. After flushing vessels with cold (4°C) Ringer solution with heparin (10 U/mL) and irrigating the lumen with Ringer, the graft was wrapped in a moist gauze and stored at 4°C while the recipient enterectomy was performed. Arterial revascularization in both groups consisted of end-to-side arterial anastomoses between the cuff of the donor aorta and the recipient infrarenal aorta with 9/0 monofilament stitches. In the PPA group, the venous outflow was reestablished by end-to-side anastomoses between graft and recipient portal veins. In the PCA we used end-to-side anastomoses between graft portal and recipient caval veins. Vein sutures were performed with 9/0 running sutures. Gastrointestinal continuity was reestablished by 2 end-to-end anastomoses between recipient jejunum and ileum and the corresponding segments of the graft.

1.3. Experimental groups

Animals were randomly assigned to 1 of the 2 groups. Half the animals in each group were killed on 2 end points at 2 and 7 days, postoperatively.

1.4. Sampling

Animals were killed by anesthetic (ether) overdose. Under sterile conditions, regional lymph nodes and vena cava and portal vein blood samples were recovered and cultured in appropriate media. Liver, spleen, lungs, and intestine were excised and sampled for histology and biochemical examination.

1.5. Histology

Samples of liver, lung, spleen, and intestine were fixed in 10% buffered formalin. After dehydrating and embedding in paraffin, 5- to 7-μm-thick sections were cut and stained with hematoxylin-eosin.

1.6. Biochemistry

Samples of liver, spleen, lungs, and intestine of known weight were frozen at −80°C. Organ DNA was measured by the Labarca-Paigen [6] method and fluorescence spectrophotometer at 365 nm. Protein was measured by bicinchoninic acid assay and spectrophotometer at 562 mm [7].

1.7. Microbiology

Peripheral and portal blood (1 mL each) were inoculated in hemoculture bottles for aerobic and anaerobic bacteria (ESP, TREK Diagnostic Systems, Westlake, Ohio) and incubated in an automatic culture system (ESP, TREK Diagnostic Systems) for 5 days. Node cultures were mixed with the same weight of sterile saline, homogenized, and 100 μL were seeded for aerobes in blood agar, McConkey agar, and blood agar with nalidixic acid and colimycin. The plates were incubated for 24 to 48 hours at 35°C in a 10% carbon dioxide atmosphere. For anaerobic microorganisms, aliquots of 100 μL were seeded in blood agar with vitamin K1 and hemin (ASA), ASA with vancomycin and amikacin, phenyl-ethyl-alcohol agar, and *Bacteroides* bile-esculin with amikacin, and were incubated in anaerobic chamber