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Effect of pre-reperfusion portal venous blood flush on early liver transplant function

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Abstract Portal venous blood for rinsing out the University of Wisconsin solution (UWs) has the advantages of being a physiological fluid, removing acidotic mesenteric venous blood and perhaps resulting in more stable haemodynamic parameters during reperfusion. A group of 209 consecutive adult OLTs carried out between July 1993 and February 1995 were studied prospectively. The UWs was flushed out with 500 ml portal blood in 95 OLTs (group 1) and with 1.0 L 0.5 % dextrose at 37 °C in 114 OLTs (group 2). The median day 1 and peak day 1–5 AST levels were significantly elevated in the 5 % dextrose group: median 755 (118–11 090) vs. 546 (121–6150) IU/l ($P = 0.007$, Wilcoxon); and median 1095 (159–11 090) vs. 744 (157–7870) IU/l ($p = 0.008$, Wilcoxon), respectively. A median of 5 (0–27) units of blood were transfused in group 1 compared to 4 (0–54) units in group 2 (n. s.). There was no difference in peak bilirubin, lowest day 1–5 PT levels, primary nonfunction, median ITU stay, total inpatient stay and 1-month graft survival between the two groups (89 % vs. 88 %). Pre-reperfusion blood flush may be associated with less hepatocellular damage, without significant additional blood usage.

Key words Early graft function · Liver transplantation · Preservation · Reperfusion injury

Introduction

In orthotopic liver transplantation (OLT), reperfusion of the cold-stored liver allograft is necessary for the expression of preservation-reperfusion injury [1, 2]. Prior to reperfusion, the potassium-rich (120 mmol/l) University of Wisconsin solution (UWs) is rinsed out, usually using a colloid or crystalloid solution. More recently special rinse solutions such as the Carolina rinse solution rich in buffers have been advocated to decrease the extent of preservation-reperfusion injury [3]. The use of portal venous blood as a flushout fluid may have potential advantages: it is physiological, achieves effective prewarming of the graft, and removes acidotic mesenteric venous blood. In addition, its use has been reported to result in more stable haemodynamic parameters and a decreased incidence of post-reperfusion syndrome [4]. However, it does add to intraoperative blood losses and may result in increased transfusion requirements. Our aims were to study the effects of a pre-reperfusion portal venous blood flush compared to a 5 % dextrose washout on parameters of early graft function and on intraoperative blood transfusion requirements.

Patients and methods

From July 1993 to February 1995, 209 consecutive adult OLTs were studied prospectively. OLT was performed using standard techniques, and all livers were preserved with UWs. In 95 cases (group 1) the UWs was washed out with portal venous blood, with the first 500 ml of effluent blood drained out via a cannula through the lower caval anastomosis. During this stage 1 unit of blood was rapidly transfused to prevent hypotension. Following this the portal venous clamp was reapplied, and both upper and lower IVC

Table 1 Blood flush vs. 5 % dextrose – demographic data, indications, cold and warm ischaemia. Values are median (range)

	Blood (n = 95)	5 % dextrose (n = 114)	
Sex (M/F)	46/49	49/65	n.s.
Age (years)	47 (16–68)	52 (17–73)	n.s.
Routine	71	82	n.s.
Urgent	16	19	n.s.
Emergency	8	13	n.s.
Cold ischaemia time (min)	763 (174–1325)	738 (265–1132)	n.s.
Warm ischaemia time (min)	50 (25–102)	49 (30–88)	n.s.
Venovenous bypass	80/15	104/10	n.s.

clamps were released, establishing caval circulation and providing adequate venous return. The portal clamp was then gradually released, carefully monitoring haemodynamic parameters, to establish revascularization of the graft. In the remaining 114 cases (group 2), the UWs was rinsed out with 1000 ml 5 % dextrose at 37° C, the caval clamps released and the graft revascularized with portal venous inflow. The two groups were comparable for age, sex, urgency of indication, use of venovenous bypass, and cold and warm ischaemia times (Table 1).

Results

The early graft function parameters are given in Table 2. The day 1 AST levels and the peak day 1–5 AST levels were significantly higher in group 2 (5 % dextrose washout). There were three cases of primary nonfunction in group 1 (blood flush) compared with one in group 2 (P = 0.25, n.s.). There was no significant difference in peak day 1–5 bilirubin levels and lowest day 1–5 prothrombin times. Patients in group 1 received a median of 5 units of blood intraoperatively, and those in group 2 received 4 units (n.s.). The median ITU stay, median total inpatient stay and 1-month graft survival were similar in both groups (Table 2).

Discussion

The degree of preservation-reperfusion injury in liver transplantation depends on several factors [1, 2], including the events prior to reperfusion such as the gradual rewarming during construction of the vascular anastomoses, the time taken to full arterial and venous revascularization of the graft, the nature and temperature of the fluid used to wash out the UWs, and the mode of reperfusion. The use of portal venous blood as a flushout fluid has possible benefits in that it gets rid of acidotic venous blood proximal to the portal venous clamp, utilizes a physiological fluid to washout the liver and achieves more effective prewarming prior to complete revascularization of the graft. There have also been reports of a decreased incidence of postreperfusion haemodynamic syndrome when the first 500 ml of portal venous blood are allowed to drain out [4]. One potential disadvantage is the associated blood loss resulting in an increase in blood transfusion requirements.

The lower transaminase levels (day 1 AST, peak day 1–5 AST) in grafts flushed with blood suggest less hepatocellular damage in this preliminary analysis. The overall incidence of primary nonfunction was low (4 of 209 OLTs, although 3 were washed out with portal venous blood; P = 0.25, n.s.). Further studies looking at more sensitive markers of preservation injury such as neutrophil activation and adhesion, platelet adhesion and cytokine release [5, 6] could determine whether grafts flushed out with venous blood do in fact suffer less preservation-reperfusion injury.

The median intraoperative blood transfusion requirements were not significantly increased in group 1 (blood flush) (5 vs. 4, n.s.), although a rapid infusion of 1 unit of blood was required in all cases.

In conclusion, the use of portal venous blood as a flushout fluid may be associated with less hepatocellular damage, without adversely affecting intraoperative transfusion requirements. Further studies looking at more specific features are necessary before its influence on preservation reperfusion injury can be determined.

Table 2 Early graft function parameters and outcome. Values are median (range)

	Blood flush (n = 95)	5 % dextrose washout (n = 114)	Wilcoxon test
Day 1 AST (IU/l)	546 (121–6150)	755 (118–11090)	p = 0.007
Peak AST (day 1–5) (IU/l)	744 (157–7870)	1095 (159–11090)	p = 0.008
Peak bilirubin (day 1–5) (mmol/L)	152 (29–1540)	170 (32–838)	ns
Lowest prothrombin time (day 1–5) (s)	15 (11–23)	14 (11–22)	ns
Primary nonfunction	3	1	ns
Intraoperative blood (units)	5 (0–27)	4 (0–54)	ns
ITU/inpatient stay (days)	3/14	3/14	ns
1-month graft survival	89 %	88 %	ns

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