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Recipient hepatectomy with preservation of inferior vena cava reduces the need for veno-venous bypass in liver transplantation

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Abstract Recipient hepatectomy with inferior vena cava (IVC) preservation, the piggy back (PGB) technique, was adopted as our routine option in the management of the anhepatic phase of orthotopic liver transplantation (OLT) to avoid the use of veno-venous bypass (VV-BP). In the last 5 years, 119 OLT in adult patients have been performed in our unit. In the first period (47 OLT), VV-BP was used in 59% of the cases and cross-clamping in the rest. In the second period, following the introduction of the PGB technique, 72 OLT were performed. VV-BP was used in 5.5% of the cases, PGB technique in 87.5% and cross-clamping in 6.9%. There was a significant reduction in the need for VV-BP in the second period. Operating time and blood transfusion were significantly greater in the VV-BP group. No PGB technique related complications were observed. In conclusion, the PGB technique reduced the need for VVBP with consequent savings in time, blood transfusion and the cost of OLT.

Key words Orthotopic liver transplantation · Piggy back technique · Veno-venous bypass · Anhepatic phase

Introduction

Some patients do not tolerate inferior vena cava (IVC) and portal clamping during the anhepatic phase of orthotopic liver transplantation (OLT) and a veno-venous bypass (VVBP) is required [1]. Recipient hepatectomy with IVC preservation, the piggy back (PGB) technique [2], was introduced into our programme in cases of segmental liver transplantation in children [3] and in adult patients with a portacaval shunt. later, it became the routine technique in all adult cases. We report our experience with the three techniques used in the anhepatic phase of OLT – clamping, VV-BP and PGB – and a comparison between the two groups of adult patients transplanted before and after the routine use of the PGB technique.

Materials and methods

From October 1988 to September 1992, 119 OLT were performed in our unit. In the last 2 years, the PGB technique was routinely used in all cases. In the first period (47 OLT), VV-BP was when the patient did not tolerate cross-clamping of the portal vein and IVC. On occasions, VV-BP was introduced in the early stages of the procedure in critical or unstable patients or when hepatectomy was deemed to be difficult. VV-BP was performed following the guidelines of the Pittsburgh programme [1]. In the second period (72 OLT), the PGB technique was used in all cases unless an anatomic condition precluded its use. VV-BP was used only when PGB could not be performed and cross-clamping was not tolerated. In the second period, patients were significantly older and less urgent cases were performed (Table 1).

Table 1 Demographics and indications
Period: Octover 1988 – September 1993
Number of transplants: 119
Mean age: 49.5 ± 11 (range: 16–66 years)
Sex: 74 male, 45 female

	1st period (47 OLT) 1988–1991	2nd period (72 OLT) 1991–1993	*P*
Age	46.0±12.9	51.7±9.8	=0.012
Sex	27 m, 20 f	47 m, 25 f	
Indications			
PNC	24	45	NS
PBC	6	5	NS
FH	6	–	=0.004
Tumours	6	16	NS
R-Tx	5	6	NS

(PNC, Postnecrotic cirrhosis; PBC, primary biliary cirrhosis; FH, fulminant hepatitis)

Table 2 Comparison between the two periods

	1st Period	2nd Period	*P*
Total:	47	72	
VV-BP	28 (59.60%)	4 (5.5%)	
cross-clamping	19 (40.43%)	5 (6.9%)	
PGB	–	63 (87.5%)	
Operation time (min)	512.4±110.2	455.3±120.9	<0.001
Transfusion:			
RBC (U)	15.46±12.47	7.66±8.73	<0.001
FFP (U)	16.55±11.03	11.36±8.66	=0.008
Plat (U)	17.17±12.56	11.73±11.70	=0.018
Operative mortality (1 month)	8 (17%)	7 (9.7%)	NS
Cost (VV-BP)			
total[a]	$81,000	$ 11,666	
per OLT	$ 1,723	$162	

[a] Estimated cost of one VV-BP: $2,900

IVC preservation: the PGB technique

The hepatic hilum was dissected with division of the hepatic artery and bile duct. Hepatic ligaments were taken down and the liver dissected out from the IVC, with all venous branches being ligated until the main hepatic veins were completely dissected. Vascular clamps were placed on the portal vein and IVC near the entrance of the hepatic veins. The latter were divided and the hepatectomy was completed. the stump of the hepatic veins was then prepared by dividing the septum between them. Implantation of the liver was performed by anastomosing the donor suprahepatic IVC to the stump of the hepatic veins with a running 4–0 prolene. The infrahepatic IVC was prepared for future closure by dissecting the vein with the aim of leaving it as short as possible. Portal anastomosis was then fashioned. The liver was flushed with 200 cc blood after the portal vein clamp was released. The donor infrahepatic IVC was clamped while the suprahepatic clamp was removed. the liver was revascularised, completing the anhepatic phase. Arterial and biliary anastomoses were then performed. Operating time, blood product use, haemodynamic control, renal function, operative mortality, cost and complications were compared among the three groups (clamping, VV-BP and PGB).

Statistical analysis

Data are expressed as mean values ±1 SD. The signicance of differences between means was assessed by the 95% confidence interval. Comparisons of proportions are based on the chi-square test.

Results

Patients transplanted in the second period were significantly older and indications were similar although more urgent patients were transplanted in the first period. In the first period, the VV-BP was used in almost 60% of cases compared with only 5.5% in the second period (Table 2). In the second period, the PGB technique was successfully performed in 87.5% of OLT without increased operating time, blood product use or complications compared with cross-clamping (Table 3). VV-BP

Table 3 Comparison between the three techniques

OLT (119)	VV-BP	cross-clamping	PGB	*P*
Number	32	24	63	
Age	46.6±11	44 ±14	52 ±9	=0.004
Operating time (min)	562 ±109	428 ±87	453 ±115	<0.001
RBC	18 ±14	8 ±4	7.8±115	<0.001
FFP	18 ±6	12 ±4	12 ±9	=0.002
Platelets	18 ±13	12 ±12	12 ±12	NS
Dopamine (μg/g per minute)	3.5±3.2	2.7±1.2	2.7±2.9	NS
Dobutamine (μg/g per minute)	3.9±6.0	2.3±1.2	3.7±2.9	NS
preop BUN (mg:dl)	64 ±61	39 ±33	47 ±47	NS
postop BUN	133 ±73	99 ±57	93 ±47	=0.007
Preop creatinine (mg/dl)	1.1±0.6	0.9±0.8	1.2±0.9	NS
postop creatinine	2.1±0.9	1.7±1.0	1.8±1.1	NS
Operative mortality (1 month)	7 (21.9%)	3 (12.5%)	5 (7.9%)	NS
Cost of VV-BP	$92.800	–	–	
Complications[a] from the technique	8 (25%)	–	–	

[a] Inguinal seroma, 4; venous thromboses, 2; tube clotting, 2

Table 4 Reasons for not performing PGB in the 2nd period

Tumours invading caudate lobe	
Hepatoma	1
Fibrolamellar HCC	1
Giant cavernous haemangioma	1
Enormous hypertrophy of caudate lobe	1
Previous surgery	
Right hepatectomy	1
Retransplantation	2
Portal thrombosis	1
Other	1

was never required when the PGB technique was performed, thus, a significant reduction in VV-BP use was achieved despite the patients' older age. The PGB technique could not be performed in nine patients for different reasons (Table 4) and 44% of these needed VV-BP as cross-clamping was not tolerated. No complications arose from the PGB procedure while 25% of VV-BP patients had several complications. The VV-BP group required more packed red cell (PRC) and plasma (FFP) transfusions and operating time was longer. the need for inotropic support and renal function was similar in all groups. The cost of OLT was reduced by saving the expensive materials required for the VV-BP (Table 3).

Discussion

The first step in OLT is total hepatectomy of the diseased liver. It is usually performed by cross-clamping the inferior vena cava (IVC) above and below the liver, the retrohepatic IVC is, thus, included in the specimen. throughout the anhepatic phase, this manoeuvre produces significant haemodynamic disturbance, renal dysfunction and blood loss in high-pressure areas. Old, unstable or critical patients do not tolerate this situation. the introduction of a VV-BP, as described by the Pittsburgh group in the early 1980s [1], carries the blood from the portal and IVC areas to the axillary vein, and signified a great advance in overcoming these problems, permitting a reduced operative mortality. VV-BP was adopted in many programmes as routine, while others used it only when cross-clamping was not tolerated. Nevertheless, some groups claimed that VV-BP was not needed and that with good anaesthetic and surgical skills, all patients could be managed without it, avoiding increasing cost, operating time and complications derived from this technique.

Over the last few years, another alternative, IVC preservation during hepatectomy or the PGB technique, has been introduced [2, 3]. The anhepatic phase includes cross-clamping of the portal and hepatic veins, maintaining IVC flow. Patient haemodynamics and renal venous outflow are less disturbed and there is less bleeding from the posterior raw surface [4]. Only in rare situations when this techniques is not feasible, as in the presence of an enormous or tumours caudate lobe that precludes IVC dissection and the patient does not tolerate cross-clamping, is a VV-BP required.

In conclusion, hepatectomy with IVC preservation is now our technique of choice in OLT. Only in the few cases that its use is not feasible and cross-clamping is not tolerated is VV-BP indicated.

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