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ORIGINAL ARTICLE

Living donor liver transplantation: effect of the type of liver graft donation on donor mortality and morbidity

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Summary

To investigate the influence of the type of liver graft donation on donor mortality and morbidity. The clinical course of 87 living liver donors operated on at our center between 2002 and 2009 was retrospectively analysed and data pertaining to all complications were retrieved. No donor mortality was observed and no donor suffered any life-threatening complication. Four donors (4.6%) developed biliary leakage, nine (10.3%) had to be readmitted to hospital and six (6.9%) required some or other type of reoperation related to the previous liver donation. Reoperations included incisional or diaphragmatic hernia repair ($n = 4$), biliary leakage repair ($n = 1$) and segmental colon resection combined with diaphragmatic hernia repair ($n = 1$). There was a statistically significant difference in hospital stay ($P < 0.001$), autologous blood transfusions ($P < 0.001$) and operating time ($P < 0.005$) when right lobe donations (Segments V–VIII) were compared with left lobe (Segments II–IV) and left lateral lobe (Segments II–III) donations, whereas no difference was found between these groups regarding hospital readmission, operative revisions and the incidence or severity of complications. Right lobe donation was associated with prolonged hospital stay, increased blood transfusions and prolonged operating time when compared with left and left lateral lobe donation, whereas donor mortality and morbidity did not differ between these groups.

Introduction

Living donor liver transplantation (LDLT) was developed in an attempt to increase the pool of donor organs, offering at the same time a graft in excellent condition with short ischemic time [1], reducing this way the mortality of pediatric patients on the waiting list for liver transplantation [2,3].

The first LDLT was performed in 1989, when the left lateral lobe was successfully transplanted from a mother to her son [4,5]. This success led to the adaptation of this technique all around the world and especially in Asian countries because of limited availability of cadaveric organs. The fact that the left lateral lobe of the liver does not provide sufficient liver mass to allow successful transplantation in adults led to the use of the full left or full right liver lobe. In 1994, the first right liver LDLT was performed in a child [6], whereas the first adult-to-adult LDLT using the right lobe was performed in the same year by Fan *et al.* [7].

Despite the impressive results, LDLT remains one of the most complicated surgical procedures and has created controversy regarding the safety of the donor. To date, 20 deaths of living hepatic lobe donors and one donor in a chronic vegetative state of physical condition have been worldwide reported [8,9]. The most common causes of death relating to liver donation were sepsis, postoperative liver failure, myocardial infarction, cerebral hemorrhage, pulmonary embolus and complications of peptic ulcer disease [10]. Although an accurate estimation of the donor mortality risk after living liver donation is not possible, mortality approaches 0.5% for

the right lobe donation and 0.1% for the left lobe donation [11].

Donor morbidity rates after liver graft donation range from 0% to 67%, with an overall crude complication rate of 31%, depending on the definition but also on the recognition of complications [12,13]. Among the most commonly noted postoperative complications are infections, development of incisional hernias and biliary complications [14]. The right hepatectomy is associated with higher rates of complications, especially of biliary leakage, in comparison with the left- and left lateral hepatectomy [15,16,17]. Moreover, respiratory complications including especially pulmonary embolism develop frequently mainly after right lobe hepatectomy [18,19]. Postoperative liver failure of the living donor with need for liver transplantation is a rare complication with only five cases having been reported worldwide and is associated with high donor mortality as seen from the fact that out of these five donors only one survived more than 9 months after the liver transplantation [20].

There is an extensive literature focusing on donor mortality and morbidity after living liver graft donation; Brown from New York, USA [12] reported on national data obtained from 84 different transplant centers engaged in performing LDLT. The national overall donor complication rate was estimated to be 14.5% with a rehospitalization rate of 8.5%. A donor mortality rate of 0.2% was reported. On the other hand, the overall complication rate presented by Ghobrial *et al.* [14] in the Adult-to-Adult Living Donor Liver Transplantation Cohort Study (A2ALL) was significantly higher when compared with the numbers presented by Brown, as 38% of the living donors evaluated between 1998 and 2003 in nine transplant centers in the United States developed a postoperative complication. The majority of these complications were minor without lasting disability, but 2% of the donors developed a life-threatening complication and the overall mortality rate was 0.8%. Regarding the effect of the type of liver graft donation on donor morbidity we have to focus on the systematic review of Beavers *et al.* [13] who demonstrated an overall crude morbidity rate of 31% after right lobectomy, with bile leakage, prolonged ileus and minor wound problems being the most commonly noted postoperative complications. Interesting is also the latest study of Therapondos *et al.* [21], who presented medical outcomes of 202 donors beyond 1 year after donor hepatectomy. According to this study, almost 40% of the donors suffered a complication during the first postoperative year, but the complication rate decreased dramatically to 1.5% after the first year. There was no donor mortality in this group.

The goal of this study was to investigate the influence of the type of liver graft donation on donor mortality and morbidity. We tested whether the donation of the right hepatic lobe (Segments V–VIII) is associated with more frequent or more serious complications such as biliary leakage when compared with the donation of the left lobe (Segments II–IV) or the left lateral lobe (Segments II–III). Moreover, we investigated the influence of the different donor procedures on the necessity of intraoperative blood transfusions, the frequency of operative revisions, the need for hospital readmission, the duration of the donor operating procedure and the average hospital stay of the donors.

Materials and methods

From January 2002 to December 2009, 87 LDLTs were performed in the Hanover Medical School and the perioperative data of the donors were retrospectively analysed. Survival of the donors was regularly checked with the German residence registration offices, the general practitioners of the donors and our interdisciplinary outpatient clinic for liver transplant patients and living donors. Systematic follow-up of all cases was carried out until 01.02.2010.

Donor demographics and the type of liver graft donation are presented in Table 1.

All potential donors underwent a complete and thorough evaluation. The principal goal of the donor evaluation procedure was to determine whether the potential donor was not only medically but also psychologically suitable for living liver donation. All donors were evaluated by a hepatologist, a transplant surgeon and a psychiatrist before determining the prospective donor's eligibility for liver donation. Donor age under 18 or over 65 years, obesity with a body mass index over 30, fatty

Table 1. Donor demographics and operative data of donor procedures.

No. donors	87
Gender (male/female) (%)	38/49 (44/56)
Average age at time of operation (years)	37 (19–60)
Donor relationship to the recipient (%)	
Biologically related	67 (77)
Parent	52 (60)
Sibling	8 (9)
Child	7 (8)
Not biologically related	20 (23)
Spouse	13 (15)
Other nonbiological	7 (8)
Type of liver resection (%)	
Left lateral lobe (Segments 2 and 3)	47 (54)
Right lobe (Segments 5, 6, 7 and 8)	36 (41)
Left lobe (Segments 2, 3 and 4)	4 (4.6)

change of the liver more than 10%, remnant liver volume <30% and of course significant medical comorbidities such as coronary artery disease, diabetes mellitus, hepatitis C virus infection and cerebrovascular disease where considered as exclusion criteria for living liver donation. The work-up of the potential donors included biochemical and serologic tests, abdominal ultrasonography and of course volumetric imaging of the liver with preoperative identification of vascular and biliary anatomy variants. A liver biopsy was performed only selectively in order to identify liver steatosis or to exclude other pathologic conditions. It has to be mentioned that no donor suffered a complication as a result of the donor evaluation procedure and more specifically after percutaneous liver biopsy. The decision for procurement of the middle hepatic vein was based on the venous anatomy of the liver and the type of liver graft donation was decided taking into consideration the remnant liver volume of the donor and of course the graft-to-body weight ratio of the recipient. Thirty-six full-right lobe hepatectomies (Segments V–VIII) were performed for adult-to-adult liver transplantation, whereas four left lobe hepatectomies (Segments II–IV) and 47 left lateral segmentectomies (Segments II–III) were performed for adult-to-child liver transplantation.

The gender distribution of the donors was 56% females ($n = 49$) and 44% males ($n = 38$). The average age of the study population at the time point of liver donation was 37 years (range from 19 to 60 years). Regarding the relationship between donor and recipient, it has to be mentioned that 77% of the donors ($n = 67$) were biologically related to the recipients and 23% of the donors ($n = 20$) were not biologically related.

The operative procedure of the living donor hepatectomy was performed through a J-shaped or through a bilateral subcostal incision with an upper midline extension depending on the type of liver graft donation. After the initial intraoperative ultrasound evaluation of the vascular structures and especially of the hepatic veins, a retrograde cholecystectomy was performed. The right or left portal vein, always depending on the type of liver graft donation, and the right or left hepatic artery were then isolated and the line of demarcation was noted during clamping of graftside vessels. The liver parenchymal transection was performed using the Cavitron Ultrasonic Surgical Aspirator (CUSA System is developed from COVIDIEN company) without inflow occlusion. The cutting line of the hepatic duct was decided based on an intraoperative cholangiography, which was performed through the cystic duct stump. After systematic administration of heparin, the portal vein, the hepatic artery and the hepatic vein were cut sharply. It has to be mentioned that only in two out of the 36 cases of full-right hepatectomy (5.5%) was the middle hepatic vein included in the graft in order to provide improved outflow and hepatic mass to the recipient. An injection of methylene blue or of indocyanine green through the cystic duct stump in order to test for bile leakage was performed only in cases of complex biliary anatomy or in cases where a biliary leakage was suspected during the operating procedure. One closed-suction drains was placed near the raw surface of the liver and the abdomen was closed in layers.

All of the donors were extubated in the operating room and remained in our surgical intensive care unit for at least 24-h monitoring. Complete blood counts, coagulation profile and liver function tests were monitored for at least 7 days after the operation. The donors were started on ambulation and oral intake on the first postoperative day (POD). Antibiotics were continued for 24 h postoperatively and pain control was accomplished with intravenous or with oral narcotics depending on the individual patient's need. Prophylaxis for deep vein thrombosis was based on early administration of low molecular weight heparin an on the use of compression sleeves. All donors underwent a routine abdominal ultrasonography to assess vessel and parenchymal integrities. The long-term follow up of the donors was at 1, 3, 6 months and then annually after the surgery in our interdisciplinary outpatient clinic.

To investigate the influence of the type of liver graft donation on donor mortality and morbidity we formed two groups of patients. The first group (Group 1, $n = 51$) included the 47 patients scheduled for left lateral segmentectomies and four patients scheduled for left lobe hepatectomies, whereas the second group (Group 2, $n = 36$) included the 36 patients scheduled for full-right lobe hepatectomies.

Statistical analysis

In order to test the influence of the different donor procedures on the end points of our study we used univariate analysis of variance (ANOVA) for the study end-point duration of the donor operative procedure in minutes, the Kruskal–Wallis test for the study end-point intraoperative blood transfusions in units, the chi-square test for the study end-points operative revision, necessity of blood transfusions, hospital readmission, biliary leakage, as well as early and late complications. The Kaplan–Meier analysis was used for the study end-point length of hospital stay in days. The Mann–Whitney test was used for comparison of the postoperative laboratory values between the two groups. For statistical analysis, the software program SPSS version 15.0 (SPSS Inc., Chicago, IL, USA) was used.

Results

Donor mortality

No donor mortality was observed in this series of 87 living donor hepatectomies.

Donor morbidity

Surgical complications were stratified according to the modified Clavien classification of postoperative complications [22,23]. The overall complication rate was 21% and no donor suffered a life-threatening complication (Clavien grade IV). The majority of postoperative complications (61%) were stratified as Clavien grade II complications, as 11 donors developed an early or a late complication which was treated only with the use of pharmacologic agents without the need of any surgical or endoscopic intervention. The rate of major complications, defined by Clavien grade III, was 6.9% as six donors required some or other type of reoperation related to the previous liver graft donation.

Table 2 shows the Clavien's classification not only for postoperative complications for all the 87 donors in general but also based on the type of liver graft donation.

More specifically, eight donors (9.2%) developed a complication in the early postoperative period and 10 donors (11.5%) suffered a complication after the initial discharge from the hospital. Early complications included surgical site infection in five donors (5.7%), biliary leakage in two donors (2.3%) and bacterial pneumonia in one donor (1.1%). After the initial discharge from the hospital, four donors (4.6%) developed an incisional hernia, two donors (2.3%) a diaphragmatic hernia after full right-lobe donation, two donors (2.3%) biliary leakage, one a portal vein thrombosis and one more donor, a surgical site infection. Nine donors had to be readmitted to the hospital (10.3%) and six of the 87 donors (7%) required some or other form of reoperation relating to the previous liver donation. To be more specific, three donors underwent an incisional hernia repair, one donor a diaphragmatic hernia repair, one more donor a segmental colon resection combined with repair of a diaphragmatic hernia and one donor a biliary leakage repair. Table 3 shows the postoperative complications of all the 87 donors.

Table 2. Clavien's classification for postoperative complications.

Clavien's grade	No. complications		
	Total of patients (n = 87)	Group 1 (S. 2–3, S. 2–4, n = 51)	Group 2 (S. 5–8, n = 36)
I/II	12	6	6
III	6	2	4
IV	0	0	0
V	0	0	0

Table 3. Postoperative complications of donors according to the type of liver graft donation (Group 1 vs. Group 2).

	No. patients (%)	Group 1 (S. 2–3, S. 2–4)	Group 2 (S. 5–8)
Death of donors	0 (0)	0	0
Early complications	8 (9.2)	4	4
Surgical site infection	5 (5.7)	3	2
Biliary leakage	2 (2.3)	1	1
Pneumonia	1 (1.1)	0	1
Late complications	10 (11.5)	4	6
Incisional hernia	4 (4.6)	1	3
Diaphragmatic hernia	2 (2.3)	0	2
Biliary leakage	2 (2.3)	2	0
Portal vein thrombosis	1 (1.1)	0	1
Surgical site infection	1 (1.1)	1	0
Readmission to hospital	9 (10.3)	3	6
Reoperation related to liver donation	6 (7)	2	4
Incisional hernia repair	3	1	2
Repair of biliary leakage	1	1	0
Diaphragmatic hernia repair	1	0	1
Segmental colon resection/hernia repair	1	0	1

Early complications: during the first week after the operative procedure of the living donor; late complications: after the initial discharge from hospital.

Hospital stay

Hospital stay of the donors was between 4 and 22 days (average 9.9 days, median 9 days). The duration of hospital stay was significantly different between Group 1 and 2 ($P < 0.001$). Donation of the right hepatic lobe was associated with significantly prolonged hospital stay when compared with donation of the left- or left lateral lobe.

Duration of the donor procedure

The duration of the donor operation was between 110 min and 400 min (average 236 min, median 230 min). In Group 1, average duration of the donor procedure was 218 min (range: 203–233 min), while in Group 2, average duration of the donor procedure was 262 min (range: 245–279 min). This difference was statistically significant ($P < 0.001$).

Intraoperative blood transfusion

Fifty donor procedures (57.5%) were associated with autologous blood transfusions via cell saver, whereas the

remaining 37 procedures (42.5%) were not. In Group 1 autologous blood transfusions via cell saver were required in 23 of the 51 patients (45%), while in Group 2 this was the case in 27 of 36 patients (75%). This difference was statistically significant ($P < 0.005$).

Operative revisions

The difference in the frequency of operative revisions was not statistically significant between Group 1 (3.9%) and Group 2 (11.1%).

Hospital readmission

The difference in the frequency of hospital readmissions was not statistically significant between Group 1 (5.9%) and Group 2 (16.7%).

Biliary leakage

Interestingly, the difference in the frequency of biliary leakage (defined as bilioma) was not statistically significant between Group 1 (5.9%) and Group 2 (2.8%).

Early complications (developed in the first week after the operative procedure of the living donor hepatectomy) and late complications (developed after the initial discharge from the hospital)

The difference in the frequency of early or late complications was not statistically significant between Group 1 (7.8% and 7.8% respectively) and Group 2 (11.1% and 16.6% respectively).

Table 4 shows the postoperative complications and the operative data of the donor procedures according to the type of liver graft donation.

Postoperative liver function tests

Table 5 and Figs 1–4 show the postoperative development of aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin and activated partial thromboplastin time (aPTT) in Group 1 and Group 2 at the 1st, 2nd, 5th, and 8th POD. There was no statistically significant difference observed regarding the postoperative development of AST between the two groups, but ALT was significantly higher at POD 8 in the group of donors

Table 4. Postoperative complications and operative data of the donor procedures according to the type of liver graft donation.

	Group 1 (n = 51) S. 2–3, S. 2–4	Group 2 (n = 36) S. 5–8	P-value
Hospital stay (days)	8.7	10	<0.001
Duration of donor procedure (min)	218 (203–233)	262 (245–279)	<0.001
Perioperative need of blood products	0	0	NS
Intraoperative autologous blood transfusions (%)	45	75	<0.005
Intraoperative blood loss (ml)	201 ± 311	540 ± 499	<0.005
Deaths of donors	0	0	NS
Operative revisions (%)	3.9	11.1	NS (P = 0.1950)
Hospital readmission (%)	5.9	16.7	NS (P = 0.1058)
Biliary leakage (%)	5.9	2.8	NS (P = 0.4984)
Early complications (%)	7.8	11.1	NS (P = 0.6055)
Late complication (%)	7.8	16.6	NS (P = 0.2064)

Table 5. Development of aspartate aminotransferase, alanine aminotransferase, total bilirubin and activated partial thromboplastin time (mean ± SD) after donor hepatectomy in Group 1 and Group 2.

		POD 1	P-value	POD 2	P-value	POD 5	P-value	POD 8	P-value
AST (U/l)	Group 1	291 ± 295	0.4937	193 ± 199	0.9331	46 ± 46	0.8589	41 ± 45	0.0569
	Group 2	184 ± 119		134 ± 88		32 ± 46		30 ± 34	
ALT (U/l)	Group 1	354 ± 359	0.2442	353 ± 383	0.1496	175 ± 146	0.0402	126 ± 110	0.0033
	Group 2	204 ± 115		168 ± 83		95 ± 57		71 ± 55	
aPTT (s)	Group 1	35 ± 8	0.0009	33 ± 5	<0.0001	28 ± 3	0.0055	30 ± 5	0.3875
	Group 2	42 ± 11		39 ± 5		34 ± 8		30 ± 4	
Total bilirubin (μmol/l)	Group 1	23 ± 13	<0.0001	17 ± 10	<0.0001	12 ± 8	<0.0001	9 ± 5	<0.0001
	Group 2	43 ± 18		36 ± 17		31 ± 27		20 ± 24	

POD, postoperative day; AST, aspartate aminotransferase; ALT, alanine aminotransferase; aPTT, activated partial thromboplastin time.

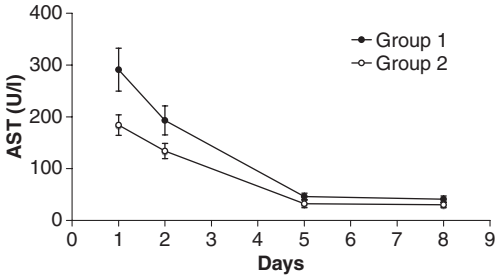

Figure 1 Development of aspartate aminotransferase after donor hepatectomy in Group 1 and Group 2.

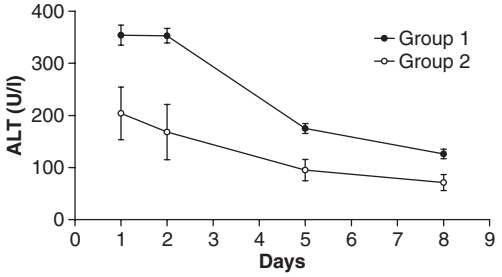

Figure 2 Development of alanine aminotransferase after donor hepatectomy in Group 1 and Group 2.

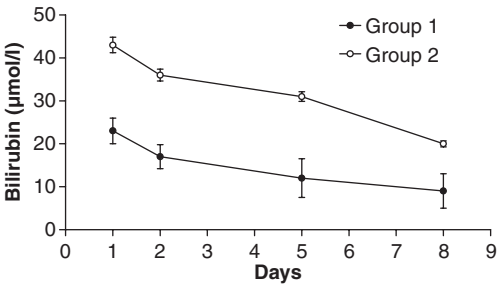

Figure 3 Development of total bilirubin after donor hepatectomy in Group 1 and Group 2.

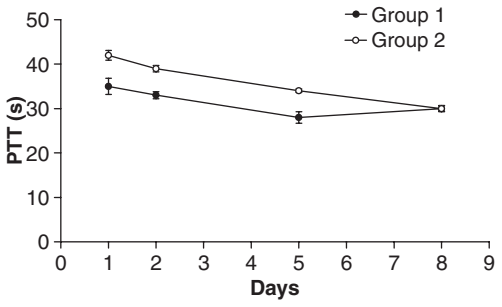

Figure 4 Development of activated partial thromboplastin time after donor hepatectomy in Group 1 and Group 2.

after left-lobe or left-lateral lobe donation (Group 1). Moreover, donors after full-right lobe donation (Group 2) presented a statistically significant increase in serum total bilirubin at POD 1, 2 and 5 and a statistically significant prolongation in aPTT at POD 1, 2, 5 and 8 in comparison to Group 1.

Discussion

Living donor liver transplantation is an established treatment modality of end-stage liver disease that alleviates the shortage of cadaveric donor organs, offering at the same time the great advantage of scheduling the transplantation before the occurrence of serious decompensation of the recipient [24,25].

Although the safety of the donor is of crucial importance for the application of LDLT, there is considerable controversy regarding the real risks of donor hepatectomy. Moreover, the absence of a worldwide registry for living liver donation makes the accurate estimation of donor mortality and morbidity almost impossible.

This single-center study presented an overall morbidity rate of 21% for the entire cohort of the 87 consecutive donor hepatectomies performed in our department between January 2002 and December 2009. No donor mortality was observed and no donor suffered a life-threatening complication. There was no statistically significant difference observed in donor mortality and morbidity between right lobe and left lobe or left lateral lobe donation, but right lobe donors underwent an operating procedure of longer duration, had a significantly longer hospital stay and required more autologous blood transfusions via cell saver when compared with left- or left lateral lobe donors.

As mentioned above, no donor mortality was recorded in our study. In our opinion, the absence of donor deaths is mainly attributable to the complete and thorough evaluation of all potential donors. Important is also the fact that all donors and especially the ones after full-right or full-left lobe hepatectomy had a remnant liver volume equal to or more than 30%, as the use of donors with remnant liver volume <30%, especially in the cases where the middle hepatic vein is included in the graft in order to improve outflow in the recipient, is related to increased donor mortality and morbidity [26,27,28].

Regarding the morbidity of our donors, surgical site infections (6.9%), biliary leakage (4.6%) and development of incisional hernia (4.6%) were the most common postoperative complications. The majority of complications were categorized as Clavien grade II complications. The rehospitalization rate was 10.3% while 7% of the donors required some or other form of reoperation relating to the previous liver donation. Our overall morbidity rate of 21% seems to be lower when compared with the numbers presented by Beavers *et al.* [13] and by Ghobrial *et al.* [14], who demonstrated an overall crude complication rate of 31% and 38% respectively. Of course, it has to be

mentioned that both of these studies refer only to donor complications after full-right lobectomy for adult-to-adult LDLT. Our complication rate after right lobectomy was 28%, as 10 of the 36 full-right lobe donors developed an early or a late postoperative complication and so our complication rates still remain lower when compared to the numbers mentioned above. On the other hand, our overall morbidity rate seems to be higher not only in comparison to figures presented from transplant centers in Asia [25,29], but also in comparison to the average morbidity rate of 16% reported from Maddern *et al.* from Australia [9]. However, it is well known that donor morbidity rates vary between different transplant centers and depend mostly on the definition and of course recognition of postoperative complications.

Regarding the development of abdominal complications after hepatic lobe donation, it has to be noticed that only four patients (4.6%) developed a biliary leakage as defined by bilioma, which correlates with numbers presented from other transplant centers in Europe and Asia [16,29,30,31]. No other biliary complications, such as biliary strictures or fistulas were present. The majority of patients with biliary leakage were treated conservatively and only one patient with persistent biliary leakage after left lateral segmentectomy underwent a reoperation as the primary endoscopic management was unsuccessful. The patient was discharged from hospital 10 days after the operative revision and suffered no furthermore complications. Moreover, our study presented a very low rate of pulmonary complications, as only one patient developed a bacterial pneumonia in the early postoperative period. Our findings correlate with the low rates of pulmonary complications presented by Hoofnagle *et al.* [32] and by Lo [31], but come in contrast to the rate of respiratory complications presented in the study of Belghiti *et al.* [18]. In our opinion the low rate of pulmonary complications is mainly attributable to the postoperative management of all donors, which includes early ambulation, incentive spirometry, adequate pain relief and of course prophylaxis of thromboembolic disease with compression sleeves and low molecular weight heparin.

In the second part of our study, we evaluated the influence of the different types of liver graft donation on donor mortality and morbidity. More specifically, we compared the frequency and the severity of the postoperative complications between donors after full-right lobe donation and donors after left-lobe or left lateral lobe donation. As mentioned above, right lobe donation was associated with prolonged hospital stay, increased need for autologous blood transfusions and prolonged operating time as compared with the left- and left lateral lobe donation. These results are easily explained by the complexity of the donor procedure in the case of full-right lobe donor hepatectomy and of course by the smaller remnant liver volume of the donors after right donor hepatectomy, especially in comparison to the left-lateral lobe donation. The effect of the smaller remnant liver volume of the donors after full-right lobe hepatectomy was also observed in the development of the laboratory values, as these donors presented postoperatively a statistically significant increase in serum total bilirubin and a statistically significant prolongation in aPTT when compared with donors after left-lobe or left lateral lobe donation. On the other hand, our study showed no statistically significant difference between these two groups regarding the development of complications and especially the development of biliary leakage. These results do not correlate with the ones presented by the majority of transplant centers in the United States, Europe and Asia, where the full right-lobe hepatectomy is associated with higher rates of postoperative complications and especially higher incidence of biliary leakage [1,13,14,16,30]. Our results could of course be attributed to the small number of donors included in our study, which does not allow a proper statistical analysis especially regarding the development of postoperative biliary leakage. This also constitutes the major potential limitation of our study. On the other hand, the low incidence of postoperative complications and especially the low incidence of biliary complications after right donor hepatectomy could be attributed to the experience and the organization of our transplant center. The operative procedure of the living donor hepatectomy is always performed by a small group of surgeons with great experience not only on living liver donation, but also on liver transplantation in general, on split liver transplantation of cadaveric organs and of course on liver surgery for primary and metastatic liver cancer. In our opinion, this great experience on liver transplantation and on liver surgery allows us to optimize not only the donor operating procedure but also the selection of the donors, which are of course factors of major importance for the safe performance of living liver donation.

To conclude, our study demonstrated no statistically significant difference in donor mortality and morbidity between donors after full-right lobe hepatectomy and donors after left lobe or left lateral lobe hepatectomy. Although the right lobe hepatectomy is believed to be associated with a higher risk of postoperative complications, our experience shows that it can be performed safely with excellent donor results as major or life-threatening complications can be prevented through strict selections of the living donor and of the type of liver graft donation, proper postoperative management of the donors and of course refinement of the surgical technique through accumulation of experience on LDLT.

Authorship

LK: collected the data, performed the study and wrote the paper; HS: performed the study and analysed the data; TB and NR: designed the study; NE: analysed the data; HB-H: collected the data; JK and FL: designed the study.

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