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ORIGINAL ARTICLE

Risks of donation and quality of donors' life after living donor liver transplantation

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Summary

The purpose is to clarify risks of donation and quality of the donor's life after living-related donor liver transplantation (LDLTx). Sixty-eight donors were classified into four groups: lateral segment group ($n = 30$); left lobe group ($n = 18$); left lobe with the middle hepatic vein group ($n = 11$); right lobe group ($n = 9$). We investigated (i) the risks of donation, and evaluated the following: blood loss, operation time, postoperative liver function and duration of hospitalization; (ii) quality of donors' life: donors were mailed a structured questionnaire and the Short-Form Health Survey (SF-36), a generic measure assessing quality of life using eight scales. The results were: (i) there were no differences in liver function and duration of hospitalization between four groups; (ii) 48 donors (71%) responded. All donors returned to normalcy. The donors did not regret their decision to donate except two cases whose recipients had died. The donors' life was almost guaranteed regardless of the lobe we used as the graft.

Introduction

Liver transplantation (LTx) has been established as the standard therapy for end-stage liver disease. But in recent years there is shortage of donors all over the world [1]. To compensate for the shortage of donor grafts, living-related donor liver transplantation (LDLTx) is globally accepted. LDLTx provides potential recipients with timely transplantation, but the procedure is associated with risks to the donor. In LDLTx the donor is exposed to the risks inherent to a surgical operation, and the donor might experience a considerable psychological burden [2]. Therefore, the safety of the donor operation and donors' life after the operation must be guaranteed while maintaining the viability of the graft. For the healthy volunteer donor, classic endpoints (i.e. control of disease, disease-free survival, return to normal activities, etc.) do not apply. For donors, any benefit of donation is primarily a psychological point of view [3,4]. Although the use of grafts from living kidney donors is common, and considerable data exists regarding the psychological impact of donation [5–7], there are only a few reports about psychosocial outcomes of living liver donors [8–10] except for the reports about donors who provided left lateral segments. There are no reports about the comparison of the psychosocial outcomes of donors who provided left lobe and those who provided right lobe in a single medical centre. Furthermore there are only a few reports, which mentioned about the relationship between the complications of donor or recipients' operation and psychosocial outcomes of donors. The purpose of this study was to clarify the risks of the donor operation and the quality of the donor's life after LDLTx for a long-term.

In our institute we have performed 68 LDLTx from July 1991 to July 2003. We transect the donor liver without using the vascular occlusion technique [11]. We retrospectively reviewed the safety of our donor operations based on parameters such as blood loss, blood transfusion, operation time, duration of hospitalization and complications. In addition, we surveyed our donors' data, which were classified into four groups by the parts of the liver grafts, to learn how they perceived their experience.

Patients and methods

Informed consent was obtained from both donors and recipients. All procedures were reviewed and approved by the ethical committee of Tohoku University School of Medicine and have therefore been performed in accordance with the ethical standards of the Declaration of Helsinki.

Sixty-eight donors for LDLTx received the liver resection in Tohoku University Hospital from July 1991 to July 2003. Age ranged from 17 to 64 years and male:female ratio was 33:35. Their mean age, weight and height were 34.7 ± 8.8 years old, 56.7 ± 7.8 kg and 162.6 ± 8.2 cm, respectively. None of the donors showed abnormal data in blood tests on preoperative assessment. We transected the donor liver without using the vascular occlusion technique [11].

Donors were classified into four groups: (i) lateral segment (LS) group ($n = 30$); (ii) left lobe (LL) group ($n = 18$); (iii) left lobe with the middle hepatic vein (LLM) group ($n = 11$); (iv) right lobe (RL) group ($n = 9$). We investigated (i) the risks at the donor operation and (ii) quality of donors' life at a mean of 1665.3 ± 1113.4 days after donation.

Postoperative complications

Blood loss, blood transfusion, operation time, postoperative liver function, complications and the length of hospitalization were evaluated.

Long-term quality of life of donors after LDLTx

Donors were mailed a structured questionnaire about the general health, present occupational status and 'what you think now about LDLTx' (Table 1). In addition, donors completed the Short Form, 36-question Health Survey (SF-36), a generic measure of quality of life [12,13]. The self-administered SF-36 survey assesses eight health domains: (i) physical functioning, (ii) physical role limits, (iii) emotional role limits, (iv) vitality, (v) pain, (vi) mental health, (vii) social function and (viii) general health.

We also reviewed recipient outcomes (i.e. major complications or death) and analysed the effect of recipient outcome on donors' SF-36 scores.

Statistics

Values are given as mean ± SD. Student's *t*-test and one-way ANOVA were used to compare categorical data. $P < 0.05$ were considered to be significant. All calculations were made with the StatView software package (SAS Institute, Cary, NC, USA).

Table 1. Structured questionnaire for donors after donation.

1. Are you tack at work
   1 yes
   2 no
2. General health*
   1 Good
   2 Not so good
   3 Bad
   4 In the hospital
3. What you think now about LDLTx
   1 Not regret
   2 Regret

*Are there any new medical symptoms which you relate to the surgery?

Results

Postoperative complications

The weight and height of the donors are given in Table 2. There were no significant differences in weight and height among the four groups, but the average age in the LL and LLM groups was significantly higher than that in the LS group ($P = 0.036$ LL versus LS; $P < 0.001$ LLM versus LS). The weight of the graft in the RL group was significantly more than that in the other three groups (LS, LL, LLM) ($P < 0.001$). The operation time in the LL and LLM groups was significantly longer than that in the LS group ($P = 0.007$ LL versus LS; $P = 0.011$ LLM versus LS) (Table 2).

Blood loss volume in the LLM group was significantly higher than that in the LS and LL groups ($P < 0.001$ LLM versus LS; $P = 0.009$ LLM versus LL). Maximum total bilirubin in the LLM and RL groups was significantly higher than that in the LS group ($P = 0.046$ LLM versus LS; $P = 0.014$ RL versus LS). But maximum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) showed no significant differences among the four groups. There were also no significant differences in the duration of hospitalization among the four groups. Heterologous blood transfusion was not required except for one donor of the LLM group (Table 2).

Postoperative complications occurred in three donors in the LS group, one in the LL group, four in the LLM group and two in the RL group (Table 3). Most postoperative complications were treated without surgical procedure. A donor in the LL group, suffering from sepsis and respiratory distress secondary to the intra-abdominal abscess, was subjected to a drainage operation and was discharged after 64 days of hospitalization. Most of the major complications, such as bile leakage and intra-abdominal abscess occurred at an early period after we started LDLTx. Apart from the donor who had undergone the drainage operation, only several minor complications

Table 2. Age, weight, height, graft weight, operation time, blood loss, postoperative liver function, and hospitalization.

	LS ($n = 30$)	LL ($n = 13$)	LLM ($n = 11$)	RL ($n = 9$)
Age (years)	30.2 ± 6.0	37.1 ± 5.3*	43.0 ± 10.5*	34.9 ± 11.9
Weight (kg)	54.9 ± 7.5	57.5 ± 6.5	61.8 ± 10.0	55.2 ± 6.3
Height (cm)	162.6 ± 7.5	162.3 ± 8.7	163.3 ± 9.4	162.2 ± 9.0
Graft weight (g)	220 ± 30.1	285 ± 46.6*	372 ± 63.7*†	553 ± 84.3*†‡
Operation time (min)	453 ± 70	544 ± 72*	541 ± 136*	443 ± 73
Blood loss (ml)	490 ± 273	722 ± 331	1201 ± 702*†	883 ± 346
Heterologous blood transfusion	0/30	0/18	1/11	0/9
Postoperative liver function				
AST Max	319 ± 247	298 ± 170	306 ± 178	294 ± 104
ALT Max	393 ± 242	334 ± 151	412 ± 281	291 ± 97
T-bil Max	1.5 ± 0.6	2.5 ± 1.4	2.7 ± 1.6*	2.9 ± 1.1*
Mean hospitalization time (days)	10.9 ± 4.7	11.8 ± 13.3	14.1 ± 11.4	11.2 ± 3.2
Mean follow- up time (days)	1608 ± 960	2347 ± 1095	1866 ± 930	249 ± 214

*$P < 0.05$ versus LS group; †$P < 0.05$ versus LL group; ‡$P < 0.05$ versus LLM group.
ALT, alanine aminotransferase; AST, aspartate aminotransferase.

Table 3. Complications of donors.

	LS ($n = 30$)	LL ($n = 13$)	LLM ($n = 11$)	RL ($n = 9$)
Age (years)	30.2 ± 6.0	37.1 ± 5.3*	43.0 ± 10.5*	34.9 ± 11.9
Complications	3/30	1/18	4/11	2/9
Biliary leakage	2 (cases 2, 44)	1 (case 6)	1 (case 4)	0
Wound infection	1 (case 2)	1 (case 6)	2 (cases 28, 37)	0
Intra-abdominal abscess	1 (case 2)	1 (case 6)	0	0
Sepsis., DIG	0	1 (case 6)	0	0
Prolongation of liver dysfunction	0	0	1 (case 4)	0
Ileus	0	0	1 (case 48)	0
Abdominal wall hernia	0	0	0	1 (case 62)
SMV thrum to sis	0	0	0	1 (case 54)

*$P < 0.05$ versus LS group.
DIC, disseminated intravascular coagulation.

were experienced by other donors. The overall incidence of complications was 13.2% (nine of 68) and that of biliary complication was 5.9% (four of 68). The overall incidence of wound infection was also 5.9% (four of 68). All donors returned to their normalcy within 1 year. There was no donor death in our series (Table 3).

Long-term quality of life of donors after LDLTx

Forty-eight donors (71%) responded at a mean of 1538.2 ± 1194.1 days after donation. But the response rate of donors whose recipients had died was 40.0%. All donors returned to normalcy, and no one was hospitalized (Table 4). Donors did not regret their decision to donate except for two cases whose recipients had died (LS = 1, LLM = 1).

Compared with published Japanese norms ($n = 3395$) [13] in SF-36, our donors scored similar or higher than the general population (Table 5). Donors whose recipients had major complications scored significantly lower on the mental and general health scale than those whose recipients had no major complications, but those donors still scored as well as the general population on the mental and general health scale. There were no significant differences between the donors who had complications and the donors who had no complications in all eight domains. There were also no significant differences among the four groups (LS, LL, LLM and RL) in all the eight domains.

Discussion

In this study, we retrospectively reviewed the safety of our donor operations based on various parameters. In addition, we surveyed our donors to find out as to how they perceived their experience. As a result, there were no significant differences among the four groups in maximum AST, maximum ALT and the duration of the hospitalization. There were no donor deaths in our series and the safety of donor operation was guaranteed no matter which lobe was used as the graft. Furthermore, in psychosocial outcomes of living liver donors, they did not regret

Table 4. Quality of donors' life based on our structured questionnaire.

	LS ($n = 30$)	LL ($n = 13$)	LLM ($n = 11$)	RL ($n = 9$)
The number of reply	19 (63.3%)	13 (72.2%)	7 (63.6%)	9 (100%)
Mean follow-up time	1608 ± 960	2347 ± 1095	1866 ± 930	249 ± 214
Present occupational status	19 (100%)	13 (100%)	7 (100%)	9 (100%)
General health				
Good	15 (78.9%)	12 (84.6%)	7 (100%)	9 (100%)
Not so good	3 (15.8%)	2 (1 5.4%,)	0	0
Bad	1 (5.3%)	0	0	0
In the hospital	0	0	0	0
What you think now about LDLTx				
Not regret	18	13	6	9
Regret	1	0	1	0

Table 5. Quality of donors' life based on SF-36 survey.

	Mental health	Role (emotional)	Social function	Vitality function	Physical	Role (physical)	Bodily pain	General health
US norm	74.7 ± 18.1	81.3 ± 33	83.3 ± 22.7	60.9 ± 21	84.2 ± 23.3	81 ± 34	75.2 ± 23.7	72 ± 20.3
Japanese norm	72.7 ± 19.2	83.8 ± 31.5	86.2 ± 19.4	65.3 ± 20.4	87.9 ± 15.5	85.3 ± 29.0	76.2 ± 22.7	65.0 ± 19.6
Japanese norm (30–39 years old)	72.6 ± 17.6	86.4 ± 28.8	87.1 ± 17.3	65.9 ± 19.0	92.6 ± 9.6	90.5 ± 22.6	77.2 ± 21.0	67.8 ± 17.0
All donors	86.4 ± 15.4	84.7 ± 26.6	93.7 ± 13.1	82.5 ± 16.4	95.8 ± 5.7	86.5 ± 18.6	86.2 ± 16.6	81.6 ± 17.6
No recipient complications	88.5 ± 14.1*	85.4 ± 27.9	93.9 ± 13.7	83.0 ± 15.7	96.5 ± 5.6	88.4 ± 18.6	86.9 ± 16.9	86.8 ± 11.6*
Recipients with complications	74.3 ± 18.0	81.0 ± 17.8	92.9 ± 9.8	79.3 ± 20.9	92.1 ± 4.9	75.0 ± 14.4	82.1 ± 15.8	68.6 ± 26.9
No donor complications	87.1 ± 14.4	85.4 ± 26.9	93.6 ± 13.7	82.9 ± 15.7	96.5 ± 5.6	87.2 ± 18.6	87.3 ± 16.9	82.4 ± 16.2
Donors with complications	82.3 ± 21.3	81.0 ± 26.2	94.6 ± 9.8	80.0 ± 21.0	92.1 ± 4.9	82.1 ± 18.9	79.7 ± 14.1	77.3 ± 25.2

*$P < 0.05$ versus recipients with complications.

their decision to donate except for two cases whose recipients died (LS = 1, LLM = 1) and all donors returned to normalcy within 1 year.

In our institute, the first LDLTx performed was that of an adult to a child in 1991. In 1997, we performed our first adult-to-adult LDLTx. We retrospectively assessed 68 donor operations and found that severe complications had occurred only in the early period after we started LDLTx at our hospital. However, in most cases the donors recovered without the need for surgical treatment. Recent donors developed no major complications. The decrease of donor complications was associated with the improvement of our surgical procedure. Only after one of the donors had undergone drainage operation because of biliary injury, intraoperative cholangiography was performed in all cases, which effectively prevented biliary injuries, decreasing the incidence of major complications. Renz and Roberts [14] reviewed the long-term complications of LDLTx. They reported routine donor hospital stays of less than 10 days; average donor blood losses were approximately 400–800 ml, and the need for heterologous blood transfusion for the donor was uncommon. Moreover, they reported an overall incidence of complications ranging from 15% to 20%. Biliary complications were the most commonly reported source of donor morbidity with an overall incidence of 5–10%. In the report of Japanese Liver Transplantation Society [15], donor hospital stays were 15.6 days and heterologous blood was given to 21 (1.1%) donors. The incidence of postoperative complications was 12.4% and that of biliary complication, which was also the most commonly complication, was 4.0%. But in the right graft group, the incidence of biliary complications was 10.2%. Compared with these data, donor hospital stays (11 days), average donor blood losses (718.5 ml) and the need for heterologous blood transfusion for the donor were similar in our institution. The overall incidence of complications was 13.2% and that of biliary complication was 5.9%. On the contrary, in the RL group, the incidence of biliary complications was 0%. In our institute there were no significant differences among the four groups in maximum AST, maximum ALT and the duration of hospitalization (Table 3). The safety of donor operation was guaranteed regardless of the lobe we used as the graft.

There has been limited information about psychosocial risks to living liver donors. But in a recent study by Johnson *et al.* [5] on long-term follow-up of 524 living kidney donors using the SF-36 survey, donors reported a better quality of life than the national norm. Generally, published reports on kidney donors indicate that

donors had an improved sense of well-being and self-esteem after donation [5–7]. In our study about psychosocial outcomes of living liver donors, they did not regret their decision to donate except for two cases whose recipients died. All donors returned to normalcy, with no negative impact on social or business interactions.

The results of the SF-36 demonstrated that compared with the published US and Japanese norms in all eight domains measured, the living donors scored well. With regard to general health and mental health, the results highlight the impact of the recipient's course on donor psychosocial outcome after donation (Table 5). The donors whose recipients had major complications scored significantly lower on the mental and general scale than those whose recipients had no major complications. There were no significant differences between the donors who had complications and the donors who had no complications in all the eight domains. In the living kidney donor study by Johnson *et al.* [5] and living liver donor study by Kim-Schluger *et al.*[10] similar results were found. The donors whose recipient died were more likely to say that they would not donate again.

We recognize that our brief survey could not expose some of the deeper and more complex personal issues that affect the quality of life and potential feelings of regret or resentment after donation. In addition, donors were undoubtedly aware that their responses were not anonymous and might in fact be seen by the member of the team responsible for the care of their recipients. We thought that the survey results should be reviewed by independent researchers blinded to the identity of the respondents. But if we adopted this method, it was nearly impossible to classify the groups of donors and to investigate donors' and recipients' complications. So it needs further consideration.

Furthermore we recognized that our study was limited. In fact only 71% of donors responded and 29% of donors did not respond. Moreover the response rate of donors whose recipients had died was only 40.0%. Possible reasons for the lack of response included the fact that some of them moved out and some of them, whose recipients had died, did not want to remember the transplantation. We could not disregard the possibility that these donors might be less satisfied with their experiences.

Living donor LTx has changed the way of the management for the end-stage liver disease. It is a promising option to resolve end-stage liver disease. Safe donor operation allows more patients to receive life-saving liver transplants. However the safety of donors is not 100% guaranteed. So, we must ensure that quality of life after donation remains a primary outcome measure when we consider the utility of LDLTx.

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