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Donor wound satisfaction after living-donor liver transplantation in the era of pure laparoscopic donor hepatectomy

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Abstract

Background Donor safety and cosmetic outcome are the main concerns raised by most living-donors. Pure laparoscopic living-donor hepatectomy (PLLDH) can provide the balance between those concerns. No studies evaluated the donors' satisfaction after PLLDH. The aim of this study is to evaluate the donors' satisfaction after PLLDH compared with donors who underwent open approach.

Methods We randomly assigned a questionnaire (Donor satisfaction questionnaire) to the donors, operated between 2011 and 2017, during their follow-up visits in the outpatient clinic. Donors who responded to the questionnaire were included in our study. Donors were divided into 3 groups: L group (conventional inverted L incision), M group (midline incision), and PL group (laparoscopic approach).

Results 149 donors were included in our study. L group included 60 donors (40.3%), M group included 39 patients (26.2%), and PL group included 50 patients (33.5%). There were no significant differences between the groups regarding preoperative and perioperative outcomes apart from shorter operation time in PL group and higher wound infection in M group. Body image scale was significantly better in PL group ($p=0.001$). Cosmetic scale was significantly higher in PL group ($p=0.001$). Regarding self-confidence scale, it was significantly higher in PL group ($p=0.001$). There was no significant difference between the groups regarding the sense of dullness or numbness on the scar ($p=0.113$).

Conclusion PLLDH is safe and feasible for living-donor hepatectomy. Donors operated by pure laparoscopic approach have better satisfaction scores compared to conventional open approach.

Keywords Living-donor liver transplantation · Laparoscopic donor hepatectomy · Donor quality of life

Living-donor liver transplantation (LDLT) is considered a safe alternative to deceased donor liver transplantation owing to improvements of the surgical techniques and perioperative patient care. Despite being a life-saving procedure for the recipient, the least harm to the donor is not accepted. Living-donors are healthy persons who are exposed to a major surgical procedure, in which a dominant proportion of their livers is resected. However, it remains a major surgical procedure entailing unpredicted morbidities [1–3].

A great concern raised by most living-donors is related to the large abdominal incisions utilized for conventional open approach. This caused a lot of mental and psychological stresses during the preoperative preparation affecting their decision to donate. On the other hand, the excess abdominal trauma with postoperative pain prolongs the hospital stay and delays the postoperative recovery [3, 4].

Several reports from highly specialized centers addressed good perioperative outcomes of pure laparoscopic adult living-donor hepatectomy. They addressed that pure laparoscopic approach has the advantages of better cosmesis, reduced intraoperative blood loss, and minimal abdominal trauma allowing for less postoperative pain and faster recovery. Also, pure laparoscopic approach has lower incidence

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of wound-related morbidities and intra-abdominal adhesions [5–12]. However, these reports focused mainly on the perioperative clinical outcomes. No reports evaluated the donors' satisfaction and cosmetic outcomes after pure laparoscopic living-donor hepatectomy in a well-designed manner.

The aim of this study is to evaluate the donors' satisfaction after pure laparoscopic living-donor hepatectomy compared with donors who underwent open living-donor hepatectomy by different abdominal incisions. We utilized a questionnaire designed to evaluate different aspects of donors' satisfaction including body image, cosmesis, self-confidence, and sensation at the abdominal scar. This questionnaire had been utilized for evaluation of donors' quality of life after different approaches of living-donor nephrectomy [13] and by our group for evaluation of the outcomes after open living-donor hepatectomy [14, 15].

Materials and methods

We retrospectively reviewed the data of living-donors who underwent living-donor hepatectomy at Seoul National University Hospital (SNUH), Seoul National University, Korea during the period between January 2011 and December 2017.

During the period between January 2011 and October 2015, we utilized the open approach for living-donor hepatectomy (open era). We utilized conventional L-shaped incision initially and then upper midline incision was introduced for donor hepatectomy. Laparoscopy-assisted approach was utilized in some donors during the open era. From November 2015, we utilized the pure laparoscopic approach for living-donor hepatectomy (laparoscopic era). Open approach was utilized in some donors with complex vascular variations. This study was approved by the institutional review board of SNUH, Seoul National University, Korea.

We prospectively randomly assigned a questionnaire (Donor satisfaction questionnaire) to the donors during their follow-up visits in the outpatient clinic in a fixed time period. The donor satisfaction questionnaire was assigned one time to the donors. Donors who agreed and responded to the questionnaire were included in our study. Then, we retrospectively reviewed the data of donors who responded to the questionnaire to evaluate the donors' outcomes. We also collected the data of their corresponding recipients to evaluate the recipients' outcomes.

Donor satisfaction questionnaire consists of 4 different scales. It includes body image scale (5 questions), cosmetic scale (3 questions), self-confidence scale (2 questions), and sensation scale (1 question). The total points of each scale are calculated, and higher scale points indicate better donor satisfaction. Donor satisfaction questionnaire was derived from body image questionnaire developed by Dunker et al. to evaluate the outcomes of laparoscopically assisted and open ileocolic resection [16]. This questionnaire was utilized for evaluation of donors' quality of life after different approaches of living-donor nephrectomy [13] and by our group to evaluate the outcomes after open donor hepatectomy [14, 15].

Donor selection and surgical techniques

The donors' selection criteria had been previously described [15, 17]. Generally, donors' age ranges from 16 to 60 years. Remnant liver volume less than 30% and hepatic macrovesicular steatosis more than 30% are considered a contraindication for donation [15, 17].

The surgical techniques of donor hepatectomy had been described elsewhere. All donor hepatectomies were performed by two surgeons (Suh K.S. and Lee K.W.). For open approach, we utilized either conventional inverted L or midline incisions. The inverted L-shaped incision extended in midline from the xiphoid process towards the umbilicus and then transversely towards the right subcostal area (Fig. 1A). The upper midline incision extended from xiphoid process for about 12 to 18 cm in length depending on abdominal cavity shape (Fig. 1B).

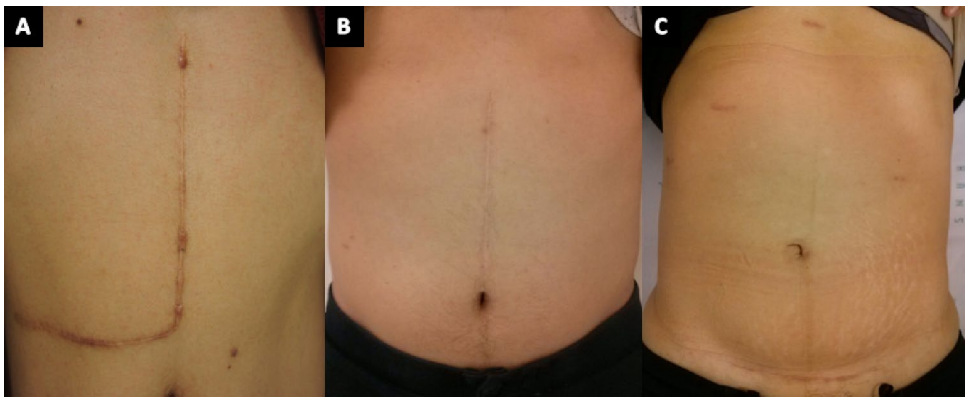

Fig. 1 Shape of the abdominal scars after different donor hepatectomy approaches. **A** Conventional L-shaped incision, **B** Midline incision, **C** Pure laparoscopic approach

For pure laparoscopic approach, CO_2 pneumoperitoneum was maintained at 12 mmHg, and five trocars were used (four 12 mm and one 5 mm trocars) (Fig. 1C). The liver graft was placed in endo-bag and extracted through a Pfannenstiel incision at the suprapubic area. Pfannenstiel incision ranged from 10 to 12 cm in length [5, 6].

Definitions

Postoperative morbidities are defined as adverse events occurring during the postoperative course and graded according to Clavien–Dindo grades [18]. Severe postoperative morbidities were grade III or higher. Early mortality is defined as patient death during the first 90 days after transplantation.

Statistical analysis

Categorical variables were addressed as numbers and percentages. Shapiro–Wilk test was used to assess the normality of the data. Normally distributed variables were addressed as means ± standard deviations, while non-normally distributed variables were addressed as medians and ranges. Comparison between the groups was done by Chi-square test for categorical variables, and One-way ANOVA and Kruskal–Wallis tests for variables when appropriate.

Statistical analysis was performed using SPSS V-20 software (IBM, Chicago, IL, USA). A p value less than 0.05 was considered statistically significant.

Results

During the study period, 662 patients underwent LDLT at SNUH, Seoul National University, Korea. We excluded 27 donors who underwent left lateral sectionectomy (pediatric patients) and 45 donors who underwent laparoscopy-assisted approach. So finally, we had 422 donors during the open approach era (January 2011 to October 2015) and 168 donors during the pure laparoscopic era (November 2015 to December 2017). 149 donors responded to the randomly assigned questionnaire in the outpatient clinic and were included in our study (Fig. 2).

Patients were divided into 3 groups. L group included 60 patients (40.3%) who underwent donor hepatectomy by conventional inverted L incision. M group included 39 patients (26.2%) who underwent donor hepatectomy by midline incision. PL group included 50 patients (33.5%) who underwent donor hepatectomy by pure 3D laparoscopic approach.

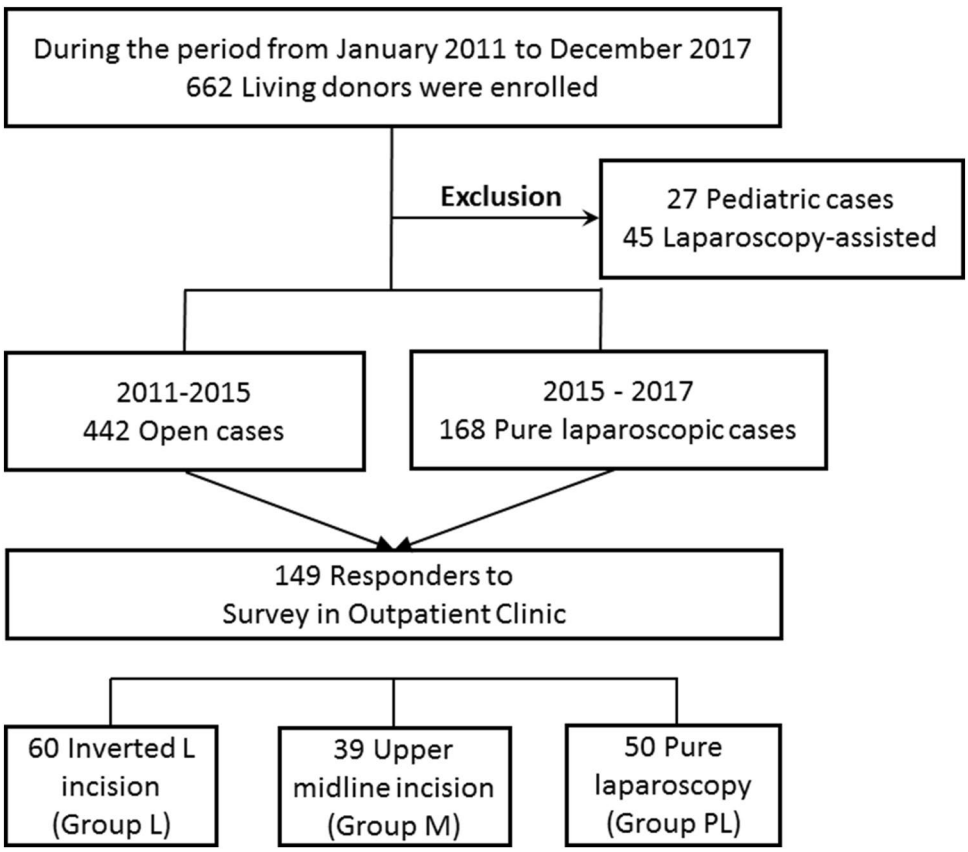

Fig. 2 Flow chart of the study donors

Donor data

Preoperative characteristics

The preoperative characteristics of the study donors are shown in Table 1. There were no significant differences between the study donors regarding preoperative characteristics. Right hemi-liver graft was the mostly commonly harvested graft.

Operative outcomes

The operative outcomes of the study donors are shown in Table 1. Shorter operation time was noticed in PL group. No open conversions occurred in PL group. There was no significant difference between groups regarding intraoperative blood loss. No perioperative transfusion was required for the study donors. None of the donors experienced any intraoperative complications.

Postoperative outcomes

The postoperative outcomes of the study donors are shown in Table 1. All donors were encouraged to start ambulation and oral fluid intake on the first postoperative day. There were no significant differences between groups regarding hospital stay, overall morbidities, and their severity according to Clavien–Dindo grades. Higher incidence of wound infection was noticed in M group. Lower postoperative peak serum bilirubin, aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were noticed in PL group.

Donor satisfaction questionnaire

The results of the donor satisfaction questionnaires are shown in Table 2. Body image scale was significantly better in PL group ($p = 0.001$). Cosmetic scale was significantly higher in PL group ($p = 0.001$), and all components of the scale were significantly higher in PL group.

Table 1 Preoperative characteristics and perioperative outcomes of the donors (*AST* aspartate aminotransferase, *ALT* alanine aminotransferase)

Variables	L Group ($n = 60$)	M Group ($n = 39$)	PL Group ($n = 50$)	p value
Preoperative characteristics				
Age (years)	30.4 ± 8.8	33.1 ± 10	33.5 ± 10.9	0.321
Gender				0.477
Male	42 (70%)	30 (76.9%)	24 (48%)	
Female	18 (30%)	9 (23.1%)	26 (52%)	
Height (cm)	169.0 ± 8.6	170.7 ± 7.8	167.5 ± 8.7	0.321
Weight (kg)	67.7 ± 11.7	68.7 ± 10.9	66.7 ± 12.0	0.798
Body mass index (kg/m^2)	23.7 ± 3.2	23.7 ± 2.9	23.9 ± 2.6	0.455
Operative data				
Operation time (min)	282.5 ± 52.5	300.3 ± 61.4	266.1 ± 56.1	0.019
Estimated blood loss (mL)	372.5 ± 308	354.4 ± 174	276 ± 198	0.111
Blood transfusion	No	No	No	–
Postoperative data				
Hospital stay (days)	8.02 ± 3.7	7.00 ± 0.87	7.12 ± 2.1	0.06
Peak total bilirubin (mg/dL)	2.27 ± 1.7	2.54 ± 1.4	1.86 ± 0.6	0.021
Peak AST (IU/L)	135.5 ± 68.9	135.1 ± 38.2	89.2 ± 79.5	0.001
Peak ALT (IU/L)	138.0 ± 80.4	128.6 ± 48.7	112.6 ± 96.1	0.319
Postoperative morbidities	6 (10%)	7 (17.9%)	2 (4%)	0.387
Clavien–Dindo grades				0.357
I	4 (6.7%)	2 (5.1%)	2 (4%)	
II	0	3 (7.7%)	0	
III	2 (3.3%)	2 (5.1%)	0	
Hyper-bilirubinemia	1 (1.7%)	0	0	0.613
Fluid collection	1 (1.7%)	0	0	0.613
Pleural effusion	2 (3.3%)	1 (2.6%)	1 (2%)	0.93
Ileus	0	1 (2.6%)	0	0.324
Wound seroma	0	0	1 (2%)	0.107
Wound infection	0	3 (7.7%)	0	0.032
Biliary complications	2 (3.3%)	2 (5.1%)	0	0.537

Table 2 Donor satisfaction questionnaire results in the different groups

Questionnaire		L Group ($n=60$)	M Group ($n=39$)	PL Group ($n=50$)	p value
Body image scale					
Are you less satisfied with your body since the operation?	1. Yes, extremely 2. Quite a bit 3. A little bit 4. No, not at all	2.68 ± 0.88	3.03 ± 0.12	3.36 ± 0.74	0.001
Do you think the operation has damaged your body?	1. Yes, extremely 2. Quite a bit 3. A little bit 4. No, not at all	3.01 ± 0.91	3.28 ± 0.11	3.60 ± 0.67	0.001
Do you feel less attractive as a result of your operation?	1. Yes, extremely 2. Quite a bit 3. A little bit 4. No, not at all	2.89 ± 0.10	3.31 ± 0.11	3.68 ± 0.62	0.001
Do you feel less feminine/masculine as a result of your operation?	1. Yes, extremely 2. Quite a bit 3. A little bit 4. No, not at all	3.27 ± 0.87	3.49 ± 0.10	3.70 ± 0.68	0.048
Is it difficult to look at yourself naked?	1. Yes, extremely 2. Quite a bit 3. A little bit 4. No, not at all	3.16 ± 0.89	3.49 ± 0.12	3.86 ± 0.49	0.001
Total score		13.1 ± 1.97	11.9 ± 2.69	18.2 ± 2.37	0.001
Cosmetic scale					
How satisfied are you with your scar?	1. Very unsatisfied 7. Very satisfied	4.71 ± 0.16	5.67 ± 0.18	5.94 ± 0.22	0.000
Could you score your own scar on another person?	1. Very bad 10. Great	4.39 ± 0.16	4.95 ± 0.19	5.71 ± 0.24	0.000
Could you score your own scar?	1. Very bad 10. Great	6.25 ± 0.25	7.62 ± 0.34	8.26 ± 1.77	0.000
Total score		18.2 ± 3.62	15.3 ± 4.73	19.9 ± 3.82	0.000
Self-confidence scale					
How confident were you before your operation?	1. Not very confident 10. Very confident	5.87 ± 0.27	6.72 ± 0.34	6.92 ± 2.69	0.130
How confident were you after your operation?	1. Not very confident 10. Very confident	6.24 ± 0.26	7.72 ± 0.29	8.80 ± 1.22	0.000
Total score		14.4 ± 3.62	12.1 ± 4.73	15.7 ± 3.28	0.001
Sensation scale					
Do you have dullness or numbness on the scar?	Yes	22 (36.7%)	7 (17.9%)	11 (22%)	0.113
	No	38 (63.3%)	32 (82.1%)	39 (78%)	

Regarding self-confidence scale, it was significantly higher in PL group ($p=0.001$). There was no significant difference between the groups regarding self-confidence before operation ($p=0.13$), which became significantly higher in PL group after operation ($p<0.001$). There was no significant difference between the groups regarding the sense of dullness or numbness on the scar ($p=0.113$).

Recipient data

Preoperative characteristics

The preoperative characteristics of the study recipients are shown in Table 3. There were no significant differences between the groups regarding preoperative characteristics.

Table 3 Preoperative characteristics and perioperative outcomes of the recipients (*MELD* model for end stage liver disease, *HA* hepatic artery, *PV* portal vein)

Variables	L Group ($n=60$)	M Group ($n=39$)	PL Group ($n=50$)	p value
Preoperative data				
Age (years)	51.4 ± 13.4	50.3 ± 15.1	52.7 ± 9.8	0.403
Gender				0.861
Male	50 (83.3%)	31 (79.5%)	38 (76%)	
Female	10 (16.7%)	8 (20.5%)	12 (24%)	
Body mass index (kg/m^2)	23.4 ± 3	23.6 ± 3.1	24.3 ± 2.7	0.906
MELD score	15.3 ± 6.5	15.7 ± 7	17 ± 4.8	0.515
ABO compatibility				0.655
Compatible	58 (96.7%)	37 (94.9%)	42 (84%)	
Incompatible	2 (3.3%)	2 (5.1%)	8 (16%)	
Operative data				
Operation time (min)	487 ± 72.3	453.3 ± 92.5	439 ± 90.3	0.028
Estimated blood loss (mL)	1815 (170–15,000)	1050 (300–7150)	1700 (200–13,900)	0.002
Blood transfusion	47 (78.3%)	20 (51.3%)	16 (32%)	0.004
Postoperative data				
Hospital stay (days)	19.5 (11–167)	19 (13–269)	18 (13–71)	0.437
Severe postoperative morbidities	16 (26.7%)	11 (28.2%)	9 (18%)	0.682
Clavien–Dindo grades				0.657
III-a	2 (3.3%)	0	4 (8%)	
III-b	12 (20%)	11 (28.2%)	5 (10%)	
V	2 (3.3%)	0	0	
Biliary complications	10 (16.7%)	9 (23.1%)	7 (14%)	0.468
Leakage	1 (1.7%)	0	1 (2%)	0.463
Strictures	9 (15%)	9 (23.1%)	6 (12%)	0.491
Vascular complications	2 (3.3%)	2 (5.1%)	2 (4%)	0.655
HA thrombosis	1 (1.7%)	2 (5.1%)	1 (2%)	0.493
PV stenosis	1 (1.7%)	0	1 (2%)	0.462
Internal hemorrhage	2 (3.3%)	2 (5.1%)	2 (4%)	0.906
Wound problem	0	1 (2.6%)	0	0.333
Reoperation	3 (5%)	4 (10.3%)	1 (2%)	0.498
Early mortality	2 (3.3%)	0	0	0.388

Operative outcomes

The operative outcomes of the study recipients are shown in Table 3. The operation time was longer in L group. The intraoperative blood loss and transfusion requirements were higher in L group.

Postoperative outcomes

The postoperative outcomes of the study recipients are shown in Table 3. There was no significant difference between the groups regarding the overall hospital stay. There were no significant differences between the groups regarding overall morbidities and their severity according to Clavien–Dindo grades, early mortality, and reoperation rate.

Discussion

Laparoscopic liver surgery has gained a worldwide acceptance and is widely applied in the management of different liver lesions [19–21]. The success of the laparoscopic approach allowed its gradual expansion to the field of LDLT. Nowadays, pure laparoscopic adult living-donor hepatectomy has been increasingly performed. Several reports from highly specialized centers in LDLT and laparoscopic surgery addressed the safety and feasibility of pure laparoscopic adult living-donor hepatectomy [5–12]. They reported comparative operative and postoperative clinical outcomes including less blood loss, less postoperative pain and analgesics requirements, and shorter hospital stay. In terms of donors' satisfaction and quality of life after operation, no previous reports evaluated the

outcomes of the pure laparoscopic approach in a well-designed method. Previous reports only addressed that laparoscopic approach is associated with better cosmesis and less wound-related morbidities.

In this study, we evaluated the donors' satisfaction and quality of life after pure laparoscopic living-donor hepatectomy compared with donors who underwent open donor hepatectomy by different abdominal incisions. We utilized a well-designed questionnaire to evaluate different aspects of donors' satisfaction including body image, cosmesis, self-confidence, and sensation at the abdominal scar. This questionnaire was previously utilized in evaluation of the outcomes of different approaches of living-donor nephrectomy [13] and by our group in evaluation of the outcomes after open living-donor hepatectomy [14, 15].

An important issue released by potential living-donors is the length and location of the abdominal incision. This issue strongly impacts their decision to donate, and causes a lot of mental and psychological stresses not only for the potential donors but also their related recipients. Efforts are being made by transplant surgeons to overcome those stresses and further motivate living-donors [22]. By the utilization of the laparoscopic approach, the liver graft is extracted through a Pfannenstiel incision (10 to 12 cm in length) which is small and hidden in the lower abdomen. This is greatly acceptable among potential donors and endorses their decision for donation.

Regarding the perioperative clinical outcomes of the donors in this study, there were no significant differences between the laparoscopic and open groups apart from shorter operation time and lower postoperative peak serum bilirubin, and AST and ALT were noticed in the laparoscopic group. This is attributed to the impact of the learning curve. Recently, we reported shortened operation time and minimized liver injury during manipulation with accumulating experience of the laparoscopic approach [5]. It should be noted that we did not experience any intraoperative complications that required conversion to open approach.

The life style of the donors is affected by donation. Sotiropoulos et al. reported that common donors' concerns after living-donation utilizing the open approach are abdominal bloating, loss of the muscle tone, poor body image, and fatigue [23]. Ishizaki et al. reported that 24% of the donors experienced wound-related complaints as throbbing, itching, and numbness after open approach [24]. In our study, we utilized a well-designed questionnaire to evaluate donors' satisfaction after liver donation. The results of the questionnaire for patient satisfaction were better in pure laparoscopic approach compared to open approach by different incisions. Body image scale was significantly better in pure laparoscopic approach. Donors in PL group were more satisfied with their bodies since the operation and had less negative attitude towards the operation. Similarly, cosmetic scale was significantly better in pure laparoscopic approach. Regarding self-confidence scale, it was interestingly increased in all the study groups after living-donor hepatectomy. This could be related to the donors' feeling that they contributed towards saving the life of their relatives, especially parents. So, they did not feel like inferior after this kind of operation. A significant improvement can be more noticed in PL group compared to other groups.

Scar itching and numbness are frequent complaints after liver donation. This is related to the division of abdominal musculature and cutaneous nerves with subsequent healing with fibrosis. Ishizaki et al. reported that 24% of the donors experienced wound-related complaints after open donation [24]. Sotiropoulos et al. reported wound pain, wound scar sensation, and upper abdominal pain in 51% of the donors after open donation [23]. In our study, there was no significant difference between the groups regarding the sense of dullness or numbness on the scar among the different approaches. It should be noted that donor's wound complaints are correlated with the follow-up duration. Donors with longer follow-up duration adopt and accept their abdominal scars so experience less wound-related complaints [13]. In our study, the follow-up duration was shorter in the PL group. This may explain the comparative wound-related complaints among the study groups.

The procured grafts by the different approaches were transplanted safely and functioned well in all recipients. There were no significant differences among the study groups regarding overall postoperative morbidities and their severity according to Clavien–Dindo grades, early postoperative mortality, and reoperation rate. This addresses the safety of the laparoscopic approaches which did not compromise the quality of the procured grafts.

Our study has several limitations. It is limited by small number of donors. It is a non-matched study depending on the random response of the donors to be included in our study. Also, donors included were operated during different periods. This is related to the natural progression of living-donor hepatectomy techniques. In the early open approach era, laparoscopy-assisted approach was utilized in some donors with favorable anatomic variations. In the recent era, laparoscopic approach is utilized in almost 90% of the donors, while open approach is utilized in some donors with complex vascular variations [5, 6]. So, recruiting donors from the same period is difficult and liable to selection bias.

In conclusion, laparoscopic approach is safe and feasible for living-donor hepatectomy. To the best of our knowledge, this is the first study evaluating the donors' quality of life and satisfaction after pure laparoscopic living-donor hepatectomy. Donors operated by pure laparoscopic approach have better satisfaction including body image, cosmesis, self-confidence, and abdominal scar sensations compared to open approach by different abdominal incisions.

Compliance with ethical standards

Disclosure Lee JM, Shehta A, Lee KW, Hong SK, Cho JH, Yi NJ, and Suh KS have no conflicts of interest or financial ties to disclose.

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