LIVER TRANSPLANTATION 21:670–682, 2015

ORIGINAL ARTICLE

Patterns and Predictors of Sexual Function After Liver Donation: The Adult-to-Adult Living Donor Liver Transplantation Cohort Study

Andrea F. DiMartini,[1,2] **Mary Amanda Dew,**[1,3,4,5] **Zeeshan Butt,**[6,7,8,9] **Mary Ann Simpson,**[11] **Daniela P. Ladner,**[6,7,8,10] **Abigail R. Smith,**[12,13] **Peg Hill-Callahan,**[13] **and Brenda W. Gillespie**[12]

Departments of [1]Psychiatry, [2]Surgery, [3]Psychology, [4]Epidemiology, and [5]Biostatistics, University of Pittsburgh, Pittsburgh, PA; [6]Department of Medical Social Sciences, [7]Northwestern University Transplant Outcomes Research Collaborative, [8]Comprehensive Transplant Center, [9]Department of Psychiatry and Behavioral Sciences, and [10]Center for Healthcare Studies, Northwestern University Feinberg School of Medicine, Chicago, IL; [11]Clinical Research and Education and Department of Transplantation, Lahey Hospital and Medical Center, Burlington, MA; [12]Department of Biostatistics, University of Michigan, Ann Arbor, MI; and [13]Arbor Research Collaborative for Health, Ann Arbor, MI

Although sexual functioning is an important facet of a living donor's quality of life, it has not received an extensive evaluation in this population. Using data from the Adult-to-Adult Living Donor Liver Transplantation Cohort Study, we examined donor sexual functioning across the donation process from the predonation evaluation to 3 months and 1 year after donation. Donors (n = 208) and a comparison group of nondonors (n = 155) completed self-reported surveys with specific questions on sexual desire, satisfaction, orgasm, and (for men) erectile function. Across the 3 time points, donor sexual functioning was lower at the evaluation phase and 3 months after donation versus 1 year after donation. In the early recovery period, abdominal pain was associated with difficulty reaching orgasm [odds ratio (OR), 3.98; 95% confidence interval (CI), 1.30-12.16], concerns over appearance were associated with lower sexual desire (OR, 4.14; 95% CI, 1.02-16.79), and not feeling back to normal was associated with dissatisfaction with sexual life (OR, 3.58; 95% CI, 1.43-8.99). Efforts to educate donors

Additional Supporting Information may be found in the online version of this article.

Abbreviations: A2ALL, Adult-to-Adult Living Donor Liver Transplantation Cohort Study; BMI, body mass index; CI, confidence interval; HRQOL, health-related quality of life; OR, odds ratio; SD, standard deviation; SE, standard error.

This study was supported by the National Institute of Diabetes and Digestive and Kidney Diseases through cooperative agreements (grants U01-DK62444, U01-DK62467, U01-DK62483, U01-DK62484, U01-DK62494, U01-DK62496, U01-DK62498, U01-DK62505, U01-DK62531, U01 DK085587, U01-DK85515, and U01-DK62536). Additional support was provided by the Health Resources and Services Administration and the American Society of Transplant Surgeons.

The supplemental data included here have been supplied by the Minneapolis Medical Research Foundation as the contractor for the Scientific Registry of Transplant Recipients. The interpretation and reporting of these data are the responsibility of the authors and in no way should be seen as an official policy of or interpretation by the Scientific Registry of Transplant Recipients or the US Government.

The Scientific Registry of Transplant Recipients data system includes data on all donors, wait-listed candidates, and transplant recipients in the United States submitted by members of the Organ Procurement and Transplantation Network, and it has been described elsewhere. The Health Resources and Services Administration of the US Department of Health and Human Services provides oversight for the activities of the Organ Procurement and Transplantation Network and Scientific Registry of Transplant Recipients contractors.

Potential conflict of interest: Nothing to report.

The members of the Adult-to-Adult Living Donor Liver Transplantation Cohort Study are included in the supporting information.

Address reprint requests to Andrea DiMartini, M.D., University of Pittsburgh Western Psychiatric Institute and Clinic, 3811 O'Hara Street, Pittsburgh, PA 15213. Telephone: 412-692-4797; FAX: 412-586-9255; E-mail: dimartiniaf@upmc.edu

DOI 10.1002/lt.24108

View this article online at wileyonlinelibrary.com.

LIVER TRANSPLANTATION.DOI 10.1002/lt. *Published on behalf of the American Association for the Study of Liver Diseases*

before the surgery and prepare them for the early recovery phase may improve recovery and reduce distress regarding sexual functioning. ***Liver Transpl 21:670-682, 2015***. **© 2015 AASLD.**

Received December 11, 2014; accepted February 8, 2015.

Living liver donors offer a portion of their own healthy liver to save the life of another. Because donors make a personal sacrifice to enhance the welfare of another, efforts to prevent adverse health and quality-of-life outcomes are essential. Much has been written about the health-related quality of life (HRQOL) of donors, their typically high levels of functioning before and after donation, and their often quick physical recovery.[1-7] However, to date, there has been little examination of donor sexual functioning through the donation process. A single-center study that included 1 question about whether donation had affected sexual function or intimacy showed that nearly 50% of donors reported worsened sexual functioning 1 week to 1 month after donation, but most reported a return to the baseline at 3 months after donation.[2] A retrospective cross-sectional survey of liver donors' HRQOL that asked a single question about sexual functioning found that those who reported a lower perception of body image and cosmesis reported significantly greater interference in their sex lives.[8]

Thus, with the intent to identify the scope and extent of donor sexual concerns, we examined donor sexual functioning before and after donation with the multisite Adult-to-Adult Living Donor Liver Transplantation Cohort Study (A2ALL). The purpose of our study was (1) to describe the sexual functioning of liver donors, including changes through the first year after donation, and (2) to evaluate whether and to what extent donation-related factors (eg, self-reported recovery from the surgery, physical symptoms, pain, appearance, and health concerns) were associated with poorer sexual functioning.

PATIENTS AND METHODS

Study Design and Cohort Definitions

The A2ALL consortium consisted of 9 North American transplant centers with data collected on potential living liver donors and their recipients. Patients were recruited from 2004 to 2009 with follow-up through August 2010. All individuals evaluated for living liver donation at these centers were asked to complete HRQOL surveys, including sexual functioning questions. Potential donors could enter the study during the donor evaluation process or at a later time point if they had already donated. Surveys were administered at evaluation and at 3 months and 1 year after donation and at evaluation and 3 months and 12 months after evaluation for those who did not donate (nondonors). For participants who enrolled after donation, the surveys were administered according to the protocol visit schedule and were started with the visit window after donation. Clinical information, including data on donor hospitalizations, complications, and recipient outcomes, was collected from the medical record, which was supplemented with data from the Scientific Registry of Transplant Recipients.

Of the 971 consenting potential donors, 170 were excluded because they enrolled in the A2ALL protocol more than 2 years after donation or evaluation and were beyond the time points of interest (Fig. 1). An additional 142 nondonating candidates were excluded because of factors that may have made their reports of sexual functioning less comparable to those of actual donors; for example, those who declined to donate or were rejected as donors for medical or psychosocial contraindications were excluded. Of the remaining 659 who were eligible to be donors, 293 were donors, and 366 were nondonors. Nondonors did not donate mostly because of recipient (eg, the recipient received a deceased donation) or anatomical reasons. Surveys were completed at the evaluation phase before it was known that the nondonors would not donate. We chose nondonors to be the control group because they would be similar to the donor group with respect to health and psychological functioning. Donors are healthier than the general population of age-matched individuals because they are specifically screened to not have medical or psychosocial issues. Thus, a comparable group would be eligible donors who eventually did not donate mostly because of recipient reasons and not because they had medical or psychological issues that prevented them from donating. Of those, 208 donors (71%) and 155 nondonors (42%) completed at least 1 sexual functioning questionnaire and were included in the analyses. There were no statistical differences between responders and nonresponders in demographics or for donors in postdonation factors (complications, hospitalizations, or recipient death/retransplantation).

Human Subjects Protection

A2ALL, which collected the data in the present report, was approved by the institutional review boards and privacy boards of the University of Michigan Data Coordinating Center and each of the 9 participating transplant centers. All participants provided written informed consent.

Instruments and Measures (see Table 1)

Surveys were self-administered. The questions were preceded by a statement that responses would be kept confidential and not revealed to the transplant team.

Sexual Functioning Questions

Of the component parts of sexual activity, desire, erectile function (for men), and overall sexual

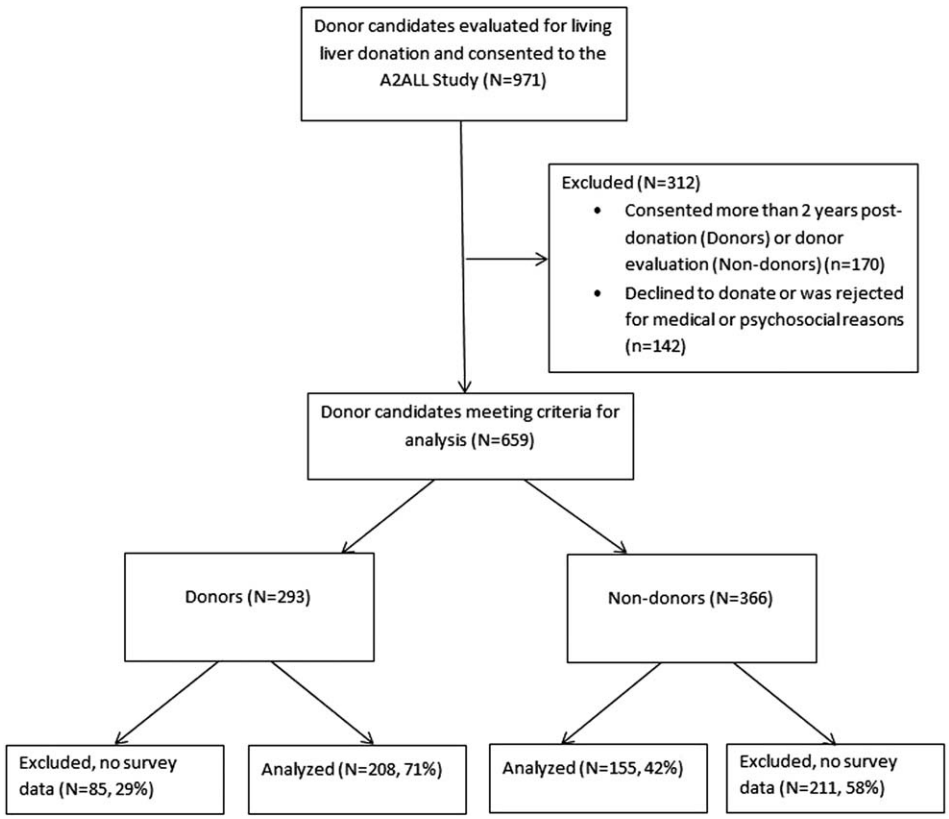

Figure 1. Study flow diagram showing the number of donors who consented and were excluded from the analysis because of ineligibility and the number of subjects with (analyzed) and without (not analyzed) sexual functioning survey responses in the first year after donation.

satisfaction are considered some of the most important dimensions of sexual functioning.[9] Self-report surveys are considered one of the most valid ways to assess sexual functioning.[9] Specific questions addressing each of these areas for men and women were developed and validated by expert sexuality researchers,[9,10,13] and they have been used in studies of sexual functioning after general and urological/gynecological surgery.[14-16] Donors were surveyed with 4 of these questions covering core sexual functioning areas: 3 assessed both men and women (orgasmic function, desire, and overall satisfaction), and a fourth item assessed men (erectile function). The time frame for each item was the prior month. We dichotomized responses on each sexual functioning item into those endorsing the item half the time or less (poorer sexual functioning) versus those endorsing better sexual functioning. For questions about erectile and orgasmic function, responses of no sexual activity (either stimulation or intercourse) were included in the poorer functioning group. The question on satisfaction with sex life was dichotomized as satisfied versus neutral or dissatisfied.

Postdonation Covariates: Symptoms and Concerns

Postdonation surveys included items on recovery (fully recovered versus not), being physically back to normal (yes versus no), pain (any versus none), pain interference with functioning (any versus never), bowel symptoms interfering with functioning (any versus never), and physical appearance (same/better versus worse). Symptoms of depression were elicited with 2 screening questions from the Mini-International Neuropsychiatric Interview[12] on the 2 cardinal symptoms of depression required for the clinical diagnosis (present or not; see Table 1).

Several validated instruments assessing donation-specific concerns (eg, relationships, satisfaction with donation, and health concerns related to donation)[11] have been used extensively in bone marrow,[17-20] kidney,[21,22] and liver[23,24] donation research. From these instruments, we chose health concerns related to the donation experience as the most relevant to sexual functioning. Four individual items representing the donation-related health concerns domain were assessed: the future negative effects of donation on health (agree versus disagree), worries about current health (any worries versus none), frequency of worries (often to sometimes versus almost never), and worries about never feeling physically 100% again (agree versus disagree).

Demographic and Donor Medical Outcomes

Basic demographics, the relationship with the actual/intended recipient, medical comorbidities, smoking

TABLE 1. Donor Survey Questions and Sources

Content Area	Specific Questions	Source	Scoring
Sexual Functioning Questions			
Desire or interest	Over the past month, how often did you feel sexual desire or interest? • Almost always or always • Most times (more than half the time) • Sometimes (about half the time) • A few times (less than half the time) • Almost never or never	For female questions, see Rosen et al.[9] (2000) For male questions, see Rosen et al.[10] (1997)	For questions on desire, orgasm/ejaculate and erection: • Poorer functioning = sometimes, a few times, almost never/never • For satisfaction question: • Poorer functioning = about equally satisfied/dissatisfied, moderately dissatisfied, very dissatisfied
Orgasm/ejaculate	Over the past month, when you had sexual stimulation or intercourse, how often did you reach orgasm (climax)/ejaculate? • Almost always or always • Most times (more than half the time) • Sometimes (about half the time) • A few times (less than half the time) • Almost never or never • No sexual stimulation/intercourse		
Satisfaction with sexual life	Over the past month, how satisfied have you been with your overall sexual life? • Very satisfied • Moderately satisfied • About equally satisfied and dissatisfied • Moderately dissatisfied • Very dissatisfied		
Ability to get an erection (for men only)	Over the past month, how often were you able to get an erection during sexual activity? • Almost always or always • Most times (more than half the time) • Sometimes (about half the time) • A few times (less than half the time) • Almost never or never • No sexual activity		
Postdonation Covariates: Donation-Specific Worries			
Content Area	Specific Questions	Source	
Worries about health related to donation	How often do you worry about the physical effects on you of having donated a part of your liver? • Often • Sometimes • Almost never	See Simmons et al.[11] (1987)	
	Would you say you are... • Very worried about your own health now • Somewhat worried • A little worried • Not at all worried about your own health now		
	Sometimes I worry that the liver donation will have negative effects on my health in the future. • Strongly agree • Agree • Disagree • Strongly disagree		
	Since my liver donation, I worry that I will never feel physically 100% well again. • Strongly agree • Agree • Disagree • Strongly disagree		

TABLE 1. *Continued*

Content Area	Specific Questions	Source	Scoring
Physical Appearance, Symptoms, and Recovery			
Bodily appearance	Compared to before donation, my general or overall physical appearance now is: • Much worse • Worse • The same • Better • Much better	Survey items created by A2ALL investigators to capture these donation-specific issues	
Abdominal pain and bowel symptoms	Abdominal pain interferes with my daily life Never Rarely Sometimes Often Always The amount of abdominal pain I have today is • None • Mild • Moderate • Severe • Very severe		
Extent of recovery	My bowel symptoms interfere with daily life • Never • Rarely • Sometimes • Often • Always Do you feel completely recovered now? • Yes • No If no, how would you rate your percentage of recovery now? • 81%-100% • 61%-80% • 41%-60% • 21%-40% • 0%-20% Compared to what I expected, my recovery has been: • Much slower • Slower • As expected • Faster • Much faster Physically, do you feel back to normal? • Yes • No		
Depression symptoms	In the past 2 weeks, have you been much less interested in most things or much less able to enjoy the things you used to enjoy most of the time? • Yes • No Have you been consistently depressed or down, most of the day, nearly every day, for the past 2 weeks? • Yes • No	See Sheehan et al.[12] (1998)	

TABLE 2. Characteristics of Living Liver Donors and Nondonors at the Predonation Evaluation Stage

	Actual Donors (n = 208), % (n) or Mean (SD)	Nondonors (n = 155), % (n) or Mean (SD)	*P* Value*
Age at evaluation, years	37.9 (10.2)	37.4 (10.6)	0.612
18-29 years	27% (56)	30% (47)	
30-39 years	31% (64)	24% (37)	
40-49 years	27% (56)	35% (54)	
≥50 years	15% (32)	11% (17)	
Male	45% (94)	52% (80)	0.23
Hispanic	12% (24)	17% (26)	0.15
White	94% (195)	85% (131)	0.004
BMI at evaluation (kg/m^2)	26.4 (4.1)	27.3 (5.3)	0.09
High school education or less†	23% (48)	22% (34)	0.85
Current or previous smoker	24% (49)	30% (46)	0.19
History of depression	8% (16)	8% (13)	0.81
Dyslipidemia	7% (14)	7% (11)	0.89
Coronary artery disease	0% (0)	1% (1)	0.43
Pulmonary disease	3% (6)	2% (3)	0.74
Diabetes	<1% (1)	0% (0)	>0.99
Hypertension	3% (7)	1% (2)	0.31
Relationship to recipient			0.91
Biological	65% (136)	66% (103)	
Nonbiological, spouse	6% (12)	6% (10)	
Other nonbiological	29% (60)	27% (42)	
Married/long-term partner	37% (77)	49% (76)	0.02

*Chi-square Fisher's exact, or *t* test.
†Missing in 10% of subjects.

status, and body mass index (BMI) were obtained from medical records. Marital/relationship status and educational level were asked by survey. For donors, data on the liver lobe donated, medical complications (number and Clavien grade), number of rehospitalizations, and recipient status at follow-up (alive, deceased, or retransplanted) were collected from medical record reviews. Donors were asked about current pain medication usage. After donation, women were asked whether they were pregnant or attempting to become pregnant.

Data Considerations

A2ALL represents 79% of living donors from the corresponding era. Those who did and did not enroll in A2ALL were similar in age (37.4 ± 10.1 and 36.2 ± 10.3 years, respectively; $P = 0.43$), and similar percentages were enrolled by sex (80% among females and 77% among males; $P = 0.53$). However, white, native, and multiracial donors were more likely to enroll (82%) than blacks (63% of 16 donors) or Asians (36% of 14 donors; $P < 0.001$). Of the 208 donors analyzed, 122 completed the questionnaire at the evaluation, 105 completed it 3 months after donation, and 107 completed it 1 year after donation. Eighty-two donors responded at the evaluation and at least 1 postdonation time point of interest (3 months and/or 1 year after donation). Of the 155 nondonors, 134 responded at the evaluation, 21 responded 3 months after the evaluation, and 13 responded 1 year after the evaluation. Only 13 nondonors responded at multiple time points, and only 12 responded at the evaluation and 1 postevaluation time point; thus, there were too few nondonors to consider for the longitudinal analyses. Among eligible donors and nondonors, no significant differences existed between those analyzed or excluded in the demographic variables in Table 2.

To maximize response rates, surveys were administered in several formats: tablet computers (n = 341), paper forms (n = 157), and a web-based format (n = 4). No statistical differences existed between the tablet and paper formats for any of the sexual functioning questions.

Statistical Analysis

Characteristics of donors and nondonors were compared with *t* tests for continuous variables and with chi-square or Fisher's exact tests for categorical variables. Graphs of the proportion indicating poorer sexual function included standard error (SE) bars based on the binomial distribution.

Potential predictors of poor sexual function were first evaluated at each time point for each question. Both donors and nondonors were included in models at evaluation; only donors were included in postdonation models. Covariates considered included donation age, sex, race, ethnicity, relationship to recipient, marital status, education, BMI, smoking history, history and current symptoms of depression, and

dyslipidemia. Diabetes, pulmonary disease, heart disease, and hypertension were uncommon and not tested. Covariates considered for the postdonation models additionally included the lobe donated and measures from the given survey or earlier: number of hospitalizations, number of complications (overall and severity), medications for pain, recipient death or retransplant, depressive symptoms, abdominal pain, bowel symptoms, concerns about appearance, and donation-related worries. Variable selection used the method of best subsets,[25] with sex retained even if not significant. Results are presented as odds ratios (ORs) with 95% confidence intervals (CIs).

To investigate changes in the probability of poorer sexual function following donation, repeated measures logistic models were fit to the subgroup with the evaluation and at least 1 postdonation survey; a compound symmetry covariance structure was used. This method yields unbiased inference even if subjects have missing surveys at some time points under the assumption that the missing data mechanism is ignorable. The covariates considered previously were tested with adjustments for sex and time point. The interactions between sex and time were tested but were not found to be significant. Results are presented as predicted probabilities of poorer sexual function, with *P* values given for tests of sex differences and pairwise time point differences. Predonation sexual function was also tested as a predictor of postdonation function with a similar model that included predonation function as a covariate.

RESULTS

Descriptive Results

Donors and nondonors were similar in most baseline demographic characteristics. They were predominantly white, were evenly divided between men and women, and were on average 37.7 years old (Table 2). Only 0% to 3% had medical comorbidities of diabetes, pulmonary disease, heart disease, or hypertension. Dyslipidemia (7% of both groups) was not significantly associated with sexual functioning. The majority intended to donate to a biological relative, and a small percentage intended to donate to a spouse. Compared to nondonors, donors were more likely to be white and unmarried. Three female donors reported attempting to get pregnant in the year after donation.

Among donors, most donated the right lobe of their liver, and after the initial donation hospitalization, most were not hospitalized again during the first year (Table 3). Most complications occurred within the first 3 months, with 36% experiencing at least 1 complication within the first year. The highest grade complication was Clavien grade 2 (21% in the first year).[26] By 1 year, 5% of the living liver donor recipients had died, and another 5% were retransplanted. Few donors reported symptoms of depression or concerns about appearance. However, bowel symptoms and pain were common. At 1 year, 40% reported bowel symptoms, and 46% reported abdominal pain that interfered with everyday life. Nevertheless, at 1 year, 75% felt back to normal. Most felt that their recovery pace was as expected or faster. Although few worried that they would never feel physically 100% again, at 3 months, 35% were at least a little worried about their health, and 42% worried about the physical effects of donation.

What Are the Prevalence and Specific Types of Sexual Concerns/Problems Both Before and After Liver Donation?

Figure 2A-D shows the percentage of responses indicating poorer sexual functioning on each survey item at evaluation, 3 months, and 1 year for male and female donors and nondonors. For all questions, the percentages of responses at each time point are similar for donors and nondonors, as suggested by the overlapping CIs.

Males were less likely to report poorer sexual functioning than females for all questions at all time points except in the area of sexual satisfaction. The percentage feeling poorer sexual desire was higher at 3 months versus the evaluation for both males and females but dropped at 1 year for both. This phenomenon was not as evident for the other 3 questions.

What Variables Predict Poorer Sexual Function at Evaluation?

Table 4 shows results for the 4 sexual function questions at evaluation. There were no significant differences between donors and nondonors in any of the 4 areas of sexual functioning. Females were significantly more likely than males to report problems with sexual desire and difficulty achieving orgasm, whereas males were more likely to be dissatisfied with their overall sex life. Unmarried respondents had a higher probability of having problems with getting an erection or reaching orgasm and of being dissatisfied with their sex life. Respondents whose intended recipient was their spouse had a significantly higher probability of being dissatisfied with their sex life. Race was significant only in predicting erection in males, with nonwhites having greater odds of lower erectile function.

What Is the Association Between Poorer Sexual Functioning After Donation and Donation-Specific Factors?

Table 4 shows models for the 3-month and 1-year postdonation time points. We examined correlates, including recovery time, complications, pain, physical symptoms, view of physical appearance, and worries about health. At 3 months, concerns about appearance, abdominal pain, and not feeling back to normal were associated with reporting poorer sexual functioning. Donors who felt that their appearance was worse or much worse were significantly more likely to report

TABLE 3. Postdonation Characteristics of Living Liver Donors

	Month 3, n = 105, %(n)	Year 1, n = 107, %(n)
Medical variables		
Left lobe donor	8% (8)	7% (7)
Number of hospitalizations*		
0	87% (91)	87% (93)
1	10% (11)	7% (8)
≥2	3% (3)	6% (6)
≥1 Complication*	28% (29)	36% (39)
≥1 Complication Clavien grade 2*	18% (19)	21% (22)
Postdonation pain medication use†	10% (11)	12% (13)
Recipient died	3% (3)	5% (5)
Recipient retransplanted	4% (4)	5% (5)
Self-reported variables‡		
Consistently depressed or down	5% (5)	3% (3)
Missing	14% (15)	22% (24)
Much less interested/able to enjoy things	9% (9)	4% (4)
Missing	16% (17)	24% (26)
General or overall appearance is worse/much worse§	12% (13)	7% (8)
Self-reported medical problems§	21% (22)	16% (17)
Abdominal pain interferes with daily life§	56% (59)	46% (49)
At least mild abdominal pain on the day of survey§	40% (42)	24% (26)
Bowel symptoms interfere with daily life§	37% (39)	40% (43)
Feels completely recovered§	41% (43)	72% (77)
Recovered slower/much slower than expected§	24% (25)	18% (19)
Percent recovery§		
0%-20%	1% (1)	1% (1)
41%-60%	4% (4)	0% (0)
61%-80%	18% (19)	6% (6)
80%-99%	32% (34)	19% (20)
100%	41% (43)	72% (77)
Feels back to normal	53% (56)	75% (80)
Missing	5% (5)	9% (10)
Worries sometimes or often about physical effects of donation	42% (44)	23% (25)
Missing	6% (6)	20% (21)
At least a little worried about own health	35% (37)	21% (22)
Missing	6% (6)	19% (20)
Worries donation will have negative effects on health in the future	27% (28)	16% (17)
Missing	6% (6)	21% (22)
Worries will never feel 100% well	14% (15)	7% (7)
Missing	6% (6)	21% (22)

NOTE: Sixty-one donors had information available at month 3 only, 63 had information available at 1 only, and 44 had information available at both. Donors who only had month 3 data differed significantly from those who had only year 1 data in terms of age (40.1 versus 35.2 years), smoking history (36% versus 14%), and marital status (41% versus 24% married).

*Cumulative number up to that time point. There were no Clavien complications higher than grade 2 in the first year after donation.

†As reported at that time point on case report forms.

‡See Table 1 for specific questions asked for self-reported variables.

§Missing ≤ 5%.

lower sexual desire (OR, 4.14; 95% CI, 1.02-16.79), and donors whose abdominal pain interfered with their daily life were more likely to report difficulty reaching orgasm (OR, 3.98; 95% CI, 1.30-12.16). Donors who did not feel back to normal at 3 months were more likely to report dissatisfaction with their sexual life (OR, 3.58; 95% CI, 1.43-8.99).

At 1 year, no donation-specific variables were significantly associated with sexual functioning, although the effect of not feeling back to normal was attenuated from the effect seen at 3 months (OR, 2.80; 95% CI, 0.94-8.37).

What Are the Probabilities of Poorer Sexual Functioning at the 3 Time Points and How Do These Differ Before and After Donation?

We tested for differences in the probability of poorer sexual functioning over time and adjusted for sex

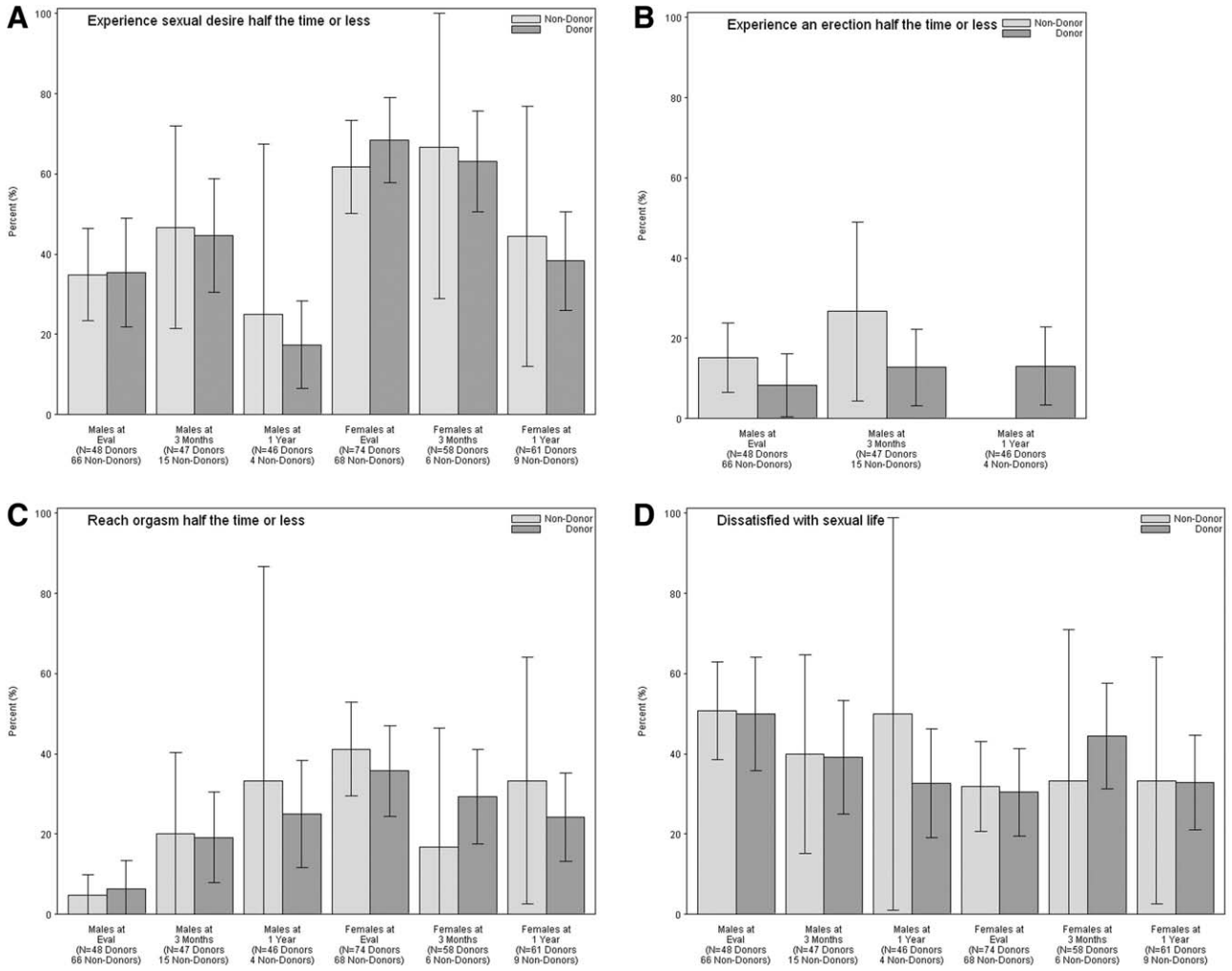

Figure 2. Percentage of subjects showing difficulty in sexual functioning, which was defined as responding half the time or less on desire, erection, and orgasm questions and neutral, dissatisfied, or very dissatisfied on the sexual satisfaction question. SE bars were calculated with the normal approximation to the binomial distribution.

(Table 5). For all 4 questions, no significant differences existed between the probabilities of poor sexual functioning at 3 months versus the evaluation. The probability of poor sexual desire decreased at 1 year with respect to the evaluation ($P < 0.001$) and 3 months ($P = 0.001$). This trend was seen in the other 3 questions but did not reach significance. Females had a higher probability of poorer sexual function than males, but this difference was significant only in the areas of sexual desire and reaching orgasm (Table 5).

Does Sexual Functioning at Evaluation Predict Sexual Functioning in the First Year After Donation?

Poorer sexual functioning at evaluation was strongly associated with a higher probability of poorer sexual functioning in the first year after donation in the areas of sexual desire (OR, 5.69; 95% CI, 1.46-22.21) and satisfaction with sex life (OR, 5.12; 95% CI, 1.56-16.77), with adjustments for sex and time.

Sensitivity Analysis

As a sensitivity analysis, participants who reported no sexual activity for erectile and orgasmic function were excluded from the 3 sets of models in Table 4 (n = 31 nondonors, n = 41 donors). The results were largely unchanged, with some previously marginally significant variables becoming nonsignificant, likely because of the reduction in sample size. More importantly, the magnitude and direction of the effects remained the same. Most respondents who completed surveys at more than 1 time point did not consistently report having no sexual activity on all of their surveys. Additional testing showed that those included in the longitudinal models did not have significantly different sexual functioning than those who responded at only 1 time point.

DISCUSSION

Living donors differ from other surgical patients because they undergo their procedure without any

TABLE 4. Correlates of Sexual Functioning at Evaluation, 3 Months, and 1 Year

	Evaluation (n = 256, 122 Donors, 134 Nondonors)		3 Months After Donation, (n = 105, All Donors)		1 Year After Donation, (n = 107, All Donors)	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Probability of feeling sexual desire half the time or less						
Donor (reference = nondonor)	1.20 (0.71-2.01)	0.50	—	—	—	—
Female (reference = male)	3.15 (1.85-5.35)	<0.001	2.95 (1.19-7.30)	0.02	3.16 (1.24-8.08)	0.02
Marital status (reference = married not donating to spouse)						
Unmarried	1.02 (0.60-1.74)	0.93	1.14 (0.45-2.91)	0.78	1.69 (0.55-5.24)	0.36
Married donating to spouse	2.82 (0.74-10.72)	0.13	0.68 (0.10-4.73)	0.70	0.57 (0.05-6.49)	0.65
Age (per 10 years)	—	—	1.90 (1.17-3.09)	0.01	—	—
Compared to before donation, my appearance is worse or much worse versus the same, better or much better*	—	—	4.14 (1.02-16.79)	0.047	—	—
Probability of getting an erection half the time or less (males only)†						
Donor (reference = nondonor)	0.70 (0.19-2.62)	0.60	—	—	—	—
Nonwhite versus white	8.47 (1.56-45.94)	0.01	—	—	—	—
Unmarried versus married‡	7.14 (1.66-30.77)	0.008	0.73 (0.12-4.58)	0.74	1.67 (0.17-16.02)	0.66
Probability of having an orgasm half the time or less						
Donor (reference = nondonor)	0.86 (0.45-1.66)	0.65		.		.
Female (reference = male)	10.19 (4.10-25.36)	<0.001	1.69 (0.61-4.72)	0.31	0.96 (0.37-2.50)	0.94
Marital status (reference = married not donating to spouse)						
Unmarried	2.21 (1.07-4.55)	0.03	0.88 (0.31-2.52)	0.81	1.25 (0.40-3.86)	0.70
Married donating to spouse	2.63 (0.80-8.67)	0.11	0.38 (0.05-3.02)	0.40	0.92 (0.08-10.60)	0.94
Age (per 10 years)	1.40 (0.98-1.99)	0.06	2.45 (1.40-4.30)	0.002	—	—
Abdominal pain interferes with my daily life‡	—	—	3.98 (1.30-12.16)	0.02	—	—
Probability of being neutral, dissatisfied, or very dissatisfied with overall sex life						
Donor (reference = nondonor)	0.93 (0.54-1.61)	0.80	—	—	—	—
Female (reference = male)	0.34 (0.19-0.61)	<0.001	1.41 (0.57-3.50)	0.46	0.78 (0.33-1.89)	0.59
Age (per 10 years)	1.55 (1.15-2.10)	0.004	—	—	—	—
Marital status (reference = married not donating to spouse)						
Unmarried	2.78 (1.51-5.12)	0.001	2.09 (0.77-5.68)	0.15	1.75 (0.58-5.31)	0.32
Married donating to spouse	5.95 (1.59-22.18)	0.008	6.17 (0.76-50.33)	0.09	3.84 (0.54-27.17)	0.18
Current or previous smoker (reference = never smoked)	—	—	4.42 (1.54-12.68)	0.006	—	—
Does not feel back to normal§	—	—	3.58 (1.43-8.99)	0.007	2.80 (0.94-8.37)	0.07

NOTE: Separate logistic regression models were used for each time point. Data are for all donors and nondonors at evaluation and for donors at 3 months and 1 year after donation.

*Missing for n = 1, excluded from model.

†n = 114 males at evaluation (48 donors, 66 nondonors), n = 47 male donors at 3 months, n = 46 male donors at 1 year. The parameter of married donating to spouse could not be estimated because only 1 male donated to his spouse at the evaluation, 3 donated at 3 months, and 0 donated at 1 year.

‡Missing for n = 2, excluded from model.

§Missing for n = 5 at 3 months and n = 10 at 1 year, excluded from models.

TABLE 5. Predicted Probabilities of Poor Sexual Functioning by Sex and Time Point

	Time Point	Female, Mean (SE)	Male, Mean (SE)	*P* Value, Males Versus Females	*P* Value, Versus Evaluation	*P* Value Versus Month 3
Probability of feeling sexual desire half the time or less	Evaluation	0.76 (0.06)	0.44 (0.10)	0.003	—	—
	Month 3	0.69 (0.08)	0.35 (0.10)		0.32	—
	Year 1	0.26 (0.09)	0.08 (0.04)		<0.001	0.001
Probability of getting an erection half the time or less (Males only)	Evaluation	—	0.12 (0.06)	—	—	—
	Month 3	—	0.12 (0.07)		0.94	—
	Year 1	—	0.07 (0.07)		0.62	0.67
Probability of having an orgasm half the time or less	Evaluation	0.40 (0.07)	0.10 (0.05)	0.001	—	—
	Month 3	0.40 (0.08)	0.10 (0.05)		0.98	—
	Year 1	0.19 (0.08)	0.04 (0.03)		0.06	0.08
Probability of being neutral, dissatisfied, or very dissatisfied with overall sex life	Evaluation	0.41 (0.07)	0.40 (0.09)	0.93	—	—
	Month 3	0.44 (0.09)	0.43 (0.10)		0.74	—
	Year 1	0.29 (0.08)	0.28 (0.10)		0.23	0.17

NOTE: Among the subset of 82 donors (52 females and 30 males) with surveys at the evaluation and at least 1 of the 3-month and 1-year time points.

expectation of health benefit. Although an extensive literature exists on sexual functioning recovery after types of abdominal/genitourinary surgery known to affect sexual functioning (eg, prostate, urological, hysterectomy, and colostomy), this literature is less relevant for living liver donors, who go into the procedure in good health. The present data provide a more comprehensive understanding of the sexual issues of living liver donors than previously available. We asked participants questions on key domains of sexual functioning important to patients. These data can provide a useful basis for developing future psychoeducational interventions to prepare donors for the postoperative recovery period.

Overall, donors were most likely to report poorer sexual functioning at the evaluation phase and at 3 months after donation, but they were least likely to report problems at 1 year. Donors who had poorer sexual functioning at evaluation continued to have poorer function in the early 3-month recovery period but were less likely to have these issues by 1 year. Although donors typically report high levels of physical and emotional functioning before donation (in fact, they are selected for these features), the fact that both donors and nondonors reported poorer sexual functioning at the evaluation phase demonstrates that some areas of psychosocial functioning are not optimal and might be affected by the stresses inherent in the decision to donate and the evaluation process. Prior studies of donor stress and anxiety show the predonation period to be the most stressful for donors, with a reduction in distress within the early months after donation.[1,3]

Differences at evaluation did not persist after donation, except that females were consistently more likely to report poorer levels of sexual desire. Because there are no inherent differences between males and females in the level of sexual functioning,[9,10] this suggests that possible issues related to the donation experience are contributing to these results. That both sexes experienced difficulties at evaluation versus the other time points suggests that this stressful time period affects both sexes but perhaps somewhat differently. A prior investigation of sex differences determined that at the predonation phase, women were more likely to be concerned about the donation's impact on their family and social obligations.[24] Although we did not ask about specific stresses reflecting women's various roles in their families with respect to caregiving responsibilities, such issues may continue after donation and affect sexual desire.

Those with donation-related complaints (abdominal pain, concerns about appearance, and not feeling back to normal again) reported lower levels in several areas of sexual functioning. Consistent with the existing liver donor literature that shows decrements in physical functioning in the immediate postoperative period (typically the first 3 months) with recovery to baseline levels within 1 year,[1] donors may expect that until they are feeling physically better and back to normal, aspects of normalcy such as sexual functioning may be decreased. Although we hypothesized that donor concerns about their recovery and the impact of donation on their current and future health would be associated with poorer sexual functioning, this was not the case.

Limitations

Missing surveys in the data set and especially the lack of longitudinal data for the nondonors are a limitation. However, we were able to use analytic

techniques to make the best use of all available data. We did not have data on donors and nondonors who did not enroll in A2ALL. Additionally, A2ALL had fewer minorities represented in comparison with all donors during that era, and this may also have introduced a bias. It is important to note that the baseline sexual functioning of donors before they entered the donation evaluation process is unknown. Donor concerns over the evaluation process, their own future health and well-being, and the health and well-being of the intended recipients may have affected their responses. It is, therefore, possible that donor baseline sexual functioning was higher than that at evaluation, and this might explain the improvement of sexual functioning after 1 year above the scores at evaluation. Although comprehensive sexual functioning instruments exist, in an effort not to overburden respondents, a smaller set of sexual functioning items was chosen. However, the questions asked capture key domains representing sexual functioning. Similarly, data on the specifics of how postdonation factors, such as aspects of physical appearance, may have influenced the donors' sexual functioning were not obtained. We did not have data on antihypertensive or antidepressant medication usage, but these medical issues were uncommon in our cohort and unlikely to affect the findings. It is possible that some participants experienced embarrassment or discomfort when they were responding to sexual functioning questions, and this may have altered their answers or willingness to respond at all. In addition, the questions do not specify whether they refer to sexual functioning with a consistent partner or other patterns of sexual activity. However, these items have been used widely in both interviewer-driven and self-reporting formats.

In conclusion, sexual function questions are likely not a routine part of donor surgical follow-up. Although patients might wish to speak with their physicians/clinicians about their sexual functioning concerns, these conversations are infrequently initiated by the patient, and clinicians must be sensitive to the need to ask. Additionally, the focus of a typical postdonation follow-up examination may be on known or expected complications, with less consideration of the broader impact of the surgery on a range of functions such as sexual activity. Thus, close monitoring during early recovery with inquiries into sexual functioning issues will provide donors an opportunity to report any problems and allow them to discuss concerns. Awareness that the inherent stresses in the predonation phase may have effects on sexual functioning is important. Educating donors on what to expect with sexual functioning, specifically early in recovery, will probably not lessen these problems but will allow donors to understand and prepare for this phase of their recovery. Donor teams might consider interventions to minimize scarring, prevent hernias, and prepare for postdonation physical appearance to decrease the impact of concerns over appearance on sexual desire. Efforts to educate the donors' sexual partners may also help to relieve/reduce anxieties and normalize expectations. As we work to maximize the positive psychological and physical experiences associated with living donation, efforts toward reducing stress by educating donors on what is expected and normal and what are anticipated outcomes are the goals of all donor teams. Appreciating that sexual functioning is an essential aspect of donor quality of life directs our focus toward this important area.

REFERENCES

1. Parikh ND, Ladner D, Abecassis M, Butt Z. Quality of life for donors after living donor liver transplantation: a review of the literature. Liver Transpl 2010;16:1352-1358.
2. Verbesey JE, Simpson MA, Pomposelli JJ, Richman E, Bracken AM, Garrigan K, et al. Living donor adult liver transplantation: a longitudinal study of the donor's quality of life. Am J Transplant 2005;5:2770-2777.
3. Schulz KH, Kroencke S, Beckmann M, Nadalin S, Paul A, Fischer L, et al. Mental and physical quality of life in actual living liver donors versus potential living liver donors: a prospective, controlled, multicenter study. Liver Transpl 2009;15:1676-1687.
4. Humar A, Carolan E, Ibrahim H, Horn K, Larson E, Glessing B, et al. A comparison of surgical outcomes and quality of life surveys in right lobe vs. left lateral segment liver donors. Am J Transplant 2005;5(pt 1):805-809.
5. Chan SC, Liu CL, Lo CM, Lam BK, Lee EW, Fan ST. Donor quality of life before and after adult-to-adult right liver live donor liver transplantation. Liver Transpl 2006; 12:1529-1536.
6. Walter M, Bronner E, Pascher A, Steinmüller T, Neuhaus P, Klapp BF, Danzer G. Psychosocial outcome of living donors after living donor liver transplantation: a pilot study. Clin Transplant 2002;16:339-344.
7. Pascher A, Sauer IM, Walter M, Lopez-Haeninnen E, Theruvath T, Spinelli A, et al. Donor evaluation, donor risks, donor outcome, and donor quality of life in adult-to-adult living donor liver transplantation. Liver Transpl 2002;8:829-837.
8. DuBay DA, Holtzman S, Adcock L, Abbey SE, Greenwood S, Macleod C, et al. Cosmesis and body image after adult right lobe living liver donation. Transplantation 2010;89: 1270-1275.
9. Rosen R, Brown C, Heiman J, Leiblum S, Meston C, Shabsigh R, et al. The Female Sexual Function Index (FSFI): a multidimensional self-report instrument for the assessment of female sexual function. J Sex Marital Ther 2000;26:191-208.
10. Rosen RC, Riley A, Wagner G, Osterloh IH, Kirkpatrick J, Mishra A. The international index of erectile function (IIEF): a multidimensional scale for assessment of erectile dysfunction. Urology 1997;49:822-830.
11. Simmons RG, Marine SK, Simmons RL. Gift of Life: The Effect of Organ Transplantation on Individual, Family, and Societal Dynamics. New Brunswick, NJ: Transaction Books; 1987.
12. Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. J Clin Psychiatry 1998;59(suppl 20):22-33.
13. Gerstenberger EP, Rosen RC, Brewer JV, Meston CM, Brotto LA, Wiegel M, Sand M. Sexual desire and the female sexual function index (FSFI): a sexual desire cutpoint for clinical interpretation of the FSFI in women with and without hypoactive sexual desire disorder. J Sex Med 2010;7:3096-3103.

14. Gacci M, Bartoletti R, Figlioli S, Sarti E, Eisner B, Boddi V, Rizzo M. Urinary symptoms, quality of life and sexual function in patients with benign prostatic hypertrophy before and after prostatectomy: a prospective study. BJU Int 2003;91:196-200.
15. Hendren SK, O'Connor BI, Liu M, Asano T, Cohen Z, Swallow CJ, et al. Prevalence of male and female sexual dysfunction is high following surgery for rectal cancer. Ann Surg 2005;242:212-223.
16. Shah SM, Bukkapatnam R, Rodríguez LV. Impact of vaginal surgery for stress urinary incontinence on female sexual function: Is the use of polypropylene mesh detrimental? Urology 2005;65:270-274.
17. Switzer GE, Dew MA, Butterworth VA, Simmons RG, Schimmel M. Understanding donors' motivations: a study of unrelated bone marrow donors. Soc Sci Med 1997;45:137-147.
18. Switzer GE, Dew MA, Simmons RG. Donor ambivalence and postdonation outcomes: implications for living donation. Transplant Proc 1997;29:1476.
19. Switzer GE, Myaskovsky L, Goycoolea JM, Dew MA, Confer DL, King R. Factors associated with ambivalence about bone marrow donation among newly recruited unrelated potential donors. Transplantation 2003;75: 1517-1523.
20. Switzer GE, Dew MA, Goycoolea JM, Myaskovsky L, Abress L, Confer DL. Attrition of potential bone marrow donors at two key decision points leading to donation. Transplantation 2004;77:1529-1534.
21. Myaskovsky L, Dew MA, Crowley-Matoka M, Unruh M, DeVito Dabbs A, Shapiro R, Tan H. Is donating a kidney associated with changes in health habits? Am J Transplant 2010;10(suppl 4):536.
22. Corley MC, Elswick RK, Sargeant CC, Scott S. Attitude, self-image, and quality of life of living kidney donors. Nephrol Nurs J 2000;27:43-50.
23. Dew MA, DiMartini AF, DeVito Dabbs AJ, Zuckoff A, Tan HP, McNulty ML, et al. Preventive intervention for living donor psychosocial outcomes: feasibility and efficacy in a randomized controlled trial. Am J Transplant 2013;13: 2672-2684.
24. DiMartini A, Cruz RJ Jr, Dew MA, Fitzgerald MG, Chiappetta L, Myaskovsky L, DeVera ME. Motives and decision making of potential living liver donors: Comparisons between gender, relationships and ambivalence. Am J Transplant 2012;12:136-151.
25. Harrell FE. Regression Modeling Strategies: With Applications to Linear Models, Logistic Regression, and Survival Analysis. Springer Series in Statistics. New York, NY: Springer; 2001.
26. Abecassis MM, Fisher RA, Olthoff KM, Freise CE, Rodrigo DR, Samstein B, et al. Complications of living donor hepatic lobectomy–a comprehensive report. Am J Transplant 2012;12:1208-1217.