Live Donor Liver Transplantation: Current Status

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The inequality between supply of grafts and demand for transplants has forced the transplant community to devise ways to increase the number of available livers for transplant (ie, through use of extended criteria donor grafts and living donation). Since 2002, the number of live donor liver transplantations (LDLT) performed has declined due to concerns of donor safety and lack of clear outcome data establishing success equivalent to that of deceased donor liver transplantation (DDLT). Recent data suggest that LDLT outcomes are comparable with those of DDLT, provided a center has performed more than 20 procedures, both in patients with and without hepatitis C. Further studies are needed to define the optimal donor and the ideal recipient for LDLT. Results from a National Institutes of Health–funded consortium of nine transplant centers are highly anticipated. These data are expected to underscore the viability of LDLT as a life-saving therapy for certain patients with end-stage liver disease.

Introduction

The first adult-to-adult live donor liver transplantation (LDLT) was performed in Hong Kong in 1993 [1]. Five years later, the first LDLT was performed in the United States, and, today, more than 90 centers across the country perform LDLTs, although most are done in a small number of larger-volume centers. The majority of LDLTs in the United States are performed on adults, using right lobe grafts. As opposed to a left hepatectomy, this procedure provides the recipient with sufficient hepatic mass to replace the cirrhotic liver while leaving the donor with enough functioning hepatocytes.

The need for LDLT is driven by the inequality between supply and demand for grafts. LDLT allows patients with end-stage liver disease (ESLD) to benefit from a life-saving intervention that would otherwise be delayed or unavailable to them given the relative shortage of organs. While the frequency of LDLT has declined in the past 3 years, increased attention to both donor safety and selection has resulted in more stringent selection criteria, which has the potential to increase public awareness and confidence in the process. The recent publication of excellent LDLT outcome data from nine different US centers of the National Institutes of Health (NIH)-sponsored Adult-to-Adult Living Donor Liver Transplantation Cohort Study (A2ALL) has infused new interest in the practice of LDLT and provides a mandate for continued improvement and further studies.

Background: Statement of Need

Currently, there are more than 13,000 people listed for a liver transplant and thousands more with ESLD who die without ever being evaluated for transplant. The number of transplants performed annually is fewer than the number of patients added to the transplant list. This discrepancy between supply and demand has forced transplant physicians to try to expand the available donor pool. This has included the increased use of extended criteria donor (ECD) livers from donors who are older, have steatosis, or have potential or actual viral exposure (eg, human T-cell lymphotropic virus, hepatitis B core antibody, or hepatitis C virus [HCV]). These grafts are often deemed inappropriate for use in some programs that are fortunate enough to have shorter waiting lists and lower Model for End-stage Liver Disease (MELD) scores at transplant. As with LDLT, potential recipients who consent to a transplant with an ECD graft can access a timelier transplant at a lower MELD score. The use of either an ECD or LDLT graft has a theoretical, if not actual, increased risk of complications after transplant when compared with the use of a full-size, MELD-allocated, standard deceased donor allograft. LDLT also has the risk of potentially causing harm to an otherwise healthy donor. While the risk is low, the amount of tolerable risk is debatable. The increased risks to the donor and possibly to the recipient must be weighed against lower waiting list mortality for the recipient. Data suggest that using ECD livers reduces

wait list mortality by more than 50% in some areas of the country [2•]. Success with ECD grafts provides part of the ethical framework for the innovative notion of transplant with partial use of a healthy liver from a living donor as another method to increase the organ pool and save the lives of patients with ESLD.

Current Status

The number of LDLTs peaked in 2001, with 519 transplants performed. Since then, LDLT has declined both in absolute number and as a percentage of total transplants performed. Three-hundred twenty-three LDLT procedures were done in both 2004 and 2005 (roughly 5% of all liver transplants performed) and only 288 were done in 2006. In 2007, as of August 31, a total of 107 LDLTs had been performed [3].

The reduced volume of LDLTs is likely a result of several factors. First, the transplant community is doing a better job of utilizing grafts from deceased donors, particularly in the form of ECD grafts. The second factor in the decline of LDLTs has been the concern about donor complications. The highly publicized death of a healthy donor in 2001 and poorly quantified complication rates cast a pall on living donation that has yet to be lifted, despite increased scrutiny leading to stricter monitoring policies and donor evaluation strategies [4]. The lack of well-defined complication rate data in a climate of increased public awareness of medical error has generated a need to define acceptable risk when the baseline risk to the donor is zero. This is a daunting task.

Despite the decline in numbers of LDLTs, recent research shows improved LDLT outcomes and substantial benefits from pursuing LDLT. Disease-specific outcome data, donor quality-of-life studies, and the ever-growing demand for liver transplants support the continued use of LDLT in the treatment of ESLD.

Donor outcomes

The most common complications in donors include wound infection, hernias, and biliary complications, most commonly a leak from the cut surface of the liver. Comprehensive data on donor outcomes have been limited due to the lack of a national registry, resulting in the majority of data available being generated from single centers with small numbers of patients or from self-reported data in national surveys. Earlier studies reported complication rates of 15% to 32%, likely reflecting differences in the rigor of the donor selection process, in the experience of the center, and in reporting [5]. National data were obtained via voluntary survey of all centers performing LDLT after an early NIH meeting on the topic. Based on these data from 84 different centers, the national overall donor complication rate was estimated to be 14.5%, with a rehospitalization rate of 8.5% and a donor mortality rate of 0.2% [6]. Currently, based on a survey of 30 different transplant centers in the country, overall donor complication rates are estimated at 10%, with mortality rates between 0.2% and 0.4% [7]. This study also revealed higher complication rates in centers that performed fewer transplants.

The A2ALL consortium represents the first multicenter study of LDLT outcomes for both donors and recipients. A2ALL donor outcome data are expected in the near future. A clear assessment of donor risk is critical not only to obtaining informed consent from potential donors, but also to the future viability of living donor transplant programs. Efforts from the United Network for Organ Sharing (UNOS) and the A2ALL group to collect these data represents the entire transplant community's commitment to the practice of LDLT. These results will enable us to more accurately describe the procedure to potential donors and identify areas that need improvement.

Recipient outcomes

Overall, LDLT outcomes are comparable with those in deceased donor liver transplantation (DDLT), although this has not always been considered true. An early, large, case-control study using the UNOS database compared graft and patient survival between 764 LDLT recipients and 1470 DDLT recipients [8]. While patient survival was not different in the two groups (2-year patient survival was 79.0% for LDLT and 80.7% for DDLT; $P = 0.5$), 2-year graft survival was significantly worse in the LDLT group (64.4% vs 73.3%; $P < 0.001$). However, these data were accrued from 1998 to 2001, a time period during which several centers were just starting to perform LDLTs. Since then, several studies have well established that a significant learning curve associated with performing LDLT exists [9,10]. In Korea, Lee et al. [11] demonstrated a decrease in mortality rate from 29% in 1997 to 5.7% in 2000, as their volume of LDLT procedures increased. Additionally, improved survival from the time of listing has been shown for patients who pursue LDLT versus those who remain on the waiting list for potential DDLT [12,13]. Similar patient survival rates between LDLT and DDLT underscore the viability of LDLT for many patients, especially those who have a low probability of receiving a deceased donor graft in a timely manner.

To date, A2ALL is the most comprehensive study with data on LDLT recipient outcomes. Nine transplant centers pooled their data on 385 LDLT recipients and reported on graft survival and complications over a 5-year period (1998–2003). Graft survival was 87% at 90 days and 81% at 1 year. One-year patient survival was 89%. Infections were the most common complication, occurring at a rate of 32% within the first 90 days and only 8% thereafter. Bile leaks were reported at a rate of 30% within the first 30 days and 2% thereafter. Twenty-four percent of patients required surgical exploration within the first 30 days. As previously mentioned, there was a clear relationship between volume and complication rate: the incidence of biliary leak was 38% in the first 20 cases performed at

the center and then dropped to 24% (P = 0.004) in cases 21 and beyond.

Centers with less than 20 LDLT cases had an 83% higher rate of graft failure (P = 0.0045). There was a 41% higher risk of graft failure with each 10-year increase in recipient age (P = 0.0008) [14••]; however, the advanced age–related increase was not significant. In fact, two recent studies have reported data suggesting that advanced donor age is not correlated with increased graft failure, although one study used age 44 as a cutoff for advanced age [15] and the other reported on experience with only 23 patients older than age 60 [16]. Regardless, the younger age of most living donors may limit the power to study this question.

A survival benefit to LDLT has recently been demonstrated in a large, multicenter trial. Berg et al. [17] studied mortality rates in patients who were evaluated for LDLT, comparing them between LDLT recipients versus patients who did not receive an LDLT (including those who received a DDLT, those who remained on the transplant list at study completion, and those who died on the list). LDLT recipients had an adjusted mortality hazard ratio of 0.56 (95% CI, 0.42–0.74; P < 0.001) relative to patients who were evaluated for but did not receive a living donor graft, controlling for clinical differences at the time of evaluation. This benefit was significantly increased at centers with experience, with a hazard ratio of 0.47 (95% CI, 0.32–0.69; P < 0.001) associated with LDLT [17]. This study, which most closely approximates an intent-to-treat analysis, quantifies the reduction in waiting list mortality for LDLT compared with remaining on the waiting list, as posttransplant survival was the same in DDLT and LDLT at experienced centers (ie, > 20 cases).

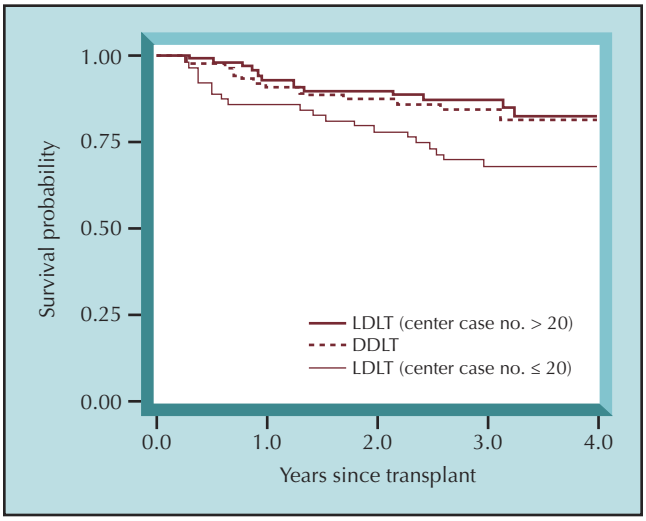

Figure 1. Graft survival after deceased donor liver transplantation (DDLT), the first 20 live donor liver transplantation (LDLT) cases performed at each center (LDLT ≤ 20), and cases beyond the first 20 at each center (LDLT > 20), conditioned on graft survival to at least 90 days. Differences in graft survival were seen between LDLT ≤ 20 compared with LDLT > 20 (P = 0.021) and DDLT (P = 0.052), but there was no significant difference in graft survival between LDLT > 20 and DDLT (P = 0.74; log rank test). (*From* Terrault et al. [22••].)

Hepatitis C

Hepatitis C remains the most common indication for liver transplant. Early data suggested that patients with HCV who received an LDLT had worse outcomes than those who received DDLT [18]. These early studies, in which LDLT was associated with increased graft failure, attributed the difference to more rapid HCV progression in the regenerating LDLT graft. Whether this rate of failure is the result of increased rates of HCV recurrence or due to other factors has been debated.

One possible explanation for the difference between LDLT and DDLT outcomes in HCV patients is that recipients of LDLT receive smaller grafts that regenerate, and several in vitro studies have suggested that dividing hepatocytes are more vulnerable to HCV infection. This could lead to increased levels of viremia—which is seen in cholestatic HCV—in LDLT recipients. This also may have been due to an increased rate of biliary complications or other problems seen during the learning curve of early LDLT experience. Whether there is an increased risk of cholestatic HCV remains unclear, and warrants further investigation.

More recent data based on protocol biopsies suggest that there is no difference in recurrent HCV between recipients of DDLT and LDLT. In a study of 23 LDLT and 53 DDLT recipients, protocol biopsies at 6 and 12 months were compared for inflammation and fibrosis; there was no difference in mean inflammation scores or fibrosis at any of the time points measured [19]. Twenty-one percent of the DDLT recipients suffered acute rejection compared with 14% of the LDLT recipients; this difference was not significant. Graft and patient survival rates between the two groups were similar: 82% and 82% for DDLT patients and 76% and 79% for LDLT patients (P = not significant) at 48 months. Results from this study, which looked at liver histology, do not support the idea that recurrent HCV is more prevalent among recipients of LDLT. Additional studies have also concluded that rates of HCV recurrence are not different among recipients of LDLT and DDLT [20•,21].

The A2ALL group also studied the role of HCV in LDLT (Fig. 1) [22••]. They compared 181 HCV-positive LDLT recipients with 94 HCV-positive DDLT recipients. Graft survival at 3 years was lower in LDLT recipients than in DDLT recipients (68% compared with 80%; P = 0.04), although the difference in patient survival was not significant. However, further analyses revealed that graft survival was not different between DDLT and LDLT once the center had performed 20 cases. For centers having performed more than 20 LDLTs, 3-year graft survival was 79% compared with 80% for DDLT recipients and only 55% for centers having performed less than 20 LDLTs. There was no difference in overall patient sur-

vival between LDLT (> 20) and DDLT (91% and 87%, respectively). Thus the initial difference in graft survival is corrected with increased experience, underscoring the need to foster centers of excellence with respect to LDLT. The reason for low survival rates in the early experience is unclear and may reflect worse outcome in all early recipients of LDLT at a center or there may be a synergy, perhaps between HCV and biliary complications.

Unfortunately, the majority of patients studied in the retrospective arm of the A2ALL group did not have protocol liver biopsies done posttransplant. Of the 63 patients (28% with functioning grafts) who were biopsied, there was no difference in total necroinflammatory or fibrosis scores between DDLT and LDLT at 1-year posttransplant. Thus the preponderance of data suggests that outcomes for HCV are similar for LDLT and DDLT at experienced centers and HCV is an acceptable indication for LDLT.

Hepatocellular Carcinoma

LDLT remains an important option for the treatment of hepatocellular carcinoma (HCC). In fact, these patients may particularly benefit from earlier transplant since the risk of disease progression on the wait list is substantial. Although MELD upgrades (to 22 points with additional points every 3 months) are offered to patients who meet the Milan (T2) criteria (ie, a single lesion < 5 cm or 2–3 lesions each < 3 cm), patients just outside these criteria (eg, those between the Milan and the more expanded, University of California, San Francisco [UCSF] criteria) will typically have very long wait list times that make transplant unfeasible. In some regions, for some blood types, even patients within Milan criteria may have a 9- to 12-month wait for DDLT.

Although it seems obvious that patients with HCC would benefit from earlier transplant, it is not clear that LDLT is a better option than DDLT. One retrospective study looked at transplant outcomes in 43 living donor recipients and compared them with the outcomes of 17 deceased donor recipients [23]. All of these patients met Milan or UCSF (solitary tumor < 6.5 cm or up to three tumor nodules, each < 4.5 cm with a total maximum size of < 8 cm) criteria. The MELD scores, Child-Pugh-Turcotte scores, and etiologies of liver disease were comparable in both groups, but there were more patients with Child's A or MELD score less than 10 in the LDLT group. Ten of 40 (25%) of the LDLT group underwent salvage transplant after resection or ablation compared with 1 of 12 (8%) of the patients who received a DDLT. Recipient complication rates were similar: 33% for LDLT and 35% for DDLT. Tumor recurrence developed in 10 of 43 (23%) LDLT and 0 of 17 DDLT patients. There was no difference in the explants between the two groups with respect to size, number, and differentiation of tumor. Multivariate analysis revealed that salvage transplant (RR 5.2) and tumor outside of UCSF criteria (RR 4.1), but not LDLT, were the only independent predictors of disease recurrence. This study is limited by the small sample size, and the fact that, despite the similarities in gross staging, the patients differed in terms of prior therapy and microscopic disease, suggesting that more aggressive tumors were disproportionately undergoing LDLT. The authors concluded that the higher recurrence rate seen in LDLT is due to confounding by more advanced stage of disease.

The A2ALL group also studied LDLT in the setting of HCC. A total of 106 patients were studied retrospectively: 58 LDLT and 34 DDLT recipients. While LDLT recipients had shorter waiting times compared with DDLT recipients (mean 160 vs 469 days; $P < 0.0001$), HCC recurrence was more common in LDLT at 3 years (29% vs 0%; $P = 0.002$) [24••]. There was no difference in overall mortality between the two groups.

One possible explanation for the increased recurrence of HCC for LDLT may be that the surgical techniques of LDLT make it a less successful cancer operation due to a need to keep vascular margins closer to the liver. Another possible explanation for this observed difference is that the groups are not truly comparable. One needs to compare HCC recipients of DDLT and LDLT with caution; LDLT is often used as salvage transplant for patients who have failed to respond to resection or ablation or in those felt to be at highest risk of disease progression. This group of patients may represent a particularly aggressive type of tumor that is not amenable to therapy—even if that therapy is transplant. Patients with this type of tumor who do not receive a LDLT would likely progress rapidly while on the transplant list and drop out or die prior to receiving DDLT. Using this logic, the wait list serves as a selection mechanism for patients who have a slow-growing tumor. One could then imagine a paradoxical situation in which longer waiting times would translate into better posttransplantation outcomes, reflecting more favorable tumor biology. Thus, increased recurrence in LDLT recipients may reflect selection of patients with more aggressive disease rather than suboptimal therapy.

The A2ALL results support this theory. Additionally, "fast-tracked" transplants, which were defined as recipients who met the Milan criteria and received additional MELD points through exception or who underwent LDLT, had higher rates of tumor recurrence posttransplant compared with recipients of non–fast-tracked transplants who received transplants on the waiting list prior to being able to receive MELD exception points [25]. These results underscore the concept that increased waiting times may provide a filter for patients whose tumor biology is amenable to cure with transplant—not that the operations fundamentally differ in outcomes.

This argument provides the basis for a conundrum as well as a mandate for future studies. The advantage of LDLT is a timelier transplant, yet, in the case of HCC, this may be selecting for patients with disease that is refractory to therapy—even transplant. Future studies need to

analyze mortality from the time of listing: to include both pretransplant and posttransplant mortality in order to adequately assess the impact of LDLT on overall survival and thus transplant benefit. If the drop-out pretransplant with DDLT significantly exceeds the tumor recurrence posttransplant with LDLT, then LDLT may offer a substantial overall survival benefit. Additionally, improved methods are needed to identify which patients with HCC are best served by transplant. As further discoveries about HCC biology are made, we will be better able to identify patients with more virulent cancers who may not benefit from transplant. Encouraging data looking at genetic material from HCC and loss of heterozygosity suggest that, in the near future, we may have at our disposal a model that predicts tumor behavior with 88% accuracy [26].

Other centers have reported data more supportive of LDLT for patients with HCC. In a study comparing 36 cases of HCC (53% outside Milan criteria) that were treated with LDLT with a cohort of 165 recipients of deceased donor organs, there was no difference in survival or recurrence rates [27]. Furthermore, data suggest that LDLT for patients with HCC not only results in similar disease-free survival rates as DDLT, but that for patients with advanced HCC outside of Milan criteria, LDLT was shown to provide a 3-year survival rate of 60% [28].

Future studies need to address the role of LDLT in HCC patients. A true comparison of LDLT and DDLT for HCC should encompass both posttransplantation recurrence as well as progression to death or drop-out pretransplant on the waiting list for both groups. Given the high rate of patient drop-out on the waiting list prior to the granting of MELD exceptions, it is likely that tumor progression on the waiting list has a higher risk of mortality than recurrence rates post-LDLT. It is also important to keep in mind that, in the absence of a MELD-allocated liver, the outcome for these patients is death. As our knowledge of HCC biology increases and we are better able to predict tumor behavior, we are likely to identify those patients with favorable tumor biology who would have time to wait for a MELD-allocated DDLT graft.

Donor Satisfaction

Donor satisfaction is at the core of LDLT. If donors did not derive some benefit from the process, it would not occur. In fact, donor satisfaction is integral to the success of an LDLT program in that future transplants depend largely on a center's reputation, which is, in part, made up of patient testimonials. Several studies have looked at donor satisfaction and all suggest that donors are typically pleased with their overall experience. A report on 30 donors at varying time points postdonation reported quality of life at or above US norms on a general quality-of-life survey [29]. A larger study of 68 Japanese donors at a mean of more than 4 years after donation also revealed that the overwhelming majority of donors were pleased with their experience. There were two donors who indicated that they would not donate again; in both of these cases the recipients had died. The correlation between recipient outcome and donor satisfaction is not surprising. However, there was no difference in scores between donors who sustained complications themselves and those who had no complications [30]. Although overall quality-of-life data are important, other areas that may cause stress and concern to donors include finances, return to work, and expected recipient outcomes; these issues should be addressed before and after donation [31]. A notable limitation to all these studies is the disproportionately high lack of response from donors whose recipients had serious complications.

The study of donor satisfaction is imperative, not only to the future success of the program but also to the process of obtaining informed consent. There is a potential ethical concern that donors cannot fully comprehend the postoperative course and possible complications, making informed consent an impossibility. Posttransplant quality-of-life data for existing donors help us provide potential donors with a better understanding of anticipated outcomes, including the potential impact of possible complications. During the evaluation process, potential donors have extensive information to process; therefore, providing them with real-life data is oftentimes helpful. For example, data that 57.5% of donors return to work by 3 months, with a mean return to work after 3.4 months, may be easier to understand then a generic statement about being able to return to work. It is also critical that donors know they are being cared for and that they are also considered patients despite the fact that they have no disease prior to donation.

Donor satisfaction studies also identify areas of deficiency that need improvement. For example, as a consequence of a study from Mount Sinai that revealed that 53% of donors reported pain worse than they expected, the transplant team started having anesthesia and pain service follow the patients more closely postoperatively [29].

LDLT is driven by the willingness of donors, making their satisfaction crucial to the successful future of any program. Future studies need to further qualify donor outcomes as well as identify specific programmatic deficiencies, such as poor communication between transplant team members and donor/recipient families. A2ALL data should be helpful in this effort as it reflects the largest group of donors studied to date; a comprehensive long-term national donor registry is also needed.

Ethical Issues

LDLT raises several ethical issues: putting a healthy donor at risk for a poorly quantified gain, obtaining informed consent without coercion and with appropriate information, and determining which donors and recipients are best suited for LDLT. Although individual programs and surgeons retain the right to refuse to perform donor surgery on any given

individual, thresholds for tolerable risk vary significantly, and, ultimately, must be largely determined by the potential donor in order to respect donor autonomy. As members of the transplant team, our obligation is to provide patients with a risk assessment that is as accurate as possible. This involves donor factors as well as those risks inherent to the procedure. Donors undergo a thorough evaluation process to screen for medical, psychological, and anatomic contraindications to transplant in an effort to minimize overall complications. This evaluation process, however, varies among different centers, and the optimal donor work-up is not yet known. This makes it difficult to accurately define the risk for each individual donor. However, as data from A2ALL and other studies become available, we will be able to provide more accurate information to potential donors with respect to complications and other donor outcomes.

The issue of potential coercion is perhaps more worrisome than the lack of rigorous long-term outcome information. Potential donors may feel compelled to donate in order to save the life of a loved one, particularly if DDLT is not a viable or likely option. Most centers deal with this issue by dedicating an entire team to the donor and pursuing extensive psychiatric and psychological counseling prior to the donation in an effort to protect the donor. The need for an independent donor advocate(s) is accepted by UNOS, the Advisory Council on Transplantation, and many transplant centers.

The ethical issues surrounding LDLT extend beyond those related to individual patient decisions. The process of selecting appropriate patients for LDLT is not uniform across the country, reflecting the fact that the ideal recipient for LDLT is neither known nor clearly defined. Most agree that candidates should meet UNOS listing criteria, but there is no consensus on a minimum or maximum MELD score cut-off for LDLT. While most centers set some limits on either end to optimize the timing of the transplant, these limits vary from center to center, introducing a fair amount of variability in the types of donor/recipient pairs accepted for LDLT. As the data on outcomes increase, it will be important to use those results to look back and attempt to identify who is best served by LDLTs so that some of the disparities among different centers can be minimized.

Future Directions

LDLT is currently limited by a paucity of outcome data and ethical concerns. The NIH, American Society of Transplant Surgeons, and the Department of Health and Human Services have jointly sponsored the multicenter cohort study of LDLT, the A2ALL study. This 7-year study aims to collect prospective long-term results for donors and recipients to correct the problem of limited outcome data. It is hoped that accurate long-term data will mitigate ethical concerns. The results of this study will enable transplant hepatologists and surgeons to appropriately inform patients and improve practice. Undertaking a study of this nature represents the most significant advance in LDLT for the past 5 years and is a commitment to excellence in the field of LDLT. Our belief is that the establishment of a national registry within UNOS to facilitate follow-up of donors will complement A2ALL by tracking the results at all centers in all donors.

LDLT affords physicians the opportunity to offer life-saving liver transplants to a larger number of patients in a more timely fashion than under the current UNOS allocation system. Many unanswered questions still remain, forming the foundation for a mandate to compile our collective experience and continue to improve the selection process for donors and recipients, surgical techniques, and long-term follow-up. Further studies are needed to assess outcomes in patients with HCV and HCC. The donor evaluation process must be evaluated and evidence-based guidelines developed to help standardize the process across centers.

It is clear that center experience (> 20 cases) leads to better outcomes—this information needs to guide practice. Experienced centers need to assist in the training of more novice centers, a practice not commonly employed but necessitated by the fact that healthy donors are putting themselves at risk. Each center needs to provide donors with center-specific as well as national outcome data to allow them to find the best center possible. Currently, given the low national volume of procedures, it is likely preferable to concentrate LDLT procedures in a few excellent centers until volumes and experience increase.

The prospective phase of the A2ALL study is under way and will focus on donor selection, donor follow-up, and recipient selection. LDLT will never become the treatment of choice for all patients with ESLD, but can be the treatment of choice for a select group of patients who are not able to benefit from DDLT in a comparable time frame. It is incumbent upon health care professionals who treat ESLD to help determine who is best served by LDLT and to ensure the best care for their donors.

Conclusions

LDLT is a viable treatment option for patients with ESLD. Data support the use of LDLT in patients with ESLD caused by HCV as well as HCC, although questions remain about which HCC patients are most suitable for LDLT. It is clear that centers with more experience have better outcomes. Future research needs to address optimal donor evaluation and identify the most suitable LDLT recipients. Results of the A2ALL study will help quantify donor risk and recipient outcomes, strengthening our ability to adequately inform patients of the risks and benefits of this life-saving intervention.

Disclosures

No potential conflicts of interest relevant to this article were reported.

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This is the first publication of the A2ALL group comparing outcomes in LDLT to those of DDLT. It also thoroughly described donor and recipient characteristics in the two groups. This group reported similar survival rates between LDLT and DDLT recipients, concluding that LDLT was a viable therapy for some patients. Additionally, the concept of improved outcomes with increased center volume was introduced in this paper, with the centers performing less than 20 cases associated with an 83% higher risk of failure.

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