



High-volume living donor liver transplantation (LDLT): what the data tells us

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The publication of “An Analysis of 10,000 Cases of Living Donor Liver Transplantation in Japan” by Eguchi *et al.* represents a landmark contribution to liver transplantation research. Based on more than three decades of data from the Japanese Liver Transplantation Society (JLTS), the analysis provides an unprecedented evaluation of living donor liver transplantation (LDLT) outcomes (1). Beyond its sheer scale, the work offers critical insights into donor selection, surgical decision-making, and long-term patient survival. Given the increasing reliance on LDLT in regions with limited access to deceased donor organs, its findings carry significant implications for both clinical practice and healthcare policy worldwide (2).

LDLT has played a pivotal role in addressing organ shortages, particularly in Japan, where cultural and logistical factors have historically limited deceased donor transplantation. The ability to examine 10,000 LDLT cases provides an extraordinary opportunity to analyze long-term trends and refine transplantation protocols. The comprehensive dataset not only advances the understanding of LDLT outcomes but also serves as a valuable benchmark for comparison with international practices, particularly in countries where LDLT represents a growing proportion of liver transplants.

One of the most significant contributions of this analysis is its in-depth evaluation of the graft-versus-recipient weight ratio (GRWR) as a key determinant of postoperative outcomes. The findings reinforce the critical role of graft size in transplant success, emphasizing the risks associated with both undersized and oversized grafts. Pediatric recipients with a GRWR exceeding 5 demonstrated significantly lower survival rates, highlighting the complications of large for size (LFS) syndrome, such as excessive graft compression, impaired vascular inflow, and difficulty with abdominal closure (3). Conversely, adult recipients with a GRWR below 0.7, particularly when the donor was over 50 years old, exhibited poorer outcomes. These insights establish clinically relevant benchmarks that can guide both donor selection and surgical planning, ensuring optimal graft function (4).

A striking aspect of the findings is the demonstration of significant improvements in LDLT outcomes over time. The data reveal substantial advancements in patient survival, particularly over the last decade [2011–2021], reflecting ongoing refinements in surgical technique, perioperative care, and immunosuppressive strategies. Pediatric survival rates at 1, 5, 10, and 20 years were 91.3%, 88.7%, 86.6%, and 83.0%, respectively, while for adult recipients, these

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rates were 83.5%, 75.0%, 68.1%, and 54.8%. These results highlight the transformative impact of continued innovation and institutional experience, providing a valuable reference point for international comparisons (5).

Another key insight is the interplay between donor age and graft size, an issue of increasing importance in LDLT programs. The data indicate that grafts from older donors are associated with inferior outcomes, particularly when the GRWR falls below optimal thresholds. This finding is particularly relevant for transplant centers that rely heavily on LDLT, where the availability of younger donors is often constrained. Strategies such as preconditioning protocols, graft optimization techniques, and novel perioperative management approaches may help mitigate risks associated with older donors (6,7). The results underscore the need for robust donor assessment protocols to ensure that age-related factors do not compromise transplant success.

The analysis also reinforces the strong correlation between institutional experience and transplant outcomes. High-volume centers consistently demonstrated superior results, highlighting the importance of centralized expertise in LDLT. This observation aligns with global trends in complex surgical procedures, where high case volume translates to greater surgical proficiency, refined perioperative protocols, and better-coordinated multidisciplinary care. Centralizing LDLT at specialized institutions not only enhances patient outcomes but also facilitates the development of innovative techniques and fosters ongoing research collaborations.

Despite its strengths, the work acknowledges several limitations. One notable gap is the lack of data on portal venous flow modulation techniques, which have gained increasing attention as a means of optimizing graft function, particularly in cases where small for size (SFS) syndrome presents a risk. Additionally, there is no detailed analysis of immunological parameters, which play a crucial role in long-term graft survival. Given the expanding interest in personalized immunosuppression strategies, future studies incorporating detailed immunological profiling could provide valuable insights into optimizing long-term transplant success.

Another area requiring further exploration is the role of emerging technologies such as machine perfusion, which is increasingly being investigated as a strategy to improve graft quality, particularly for marginal donors. While LDLT traditionally involves healthy, preselected donors, the potential benefits of machine perfusion in optimizing graft viability before implantation warrant further study.

Expanding research in this area may provide a pathway to enhancing outcomes, especially when donor characteristics are less than ideal.

Additionally, a more detailed examination of postoperative management strategies would strengthen the clinical applicability of the findings. While the study provides a broad overview of long-term survival, greater insight into post-transplant complications, graft function over time, and quality-of-life indicators would further enhance its impact. Understanding how post-transplant care—including immunosuppressive regimens, rejection episodes, and metabolic complications—affects long-term outcomes is critical for refining treatment protocols. Addressing these gaps in future research will contribute to a more comprehensive understanding of LDLT outcomes and inform best practices.

From a global perspective, the findings align with trends observed in other high-volume LDLT programs, such as those in South Korea, India, and select centers in North America and Europe. Comparative analyses of LDLT outcomes across different healthcare systems could offer further insights into how institutional expertise, surgical techniques, and post-transplant management strategies influence long-term success. While Japan has pioneered many LDLT innovations, integrating lessons from other regions could further refine best practices and optimize patient outcomes worldwide.

Looking ahead, the insights gained from this work pave the way for continued innovation in LDLT. Emerging therapies, including cellular treatments, regenerative medicine approaches, and graft optimization protocols, hold promise for further improving outcomes, particularly in challenging donor-recipient scenarios. The development of precision medicine strategies, incorporating molecular and genetic markers into donor-recipient matching, could lead to more personalized transplantation approaches, ultimately enhancing patient outcomes. Additionally, as machine learning and artificial intelligence gain traction in medicine, their potential application in optimizing donor selection and predicting transplant success warrants further exploration.

The implications extend beyond clinical practice to transplant policy and healthcare system planning. Given the demonstrated impact of institutional volume on outcomes, policymakers should consider strategies to encourage the centralization of LDLT procedures at experienced centers. Additionally, continued investment in research and innovation will be essential to further refine

donor selection criteria, optimize surgical techniques, and enhance perioperative management strategies. The findings highlight the importance of sustained efforts to improve LDLT outcomes through a combination of clinical expertise, technological advancements, and policy-driven initiatives.

Eguchi *et al.* (1) have produced a study of exceptional depth and rigor, setting a new benchmark in transplantation research. Their meticulous approach, combined with the ability to translate data into actionable clinical insights, provides a solid foundation for future progress in LDLT. By systematically addressing key challenges in donor-recipient matching, emphasizing the role of institutional expertise, and identifying areas for future exploration, the study represents a major step forward in the field.

In conclusion, “An Analysis of 10,000 Cases of Living Donor Liver Transplantation in Japan” is a landmark study that will shape the future of LDLT. By offering a data-driven evaluation of critical factors influencing transplant outcomes, the work serves as both a reference for transplant professionals and a catalyst for future innovation. The authors are to be commended for their exceptional contribution, which will undoubtedly inform best practices and inspire continued advancements in LDLT for years to come. Their findings not only reflect the achievements of the JLTS but also exemplify the transformative power of data-driven research in improving patient care.

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appropriately investigated and resolved.

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