

REVIEW

Living liver donor safety: Intraoperative considerations in living liver donation—Guidelines from the ILTS–iLDLT group consensus conference 2025

Prashant Bhangui¹  | Abdul Rahman Hakeem²  | Tommaso Di Maira³ |
 Ashwin Rammohan⁴  | Blayne Amir Sayed⁵  | Yuji Soejima⁶ |
 Alexandra Shingina⁷ | Yee Lee Cheah⁸ | Stuart McCluskey⁹  |
 Michael Spiro¹⁰ | Swaytha Ganesh¹¹ | Rajesh Rajalingam⁴ |
 Subash Gupta¹²  | James Findlay¹³ | Amar Gupta¹⁴ |
 Alfred Kow Wei Chieh¹⁵ | Seisuko Sakamoto¹⁶  | Qiang Xia¹⁷  |
 Ki-Hun Kim¹⁸ | Wojciech G. Polak¹⁹  | Gonzalo Sapisochin²⁰  |
 Arvinder Singh Soin¹ | James Pomposelli²¹  | Mary Vyas²² |
 Chantal Wiggins²² | Valeria Mas²³ | Timucin Taner²⁴ | Dieter Broering²⁵ |
 Chao-Leng Chen²⁶ | Norah Terrault²⁷ | Patrizia Burra²⁸ | Gideon Hirschfield²⁹ |
 Nancy Ascher³⁰ | Jan Lerut³¹ | Mohamed Rela⁴ | Julie Heimbach²⁴ |
 Nazia Selzner³²  | Deniz Balci³³  | Kim Olthoff³⁴

¹Medanta Institute of Liver Transplantation and Regenerative Medicine, Medanta—The Medicity, Delhi, NCR, India

²Institute of Liver Studies, King's College Hospital NHS Foundation Trust, Denmark Hill, London, UK

³Department of Digestive Diseases, Hepatology and Liver Transplantation Unit, Hospital Universitari i Politècnic La Fe, Valencia, Spain

⁴Institute of Liver Disease and Transplantation, Dr. Rela Institute and Medical Center, Bharath Institute of Higher Education and Research, Chennai, India

⁵Liver Transplantation Program, The Hospital for Sick Children and Toronto General Hospital, Toronto, Canada

⁶Department of Surgery, Shinshu University School of Medicine, Matsumoto, Japan

⁷Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, Michigan, USA

⁸Division of Transplantation, Division of Surgery, Houston Methodist Hospital, Houston, Texas, UK

⁹Department of Anesthesiology and Pain Medicine, University of Toronto and Toronto General Hospital, University Health Network, Toronto, Canada

¹⁰Department of Anaesthesia and Intensive Care Medicine, The Royal Free Hospital, London, UK

¹¹Department of Gastroenterology and Liver Transplantation, Thomas E. Starzl Transplantation Institute, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA

¹²HPB Surgery and Liver Transplant, Center for Liver and Biliary Surgery, New Delhi, India

¹³Department of Anesthesiology and Critical Care Medicine, Mayo Clinic, Rochester, Minnesota, USA

¹⁴Liver and Pancreas Disease Center, Baylor University Medical Center, Dallas, Texas, USA

¹⁵Division of Hepatobiliary and Pancreatic Surgery, Department of Surgery, National University Hospital, Singapore, Republic of Singapore

¹⁶Organ Transplantation Center, National Center for Child Health and Development, Tokyo, China

¹⁷Department of Liver Surgery, Renji Hospital, School of Medicine, Shanghai Jiao Tong University, Shanghai, China

¹⁸Division of HB Surgery and Liver Transplant, Department of Surgery, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea

¹⁹Division of Hepatopancreatobiliary and Transplant Surgery, Department of Surgery, Erasmus MC Transplant Institute, University Medical Center Rotterdam, The Netherlands

²⁰Hospital Universitario Vall d'Hebron and Vall d'Hebron Institute of Research, Barcelona, Spain

²¹Division of Abdominal Transplant and Hepatobiliary Surgery, Tufts University School of Medicine, Boston, Massachusetts, USA

²²PSC Partners Seeking a Cure, Toronto, Canada

²³Department of Surgery, University of Maryland School of Medicine, Baltimore, Maryland, USA

²⁴Division of Transplant Surgery, Mayo Clinic, Rochester, Minnesota, USA

²⁵Organ Transplant Center of Excellence, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

²⁶Liver Transplantation Center, Kaohsiung Chang Gung Memorial Hospital, Kaohsiung, Taiwan.

²⁷Department of Surgery, Keck Medical Center of the University of California, San Francisco (UCSF), San Francisco, California, USA

²⁸Department of Gastroenterology, Surgery, Oncology and Gastroenterology, Padua University Hospital, Padua, Italy

²⁹Division of Gastroenterology and Hepatology, The Autoimmune and Rare Liver Disease Programme, Toronto General Hospital, University Health Network, Toronto, Canada

³⁰Department of Surgery, University of California, San Francisco, San Francisco, CA, USA

³¹Institute for Experimental and Clinical Research (IREC) Université Catholique de Louvain (UCL), Brussels, Belgium

³²Ajmera Transplant Center, University of Toronto, Toronto, Canada

³³Department of Surgery and Transplantation, Bahcesehir University School of Medicine, Medical Park Goztepe Hospital, Istanbul, Turkey

³⁴Division of Transplant Surgery, Department of Surgery, University of Pennsylvania, Philadelphia, Pennsylvania, USA

Correspondence

Prashant Bhangui, Liver Transplantation and Hepatobiliary Surgery, Medanta – The Medicity, Sector 38 Gurgaon, Gurgaon, Haryana 122001, India.
E-mail: pbhangui@gmail.com

Abstract

The success of living donor liver transplantation (LDLT) has bridged the growing gap between organ demand and availability in patients with liver failure or liver cancer. Safety of the living liver donor (LLD) is paramount, and astute intraoperative management plays a critical role in ensuring optimal outcomes for them. Given that intraoperative surgical and anesthesia practices vary widely across centers, the International Liver Transplantation Society (ILTS) and the International Living Donor Liver Transplantation Group (iLDLT Group) convened a global consensus conference in Toronto in March 2025 to develop guidelines for intraoperative management of the LLD. This manuscript details the recommendations on intraoperative considerations for the safety of LLD developed by Working Group II of the Consensus Scientific Committee, using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) system for assessment of recommendations, and the Danish model of consensus. Working Group II focused on intraoperative monitoring, fluid and ventilation strategies, surgical techniques for vascular and biliary division, surgeon and center-specific experience, and intraoperative crises planning. These guidelines aim to support both established and emerging LDLT teams to ensure high-quality and safe intraoperative care for the LLD.

Keywords: consensus, donor safety, hepatectomy, minimally invasive, perioperative care, recommendation

Abbreviations: ARMs, alveolar recruitment maneuvers; BMI, body mass index; CEA, continuous epidural analgesia; CUSA, Cavitron ultrasonic surgical aspirator; CUSUM, cumulative sum (learning-curve analysis); CVC, central venous catheter; CVP, central venous pressure; EEG, electroencephalogram; ERAS, enhanced recovery after surgery; ESP, erector spinae plane block; GRADE, Grade of recommendations, assessment, development and evaluation; ICG, indocyanine green fluorescence; iLDLTG, International Living Donor Liver Transplantation Group; ILTS, International Liver Transplantation Society; IOC, intraoperative cholangiography; LapDH, laparoscopic donor hepatectomy; LDH, living donor hepatectomy; LDLT, living donor liver transplantation; LLD, living liver donor; LOE, level of evidence; LPV, lung protective ventilation; MAP, mean arterial pressure; MIDH, minimally invasive donor hepatectomy; MRCP, magnetic resonance cholangiopancreatography; NSAID, non-steroidal anti-inflammatory drug; ODH, open donor hepatectomy; PEEP, positive end-expiratory pressure; PIV, peripheral intravenous; PPCs, postoperative pulmonary complications; PPV, pulse pressure variation; RDH, robotic donor hepatectomy; SVV, stroke volume variation; TAP, transversus abdominis plane block; Vt, tidal volume; WG, working group.

Prashant Bhangui and Abdul Rahman Hakeem are joint first authors.

Deniz Balci and Kim Olthoff are joint senior authors.

Supplemental Digital Content is available for this article. Direct URL citations are provided in the HTML and PDF versions of this article on the journal's website, www.ltxjournal.com.

Copyright © 2025 American Association for the Study of Liver Diseases.

INTRODUCTION

Living donor liver transplantation (LDLT) has evolved into a life-saving procedure that addresses a critical gap between organ demand and availability.^[1] As global LDLT activity increases, the safety of the living liver donor (LLD), an otherwise healthy individual undergoing major surgery, remains of paramount importance. The complexity of living donor hepatectomy (LDH) demands a high degree of technical precision, multidisciplinary coordination, and evidence-based perioperative management to optimize outcomes. In this context, intraoperative anaesthetic management and surgical techniques in the donor are particularly crucial, since this phase presents the highest risk for both surgical and anesthetic adverse events that could significantly impact both, early donor recovery, and long-term health.^[2] Further, center experience, team training, and intraoperative crises planning are important considerations.

Intraoperative protocols and techniques vary widely across centers due to differences in experience, resources, and individual preference. As the practice of LDLT expands, a unified, evidence-based framework is needed for guidance as regards LLD safety, and would be extremely useful for new programs. To address this, the International Liver Transplantation Society (ILTS) and the International Living Donor Liver Transplantation Group (iLDLT Group) convened a global consensus conference in Toronto in March 2025, focusing on donor safety. As part of this initiative, a dedicated working group (WG-II) was tasked with developing comprehensive guidelines on intraoperative management of the LLD (Figure 1).

We acknowledge that while some recommendations are supported by moderate evidence and are widely adopted, others rely on expert consensus due to limited prospective data in this unique surgical population. Thus, the recommendations are intended not as rigid protocols but as adaptable principles to guide surgical teams in optimizing donor safety across a range of operative settings and levels of experience. By providing a unified reference for intraoperative best practices in LDH, this guideline document seeks to support both established and emerging LDLT programs in delivering safe donor care.

METHODS

Details regarding the Scientific Committee and Preparation for the Consensus Meeting, as well as the Consensus process, are available in the report from Working Group 1 of the Consensus Conference (reference) and also in the Supplemental content of this article, <http://links.lww.com/LVT/B71>.

WG II addressed 10 key questions with 9 subcategories (Table 1), leading to 16 recommendations outlined in the sections below.

Anaesthetic and analgesic considerations in living donor hepatectomy

Anesthetic considerations

Evidence for most recommendations is graded as low to moderate, as the majority of evidence comes from liver resection data, not necessarily pertaining to LDH.

Q1: What should be the access, monitoring, and other anesthetic considerations for LDH?

In most cases, especially in adults, LDH is a major hepatectomy (≥ 3 segments) wherein even modest hemodynamic fluctuations can have significant consequences for both donor safety and graft viability. Dynamic monitoring is critical to guide judicious fluid administration and to maintain low central venous pressure (CVP) during parenchymal transection, minimizing intraoperative blood loss while preserving adequate perfusion. Most international societies suggest the minimum monitoring standards for the provision of safe anesthesia, including neuromuscular monitoring during hepatectomy.^[3] Due to the surgical complexities of LDH as well as its medico-legal aspects, additional access and monitoring should be considered as standard, including: an arterial line, central venous catheters (CVCs), and wide-bore peripheral intravenous (PIV) access.

Arterial lines

Beat-to-beat arterial blood pressure monitoring enables rapid identification of hemodynamic instability. It also

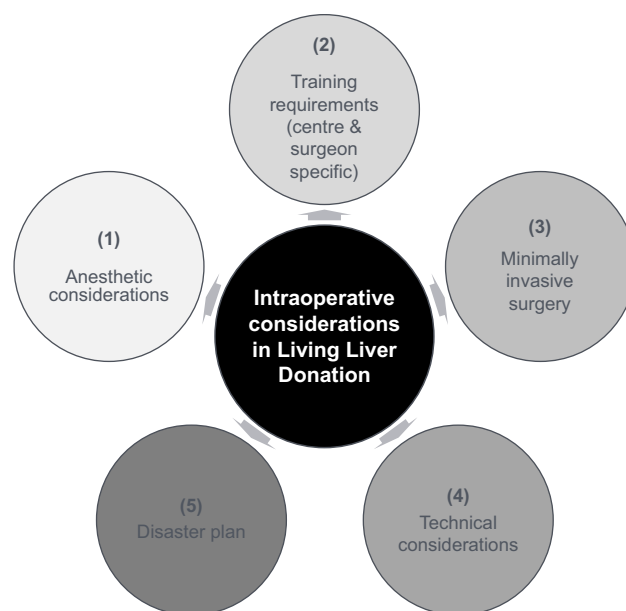


FIGURE 1 Intraoperative considerations in living liver donation.

TABLE 1 Working group II—10 key questions for scoping review

1. What should be the access, monitoring, and other anesthetic considerations for living donor hepatectomy?
2. What is the best analgesic approach for the living liver donor?
3. What are the surgeon-specific requirements for a safe live donor hepatectomy?
4. What are the center-specific requirements for a safe live donor hepatectomy?
5. What are the safety and benefits of various approaches to donor hepatectomy?
6. What are the indications and contraindications for minimally invasive donor hepatectomy?
7. What are the acceptable bile duct division technique(s) in living liver donor hepatectomy?
8. What are the acceptable vascular division technique(s) in living liver donor hepatectomy?
9. What should be the disaster plan if there are intraoperative donor issues?
10. How to manage the donor if there are recipient issues during the donor operation?

allows for the assessment of pulse pressure variation (PPV), an important dynamic tool for the assessment of fluid status.^[4] This is especially critical during the parenchymal transection phase, where low CVP strategies are employed to minimize blood loss.

Central venous catheters

Low and controlled CVP strategies during hepatic transection reduce hepatic venous pressure, minimizing intraoperative blood loss^[5] and transfusion requirements. Techniques to achieve low CVP include fluid restriction, pharmacological interventions such as use of nitroglycerine or diuretics, patient positioning,^[5,6] and hypovolemic phlebotomy.^[7] While many centers employ a target CVP ≤ 5 cm H₂O, as proposed for liver resection, available evidence does not support this specific value^[5] (Supplemental Table S1, <http://links.lww.com/LVT/B71>).

Given these observations, CVP should be used in conjunction with dynamic monitoring like stroke volume variation (SVV), PPV, and cardiac output monitoring to optimize intraoperative fluid therapy.^[5] This integrated approach ensures effective volume management while maintaining adequate perfusion and hemodynamic stability.

SVV monitoring

SVV-based monitoring is superior to traditional CVP-guided approaches in liver resection with reduced intraoperative fluid administration, improved hemodynamic stability, and decreased perioperative complications.^[8] Studies consistently show that maintaining a SVV range of 10%–20% during hepatic transection reduces intraoperative blood loss and improves surgical conditions without increasing renal or pulmonary complications.^[9] However, SVV should be used cautiously as a sole indicator, given its weak correlation with other hemodynamic parameters, including cardiac output, in certain scenarios.^[10] PPV, based on arterial pressure monitoring, is more widely available and offers a similar evaluation of fluid responsiveness,^[11] but specific evidence in donor hepatectomy is lacking. However, when available, SVV

should be integrated into intraoperative hemodynamic management. Following completion of hepatic transection, fluid should be administered to achieve normovolemia by the end of the case Supplemental Table S2, <http://links.lww.com/LVT/B71>.

Recommendation: We recommend that fluid restrictive strategies be routine during parenchymal transection in living donors, and low CVP should be used in conjunction with dynamic parameters such as SVV, cardiac output, and PPV monitoring to achieve accurate assessment of hemodynamic status.

Level of evidence: Moderate.

Grade of recommendation: Strong.

Ventilation

The role of lung protective ventilation (LPV) has been studied in patients undergoing both open and laparoscopic abdominal surgery. While strong evidence supports the benefits of LPV in major abdominal surgery, studies specifically evaluating its impact in LDH remain limited. Current recommendations are extrapolated from broader surgical populations.^[12] A scoping review suggests that LPV strategies, including lower tidal volumes (V_t) of 6–10 mL/kg, moderate positive end-expiratory pressure (PEEP) of 5–15 cm H₂O titrated to optimize lung compliance, may help minimize pulmonary complications in LDH (Supplemental Table S3, <http://links.lww.com/LVT/B71>).

The role of alveolar recruitment maneuvers (ARMs) in lung-protective ventilation is debatable. In liver resection, strategies such as ARMs, individualized PEEP, and lower tidal volumes improve oxygenation, reduce ventilator-associated injury, and lower blood loss without increasing hemodynamic instability, transfusion needs, or conversion to open surgery.^[13,14]

Recommendation: We recommend the implementation of lung protective ventilation (LPV) to optimize pulmonary function and minimize postoperative complications.

Level of evidence: Low.

Grade of recommendation: Strong.

Processed frontal electroencephalographic (EEG) monitoring in living donors is detailed in SDC and Supplemental Table S4, <http://links.lww.com/LVT/B71>.

Analgesic considerations

Q2: What is the best analgesic approach in the LLD?

Effective pain management is crucial for LLDs, as a proportion of donors may experience moderate to severe pain in the immediate postoperative period, which also depends on the pain threshold, which varies from individual to individual.^[15] The degree of pain may vary based on the approach (ODH vs. MIDH), and the type of incision (inverted J-shaped vs. upper midline vs. Pfannenstiel incision). Careful multimodal analgesic strategies are recommended to optimize recovery.

Multimodal analgesia, combining medications and regional analgesia techniques, is the recommended paradigm for all post-surgical patients. Specific to LLD, a recent systematic review recommended multimodal analgesia to reduce post-operative opiate requirement, pain scores, hospital stay, and to facilitate early mobilization, promote earlier return of bowel function, although the quality of evidence was assessed as low.^[16] In this review, pharmacologic adjuvants included acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), ketamine, dexmedetomidine, and lidocaine. Regional analgesia techniques used included local infiltration and catheters, transversus abdominus plane (TAP) block, erector spinae plane (ESP) block, intrathecal opiate, and continuous epidural analgesia (CEA). Regional analgesia techniques can also be used in combination with pharmacologic modalities^[16] (Supplemental Table S5, <http://links.lww.com/LVT/B71>). There is inadequate evidence to recommend one locoregional technique over another. The potential for differing post-operative pain associated with the different surgical approaches (open vs. laparoscopic vs. robotic) also confounds the picture.^[15,16]

While CEA has demonstrated superior pain relief in some studies, concerns remain regarding its safety profile in LLD.^[15,17] Given the potential for perioperative coagulopathy, catheter associated infection, delayed mobilization and hypotension, a recent enhanced-recovery after surgery (ERAS) guideline recommends using alternative locoregional techniques.^[16]

Recommendation: We recommend multimodal analgesia in all living liver donors. Based on the available evidence, it is not possible to recommend one locoregional analgesic technique over another.

Level of evidence: Low.

Grade of recommendation: Strong.

Surgical considerations during live donor hepatectomy

Surgical considerations: Surgeon experience

Q3: What are the surgeon-specific requirements for a safe donor hepatectomy?

Safe open and minimally invasive donor hepatectomy (MIDH) requires prior experience in non-donor hepatectomy and liver transplantation.^[18–28] In published studies, “mastery” or proficiency in performing safe donor hepatectomy has been defined using a variety of metrics. Some studies applied cumulative sum (CUSUM) analysis to operative time, identifying the point at which operative durations plateaued and variability decreased. Others used donor complications, including intraoperative blood loss, need for reoperation, bile leaks, and overall morbidity, as metrics for proficiency. A few studies additionally incorporated recipient outcomes, such as biliary complications and graft survival, to ensure that donor surgeon competence did not compromise recipient outcomes (Table 2).

CUSUM or operative time and complication trends across case-number thresholds have been typically used to draw up learning curves. Open donor hepatectomy (ODH) proficiency is typically reached after 32–68 cases, with reduced complications and improved outcomes^[23,27,28] (Table 2). Laparoscopic donor hepatectomy (LapDH) learning curves range from 30 to 60 cases for right and 25–34 for left or left-lateral donor hepatectomy, assuming prior experience of 105–450 non-donor laparoscopic hepatectomies, as per published reports.^[22,24,26–28]

Three learning curve studies on robotic donor hepatectomy (RDH) demonstrated attainment of proficiency after 17–25 cases using operative time CUSUM analysis, but required 165 cases using donor complications such as transfusion requirement, bile leaks, and reoperations as a metric.^[18,19,21] Recipient outcomes were comparable or improved throughout. All surgeons assessed in these studies had extensive prior experience in open and/or MIDH and non-donor hepatectomy.

Four out of 11 published studies highlighted proctoring or mentorship by an expert or senior surgeon during program initiation (1 of 3 open series and 3 of 8 MIDH series).^[18,21,22,25]

Prospective and continuous analysis of donor and recipient outcomes right from the onset of the surgeon’s experience is critical for ensuring safety, identifying learning curve effects, and maintaining quality in both open and MIDH.^[19] Structured outcome tracking improves complication recognition and training, and consensus guidelines endorse prospective auditing to ensure transparency and optimize LDLT outcomes.^[29,30]

TABLE 2 Surgeon-specific training requirements for living donor hepatectomy

References	Study type	Study period	Surgeon 1 or >1	Type (ODH, LapDH, RDH)	Graft type (RL, LL, LLS, RPS)	Type of learning curve (CUSUM, before vs. after)	Results	Comments/recommendations	GRADE evidence level
Cheah YL et al. ^[18]	Observational, Multi-center	2016–2022	>1	RDH (n = 116)	RL	CUSUM and before vs. after	LC—17 RDH cases Overall/serious complications—23.3%/6.9%	Recommendation: 1. Surgeon experience in robotic non-donor HPB surgery 2. Center experience in LDLT, robotic non-donor complex HPB surgery	Low
Raptis DA et al. ^[19]	Observational, Single-center	2011–2023	1	ODH (n = 646), LapDH (n = 165), RDH (646)	RL, LL, LLS	CUSUM	LC For RDH—165 cases Complications as metric	Recommendation: Surgeon experience in open, lap, and robotic DH	Low
Kikuchi K et al. ^[20]	Observational, Single-center	2012–2022	1	LapDH (n = 48)	RL, LL	CUSUM (based on OR time (75th percentile))	LC—33–34 LapDH cases Open conversion 6.25% RH serious comp 20% LH serious comp 16.7%	Recommendation: Surgeon's experience 300 lap non-donor major hepatectomy, 150 lap-assisted major hepatectomy, 100 open DH	Low
Troisi RI et al. ^[21]	Observational, Single-center		>1	LapDH, RDH (n = 75)	LLS	Before vs. after	LC—25 cases Less EBL, same complication rate	Recommendation: 1. Proctorship 2. Surgeon experts in DH (all approaches)	Low
Broering DC et al. ^[22]	Observational, Single-center	2013–2017	1	LapDH (n = 72) Proctor performed 3 cases, assisted the next 12	LLS	CUSUM and before vs. after	LC—25 lap LLS cases Overall/serious complications —2.8% vs. 0% Less EBL, OR time after LC, 3 open conversions	Recommendation: extensive experience in open DH with excellent results in both donor and recipient Rec: proctorship by expert Rec: experience in traditional HB surgery and LD	Moderate
Takagi K et al. ^[23]	Observational, Single-center	1996–2019	1	ODH (n = 408)	RL, LL, LLS, RPS	Before vs. after	LC 68 ODH Shorter hospital stay (only ss data point) Complications rates lower, but not ss	Recommendation: donor outcomes improved over time Rec: most biliary issues resolved conservatively, ERBD donors stent-free Rec: Outcomes similar across graft types	Low
Lee B et al., 2019 ^[24]	Observational, Single-center	2010–2017	>1	ODH (43), LapDH (35)	RL	Moving average and Before vs. after CUSUM	LC—15 cases (lap) LC—17 cases (open) Less EBL Shorter hospital stay and lower complications with LapDH CUSUM for lap major non-donor hepatectomy 70 cases	Recommendation: 1. 19 open major hepatectomy before starting lap non-donor 2. LapDH after 67 minor and 38 major lap non-donor hepatectomy CUSUM for lap major non-donor hepatectomy 70 cases NB: This is a small volume LDLT center (average 11 cases per year)	Low

TABLE 2. (continued)

References	Study type	Study period	Surgeon 1 or > 1	Type (ODH, LapDH, RDH)	Graft type (RL, LL, LLS, RPS)	Type of learning curve (CUSUM, before vs. after)	Results	Comments/recommendations	GRADE evidence level
Hong SK et al. ^[25]	Observational, Single-center	2015–2017	1	LapDH (n = 100)	RL	CUSUM surgical events based on OR time (RA CUSUM performed)	LC 60 lap right DH cases Overall comp 9% Serious comp 2% Readmission 4%	Recommendation: 1. Surgeon's experience 1000 open DH (including 60 lap-assisted DH) and 200 non-donor lap hepatectomy 2. Reference proctoring a second surgeon with success	Moderate
Rhu J et al. ^[26]	Observational, Single-center (4 quartiles)	2014–2018	1	ODH (n = 96), Lap (n = 103)	RL	Before vs. after	LC 50 cases (lap) Trend for lower complications in LapDH OR time shorter in LapDH after 50 cases Before LC: more BD openings than expected	Recommendation: teams with experience in lap liver surgery and donor hepatectomy	Low
Ikegami T et al. ^[27]	Observational, Single-center	2012–2016	1 (399 LD using non-midline incisions prior)	Open (Upper midline) (n = 101)	RL, LL	CUSUM surgical events and before vs. after	LC: overall 32 ODH, open RH 9 cases; open LH 19 cases Lower EBL, smaller incision	Recommendation: experienced HB surgeons in hepatic resection, biliary reconstruction, and LT	Low
Chan SC et al. ^[28]	Observational, Single-center		> 1	Open (n = 450) (1st 200—3 surgeons, next 250—4 others as senior + 4 fellows)	RL, RPS	Before vs. after	LC—50 open cases Comp rates 34% first 50, dropped to 16% next 50	Recommendations: 1. For LDLT trainee—must be certified gen surgeon (6-year training), 1 year HPB experience 2. Surgeon's extensive experience in major hepatectomy 3. To be a senior surgeon with experience assisting in DH and non-donor hepatectomies	Moderate

Abbreviations: BD, bile duct; CUSUM, cumulative sum (learning-curve analysis); DH, donor hepatectomy; EBL, estimated blood loss; ERBD, Endoscopic retrograde biliary drainage; HB, hepato-biliary; HPB, hepato-pancreato-biliary; lap, laparoscopic; LapDH, laparoscopic donor hepatectomy; LC, learning curve; LD, living donor; LDH, living donor hepatectomy; LDLT, living donor liver transplantation; LL, left lobe; LLS, left lateral segment; LT, liver transplantation; n, number of patients; ODH, open donor hepatectomy; OR, operating room; RA-CUSUM, risk-adjusted cumulative sum; RDH, robotic donor hepatectomy; RH, right hepatectomy; RL, right lobe; Rob, robotic surgical approach; RPS, right posterior segment; ss, statistically significant.

Recommendations: Prior to initiation of open living donor hepatectomy, the surgical team should have adequate experience in non-donor major hepatectomy and liver transplantation with acceptable outcomes.

Level of evidence: Low.

Grade of recommendation: Strong.

Prior to initiation of MIDH, the surgical team should have experience in demonstrating competence in open living donor hepatectomy and minimally invasive non-donor major hepatectomy, with acceptable outcomes.

Level of evidence: Low.

Grade of recommendation: Strong.

Proctorship or mentorship by an expert is recommended during the early part of the learning curve for open and minimally invasive donor hepatectomy to optimize donor safety.

Level of evidence: Low.

Grade of recommendation: Strong.

We recommend prospective and continuous analysis of donor and recipient outcomes from the onset of a surgeon's experience with donor hepatectomy, regardless of the open or MIDH approach.

Level of evidence: Low.

Grade of recommendation: Moderate.

Surgical considerations: Center volume

Q4: What are the center-specific requirements for a safe donor hepatectomy?

Establishing and maintaining a safe LDLT program requires stringent center-specific norms and infrastructure to ensure donor safety and optimize recipient outcomes. Multiple studies have shown that there is a higher incidence of donor and recipient morbidity and mortality in low-volume centers, defined as performing fewer than 10 LDLTs per year.^[31]

Low-volume LDLT centers benefit from implementing robust prospective quality assurance measures from the outset. While establishing formal partnerships or proctorships with experienced centers may be valuable for low-volume centers, one may argue that cumulative surgeon experience and demonstrated competence can also sustain safe practice, even in settings with limited annual case volume. Strategies to ensure continuous monitoring and quality improvement remain essential to maintaining high standards of donor safety and care.

Recommendation: LDLT centers (particularly low-volume centers) should have a robust quality assurance monitoring process in place to ensure the safety of the donors, and should consider a close partnership and proctorship with experienced surgeons and centers as they build their volumes.

Level of evidence: Low.

Grade of recommendation: Strong.

Surgical considerations: Approach—Open and minimally invasive donor hepatectomy (MIDH)

Q5: What is the safety of, and the benefits of, various approaches to donor hepatectomy?

Q6: What are the indications and contraindications for minimally invasive donor hepatectomy?

ODH remains the most common and best-established LDH approach, offering consistent safety, excellent visibility, and control, particularly in complex anatomical scenarios.^[32] The use of MIDH—LapDH since 2010 and robotic-assisted LDH since 2020—has expanded. 3D reconstruction of imaging data can aid preoperative planning of MIDH by improving anatomical visualization and surgical confidence; however, robust evidence on whether it improves outcomes remains limited. In 2022, a survey of 66 institutions reported that 32.6% of donor hepatectomies were performed via a minimally invasive approach, comprising 25.9% right, 48.4% left, and 49.4% left lateral hepatectomies.^[33] Most of the MIDH were robotic (63.9%); pure laparoscopic and laparoscopic-assisted constituted 35.7% and 0.4%, respectively. Notably, 60% of centers using the robot had no prior LapDH experience.^[33] Recently, the International LDLT Registry reported that donor hepatectomy were performed in 71% by the open approach, whereas 13% and 16% were performed laparoscopically and robotically respectively.^[34]

In LapDH, views are magnified, but the learning curve is steep, tactile feedback is limited, and the operative times are longer initially.^[35] In RDH, dexterity and precision are significantly improved. Limitations include initial difficulty in adapting to absent haptics, longer operative times in the early period, and the higher cost. The outcomes depend on surgical expertise.^[36]

MIDH may offer advantages such as less pain, shorter stay, and improved cosmesis.^[37] However, these benefits must be carefully balanced against technical complexity, longer learning curves, and potential risks, particularly during program initiation. Minimally invasive right donor hepatectomy remains technically challenging, requiring strict donor selection early on, with due consideration of graft size, anatomy, steatosis, and donor BMI.^[38]

In a recent multicenter study of 10,025 donor hepatectomies, the overall incidence of severe complications (Clavien–Dindo IIIb–IV) was low and comparable between open and minimally invasive (laparoscopic/robotic) approaches. However, MIDH was associated with a higher incidence of postoperative bleeding, particularly from the IVC and abdominal wall, highlighting the need for technical refinement and tailored perioperative strategies, including the selection of anatomically less complex donors at least in the

initial stages of the learning curve.^[39] Some robotic surgeons (especially surgeons experienced in complex hepatobiliary surgery) may argue that with 10× magnification, dealing with multiple graft arteries and ducts in the donor may be simpler, and using the robot could better address complex donor anatomy. Emerging data suggest improving outcomes,^[40,41] but further large-scale, long-term studies are needed before routine expansion of MIDH can be recommended in donors with complex bilio-vascular anatomy.

Selection criteria may broaden as proficiency grows, however prioritizing donors with simple vascular and biliary anatomy and minimal steatosis remains essential, at least in the initial period when transitioning from ODH to MIDH.^[18,29]

Recommendations: During the initiation of a minimally invasive donor hepatectomy program, the choice of the donor and the graft should be highly selective. Donors with minimal hepatic steatosis, sufficient remnant liver volume, and favorable graft anatomy, such as a single vascular and bile duct anatomy, should be preferred. Larger size grafts and grafts with complex vascular variations (ie, concomitant and/or combination of portal vein and biliary variations, and those with multiple short hepatic (right inferior hepatic) veins should be avoided.

Level of evidence: Low.

Grade of recommendation: Strong.

Minimally invasive donor hepatectomy in donors with complex vascular and biliary anatomy should be performed only by experienced donor surgeons and teams who have successfully overcome the learning curve.

Level of evidence: Low.

Grade of recommendation: Strong.

Surgical considerations: Bile duct and vascular division techniques

Q7: What are the acceptable bile duct division techniques in LDH?

Bile duct division in LDH demands precise anatomical understanding and careful preoperative and intraoperative assessment to minimize biliary complications in the donor and recipient. The incidence of donor biliary complications is known to reduce with surgical experience.^[42]

For ODH, preoperative MRCP (magnetic resonance cholangiography) mapping is essential, and real-time guidance with intraoperative cholangiography (IOC) has been standard.^[43] Although IOC remains the gold standard for bile duct transection, it is technically challenging to perform during MIDH. Indocyanine green (ICG) fluorescence mapping is increasingly adopted as a helpful alternative, though it does not provide the same real-time anatomical detail as IOC. In MIDH, recommended ICG administration is

0.25 mg/kg intravenously, given 30–45 minutes before bile duct division, allowing optimal visualization of biliary anatomy. Among 22 MIDH studies, IOC was used in 6,^[44–49] ICG in 15,^[19,41,42,44–46,48,50–57] and both modalities together in 4.^[44–46,48] Based on surgeon preference, techniques typically include sharp transection using clip-and-cut, cut-and-clip, or cut and suture ligation, so as to preserve adequate duct stump length on the donor remnant side. Three RDH series reported fewer multiple bile ducts in grafts compared with LapDH.^[19,50,51] As regards comparison between LapDH and ODH, one study showed more incidence of multiple graft ducts in the laparoscopic group,^[56] another showed fewer,^[46] and one reported no difference.^[54] Although recipient complications are not the focus here, the number of graft duct openings can significantly affect biliary complication rates in the recipient.^[32,58]

A completion cholangiogram has been generally considered the most objective test to confirm adequate closure of the bile duct stump, and to intervene in a timely manner, without waiting for postoperative complications to occur.^[43,58] Some centers nowadays refrain from performing routine completion cholangiogram after closure of the bile duct stump, to prevent increased pressure within the bile duct in the donor and avoid potential complications like pancreatitis.^[50] However, in cases of suspicion of narrowing or bile leakage, completion cholangiography should ideally be performed. Low injection pressure and minimal use of dye could help prevent cholangitis and pancreatitis. Completion cholangiography is technically challenging in LapDH and not feasible with existing robotic systems. It may be apt to state that MIDH in grafts with complex biliary variations should be avoided to optimize donor safety. If such donors and grafts are accepted, the biliary anatomy must be clearly delineated preoperatively, and a robust intraoperative plan—including predefined criteria and strategy for conversion—should be established and agreed upon within the surgical team.

In cases where there is a leak, repair with additional sutures is seldom successful. Repeat closure of the stump, or use of a cystic duct patch, or finally a hepaticojejunostomy may be required to mend the same.^[39] A completion cholangiogram may thus give the opportunity to intervene timely, without waiting for post-operative complications to happen (Table 3).

Recommendations: In living donor hepatectomy, bile duct division should be guided by accurate preoperative imaging and intraoperative cholangiography or indocyanine green guidance.

Level of evidence: Low.

Grade of recommendation: Strong.

The donor surgeon should ensure safe donor duct closure to prevent both short-term and long-term biliary complications using an objective intraoperative assessment as deemed necessary.

Level of evidence: Low.

Grade of recommendation: Strong.

Q8: What are the acceptable vascular division technique(s) in living donor hepatectomy?

Safe vascular separation and preservation of adequate vessel length for graft anastomosis are critical during parenchymal transection. At the same time, it is necessary to make sure that there is no compromise of vascular inflow and outflow on the remnant side with good stump lengths preserved. The preference for parenchymal transection techniques varies based on the approach used. In ODH and LapDH (12 and 18 studies, respectively), the cavitronic ultrasonic surgical aspirator (CUSA) was the predominant method used for parenchymal transection (in 10 studies and 9 studies, respectively). RDH series (8 studies) described the use of CUSA in 2, harmonic in 3, and multiple devices in 1 (Table 4).

Intermittent Pringle maneuver to ensure hemostasis during transection was used routinely in 4 studies, selectively in 2, avoided in 8, and not specifically mentioned in 8. Recourse to intermittent inflow occlusion in both open and minimally invasive donor hepatectomy is safe, as it may help control bleeding, ensuring safe parenchymal transection. Further, it may facilitate bile duct division^[61] (Table 4).

Vascular division techniques include sharp division using vascular clamps with suturing, or the use of stapling devices. Stapling device performance remains inadequately studied, with isolated case reports of failure.^[62]

Although some portal or hepatic vein tears during parenchymal transection and vascular division in MIDH can be managed by the minimally invasive approach itself, they may necessitate emergency conversion to open surgery. Simple tears can sometimes be managed with primary suture repair, whereas larger defects often require vein patch angioplasty or interposition grafts.^[63] Prompt recognition and control of bleeding are imperative to not only prevent hemodynamic compromise and post-operative risk in the donor, but also to ensure that the graft remains well perfused and viable.

Clear, pre-defined “conversion to open procedure” thresholds need to be established, such as uncontrolled bleeding, prolonged warm ischemia, or unexpected anatomy, which can compromise donor safety. Teams should adopt a proactive mindset: early conversion at the first sign of significant risk minimizes complications rather than persisting with a challenging MIDH approach. Conversion to an open procedure should not be viewed as a failure, but rather as an essential safety measure to protect both the donor and the graft.^[33,63] In this context, hybrid approaches may offer a compromise between minimally invasive benefits and donor safety. These procedures typically involve laparoscopic mobilization, and/or sectioning of ligamentous attachments, with or without hilar dissection, followed by open parenchymal

and vascular transection through a limited midline incision. Such strategies may reduce technical complexity and bleeding risk while preserving many advantages of a minimally invasive approach.^[64] In very rare situations, in order to ensure donor safety, it may be necessary to abandon the living donor hepatectomy if significant hemodynamic compromise occurs for any reason and cannot be corrected.^[63,65]

Recommendations: At any stage during MIDH, if donor safety is compromised, we recommend a low threshold to convert to an open procedure.

Level of evidence: Low.

Grade of recommendation: Strong.

Surgical teams involved in LDH should proactively establish contingency plans and alternate strategies for donor safety, recognizing the potential risks during vascular division using different techniques.

Level of evidence: Low.

Grade of recommendation: Strong.

Disaster planning

Q9: What should be the disaster plan if there are intraoperative donor issues?

The risk of early death among live liver donors is ~1 per 5000 donors, highlighting the need for rigorous evaluation, transparent risk communication, informed consent, disaster preparedness, and unbiased reporting.^[66] Recent data show that with experience building in LDLT, the risk of early LLD death is decreasing (now 1 in 1000).^[66] Oversight varies globally; some countries mandate transparent reporting of donor deaths, while others lack centralized registries and standardized long-term outcome reporting.^[67,68]

To mitigate “never” events, transplant programs need comprehensive crisis protocols.^[69] A robust intraoperative disaster plan should include standardized checklists, detailed donor consent outlining unutilized graft protocols (plans for situations in which the recovered graft cannot be transplanted, for example, due to recipient complications, including intraoperative recipient death), reversible steps for bile duct injuries, and limits of vascular reconnection.^[63] Checklists reinforce critical steps and ensure clear team communication. Escalation pathways must connect surgical teams with leadership, ethics committees, and regulators for timely notification and decisions. In case of serious complications or donor death, pre-established communication plans should guide interactions with families, recipients, and hospital leadership, with prepared public statements when possible.^[69] Psychological support should be made available for all staff, followed by root cause analyses (RCA) to prevent recurrence.^[70] Quality improvement systems with near-miss reporting and multidisciplinary simulations, including robotic failures and crisis drills, strengthen preparedness, streamline response, and protect both donors and staff.

TABLE 3 Bile duct division and closure techniques for living donor hepatectomy: Outcomes in the published literature

References	Study type	Procedure type	No. of donors	IOC	ICG	Multiple bile ducts (more than expected)	Stamp closing	Complications (leak)	Complications (stricture)	GRADE evidence level
Rapits DA et al, ^[19]	Comparative Observational	RDH vs. LapDH vs. ODH	1724 RDH 913 LapDH 195 ODH 673	No	Yes	Less in RDH vs. LapDH	C/S	2.3% RDH 14.1% LapDH 13.1% ODH	0%	Low
Lee B et al, ^[24]	Comparative Observational	LapDH vs. ODH	76 LapDH 33 ODH 43	No	No	NM	C/S	0%	0%	Low
Troisi R et al, ^[35]	Comparative Observational (PSM)—(Multicenter)	RDH vs. LapDH vs. ODH	1194 RDH 92 LapDH 306 ODH 796	NM	NM	NM	NM	3.3% RDH 2.2% LapDH 1.6% ODH	0%	Low
Yang J et al, ^[37]	Comparative Observational—(Multicenter)	MIDH (RDH + LapDH) vs. ODH	1694 MIDH 304 (RDH 27 + LapDH 277) ODH 1390	NM	NM	NM	NM	2.4% MIDH 1.6% ODH	NM	Low
Varghese CT et al, ^[41]	Comparative Observational PSM (extended criteria grafts; Wt. > 800 g, type 2/3 PV, > 1 BD or HA, IRHV > 5 mm requiring reconstruction)	RDH	170 ECD 100 SCD 70	No	Yes	NM	C/S	7.6% ECD 6.1% SCD	NM	Low
Kim J et al, ^[42]	Observational	LapDH	76 (30 pre-ICG vs. 46 post-ICG)	No	± Yes	NM	CL/C	0% Pre-ICG 4.4% Post-ICG	Pre-ICG 3.3% Post-ICG 0%	Low
Ju MK et al, ^[44]	Comparative Observational	LapDH vs. ODH	56 LapDH 38 ODH 18	Yes	± Yes	NM	CL/C	2.6% LapDH 0% ODH	NM	Low
Rhu J et al, ^[45]	Comparative Observational (bile leak vs. no bile leak)	LapDH	636	Yes	Yes (since 2021)	NM	CL/C (initial) C/CL (current)	3.3% LapDH	1.6% LapDH	Low
Rhu J et al, ^[46]	Comparative Observational	LapDH vs. ODH	775 LapDH 506 ODH 269	Yes	Yes (since 2021)	Less in LapDH vs. ODH	CL/C (initial) C/CL (current)	0.6% re-exploration in LapDH (5.4% in ODH)	0.4% LapDH	Low
Rhu J et al, ^[47]	Comparative Observational (clip and cut vs. cut and clip)	LapDH	144 CL/C 78 C/CL 66	Yes	No	Common duct channel (78% CL/C vs. 94% C/CL; $p=0.019$)	CL/C (initial) C/CL (current)	8.9% CL/C 4.5% C/CL	1.2% CL/C 1.5% C/CL	Low
Cho HD et al, ^[48]	Comparative Observational	LapDH vs. ODH	180 LapDH 90 ODH 90	Yes	Yes	NM	CL/C	0%	0%	Low
Samstein B et al, ^[49]	Comparative Observational	LapDH vs. ODH	102 LapDH 51 ODH 51	Yes	No	NM	CL/C	LapDH 4.0% ODH 6.0%	NM	Low

Raptis DA et al. ^[50]	Comparative Observational	RDH vs. ODH	835 RDH 425 ODH 414	No	Yes	Less in RDH vs. LapDH	C/S	3.0% RDH 9.0% ODH ($p < 0.001$)	0%	Low
Kim NR et al. ^[51]	Comparative Observational (PSM)	RDH vs. LapDH	235 RDH 117 LapDH 118 PSM— 71:71	No	Yes	Less in RDH vs. LapDH	CL/C	NM	NM	Low
Soin AS et al. ^[52]	Comparative Observational (clip and suture vs. clip and cut)	RDH	137 C/S 33 CL/C 104	No	Yes	NM	C/S and CL/C	15.2% C/S 2.9% CL/C ($p < 0.009$)	3.0% C/S 0% CL/C	Low
Rajalingam R et al. ^[53]	Comparative Observational (PSM)	RDH vs. ODH	201 RDH 101 ODH 100	No	Yes	NM	C/S	NM	NM	Low
Hong SK et al. ^[54]	Observational	LapDH	556	No	Yes	No difference	C/S	2.0%	0.5%	Low
Fujiki M et al. ^[55]	Comparative Observational	LapDH vs. ODH	186 LapDH 91 ODH 95	No	Yes	NM	CLx2/C CL	NM	NM	Low
Hong SK et al. ^[56]	Comparative Observational (PSM)	LapDH vs. ODH	894 LapDH 213 ODH 505 PSM— 198:198	No	Yes	More in LapDH vs. ODH	CL/S and C/S	2.0% LapDH 2.0% ODH	1.0% LapDH 0.5% ODH	Low
Hong SK et al. ^[57]	Observational— (Multicenter)	LapDH	545 (481 RL donors)	NM	NM	NM	NM	2.8%	0.6%	Low
Kim SH et al. ^[59]	Observational (Multicenter)	LapDH	543	NM	NM	NM	NM	2.9%	0.6%	Low
Han ES et al. ^[60]	Comparative Observational	LapDH vs. ODH	150 LapDH 100 ODH 50 (UMI)	No	Yes (except initial few cases)	NM	C/S (initial) CL/C (recent)	0% LapDH 2% ODH	2.3% LapDH 0% ODH	Low

Abbreviations: BD, bile duct; C, clip; C/CL, cut and clip or ligate; CL, clip and ligate; CL/C, clip and ligate or cut; C/S, clip and suture; ECD, extended criteria donor; GRADE, Grading of Recommendations, Assessment, Development and Evaluations; HA, hepatic artery; ICG, indocyanine green; IOC, intraoperative cholangiography; IRHV, inferior right hepatic vein; LapDH, laparoscopic donor hepatectomy; MIDH, minimally invasive donor hepatectomy; NM, not mentioned; ODH, open donor hepatectomy; PSM, propensity score matching; PV, portal vein; RDH, robotic donor hepatectomy; RL, right lobe; SCD, standard criteria donor; UM, upper midline; UMI, upper midline incision; Wt., weight.

TABLE 4 Parenchymal transection and vascular techniques for living donor hepatectomy: Outcomes in the published literature

References	Study type	Procedure type	No. of donors	Parenchymal transection	Pringle	Average blood loss (mL)	Conversion rate	Re-exploration %	Minor complications	Major complications	GRADE evidence level
Raptis DA et al, ^[19]	Comparative Observational	RDH vs. LapDH vs. ODH	1724 RDH 913 LapDH 195 ODH 673	Harmonic	No	RDH 50 LapDH 100 ODH 250	RDH 0.2% LapDH 3.6% ($p < 0.001$)	NA	RDH 3.9% LapDH 8.0% ODH 15.2%	RDH 0.1% LapDH 0% ODH 0.8%	Low
Lee B et al, ^[24]	Comparative Observational	LapDH vs. ODH	76 LapDH 33 ODH 43	CUSA (LapDH)	No	LapDH 572 ODH 558	LapDH 6.1%	LapDH 3.0%	LapDH 9.1% ODH 20.9%	LapDH 9.0% ODH 11.3%	Low
Troisi R et al, ^[35]	Comparative Observational (PSM)—(Multicenter)	RDH vs. LapDH vs. ODH	1194 RDH 92 LapDH 306 ODH 796	NM	NM	RDH 114 LapDH 302 ODH 293 ($p < 0.001$)	RDH 1.1% LapDH 2.2% ODH 0%	NM	NM	RDH 3.3% LapDH 2.2% ODH 1.6%	Low
Yang JD et al, ^[37]	Comparative Observational—(Multicenter)	MIDH (RDH + LapDH) vs. ODH	1694 MIDH 304 (RDH 27 + LapDH) LapDH 277 ODH 1390	NM	NM	NM	NM	NM	NM	MIDH (RDH + LapDH) 2.0% ODH 2.0% ($p = ns$)	Low
Varghese CT et al, ^[41]	Comparative Observational PSM (extended criteria grafts; Wt. > 800 g, type 2/3 PV, > 1 BD or HA, IRHV > 5 mm requiring reconstruction)	RDH	170 ECD 100 SCD 70	Bipolar shears + CUSA	Mixed	RDH ECD 275 RDH SCD 250	RDH 3.5%	NM	RDH ECD 4.5% RDH SCD 7.6%	RDH ECD 7.6% RDH SCD 3.0%	Low
Kim J et al, ^[42]	Observational	LapDH	76 (30 pre-ICG vs. 46 post-ICG)	CUSA (LapDH)	NM	LapDH pre-ICG 398 LapDH post-ICG 380	NM	0%	LapDH pre-ICG 3.3% LapDH post-ICG 6.5%	LapDH pre-ICG 3.3% LapDH post-ICG 0%	Low
Ju MK et al, ^[44]	Comparative Observational	LapDH vs. ODH	56 LapDH 38 ODH 18	Harmonic (LapDH)	No	LapDH 496 ODH 676 ($p = 0.033$)	LapDH 0%	NA	NM	NM	Low
Rhu J et al, ^[45]	Comparative Observational (bile leak vs. no bile leak)	LapDH	636	Harmonic (LapDH)	Yes (57%)	LapDH 200	LapDH 1.6%	NM	LapDH 10.5%	LapDH 6.3%	Low
Rhu J et al, ^[46]	Comparative Observational	LapDH vs. ODH	775 LapDH 506 ODH 269	Harmonic (LapDH)	Yes	NM	LapDH 1.6%	LapDH 2.2%	LapDH 11.9% ODH 9.5%	LapDH 5.2% ODH 6.7%	Low
Rhu J et al, ^[47]	Comparative Observational (clip and cut vs. cut and clip)	LapDH	144 CL/C 78 C/CL 66	Harmonic (LapDH)	Yes (few cases)	NM	NM	NM	LapDH CL/C 10.3% LapDH C/CL 6.1%	LapDH CL/C 5.1% LapDH C/CL 3.0%	Low
Cho HD et al, ^[48]	Comparative Observational	LapDH vs. ODH	180 LapDH 90 ODH 90	CUSA (LapDH)	NM	LapDH 174 ODH 283 ($p < 0.001$)	LapDH 0%	NM	LapDH 0% ODH 3%	LapDH 0% ODH 0%	Low
Samstein B et al, ^[49]	Comparative Observational	LapDH vs. ODH	102 LapDH 51 ODH 51	CUSA (LapDH)	No	LapDH 236 ODH 405 ($p = 0.001$)	LapDH 9.4%	NM	NM	LapDH 12.0% ODH 21.0% ($p = ns$)	Low

Raptis DA et al. ^[50]	Comparative Observational	RDH vs. ODH	835 RDH 425 ODH 414	Harmonic	No	RDH 50 ODH 300 ($p < 0.001$)	1.0%	Nil	RDH 6.0% ODH 17.8% ($p = 0.029$)	RDH 0% ODH 1.2% ($p = 0.029$)	Low
Kim NR et al. ^[51]	Comparative Observational (PSM)	RDH vs. LapDH	235 RDH 117 LapDH 118 PSM—71:71	Harmonic (RDH) CUSA (LapDH)	NM	RDH 107 LapDH 193 ($p < 0.001$)	RDH 0% LapDH 0%	NA	NM	RDH 2.8% LapDH 5.6%	Low
Soin AS et al. ^[52]	Comparative Observational (clip and suture vs. clip and cut)	RDH	137 C/S 33 CL/C 104	Mixed	No	RDH C/S 764 RDH CL/C 426 ($p = 0.0001$)	RDH C/S 12.1% RDH CL/C 3.8% ($p = ns$)	RDH C/S 3.0% RDH CL/C 1.0% ($p = ns$)	RDH C/S 33.0% RDH CL/C 20.0% ($p = ns$)	RDH C/S 3.0% RDH CL/C 2.0% ($p = ns$)	Low
Rajalingam R et al. ^[53]	Comparative Observational (PSM)	RDH vs. ODH	201 RDH 101 ODH 100	CUSA assisted (RDH)	Yes (12 min)	NM	NM	NM	NM	NM	Low
Hong SK et al. ^[54]	Observational	LapDH	556	CUSA (LapDH)	Yes (few cases)	LapDH 266	NM	NM	LapDH 4.9%	LapDH 2.0%	Low
Fujiki M et al. ^[55]	Comparative Observational	LapDH vs. ODH	186 LapDH 91 ODH 95	NM	No	LapDH 184 ODH 578 ($p < 0.001$)	LapDH 1%	LapDH 4%	NM	NM	Low
Hong SK et al. ^[56]	Comparative Observational (PSM)	LapDH vs. ODH	894 LapDH 213 ODH 505 PSM—198:198	CUSA (LapDH)	No	LapDH 335 ODH 306 ($p = ns$)	NM	NM	LapDH 8.2% ODH 3.5% ($p = ns$)	LapDH 2.4% ODH 2.6%	Low
Hong SK et al. ^[57]	Observational—(Multicenter)	LapDH	545 (481 RL donors)	CUSA	NM	LapDH 303	LapDH 1.8%	NM	LapDH 4.4%	LapDH 4.8%	Low
Kim SH et al. ^[59]	Observational (Multicenter)	LapDH	543	NM	NM	LapDH 268	LapDH 1.7%	NM	LapDH 4.6%	LapDH 4.8%	Low
Han ES et al. ^[60]	Comparative Observational	LapDH vs. ODH	150 LapDH 100 ODH 50 (UMI)	CUSA (LapDH)	Yes (few cases)	LapDH initial 344 LapDH recent 161 UMI 378 ($p < 0.01$)	NM	2% (2 pts—IVC bleed, biliary stricture)	LapDH initial 4.7% LapDH recent 4.7% UMI 8.0% ($p = ns$)	LapDH initial 4.7% LapDH recent 1.8% UMI 2.0% ($p = ns$)	Low

Abbreviations: BD, bile duct; C, clip; C/C, cut and clip or ligate; C/S, clip and suture; CL, clip and ligate; CL/C, clip and ligate or cut; CUSA, Caviron ultrasonic surgical aspirator; ECD, extended criteria donor; GRADE, Grading of Recommendations, Assessment, Development and Evaluations; HA, hepatic artery; Harmonic, ultrasonic shears (Harmonic scalpel); ICG, indocyanine green; IRHV, inferior right hepatic vein; LapDH, laparoscopic donor hepatectomy; MIDH, minimally invasive donor hepatectomy; NA, not available; NM, not mentioned; ODH, open donor hepatectomy; PSM, propensity score matching; PV, portal vein; RDH, robotic donor hepatectomy; RL, right lobe; SCD, standard criteria donor; UMI, upper midline incision; Wt., weight.

Recommendations: LDLT programs must have an incorporated system to report any serious adverse events and near-misses in the donor with root-cause analysis and quality improvement processes in place.

Level of evidence: Low.

Grade of recommendation: Strong.

A robust crisis response system for donor death must be in place before starting a living-donor program, and the response must be automatic once activated. All members of the LDLT team and hospital administration should be aware and familiar with the details of the crisis response system.

Level of evidence: Low.

Grade of recommendation: Strong.

Q10: How to manage the donor if there are recipient issues during the donor operation?

If recipient issues arise during an ongoing LDH, donor safety must remain the top priority. Intraoperative communication between the donor and recipient teams is essential to ensure coordinated decision-making.^[71] If a recipient develops sudden hemodynamic instability, arrhythmia, or is found intraoperatively to be unsuitable for transplantation (eg, extensive portal vein thrombosis or unexpected malignancy), the donor hepatectomy procedure can be paused, or even aborted to prevent unnecessary donor risk (ideally before irreversible steps like biliary and/or vascular division).^[71]

When graft procurement has already begun or been completed, the team must consider backup recipient listing or emergent organ sharing via regional networks to avoid an orphaned organ, although this is rare and logistically complex.

CONCLUSIONS

Intraoperative management during living donor hepatectomy requires meticulous surgical expertise, vigilant anesthetic strategies, and structured crisis preparedness. These consensus recommendations provide adaptable, evidence-informed guidance to optimize donor safety. By harmonizing global practices, they aim to support established and emerging LDLT programs in delivering safe, ethical, and high-quality donor care.

AUTHOR CONTRIBUTIONS

All the authors participated in literature review, consensus conference discussion and voting, article writing and editing, and critical review. Prashant Bhangui, Abdul Rahman Hakeem, Tommaso Di Maira, and Alexandra Shingina were working group coordinators. Prashant Bhangui and Abdul Rahman Hakeem contributed equally to the writing of the manuscript and are co-first authors. Deniz Balci and Kim Olthoff are joint senior authors.

CONFLICTS OF INTEREST

Tommaso Di Maria received grants from Chiesi. Yee Lee Cheah consults for Intuitive Surgical. Gonzalo Sapisochin consults for and received grants from AstraZeneca, Roche, Eisai, Heparegenix, Integra, and Natera. Norah Terrault received grants from GSK, Genentech, Helio Health, Durect Corp, Eiger BioPharmaceuticals, Immunocore, Aligos Therapeutics, Bluejay Therapeutics, Siemens Healthcare, Vir Biotechnology, Hoffman-LaRoche, and Gilead. She has other interests in Elsevier, Clinical Care Options, and Simply Speaking. She is employed by AASLD, HBV Forum, and the Hepatitis B Foundation. Patrizia Burra advises GSK, Ipsen, Novo Nordisk, Chiesi, Kedrion, Biotest, and Sandoz. Kim Olthoff advises OrganOx. The remaining authors have no conflicts to report.

ORCID

Prashant Bhangui  <https://orcid.org/0000-0002-4839-5852>

Abdul Rahman Hakeem  <https://orcid.org/0000-0001-7266-3848>

Ashwin Rammohan  <https://orcid.org/0000-0001-9528-8892>

Blayne Amir Sayed  <https://orcid.org/0000-0003-3224-8871>

Stuart McCluskey  <https://orcid.org/0000-0002-6684-0497>

Subash Gupta  <https://orcid.org/0000-0002-7782-2593>

Seisuko Sakamoto  <https://orcid.org/0000-0003-3031-7319>

Qiang Xia  <https://orcid.org/0000-0001-9482-6951>

Wojciech G. Polak  <https://orcid.org/0000-0002-3096-4893>

Gonzalo Sapisochin  <https://orcid.org/0000-0001-9527-8723>

James Pomposelli  <https://orcid.org/0000-0002-1291-3312>

Nazia Selzner  <https://orcid.org/0000-0002-9435-2597>

Deniz Balci  <https://orcid.org/0000-0002-6246-1123>

REFERENCES

1. Staubli S, Grover AS, Turner BRH, Raptis DA, Spiro M, Tinguely P, et al. Launch of the International Living Donor Liver Transplantation Outcomes Registry. *Lancet Gastroenterol Hepatol*. 2023;8:698–9.
2. Magyar CTJ, Choi WJ, Li Z, Cattral MS, Selzner N, Ghanekar A, et al. The aim of donor safety: Surgical approaches and current results. *Updates Surg*. 2025;77:1755–66.
3. Standards for Basic Anesthetic Monitoring in AMA, American Society of Anesthesiologists. Standards for Basic Anesthetic Monitoring. 2020. Accessed July 15, 2025. <https://www.asahq.org/standards-and-practice-parameters/standards-for-basic-anesthetic-monitoring>
4. Chaves R, Barbas C, Queiroz V, Serpa Neto A, Deliberato RO, Pereira AJ, et al. Assessment of fluid responsiveness using pulse pressure variation, stroke volume variation, plethysmographic variability index, central venous pressure, and inferior vena cava variation in patients undergoing mechanical ventilation: A systematic review and meta-analysis. *Crit Care*. 2024;28:289.

5. Liu T, Shen Q, Zhou X, Shen X, Lai L, Hou X, et al. Application of controlled low central venous pressure during hepatectomy: A systematic review and meta-analysis. *J Clin Anesth*. 2021;75:110467.
6. Yang P, Gao S, Chen X, Xiong W, Hai B, Huang X. Milrinone is better choice for controlled low central venous pressure during hepatectomy: A randomized, controlled trial comparing with nitroglycerin. *Int J Surg*. 2021;94:106080.
7. Martel G, Carrier FM, Wherrett C, Lenet T, Mallette K, Brousseau K, et al. Hypovolaemic phlebotomy in patients undergoing hepatic resection at higher risk of blood loss (PRICE-2): A randomised controlled trial. *Lancet Gastroenterol Hepatol*. 2025;10:114–24.
8. Giustiniano E, Procopio F, Ruggieri N, Grimaldi S, Torzilli G, Raimondi F. Impact of the FloTrac/VigileoTM monitoring on intraoperative fluid management and outcome after liver resection. *Dig Surg*. 2018;35:435–41.
9. Shih TH, Tsou YH, Huang CJ, Chen CL, Cheng KW, Wu SC, et al. The correlation between CVP and SVV and intraoperative minimal blood loss in living donor hepatectomy. *Transplant Proc*. 2018;50:2661–3.
10. Nakamoto S, Tatara T, Okamoto T, Hirose M. Complex effects of continuous vasopressor infusion on fluid responsiveness during liver resection: A randomised controlled trial. *Eur J Anaesthesiol*. 2019;36:667–75.
11. Messina A, Caporale M, Calabrò L, Lionetti G, Bono D, Matronola GM, et al. Reliability of pulse pressure and stroke volume variation in assessing fluid responsiveness in the operating room: A meta-analysis and a metaregression. *Crit Care*. 2023;27:431.
12. Jivraj NK, Lakbar I, Sadeghirad B, Müller MM, Sohn SY, Peel JK, et al. Intra-operative ventilation strategies and their impact on clinical outcomes: A systematic review and network meta-analysis of randomised trials. *Anaesthesia*. 2025;80:973–87.
13. Neuschwander A, Futier E, Jaber S, Pereira B, Eurin M, Marret E, et al. The effects of intraoperative lung protective ventilation with positive end-expiratory pressure on blood loss during hepatic resection surgery: A secondary analysis of data from a published randomised control trial (IMPROVE). *Eur J Anaesthesiol*. 2016;33:292–8.
14. Gao X, Xiong Y, Huang J, Zhang N, Li J, Zheng S, et al. The effect of mechanical ventilation with low tidal volume on blood loss during laparoscopic liver resection: A randomized controlled trial. *Anesth Analg*. 2021;132:1033–41.
15. Holtzman S, Clarke HA, McCluskey SA, Turcotte K, Grant D, Katz J. Acute and chronic postsurgical pain after living liver donation: Incidence and predictors. *Liver Transpl*. 2014;20:1336–46.
16. Hogan BJ, Pai SL, Planinsic R, Suh KS, Hillingso JG, Ghani SA, et al. Does multimodal perioperative pain management enhance immediate and short-term outcomes after living donor partial hepatectomy? A systematic review of the literature and expert panel recommendations. *Clin Transplant*. 2022;36:e14649.
17. Zubair M, Adil Khan M, Khan MNA, Iqbal S, Ashraf M, Saleem SA. Comparison of continuous thoracic epidural with erector spinae block for postoperative analgesia in adult living donor hepatectomy. *Cureus*. 2022;14:e23151.
18. Cheah YL, Yang HY, Simon CJ, Akoad ME, Connor AA, Daskalaki D, et al. The learning curve for robotic living donor right hepatectomy: Analysis of outcomes in 2 specialized centers. *Liver Transpl*. 2025;31:190–200.
19. Raptis DA, Elsheikh Y, Alnemary Y, Marquez KAH, Bzeizi K, Alghamdi S, et al. Robotic living donor hepatectomy is associated with superior outcomes for both the donor and the recipient compared with laparoscopic or open—A single-center prospective registry study of 3448 cases. *Am J Transplant*. 2024;24:2080–91.
20. Kikuchi K, Nitta H, Umemura A, Katagiri H, Kanno S, Takeda D, et al. Risk-adjusted assessment of the learning curve for pure laparoscopic donor hepatectomy for adult recipients. *World J Surg*. 2023;47:2488–98.
21. Troisi RI, Elsheikh Y, Alnemary Y, Zidan A, Sturdevant M, Alabbad S, et al. Safety and feasibility report of robotic-assisted left lateral sectionectomy for pediatric living donor liver transplantation: A comparative analysis of learning curves and mastery achieved with the laparoscopic approach. *Transplantation*. 2021;105:1044–51.
22. Broering DC, Berardi G, El Sheikh Y, Spagnoli A, Troisi RI. Learning curve under proctorship of pure laparoscopic living donor left lateral sectionectomy for pediatric transplantation. *Ann Surg*. 2020;271:542–8.
23. Takagi K, Umeda Y, Yoshida R, Watanabe N, Kuise T, Yoshida K, et al. Short-term and long-term outcomes in living donors for liver transplantation: Cohort study. *Int J Surg*. 2020;84:147–53.
24. Lee B, Choi Y, Han HS, Yoon YS, Cho JY, Kim S, et al. Comparison of pure laparoscopic and open living donor right hepatectomy after a learning curve. *Clin Transplant*. 2019;33:e13683.
25. Hong SK, Suh KS, Yoon KC, Lee JM, Cho JH, Yi NJ, et al. The learning curve in pure laparoscopic donor right hepatectomy: A cumulative sum analysis. *Surg Endosc*. 2019;33:3741–8.
26. Rhu J, Choi GS, Kwon CHD, Kim JM, Joh JW. Learning curve of laparoscopic living donor right hepatectomy. *Br J Surg*. 2020;107:278–88.
27. Ikegami T, Harimoto N, Shimokawa M, Yoshizumi T, Uchiyama H, Itoh S, et al. The learning curves in living donor hemiliver graft procurement using small upper midline incision. *Clin Transplant*. 2016;30:1532–7.
28. Chan SC, Chan ACY, Sharr WW, Chok KSH, Cheung TT, Fan ST, et al. Perpetuating proficiency in donor right hepatectomy for living donor liver transplantation. *Asian J Surg*. 2014;37:65–72.
29. Cherqui D, Ciria R, Kwon CHD, Kim KH, Broering D, Wakabayashi G, et al. Expert Consensus Guidelines on minimally invasive donor hepatectomy for living donor liver transplantation from innovation to implementation: A joint initiative from the International Laparoscopic Liver Society (ILLS) and the Asian-Pacific Hepato-Pancreato-Biliary Association (A-PPBA). *Ann Surg*. 2021;273:96–108.
30. Sturdevant M, Ganesh S, Samstein B, Verna EC, Rodriguez-Davalos M, Kumar V, et al. Advances and innovations in living donor liver transplant techniques, matching and surgical training: Meeting report from the living donor liver transplant consensus conference. *Clin Transplant*. 2023;37:e14968.
31. Yoo S, Jang EJ, Yi NJ, Kim GH, Kim DH, Lee H, et al. Effect of institutional case volume on in-hospital mortality after living donor liver transplantation: Analysis of 7073 cases between 2007 and 2016 in Korea. *Transplantation*. 2019;103:952–8.
32. Papoulas M, Hakeem AR, Heaton N, Menon KV. Pure laparoscopic versus open donor hepatectomy for adult living donor liver transplantation—A systematic review and meta-analysis. *J Minim Access Surg*. 2022;18:1–11.
33. Troisi RI, Giglio MC, Kim J, Broering D, Cherqui D, Wakabayashi G, et al. Current status of minimally invasive surgery for donor hepatectomy: A worldwide survey (A joint initiative of the International Laparoscopic Liver Society and the International Living Donor Liver Transplantation Group). *Transplantation*. 2025;109:1754–64.
34. LDLTregistry.org Collaborative. Global variation in living donor liver transplantation practices impacts donor and recipient short-term outcomes: initial insights from the International LDLT Registry. *Am J Transplant*. 2025;25:1735–45.
35. Troisi RI, Cho HD, Giglio MC, Rhu J, Cho JY, Sasaki K, et al. Robotic and laparoscopic right lobe living donation compared to the open approach: A multicenter study on 1194 donor hepatectomies. *Liver Transpl*. 2024;30:484–92.
36. Hasegawa Y. Advancements and challenges in robotic donor hepatectomy: Current evidence and unresolved questions. *Hepatobiliary Surg Nutr*. 2025;14:467–9.
37. Yang JD, Lee KW, Kim JM, Kim MS, Lee JG, Kang KJ, et al. A comparative study of postoperative outcomes between minimally invasive living donor hepatectomy and open living donor hepatectomy: The Korean Organ Transplantation Registry. *Surgery*. 2021;170:271–6.

38. Bhangui P, Sah J, Choudhary N, Gautam D, Gupta V, Srinivasan T, et al. Safe use of right lobe live donor livers with up to 20% macrovesicular steatosis without compromising donor safety and recipient outcome. *Transplantation*. 2020;104:308–16.
39. Haruki K, Krishnamurthy J, Kumar Olaniya M, Shankar S, Rammohan A, Rhu J, et al. The incidence of severe complications in liver donation from living donors: Real-world data in the era of minimally invasive surgery. *Liver Transpl*. 2025;31:1379–88.
40. Yadav KS, Shetty N, Valappil F, Selvathangam A, Chaudhary S, Gupta A, et al. Complex donor anatomy does not influence early donor or recipient outcomes after robotic donor hepatectomy at a high-volume center. *Am J Transplant*. 2025;25:1987–95.
41. Varghese CT, Chandran B, Gopalakrishnan U, Nair K, Mallick S, Mathew JS, et al. Extended criteria donors for robotic right hepatectomy: A propensity score matched analysis. *J Hepatobiliary Pancreat Sci*. 2022;29:874–83.
42. Kim J, Hong SK, Lim J, Lee JM, Cho JH, Choi Y, et al. Demarcating the exact midplane of the liver using indocyanine green near-infrared fluorescence imaging during laparoscopic donor hepatectomy. *Liver Transpl*. 2021;27:830–9.
43. Bhangui P, Saha S. The high-end range of biliary reconstruction in living donor liver transplant. *Curr Opin Organ Transplant*. 2019;24:623–30.
44. Ju MK, Yoo SH, Choi KH, Yoon DS, Lim JH. Selective hanging maneuver and rubber band retraction technique for pure laparoscopic donor right hepatectomy. *Asian J Surg*. 2024;47:354–9.
45. Rhu J, Choi GS, Kim JM, Kwon CHD, Joh JW. Risk factors associated with surgical morbidities of laparoscopic living liver donors. *Ann Surg*. 2023;278:96–102.
46. Rhu J, Choi GS, Kim JM, Kwon CHD, Joh JW. Complete transition from open surgery to laparoscopy: 8-year experience with more than 500 laparoscopic living donor hepatectomies. *Liver Transpl*. 2022;28:1158–72.
47. Rhu J, Kim MS, Choi GS, Jeong WK, Kim JM, Joh JW. A novel technique for bile duct division during laparoscopic living donor hepatectomy to overcome biliary complications in liver transplantation recipients: “cut and clip” rather than “clip and cut”. *Transplantation*. 2021;105:1791–9.
48. Cho HD, Kim KH, Yoon YI, Kang WH, Jung DH, Park GC, et al. Comparing purely laparoscopic versus open living donor right hepatectomy: propensity score-matched analysis. *Br J Surg*. 2021;108:e233–4.
49. Samstein B, Griesemer A, Halazun K, Kato T, Guarrera JV, Cherqui D, et al. Pure laparoscopic donor hepatectomies: Ready for widespread adoption? *Ann Surg*. 2018;268:602–9.
50. Raptis DA, Vashist YK, Kulkarni R, Alabbad S, Elsheikh Y, Alnemary Y, et al. Outcomes of adult right graft living donor liver transplantation utilizing the robotic platform-integrated real-time indocyanine green fluorescence cholangiography compared to the open approach. *Ann Surg*. 2024;280:870–8.
51. Kim NR, Han DH, Joo DJ, Lee JG, Kim DG, Kim MS, et al. Propensity score-matched donor and recipient outcomes: Robotic versus laparoscopic donor right hepatectomy. *Transplantation*. 2025;109:e166–74.
52. Soin AS, Yadav KS, Valappil F, Shetty N, Bansal R, Chaudhary S, et al. Hepatic duct division during robotic living donor hepatectomy: A comparison between the novel triple C (clip-clamp-cut) and the cut-suture techniques. *J Transplant*. 2024;2024:8955970.
53. Rajalingam R, Rammohan A, Kumar SA, Cherukuru R, Uday U, Palaniappan K, et al. Effect of donor warm ischemia time during graft extraction in right lobe robotic donor hepatectomy on recipient outcomes—A propensity score matched analysis. *Am J Transplant*. 2025;25:164–9.
54. Hong SK, Kim JY, Lee J, Kim J, Choi HH, Lee S, et al. Pure laparoscopic donor hepatectomy: Experience of 556 cases at Seoul National University Hospital. *Am J Transplant*. 2024;24:222–38.
55. Fujiki M, Pita A, Kusakabe J, Sasaki K, You T, Tuul M, et al. Left lobe first with purely laparoscopic approach: A novel strategy to maximize donor safety in adult living donor liver transplantation. *Ann Surg*. 2023;278:479–88.
56. Hong SK, Tan MY, Worakitti L, Lee JM, Cho JH, Yi NJ, et al. Pure laparoscopic versus open right hepatectomy in live liver donors: A propensity score-matched analysis. *Ann Surg*. 2022;275:e206–12.
57. Hong SK, Choi GS, Han J, Cho HD, Kim JM, Han YS, et al. Pure laparoscopic donor hepatectomy: A multicenter experience. *Liver Transpl*. 2021;27:67–76.
58. Jung DH, Ikegami T, Balci D, Bhangui P. Biliary reconstruction and complications in living donor liver transplantation. *Int J Surg*. 2020;82S:138–44.
59. Kim SH, Kim KH, Cho HD, Suh KS, Hong SK, Lee KW, et al. Donor safety and risk factors of pure laparoscopic living donor right hepatectomy: A Korean multicenter study. *Ann Surg*. 2023;278:e1198–203.
60. Han ES, Lee KW, Suh KS, Yi NJ, Choi Y, Hong SK, et al. Shorter operation time and improved surgical outcomes in laparoscopic donor right hepatectomy compared with open donor right hepatectomy. *Surgery*. 2021;170:1822–9.
61. Ikegami T, Yoshizumi T, Soejima Y, Mori M. Effective and safe living donor hepatectomy under intermittent inflow occlusion and outflow pressure control. *J Gastrointest Surg*. 2019;23:1529–30.
62. Chorasaya V, Khan AA, Rodricks S. Vascular stapler malfunction during laparoscopic donor hepatectomy. *J Clin Exp Hepatol*. 2023;13:S34–5.
63. Toshima T, Rhu J, Yoon YI, Ito T, Uchida H, Hong SK, et al. Aborted living-donor liver transplantation in the real-world setting, lessons from 13 937 cases of Vanguard Multi-center Study of International Living Donor Liver Transplantation Group. *Am J Transplant*. 2024;24:57–69.
64. Kwon CHD, Choi GS, Joh JW. Laparoscopic right hepatectomy for living donor. *Curr Opin Organ Transplant*. 2019;24:167–74.
65. Mallick S, Nair K, Varghese CT, Amma BSPT, Menon RN, Balakrishnan D, et al. To Err Is Robot—An analysis of complications following robotic donor hepatectomy. *Liver Transpl*. 2025;31:1269–76.
66. King EA, Hernandez-Alejandro R, Emamaullee J, Al-Adra D, Byrne MM, Selzner N, et al. Over 30 years of living liver donation in North America: Mortality associated with donation. *Ann Surg*. 2025;282:650–7.
67. Hong SK, Choe S, Yi NJ, Shin A, Choe EK, Yoon KC, et al. Long-term survival of 10,116 Korean live liver donors. *Ann Surg*. 2021;274:375–82.
68. Choi JY, Kim JH, Kim JM, Kim HJ, Ahn HS, Joh JW. Outcomes of living liver donors are worse than those of matched healthy controls. *J Hepatol*. 2022;76:628–38.
69. Cheah YL, Simpson MA, Pomposelli JJ, Pomfret EA. Incidence of death and potentially life-threatening near-miss events in living donor hepatic lobectomy: A world-wide survey. *Liver Transpl*. 2013;19:499–506.
70. Miller C, Smith ML, Fujiki M, Uso TD, Quintini C. Preparing for the inevitable: The death of a living liver donor. *Liver Transpl*. 2013;19:656–60.
71. Park J, Choi GS, Gwak MS, Ko JS, Han S, Han B, et al. Intraoperative abortion of adult living donor liver transplantation: 15 cases from 1,179 cases in 20 years of experience in a single center. *Ann Surg Treat Res*. 2018;95:213–21.

How to cite this article: Bhangui P, Hakeem AR, Di Maira T, Rammohan A, Sayed BA, Soejima Y, et al. Living liver donor safety: Intraoperative considerations in living liver donation—Guidelines from the ILTS-iLDLT group consensus conference 2025. *Liver Transpl*. 2026;32:592–608.
<https://doi.org/10.1097/LVT.0000000000000800>