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Standardized evaluation protocols for deceased and living liver donors: a practical framework for emerging liver transplant programs

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Background: Liver transplantation (LT) remains the definitive therapy for end-stage liver disease. However, significant variability in infrastructure, policy, and clinical practice continues to influence the implementation of deceased donor (DDLT) and living donor liver transplantation (LDLT) worldwide, particularly across emerging and expanding programs.

Methods: This narrative review synthesizes contemporary guidelines, expert consensus documents, and high-impact clinical studies on donor evaluation. It presents a standardized and pragmatic framework for both DDLT and LDLT, integrating medical, radiologic, ethical, and psychosocial domains. Protocols are designed to be evidence-based, reproducible, and aligned with international standards.

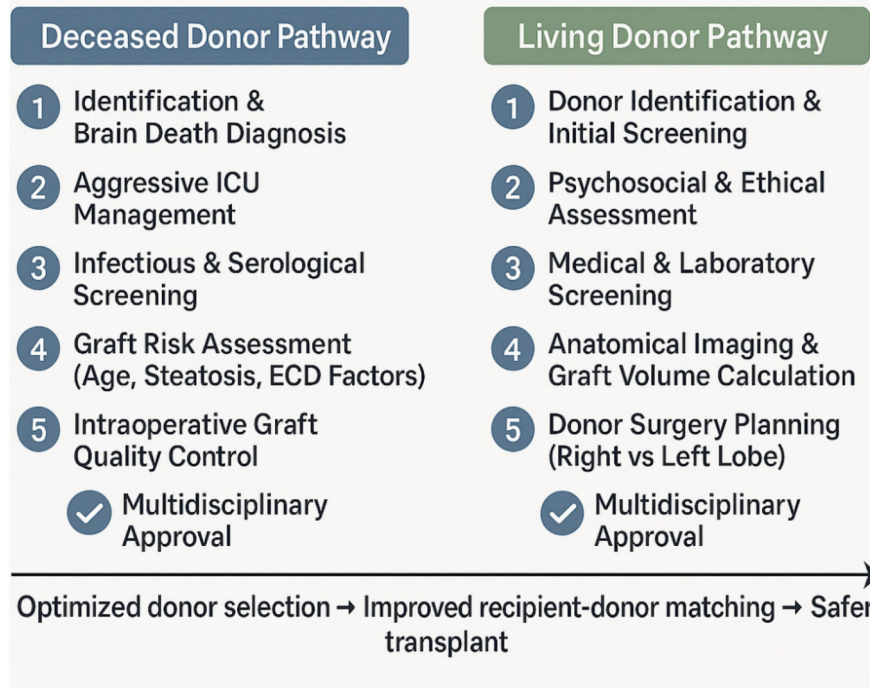
Key content and findings: In DDLT, optimal donor management, accurate neurological determination of death, and comprehensive infectious disease screening are essential for graft viability. In LDLT, meticulous psychosocial and anatomical assessments remain critical to donor safety. Advances such as machine perfusion, desensitization protocols, and expanded donor criteria have improved outcomes and broadened transplant opportunities. The proposed framework consolidates global best practices to support program consistency and quality assurance.

Conclusions: This review provides a comprehensive and practical approach to donor evaluation in LT, promoting harmonization of practices across diverse healthcare systems. Its adoption may enhance donor safety, optimize graft utilization, and support the sustainable growth of both DDLT and LDLT programs worldwide.

KEYWORDS

deceased donor, donor evaluation, emerging programs, extended criteria donor, liver transplantation, living donor, transplant protocol

Standardized Donor Evaluation Pathways for Liver Transplantation



GRAPHICAL ABSTRACT

Highlights

- Practical framework for standardized donor evaluation in emerging and expanding liver transplant programs.
- Integrates protocols for both deceased and living donor liver transplantation.
- Multidisciplinary, evidence-based approach to enhance donor safety and evaluation consistency.
- Supports responsible donor pool expansion while maintaining ethical and clinical safety standards.

Abbreviations

AI, artificial intelligence; AMA, anti-mitochondrial antibody; ANA, anti-nuclear antibody; CRLM, colorectal liver metastases; CT, computed tomography; CVP, central venous pressure; DAA, direct-acting antiviral; DBD, donation after brain death; DCD, donation after circulatory death; DDLT, deceased donor liver transplantation; DRI, donor risk index; EAD, early allograft dysfunction; ECD, extended criteria donor; GRWR, graft-to-recipient weight ratio; HBV, hepatitis B virus; HCV, hepatitis C virus; HOPE, hypothermic oxygenated perfusion; ICU, intensive care unit; ILTS, international liver transplantation society; LB, liver biopsy; LDLT, living donor liver transplantation; LT, liver transplantation; NMP, normothermic machine perfusion; MAP, mean arterial pressure; MELD, model for end-stage liver disease; MRI, magnetic resonance imaging; PDFF, proton density fat fraction; RLV, remnant liver volume; SFSS, small-for-size syndrome; SLV, standard liver volume; TLV, total liver volume.

1 Introduction

Despite the remarkable success of liver transplantation (LT) as a life-saving therapy, a widening gap persists between the number of patients in need and the availability of donor organs (1). This imbalance reflects multiple contributing factors, including the global rise in liver disease burden, limited donor registration and recovery rates, and logistical constraints in organ procurement and allocation systems (1–3).

Cultural and socioeconomic differences influence donor types across regions. In Asia, more than 90% of liver transplants are performed using living donors (LD), whereas in most Western countries a similar proportion relies on deceased donors (DD) (4). Consequently, living donor liver transplantation (LDLT) remains markedly underutilized across the Western world, representing only 5%–10% of all liver transplants in the United States (3). A comparable trend is observed in Latin America, where a 2019 survey of 143 transplant centers across 15 countries found that only 12.5% of the 3,837 transplants performed involved living donors, underscoring the limited adoption of LDLT in the region (5).

While DDLT is generally considered technically less complex and offers larger grafts, donor quality and donation rates often remain suboptimal in many low- and middle-income countries (5, 6). Conversely, LDLT offers several distinct advantages: it reduces waiting time, confers a clear survival advantage over remaining on the waitlist, with significant life-years gained, and improves overall access to transplantation by expanding the donor pool (3, 7). Moreover, LDLT enables elective surgical planning for urgent or high-risk candidates, ensures superior graft quality through donor optimization, and facilitates transplantation in cases with extended indications such as hepatocellular carcinoma, cholangiocarcinoma, metastatic liver disease, or low MELD scores. However, LDLT also introduces unique ethical, medical, and surgical challenges and entails inherent risks for the donor (8, 9) (Figure 1).

In both modalities, rigorous donor evaluation is essential to ensure safety, optimize graft outcomes, and uphold ethical transplantation practices. This review summarizes current practices in DD and LD evaluation and proposes a practical, evidence-based framework to guide emerging and developing liver transplant programs, providing an overview of updated international standards and best practices that can be adapted across diverse healthcare settings.

2 Deceased donor evaluation (DDLT)

2.1 Medical evaluation and pre-operative optimization

Optimal recipient outcomes in DDLT depend on comprehensive donor evaluation and meticulous intensive care unit (ICU) management aimed at preserving organ function. Donor evaluation should include comprehensive medical and behavioral history, physical examination, and laboratory workup. Core tests encompass ABO blood typing, complete blood count (CBC), electrolytes, renal and hepatic function tests, coagulation profile, glucose, and a comprehensive infectious screening panel (HBsAg, anti-HBc, anti-HBs, anti-HCV, anti-HIV, CMV, EBV, VDRL, toxoplasmosis, varicella-zoster virus, HTLV-I/II, HSV-I/II, *Trypanosoma cruzi*, and SARS-CoV-2).

Depending on the donor’s origin and local epidemiology, expanded screening for endemic pathogens, such as *Strongyloides stercoralis*, *West Nile virus*, malaria, and *Leptospira* species, may be warranted. Additional evaluations include arterial blood gases, urinalysis, chest radiography, abdominal ultrasound, and, when hospitalization exceeds 72 h, blood, and urine cultures (10–12). Pre-procurement liver biopsy (LB) and computed tomography (CT) Imaging are recommended when steatosis, focal lesions, or vascular abnormalities are suspected.

Most DDLT grafts originate from donors after brain dead (DBD). Brain death is defined as the complete and irreversible cessation of all brain activity, including the brainstem (13). Diagnosis is based primarily on clinical criteria and bedside neurological examination, while ancillary testing is reserved for cases with diagnostic uncertainty (14). Legal and ethical requirements for death certification and consent vary by jurisdiction and must be strictly observed before any procurement procedure (13, 14).

Goal-directed donor management is essential to maintain hemodynamic and metabolic homeostasis, thereby preserving graft quality (15, 16). Recommended targets include: mean arterial pressure >60 mmHg, urine output >1 ml/kg/h, temperature >35 °C, serum sodium <150 mEq/L, lactate normalization, PaO₂ > 80 mmHg, hemoglobin >7 g/dl, hematocrit >30%, glucose <180 mg/dl, central venous pressure <10 mmHg, pH 7.35–7.45, caloric intake 70%–85% of baseline needs, fibrinogen >100 mg/dl, platelets >80,000/mm³, and hormonal support (e.g., thyroid and corticosteroids) (17–21).

In many regions, effective donor evaluation relies on Organ Procurement Organizations (OPOs) or equivalent procurement networks that operate independently from the recipient team. This organizational separation ensures transparency, minimizes conflicts of interest, and allows specialized personnel to focus exclusively on donor optimization (22).

Beyond DBD, donation after circulatory death (DCD) has become an increasingly relevant source of grafts, particularly with the advent of machine perfusion technologies. Although DCD donation presents unique challenges related to warm ischemia and early graft dysfunction, advances in hypothermic and normothermic

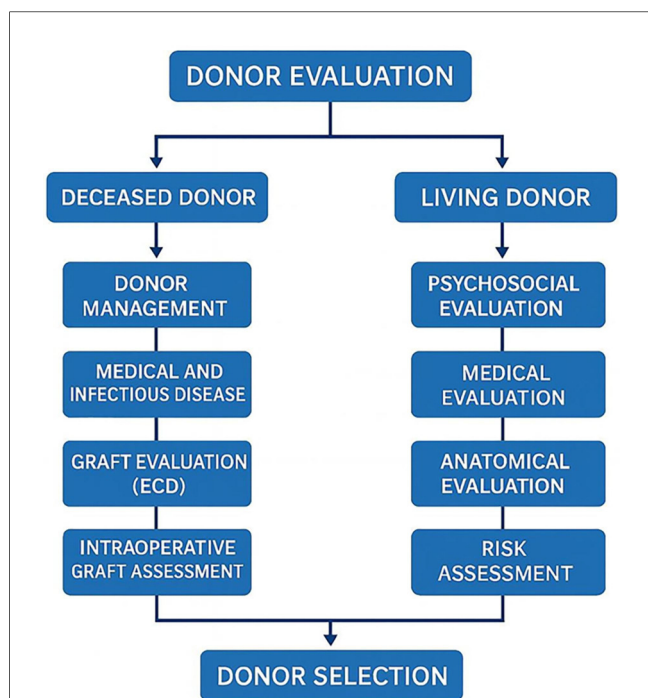


FIGURE 1
Evaluation algorithm summarizing the key steps for DDLT/LDLT programs. This flowchart outlines the structured evaluation process for both deceased and living liver donors. For deceased donors, the assessment includes donor management, medical and infectious disease screening, graft evaluation—including consideration of extended criteria donors (ECD)—and intraoperative graft assessment. For living donors, the pathway begins with psychosocial evaluation, followed by detailed medical and anatomical assessment, and concludes with a comprehensive risk-benefit analysis to ensure donor safety and transplant feasibility. Both processes culminate in multidisciplinary donor selection.

perfusion have markedly improved outcomes, enabling the safe expansion of this donor pool (23, 24).

2.2 Graft function evaluation

Given the shortage of organs, the use of marginal or extended criteria donors (ECDs) has increased. Although there is no universally accepted definition of ECDs, they are generally associated with higher risks of early allograft dysfunction (EAD), suboptimal graft function, or transmission of donor-derived diseases (25). Emerging and developing liver transplant programs, apply varying acceptance criteria depending on local policies, access to LDLT, and the risk of patient mortality (5, 6, 25).

Key donor risk factors include:

- Age: No strict upper limit exists, but donors >60 years require meticulous evaluation (25–29).
- Cold ischemia time <8 h may optimize outcomes in elderly donors (11, 30–32). Functional warm ischemia (SBP <50 mmHg or SpO₂ <80% to cold flush) should not exceed 30 min in standard DCD procurement (33, 34).
- Steatosis: Mild steatosis (<30%) has minimal impact on graft outcomes. In contrast, moderate to severe macrovesicular steatosis is associated with an increased risk of severe preservation injury, primary non-function, delayed graft function, and graft failure (25, 26, 35, 36). When uncertainty exists, LB remains the gold standard for evaluation (37, 38). Microvesicular steatosis, even when moderate, is not associated with worse outcomes (39).
- Liver Enzymes: In transplanted livers, several studies have shown that markers of ischemic liver injury and recovery, such as peak ALT levels and the change from peak ALT to terminal ALT prior to transplant, are not associated with graft outcomes. Therefore, no definitive upper cut-off for graft acceptance based on these parameters has been established (40, 41). However, a marked increase in GGT (over 200 UI/L) should be carefully evaluated, and according to some consensus guidelines, a liver biopsy is recommended in such cases (25, 26).
- Hyponatremia: Early reports associated donor hyponatremia with increased rates of graft loss, poor initial graft function, and higher post-transplant mortality (42–44). Specifically, a serum sodium level >155 mEq/L was linked to worse outcomes within the first month after LT (45, 46). However, subsequent studies have failed to confirm a consistent association with poor prognosis. To date, donor serum sodium levels alone do not appear to have a clinically significant impact on post-transplant liver function (47–52).
- Sepsis/infection: A major UNOS study found that donors with positive blood cultures were associated with reduced graft survival, though patient survival was unaffected (53). Conversely, more recent studies did not report adverse outcomes when using bacteremic DD (54–56). Donor infection is not an absolute contraindication for liver transplantation. However, grafts from potentially septic

donors should meet the following criteria: non-hepatic infection source, effective antibiotic coverage for at least 24–48 h, and absence of multidrug-resistant organisms (11).

- Hepatitis C and B viruses (HCV, HBV): In the post–direct-acting antiviral (DAA) era, the use of HCV-viremic donors has shown excellent outcomes in both HCV-positive and HCV-negative recipients (57–59). Similarly, liver transplantation from hepatitis B core antibody–positive (HBcAb+) donors, when combined with appropriate prophylaxis [nucleos(t)ide analogues and hepatitis B immunoglobulin], yields outcomes comparable to HBcAb-negative grafts (60–62). As a result, these donors are increasingly accepted in clinical practice. Recent series demonstrate that carefully selected HBsAg-positive donor grafts transplanted into HBV-negative recipients can achieve survival exceeding 90% at 3 years when the donor liver is non-fibrotic and HBV DNA is undetectable (63). Patients must be carefully counseled about the risks and benefits.
- Malignancy: Although rare, donor-transmitted cancers (DTCs) represent a low but nonzero risk (12, 64). Graft acceptance should be individualized following thorough clinical, laboratory, and radiologic evaluation, and discussed by a multidisciplinary team considering cancer type, stage, disease-free interval, and transplant urgency. Recent guidelines recommend additional imaging (e.g., CT) in high-risk donors, exclusion of malignancy or intracranial metastases in cases of intracranial bleeding, and Beta-human chorionic gonadotropin (β -HCG) testing in women of childbearing age with unexplained intracranial hemorrhage (12). Several resources are available to guide decision-making in specific scenarios (12, 64–66).

Several scoring systems have been developed to assess donor risk based on clinical parameters, with the Donor Risk Index (DRI) being the most widely used (67–72). However, its applicability is limited in the current era of refined surgical techniques, enhanced perioperative management, and machine perfusion, highlighting the need for recalibration (73). Emerging tools—such as artificial intelligence, molecular profiling (multi-omics, single-cell technologies), and machine perfusion—offer promising avenues for improving graft evaluation (74–79).

Advances in dynamic preservation have reshaped the evaluation of ECD and DCD grafts. Hypothermic oxygenated perfusion (HOPE) reduces ischemia–reperfusion injury by restoring mitochondrial respiration and promoting metabolic recovery prior to implantation, consistently lowering rates of early allograft dysfunction (80). Normothermic machine perfusion (NMP), by maintaining physiological temperature, allows real-time functional assessment through lactate clearance, glucose metabolism, bile production, and bile quality (pH or bicarbonate content), and perfusate transaminase trends (24, 81). Both modalities have demonstrated improved outcomes in DCD grafts and enable prolonged preservation beyond traditional cold-storage limits, facilitating broader graft utilization while supporting objective viability assessment (24, 80).

At the time of organ retrieval, there is no standardized criterion for determining when a LB is necessary; this decision remains center- and surgeon-dependent (82, 83). The

pathologist plays a key role in interpreting histological findings within the broader donor risk context (84, 85).

Historically, the concept of donor–recipient risk matching has guided allocation strategies in LT. Although no randomized controlled trial has definitively established a rigid algorithm, recent evidence supports aligning graft quality with recipient condition, that is, allocating higher-risk or ECD livers to physiologically robust, typically lower-MELD recipients, while reserving optimal grafts for those with higher urgency or comorbid burden. This risk-balancing approach aims to maximize graft utility and overall survival across the waiting list (86).

Ultimately, graft acceptance should be determined by a multidisciplinary team, balancing graft quality, recipient urgency, and center experience. Informed consent should include disclosure of any allograft-specific risks (25).

Although volumetric considerations are traditionally emphasized in LDLT, graft–recipient size mismatch also represents an important risk factor in DDLT. Oversized grafts may be difficult to implant in smaller recipients and have been associated with impaired venous

outflow, increased intra-abdominal pressure, and abdominal compartment syndrome, particularly in pediatric or sarcopenic adults (87). Pre-procurement CT volumetry and anthropometric assessment can assist in anticipating mismatch, while intraoperative measures, such as temporary abdominal closure or delayed fascial closure, may mitigate mechanical constraints. Incorporating basic size-matching principles into DDLT evaluation adds an additional layer of safety and may improve implantation outcomes in selected recipients (Table 1).

3 LDLT donor evaluation

3.1 Initial considerations

The first step in LDLT is identifying a suitable donor, with donor safety as the overriding priority (88, 89). A multidisciplinary transplant team should perform a comprehensive assessment encompassing ethical, psychosocial,

TABLE 1 Donor evaluation checklist for deceased donor liver transplantation (DDLT).

Step	Key components
1. Donor identification and intensive care management	<ul style="list-style-type: none"> • Identification and documentation: declaration of brain death and informed consent. • Intensive care management by goals: <ul style="list-style-type: none"> - Mean arterial pressure >60 mmHg - Urine output >1 mL/kg/h - Temperature >35 °C - Serum sodium <150 mEq/dl - Normal arterial blood lactate - PaO₂ > 80 mmHg - Hemoglobin >7 g/dL and hematocrit >30% - Glucose levels <180 mg/dL - Central venous pressure <10 mmHg - pH between 7.35–7.45 - Caloric intake: 70%–85% of baseline energy expenditure - Fibrinogen >100 mg/dl - Platelet count >80,000/mm³ - Thyroid and steroid replacement, among others.
2. Medical evaluation	<ul style="list-style-type: none"> a) Complete medical/behavioral history and physical examination: <ul style="list-style-type: none"> - Includes blood pressure, vasopressor doses, urine output, temperature, ventilation parameters. b) Laboratory tests: <ul style="list-style-type: none"> - Blood type, hematology tests, metabolic panel, liver function tests (LFTs), glucose - Basic serological testing: HBsAg, total anti-HBc, anti-HCV, anti-HIV, anti-CMV, anti-EBV, VDRL, toxoplasma IgG, VZV, HTLV-I/II, HSV-I/II, Chagas disease, SARS-CoV-2 - Coagulation tests, arterial blood gases, urinalysis c) Radiology: <ul style="list-style-type: none"> - Chest x-rays, abdominal ultrasonography d) Other: <ul style="list-style-type: none"> - Blood and urine cultures if hospitalization >72 h - Pre-procurement liver biopsy (LB) and CT imaging may be required.
3. Graft function evaluation	<ul style="list-style-type: none"> • Evaluation of extended criteria donors (ECD), including: <ul style="list-style-type: none"> - Donor age, hepatic steatosis, abnormal LFTs, hypernatremia, sepsis, malignancy, etc. • Application of donor risk scores (e.g., DRI) when applicable • Multidisciplinary analysis and decision-making process
4. Intraoperative graft assessment	<ul style="list-style-type: none"> • Visual assessment of graft during retrieval • Liver biopsy (LB) may be required based on appearance or risk profile • Histological assessment by pathologist • Final decision by multidisciplinary transplant team • Recipient informed consent for graft-specific risks

This table summarizes the essential steps in the evaluation of deceased donors for liver transplantation, including clinical stabilization, comprehensive laboratory, and imaging work-up, assessment of extended criteria donor (ECD) risk factors, and intraoperative graft evaluation. MAP, mean arterial pressure; CVP, central venous pressure; LFTs, liver function tests; ABG, arterial blood gases; LB, liver biopsy; CT, computed tomography; US, ultrasound; DRI, donor risk index.

medical, and anatomical evaluations (vascular and biliary integrity) (89, 90). The donor team should be separate and distinct from the recipient team to minimize any potential conflicts of interest or bias. Institutional protocols vary depending on local resources and experience, and only about 40% of potential donors ultimately qualify for donation (91) (Table 2).

3.2 Psychosocial evaluation

Living donor liver transplantation (LDLT) represents a unique scenario in which the donor undergoes major surgery for purely altruistic reasons without any direct medical benefit. The foundational ethical principles of autonomy, beneficence, non-maleficence, and justice must be upheld, and the donor’s risk must be carefully balanced against the recipient’s potential benefit under the concept of clinical equipoise (88, 92, 93).

The Vancouver Forum established key tenets to optimize donor safety (94). It specifies that: a) the risk to the donor must be justified by a predictable and acceptable outcome in the recipient; b) graft and patient survival should be comparable to outcomes achieved with DDLT; and c) LDLT should provide a clear advantage over remaining on the DDLT waiting list.

Living-donor surgery carries an overall complication rate of approximately 10%–40% and a mortality rate of <1% (95–97). LDLT also entails a significant learning curve, with most programs achieving procedural consistency after 15–20 consecutive donor hepatectomies (90). Consequently, informed consent is paramount: donors must clearly understand potential risks, and center-specific outcome and complication data should be transparently disclosed.

A licensed mental-health professional should assess each donor’s psychological readiness and document full informed consent (9, 89, 90, 98). Donors retain the absolute right to refuse or withdraw consent at any time before surgery (93, 99).

The International Liver Transplantation Society (ILTS) and the International LDLT Group recently convened the ILTS-iLDLT Consensus Conference on Living Donor Safety. Although its formal publication is pending, this global initiative provides updated recommendations on ethical, psychosocial, and procedural safeguards, further strengthening donor protection within LDLT programs.

3.3 Medical evaluation

A thorough clinical history, physical examination, and initial laboratory testing are essential to exclude contraindications. Common baseline studies include hematologic, biochemical, and serologic panels for viral hepatitis (HBsAg, anti-HBc, anti-HCV, anti-HIV, CMV, EBV), chronic liver disease (ANA, ferritin/iron saturation, ceruloplasmin, α 1-antitrypsin, IgG), and infectious disease screening adapted to geographic endemicity (VDRL, toxoplasmosis, varicella-zoster virus, HTLV-I/II, HSV-I/II, Chagas disease, tuberculosis screening with QuantiFERON or PPD), as well as pregnancy testing in women under 50 years (9, 11, 100, 101).

Although not universally standardized, screening for hypercoagulable states (factor V Leiden, prothrombin G20210A mutation, antithrombin III, protein C and S deficiency, antiphospholipid antibodies, homocysteine) is advisable (9, 90, 102, 103). When cost is a concern, testing can be performed in phases, starting with basic serologies and expanding as indicated. There should be a low threshold for

TABLE 2 Donor evaluation process for living donor liver transplantation (LDLT).

Step	Key components
1. Psychosocial evaluation	a) Education about procedure and associated risks. b) Assessment of motivation and ability to provide informed consent.
2. Medical evaluation	c) Initial evaluation: age, ABO blood type, BMI. d) Full medical history and physical examination. e) Laboratory testing: <ul style="list-style-type: none"> - Hematologic and metabolic panels, TSH, LFTs - Serologies: HBsAg, anti-HBc, anti-HCV, anti-HIV, anti-CMV, anti-EBV, VDRL, toxoplasmosis IgG, VZV, HTLV-I/II, HSV-I/II, Chagas - Coagulation and hypercoagulability screening - Genetic screening (if blood relative with liver disease) - Pregnancy test (women <50 years) f) Imaging: chest x-ray, abdominal ultrasound, transient elastography g) Electrocardiogram (EKG)
3. Graft anatomy and function evaluation	h) Cross-sectional imaging (MRI/CT), including 3D volumetry and anatomical assessment of vasculature and biliary structures
4. Preoperative risk and further evaluation	i) Cardiopulmonary evaluation as indicated: echocardiogram, stress echocardiography, cardiac CT angiogram, coronary angiography, pulmonary function tests j) Autoimmune markers (ANA, AMA), infectious disease screening (TB, endemic pathogens) k) Consultations: social work, nutrition, transplant coordination, psychiatry, anesthesiology l) Selective liver biopsy (LB): unexplained abnormal LFTs, suspected metabolic disorders, steatosis \geq 10% on imaging, or lack of advanced imaging

This table summarizes the multidisciplinary evaluation of potential living liver donors, including psychosocial readiness, comprehensive medical and radiologic assessment, anatomic suitability of the graft, and risk-based preoperative workup. Key abbreviations: LFTs, liver function tests; TSH, thyroid-stimulating hormone; MRI, magnetic resonance imaging; CT, computed tomography; EKG, electrocardiogram; LB, liver biopsy; ANA, anti-nuclear antibody; AMA, anti-mitochondrial antibody.

screening for genetic liver diseases, especially among related donor-recipient pairs (9, 104, 105).

If initial testing is acceptable, further evaluation guided by center-specific protocols may include chest radiography, electrocardiography, abdominal imaging (ideally CT and MRI/MRCP), cardiovascular assessment (echocardiography, stress testing, or CT angiography in selected cases), pulmonary function testing (in smokers, asthmatics, or donors >40 years), and age- or risk-adapted cancer screening (11, 12, 90).

Multidisciplinary assessment by hepatology, surgery, anesthesiology, psychiatry, social work, nutrition, and transplant coordination teams is also standard (11, 12, 90). LB is reserved for selected cases, such as unexplained abnormal liver function tests, suspected metabolic disease (e.g., Wilson's disease, α 1-antitrypsin deficiency), or when imaging suggests significant steatosis and advanced noninvasive modalities are unavailable (106–108).

While donor age limits vary by region and center, most programs accept candidates between 18 and 60 years (7, 28, 109). Although younger donors typically offer more favorable vascular characteristics—reduced atherosclerosis, less vascular tortuosity, and larger, more uniform vessel calibers—age alone is not an absolute contraindication (110–112). Outcomes among donors over 55–60 years are variable and associated with reduced regenerative capacity and higher complication rates; therefore, more rigorous evaluation is warranted in this group (28, 97). Donation beyond age 60 should generally be limited to high-volume centers with extensive LDLT experience.

Ideal living donors should have no significant comorbidities, or only well-controlled mild conditions, and no evidence of major end-organ dysfunction, including cardiopulmonary disease or active malignancy. For donors with metabolic risk factors (prediabetes, hypertension, hyperlipidemia, obesity), metabolic syndrome should be optimized, and further evaluation should include screening for metabolic dysfunction-associated steatohepatitis (MASH), fibrosis, and cardiac risk assessment (89).

Body mass index (BMI) thresholds vary internationally, ranging from >25 kg/m² (Indian guidelines) to >40 kg/m² (absolute contraindication in some U.S. centers), but there is no universally accepted cutoff (109, 113). Most Western and Latin American programs set an upper limit of 30–32 kg/m², with select acceptance up to 35 kg/m² only in isolated obesity without metabolic abnormalities and in centers with extensive LDLT experience (7, 9). Donors with BMI >30 kg/m² should undergo non-invasive quantification of hepatic steatosis [MRI-Proton Density Fat Fraction (PDFF) or CAP] and, when uncertainty persists, LB to exclude steatohepatitis or fibrosis (9, 89, 100, 114, 115).

ABO compatibility remains the standard criterion; however, emerging desensitization protocols (rituximab, plasmapheresis, intravenous immunoglobulin) have yielded acceptable outcomes in carefully selected ABO-incompatible cases (116–123). Final decisions depend on institutional expertise, available resources, and local experience.

3.4 Anatomical and functional assessment

Once donor physical and psychological suitability is confirmed, a comprehensive evaluation of graft anatomy, size, and function is essential. This includes assessment of liver volume, vascular and biliary anatomy, and hepatic parenchymal quality (e.g., exclusion of fibrosis, significant steatosis, or liver injury), using imaging modalities such as CT, MRI/MRCP, angiography, cholangiography, transient elastography, and, when indicated, LB (89, 124).

Expert consensus recommends MRI/MRCP and CT angiography as preferred modalities for biliary and vascular mapping, respectively, with adaptation to local expertise and resource availability (108). For graft selection (right lobe, left lobe, left/caudate lobe, or dual grafts), 3D reconstructions are advised to optimize volumetric planning and detect anatomical variations that may influence surgical strategy (9).

MRI, ideally incorporating PDFF, provides superior sensitivity and negative predictive value for detecting low-grade steatosis and can often reduce the need for biopsy (108). LB may be considered in high-risk candidates, those with metabolic syndrome, suspected MASH, elevated liver enzymes, or uncertainty in MRI-PDFF accuracy.

Although no universal threshold for acceptable macrovesicular steatosis exists, most centers adopt a <10% cutoff on LB (90, 101). Importantly, MRI-PDFF and histologic steatosis do not correlate linearly; in the study by Qadri et al., PDFF and biopsy estimates were comparable at 5%, however, PDFF values beyond this level consistently underestimated histologic steatosis with up to a 3.5-fold difference (125). Hence, if aiming for <10% macrosteatosis on biopsy, these intermodality differences must be considered. High-volume Asian centers may accept 10%–30% steatosis in young, otherwise ideal donors (9, 126).

The extent of hepatectomy is guided by recipient volume requirements, donor remnant liver volume (RLV), and anatomic feasibility. The right lobe (\approx 60% of total liver volume) is most used for adult LDLT, followed by the left lobe (\approx 40%), while left lateral segment grafts (\approx 20%) are reserved for pediatric recipients. Adequate graft size is critical to avoid small-for-size syndrome (SFSS). Graft adequacy is determined using the graft-to-recipient weight ratio (GRWR) and the graft volume-to-standard liver volume ratio (GV/SLV). A GRWR \geq 0.8% or GV/SLV \geq 40% is generally recommended, though high-risk recipients may require higher targets (1.0%–1.2% or >45%) (127).

SFSS manifests as early post-transplant dysfunction with hyperbilirubinemia, coagulopathy, ascites, and/or encephalopathy in the absence of technical or vascular causes (90). It is associated with graft hyperperfusion, portal hypertension, and inadequate venous outflow (90, 128). Portal inflow modulation (PIM), through splenic embolization, ligation, splenectomy, or shunting, can mitigate this risk. With careful PIM, successful LDLT using smaller grafts (GRWR \geq 0.6% or GV/SLV \geq 25%) has been reported in high-volume Asian centers when donor quality is excellent and urgency is high (129–131). Each case should be evaluated individually, particularly when flow-modulation strategies are applied (132, 133).

Donor safety requires maintaining a residual liver volume (RLV/TLV) $\geq 30\%$, although factors such as donor age, sex, and steatosis may influence this threshold (101, 108). Selected low-risk donors (<50 years, minimal steatosis, preserved middle hepatic vein) may tolerate slightly lower remnants, but these should be exceptions in highly experienced centers with advanced intraoperative monitoring (134–136). Most programs adopt a strict $\geq 30\%$ cutoff. As graft size increases, recipient benefit rises but donor risk escalates proportionally; hence, the global trend favors greater utilization of left lobe grafts to enhance donor safety (90, 128, 137–140). However, left lobe graft should be avoided in recipients with BMI >30, MELD >20, age >45 years, or severe portal hypertension (128, 141–144).

When a single partial graft is insufficient, dual-graft LDLT (e.g., two left lobes or a left and right lobe) may be an option in select high-volume centers. Though effective, this technique involves substantial technical and logistical complexity and should be limited to institutions with extensive experience (145, 146).

3.5 Expansion of indications

In transplant oncology, LDLT plays an increasingly pivotal role—particularly for patients undergoing downstaging or bridging therapies for hepatocellular carcinoma (HCC), or for those with limited access to deceased donor grafts, such as cases of colorectal liver metastases (CRLM). The elective and planned nature of LDLT allows time-sensitive coordination crucial for patients requiring documented tumor control before transplantation.

Given its voluntary nature, some centers cautiously extend LDLT indications beyond those of DDLT, including selected cases of cholangiocarcinoma, CRLM, or HCC beyond conventional criteria (Milan, UCSF), when favorable tumor biology (low AFP, PET-negativity, sustained response to therapy) suggests a meaningful survival benefit (147, 148).

Several high-volume Asian centers have reported positive outcomes in high-urgency settings such as acute liver failure or acute-on-chronic liver failure patients. Although consensus is lacking, decisions should be guided by multidisciplinary risk-benefit analysis and supported by expedited donor-recipient evaluation protocols (149–155). Success depends on appropriate risk matching between donor and recipient and robust perioperative planning.

In summary, LDLT offers a life-saving alternative where deceased donor organs are scarce. Nonetheless, donor selection criteria should remain conservative, particularly in developing or mid-volume centers. Thresholds for age, BMI, steatosis, and remnant liver volume must prioritize donor safety rather than expansion. Any deviation from these standards should occur only in experienced, high-volume programs with multidisciplinary expertise and structured mentorship.

4 Conclusion

LT remains the definitive therapy for end-stage liver disease; however, significant disparities persist in donor utilization and access,

particularly in emerging programs. A standardized, multidisciplinary evaluation framework is essential to safeguard donor welfare, optimize graft function, and ensure equitable access to transplantation.

This review provides a comprehensive and pragmatic framework for donor evaluation in both deceased and living liver transplantation, aligned with current international guidelines. Beyond technical standards, there should be an emphasis in the importance of peer mentorship, capacity building, and collaborative networks between established and developing programs. The implementation of standardized, stepwise protocols, combined with inter-institutional collaboration, remains fundamental to ensuring donor safety, maximizing graft utilization, and advancing equitable access to LT worldwide.

Author contributions

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References

1. Rela M, Rammohan A. Why are there so many liver transplants from living donors in Asia and so few in Europe and the US? *J Hepatol.* (2021) 75(4):975–80. doi: 10.1016/j.jhep.2021.05.036
2. Terrault NA, Francoz C, Berenguer M, Charlton M, Heimbach J. Liver transplantation 2023: status report, current and future challenges. *Clin Gastroenterol Hepatol.* (2023) 21(8):2150–66. doi: 10.1016/j.cgh.2023.04.005
3. Kwong AJ, Kim WR, Lake JR, Schladt DP, Handarova D, Howell J, et al. OPTN/SRTR 2023 annual data report: liver. *Am J Transplant.* (2025) 25(2S1):S193–287. doi: 10.1016/j.ajt.2025.01.022
4. Rela M, Reddy MS. Living donor liver transplant (LDLT) is the way forward in Asia. *Hepatology Int.* (2017) 11(2):148–51. doi: 10.1007/s12072-016-9780-z
5. Zapata R, Castro G, Pagés J, Cairo F, Invertarza O, Villamil A, et al. Current status of liver transplantation in Latin America: the Latin-American ALEH special interest group, international survey 2020. *Ann Hepatol.* (2021) 24(1):1665–2681.
6. Aguirre-Villarreal D, Servin-Rojas M, Sánchez-Cedillo A, Chávez-Villa M, Hernández-Alejandro R, Arab JP, et al. Liver transplantation in Latin America: reality and challenges. *Lancet Reg Health Am.* (2023) 28:100633. doi: 10.1016/j.lana.2023.100633
7. Jackson WE, Malamon JS, Kaplan B, Saben JL, Schold JD, Pomposelli JJ, et al. Survival benefit of living-donor liver transplant. *JAMA Surg.* (2022) 157(10):926–32. doi: 10.1001/jamasurg.2022.3327
8. Hendrickse A, Ko J, Sakai T. The care of donors and recipients in adult living donor liver transplantation. *BJA Educ.* (2022) 22(10):387–95. doi: 10.1016/j.bjae.2022.06.004
9. Manas D, Burnapp L, Andrews PA. Summary of the British transplantation society UK guidelines for living donor liver transplantation. *Transplantation.* (2016) 100(6):1184–90. doi: 10.1097/TP.0000000000001128
10. European Association for the Study of the Liver. EASL Clinical practice guidelines: liver transplantation. *J Hepatol.* (2016) 64(2):433–85. doi: 10.1016/j.jhep.2015.10.006
11. Puri P, Kumar A, Qaleem M. Donor evaluation protocol for live and deceased donors. *J Clin Exp Hepatol.* (2024) 14(1):101217. doi: 10.1016/j.jceh.2023.07.004
12. Domínguez-Gil B, Moench K, Watson C, Serrano MT, Hibi T, Asencio JM, et al. Prevention and management of donor-transmitted cancer after liver transplantation: guidelines from the ILTS-SETH consensus conference. *Transplantation.* (2022) 106(1):e12–29. doi: 10.1097/TP.0000000000003995
13. Rizvi T, Batchala P, Mukherjee S. Brain death: diagnosis and imaging techniques. *Semin Ultrasound CT MR.* (2018) 39(5):515–29. doi: 10.1053/j.sult.2018.01.006
14. Wijdicks EF, Varelas PN, Gronseth GS, Greer DM, American Academy of Neurology. Evidence-based guideline update: determining brain death in adults: report of the quality standards subcommittee of the American academy of neurology. *Neurology.* (2010) 74(23):1911–8. doi: 10.1212/WNL.0b013e3181e242a8
15. Patel MS, De La Cruz S, Sally MB, Groat T, Malinoski DJ. Active donor management during the hospital phase of care is associated with more organs transplanted per donor. *J Am Coll Surg.* (2017) 225(4):525–31. doi: 10.1016/j.jamcollsurg.2017.06.014
16. Hwang HP, Kim JM, Shin S, Ahn HJ, Lee S, Joo DJ, et al. Organ procurement in a deceased donor. *Korean J Transplant.* (2020) 34(3):134–50. doi: 10.4285/kjt.2020.34.3.134
17. Champigneulle B, Neuschwander A, Bronchard R, Favé G, Jossierand J, Lebas B, et al. Intraoperative management of brain-dead organ donors by anesthesiologists during an organ procurement procedure: results from a French survey. *BMC Anesthesiol.* (2019) 19(1):108. doi: 10.1186/s12871-019-0766-y
18. Yoshikawa MH, Rabelo NN, Welling LC, Telles JPM, Figueiredo EG. Brain death and management of the potential donor. *Neurol Sci.* (2021) 42(9):3541–52. doi: 10.1007/s10072-021-05360-6
19. Souter MJ, Eidbo E, Findlay JY, Lebovitz DJ, Moguilevitch M, Neidlinger NA, et al. Organ donor management: part 1. Toward a consensus to guide anesthesia services during donation after brain death. *Semin Cardiothorac Vasc Anesth.* (2018) 22(2):211–22. doi: 10.1177/1089253217749053
20. Meyfroidt G, Gunst J, Martin-Loeches I, Smith M, Robba C, Taccone FS, et al. Management of the brain-dead donor in the ICU: general and specific therapy to improve transplantable organ quality. *Intensive Care Med.* (2019) 45(3):343–53. doi: 10.1007/s00134-019-05551-y
21. Kotloff RM, Blosser S, Fulda GJ, Malinoski D, Ahya VN, Angel L, et al. Management of the potential organ donor in the ICU: society of critical care medicine/American college of chest physicians/association of organ procurement organizations consensus statement. *Crit Care Med.* (2015) 43(6):1291–325. doi: 10.1097/CCM.0000000000000958
22. Matesanz R, Domínguez-Gil B, Coll E, Mahillo B, Marazuela R. How Spain reached 40 deceased organ donors per million population. *Am J Transplant.* (2017) 17(6):1447–54. doi: 10.1111/ajt.14104
23. Markmann JF, Abouljoud MS, Ghobrial RM, Bhati CS, Pelletier SJ, Lu AD, et al. Impact of portable normothermic blood-based machine perfusion on outcomes of liver transplant: the OCS liver PROTECT randomized clinical trial. *JAMA Surg.* (2022) 157(3):189–98. doi: 10.1001/jamasurg.2021.6781
24. Nasralla D, Coussios CC, Mergental H, Akhtar MZ, Butler AJ, Ceresa CD, et al. A randomized trial of normothermic preservation in liver transplantation. *Nature.* (2018) 557(7703):50–56. doi: 10.1038/s41586-018-0047-9
25. Durand F, Renz JF, Alkofer B, Burra P, Clavien PA, Porte RJ, et al. Report of the Paris consensus meeting on expanded criteria donors in liver transplantation. *Liver Transpl.* (2008) 14(12):1694–707. doi: 10.1002/lt.21668
26. Nemes B, Gámán G, Polak WG, Gelly F, Hara T, Ono S, et al. Extended criteria donors in liver transplantation part I: reviewing the impact of determining factors. *Expert Rev Gastroenterol Hepatol.* (2016) 10(7):827–39. doi: 10.1586/17474124.2016.1149061
27. Gao Q, Mulvihill MS, Scheuermann U, Davis RP, Yerxa J, Yerokun BA, et al. Improvement in liver transplant outcomes from older donors: a US national analysis. *Ann Surg.* (2019) 270(2):333–9. doi: 10.1097/SLA.0000000000002876
28. Durand F, Levitsky J, Cauchy F, Gilgenkrantz H, Soubrane O, Francoz C. Age and liver transplantation. *J Hepatol.* (2019) 70(4):745–58. doi: 10.1016/j.jhep.2018.12.009
29. Neri I, Pascale MM, Bianco G, Frongillo F, Agnes S, Giovinazzo F. Age and liver graft: a systematic review with meta-regression. *Updates Surg.* (2023) 75(8):2075–83. doi: 10.1007/s13304-023-01641-1
30. Gastaca M, Guerra M, Alvarez Martinez L, Ruiz P, Ventoso A, Palomares I, et al. Octogenarian donors in liver transplantation. *Transplant Proc.* (2016) 48(9):2856–8. doi: 10.1016/j.transproceed.2016.06.063
31. Zapletal C, Faust D, Wullstein C, Woeste G, Caspary WF, Golling M, et al. Does the liver ever age? Results of liver transplantation with donors above 80 years of age. *Transplant Proc.* (2005) 37(2):1182–5. doi: 10.1016/j.transproceed.2004.11.056
32. Iaz Jaime F, Berenguer M. Pushing the donor limits: deceased donor liver transplantation using organs from octogenarian donors. *Liver Transpl.* (2017) 23(S1):S22–6. doi: 10.1002/lt.24841
33. Phillips B, Asgari E, Berry M, Callaghan C, Cerisuelo MC, Johnson P, et al. British Transplantation society guidelines on abdominal organ transplantation from deceased donors after circulatory death. *Transplant Rev (Orlando).* (2024) 38(1):100801. doi: 10.1016/j.trre.2023.100801
34. Croome KP, Barbas AS, Whitson B, Zarrinpar A, Taner T, Lo D, et al. American Society of transplant surgeons recommendations on best practices in donation after circulatory death organ procurement. *Am J Transplant.* (2023) 23(2):171–9. doi: 10.1016/j.ajt.2022.10.009
35. Chu MJ, Dare AJ, Phillips AR, Bartlett AS. Donor hepatic steatosis and outcome after liver transplantation: a systematic review. *J Gastrointest Surg.* (2015) 19(9):1713–24. doi: 10.1007/s11605-015-2832-1
36. Zhang QY, Zhang QF, Zhang DZ. The impact of steatosis on the outcome of liver transplantation: a meta-analysis. *Biomed Res Int.* (2019) 2019:3962785. doi: 10.1155/2019/3962785
37. Martins AM, Coelho GR, Marques GA, Moraes MO, Valença JT Jr, Garcia JH. Hepatic steatosis assessment: a comparative study between surgeon evaluation and forward histopathologic findings. *Arq Gastroenterol.* (2013) 50(1):15–8. doi: 10.1590/s0004-28032013000100004
38. Yersiz H, Lee C, Kaldas FM, Hong JC, Rana A, Schnickel GT, et al. Assessment of hepatic steatosis by transplant surgeon and expert pathologist: a prospective, double-blind evaluation of 201 donor livers. *Liver Transpl.* (2013) 19(4):437–49. doi: 10.1002/lt.23615
39. Spitzer AL, Lao OB, Dick AA, Bakthavatsalam R, Halldorson JB, Yeh MM, et al. The biopsied donor liver: incorporating macrosteatosis into high-risk donor assessment. *Liver Transpl.* (2010) 16(7):874–84. doi: 10.1002/lt.22085
40. Kaltenbach MG, Harhay MO, Abt PL, Goldberg DS. Trends in deceased donor liver enzymes prior to transplant: the impact on graft selection and outcomes. *Am J Transplant.* (2020) 20(1):213–9. doi: 10.1111/ajt.15573

41. Martins PN, Rawson A, Movahedi B, Brüggewirth IMA, Dolgin NH, Martins AB, et al. Single-Center experience with liver transplant using donors with very high transaminase levels. *Exp Clin Transplant.* (2019) 17(4):498–506. doi: 10.6002/ect.2017.0172
42. Figueras J, Busquets J, Grande L, Jaurieta E, Perez-Ferreiroa J, Mir J, et al. The deleterious effect of donor high plasma sodium and extended preservation in liver transplantation. A multivariate analysis. *Transplantation.* (1996) 61(3):410–3. doi: 10.1097/00007890-199602150-00016
43. Briceño J, Pera-Rojas C, Solorzano G, De la Mata M, Pera-Madrazo C. Use of high-risk liver donors for urgent and elective liver transplantation. *Transplant Proc.* (1999) 31(1-2):440–2. doi: 10.1016/s0041-1345(98)01697-2
44. Avolio AW, Agnes S, Magalini SC, Foco M, Castagneto M. Importance of donor blood chemistry data (AST, serum sodium) in predicting liver transplant outcome. *Transplant Proc.* (1991) 23(5):2451–2.
45. Totsuka E, Fung U, Hakamada K, Tanaka M, Takahashi K, Nakai M, et al. Analysis of clinical variables of donors and recipients with respect to short-term graft outcome in human liver transplantation. *Transplant Proc.* (2004) 36(8):2215–8. doi: 10.1016/j.transproceed.2004.08.052
46. Totsuka E, Dodson F, Urakami A, Moras N, Ishii T, Lee MC, et al. Influence of high donor serum sodium levels on early postoperative graft function in human liver transplantation: effect of correction of donor hypernatremia. *Liver Transpl Surg.* (1999) 5(5):421–8. doi: 10.1002/lt.500050510
47. Cywinski JB, Mascha E, Miller C, Eghtesad B, Nakagawa S, Vincent JP, et al. Association between donor-recipient serum sodium differences and orthotopic liver transplant graft function. *Liver Transpl.* (2008) 14(1):59–65. doi: 10.1002/lt.21305
48. Zhou ZJ, Chen GS, Si ZZ, Li Q, Bin YY, Qi HZ, et al. Prognostic factors influencing outcome in adult liver transplantation using hypernatremic organ donation after brain death. *Hepatobiliary Pancreat Dis Int.* (2020) 19(4):371–7. doi: 10.1016/j.hbpd.2020.06.003
49. Mangus RS, Fridell JA, Vianna RM, Milgrom ML, Chestovich P, Vandenboom C, et al. Severe hypernatremia in deceased liver donors does not impact early transplant outcome. *Transplantation.* (2010) 90(4):438–43. doi: 10.1097/TP.0b013e3181e764c0
50. Khosravi MB, Firoozifar M, Ghaffaripour S, Sahmeddini MA, Eghbal MH. Early outcomes of liver transplants in patients receiving organs from hypernatremic donors. *Exp Clin Transplant.* (2013) 11(6):537–40. doi: 10.6002/ect.2012.0274
51. Kaseje N, McClin V, Toso C, Poncet A, Wildhaber BE. Donor hypernatremia before procurement and early outcomes following pediatric liver transplantation. *Liver Transpl.* (2015) 21(8):1076–81. doi: 10.1002/lt.24145
52. Kaseje N, Lüthold S, Mentha G, Toso C, Belli D, McClin V, et al. Donor hypernatremia influences outcomes following pediatric liver transplantation. *Eur J Pediatr Surg.* (2013) 23(1):8–13. doi: 10.1055/s-0032-1329703
53. Huaman MA, Vilchez V, Mei X, Shah MB, Daily MF, Berger J, et al. Decreased graft survival in liver transplant recipients of donors with positive blood cultures: a review of the united network for organ sharing dataset. *Transpl Int.* (2017) 30(6):558–65. doi: 10.1111/tri.12900
54. Feijó MS, Galdino-Vasconcelos MR, Simões V, Atik F, Castro FFS, Ferreira G, et al. Impact of donor positive blood culture in deceased donor liver transplantation. *Transplant Proc.* (2020) 52(5):1236–42. doi: 10.1016/j.transproceed.2020.02.027
55. Lin TL, Kuo SC, Yeh CH, Chan YC, Lin YH, Li WF, et al. Donor-Transmitted bacterial infection in deceased donor liver transplantation: experience of southern Taiwan medical center. *Transplant Proc.* (2018) 50(9):2711–4. doi: 10.1016/j.transproceed.2018.04.017
56. Chan KM, Cheng CH, Wu TH, Lee CF, Wu TJ, Chou HS, et al. Impact of donor with evidence of bacterial infections on deceased donor liver transplantation: a retrospective observational cohort study in Taiwan. *BMJ Open.* (2019) 9(3):e023908. doi: 10.1136/bmjopen-2018-023908
57. Cotter TG, Sandıkçı B, Paul S, Gampa A, Wang J, Te H, et al. Liver transplantation for alcoholic hepatitis in the United States: excellent outcomes with profound temporal and geographic variation in frequency. *Am J Transplant.* (2021) 21(3):1039–55. doi: 10.1111/ajt.16143
58. Sobotka LA, Mumtaz K, Wellner MR, Kelly SG, Conteh LF, Hanje AJ, et al. Outcomes of hepatitis C virus seropositive donors to hepatitis C virus seronegative liver recipients: a large single center analysis. *Ann Hepatol.* (2021) 24:100318. doi: 10.1016/j.aohp.2021.100318
59. Ting PS, Hamilton JP, Gurakar A, Urrunaga NH, Ma M, Glorioso J, et al. Hepatitis C-positive donor liver transplantation for hepatitis C seronegative recipients. *Transpl Infect Dis.* (2019) 21(6):e13194. doi: 10.1111/tid.13194
60. Zhou J, Sun HC, Wang Z, Cong WM, Wang JH, Zeng MS, et al. Guidelines for diagnosis and treatment of primary liver cancer in China (2017 edition). *Liver Cancer.* (2018) 7(3):235–60. doi: 10.1159/000488035
61. Chen PH, Limketkai BN, Trilianos P, Pirtini-Cetinglu M, Woreta T, Kim B, et al. Effect of prior hepatitis B virus exposure on long-term risk of liver-related events after liver transplantation. *Clin Transplant.* (2016) 30(5):579–88. doi: 10.1111/ctr.12723
62. Bae SK, Akamatsu N, Togashi J, Ichida A, Kawahara T, Maki H, et al. Hepatitis B virus recurrence after living donor liver transplantation of anti-HBc-positive grafts: a 22-year experience at a single center. *Biosci Trends.* (2019) 13(5):448–55. doi: 10.5582/bst.2019.01283
63. Bhatnagar A, Prakash S, Lymberopoulos P, Goff C, Shaikh A, Kim D, et al. Transplanting hepatitis B surface antigen-positive livers in the United States: outcomes and opportunities. *Am J Transplant.* (2023) 23(8):1221–6. doi: 10.1016/j.ajt.2023.04.024
64. Nalesnik MA, Woodle ES, Dimairo JM, Vasudev B, Teperman LW, Covington S, et al. Donor-transmitted malignancies in organ transplantation: assessment of clinical risk. *Am J Transplant.* (2011) 11(6):1140–7. doi: 10.1111/j.1600-6143.2011.03565.x
65. Colmenero J, Berenguer M, Watt KD. The ILTS-SETH consensus conference on extrahepatic cancer and liver transplantation: paving the way. *Transplantation.* (2022) 106(1):e1–2. doi: 10.1097/TP.0000000000003994
66. Salcedo M, Vinaixa C, Javle M, Trapero-Marugán M, Bustamante J, Line PD. Evaluation and management of liver transplant candidates with prior nonhepatic cancer: guidelines from the ILTS/SETH consensus conference. *Transplantation.* (2022) 106(1):e3–e11. doi: 10.1097/TP.0000000000003997
67. Winter A, Féray C, Audureau E, Azoulay D, Antoine C, Daurès JP, et al. A donor quality Index for liver transplantation: development, internal and external validation. *Sci Rep.* (2018) 8(1):9871. doi: 10.1038/s41598-018-27960-7 Erratum in: *Sci Rep.* 2018;8(1):15109. doi: 10.1038/s41598-018-30974-w
68. Agopian VG, Markovic D, Klintmalm GB, Saracino G, Chapman WC, Vachharajani N, et al. Multicenter validation of the liver graft assessment following transplantation (L-GrAFT) score for assessment of early allograft dysfunction. *J Hepatol.* (2021) 74(4):881–92. doi: 10.1016/j.jhep.2020.09.015
69. Feng S, Goodrich NP, Bragg-Gresham JL, Dykstra DM, Punch JD, DebRoy MA, et al. Characteristics associated with liver graft failure: the concept of a donor risk index. *Am J Transplant.* (2006) 6(4):783–90. doi: 10.1111/j.1600-6143.2006.01242.x Erratum in: *Am J Transplant.* 2018;18(12):3085. doi: 10.1111/ajt.15155
70. Braat AE, Blok JJ, Putter H, Adam R, Burroughs AK, Rahmel AO, et al. The eurotransplant donor risk index in liver transplantation: eT-DRI. *Am J Transplant.* (2012) 12(10):2789–96. doi: 10.1111/j.1600-6143.2012.04195.x
71. Rana A, Hardy MA, Halazun KJ, Woodland DC, Ratner LE, Samstein B, et al. Survival outcomes following liver transplantation (SOFT) score: a novel method to predict patient survival following liver transplantation. *Am J Transplant.* (2008) 8(12):2537–46. doi: 10.1111/j.1600-6143.2008.02400.x
72. Rana A, Sigureddi RR, Halazun KJ, Kothare A, Wu MF, Liu H, et al. Predicting liver allograft discard: the discard risk Index. *Transplantation.* (2018) 102(9):1520–9. doi: 10.1097/TP.0000000000002151
73. Flores A, Asrani SK. The donor risk index: a decade of experience. *Liver Transpl.* (2017) 23(9):1216–25. doi: 10.1002/lt.24799
74. Yu YD, Lee KS, Man Kim J, Ryu JH, Lee JG, Lee KW, et al. Artificial intelligence for predicting survival following deceased donor liver transplantation: retrospective multi-center study. *Int J Surg.* (2022) 105:106838. doi: 10.1016/j.ijsu.2022.106838
75. Wingfield LR, Ceresa C, Thorogood S, Fleuriot J, Knight S. Using artificial intelligence for predicting survival of individual grafts in liver transplantation: a systematic review. *Liver Transpl.* (2020) 26(7):922–34. doi: 10.1002/lt.25772
76. Briceño J, Cruz-Ramírez M, Prieto M, Navasa M, de Urbina J O, Orti R, et al. Use of artificial intelligence as an innovative donor-recipient matching model for liver transplantation: results from a multicenter Spanish study. *J Hepatol.* (2014) 61(5):1020–8. doi: 10.1016/j.jhep.2014.05.039
77. Lin Y, Huang H, Chen L, Chen R, Liu J, Zheng S, et al. Assessing donor liver quality and restoring graft function in the era of extended criteria donors. *J Clin Transl Hepatol.* (2023) 11(1):219–30. doi: 10.14218/JCTH.2022.00194
78. Staubli SM, Ceresa CDL, Pollok JM. The current role and future applications of machine perfusion in liver transplantation. *Bioengineering (Basel).* (2023) 10(5):593. doi: 10.3390/bioengineering10050593
79. Da Silva RX S, Weber A, Dutkowski P, Clavien PA. Machine perfusion in liver transplantation. *Hepatology.* (2022) 76(5):1531–49. doi: 10.1002/hep.32546
80. van Rijn R, Schurink IJ, de Vries Y, van den Berg AP, Cortes Cerisuelo M, Darwish Murad S, et al. Hypothermic machine perfusion in liver transplantation - A randomized trial. *N Engl J Med.* (2021) 384(15):1391–401. doi: 10.1056/NEJMoa2031532
81. Mergental H, Laing RW, Kirkham AJ, Perera MTPR, Boteon YL, Attard J, et al. Transplantation of discarded livers following viability testing with normothermic machine perfusion. *Nat Commun.* (2020) 11(1):2939. doi: 10.1038/s41467-020-16251-3
82. Oliver JB, Marcus AF, Paster M, Nespral J, Bongu A, Dikdan G, et al. Organ procurement organization survey of practices and beliefs regarding prerecovery percutaneous liver biopsy in donation after neurologic determination of death. *Transplantation.* (2017) 101(4):821–5. doi: 10.1097/TP.0000000000001632
83. Mangus RS, Borup TC, Popa S, Saxena R, Cummings O, Tector AJ. Utility of pre-procurement bedside liver biopsy in the deceased extended-criteria liver donor. *Clin Transplant.* (2014) 28(12):1358–64. doi: 10.1111/ctr.12461

84. Flechtenmacher C, Schirmacher P, Schemmer P. Donor liver histology—a valuable tool in graft selection. *Langenbecks Arch Surg.* (2015) 400(5):551–7. doi: 10.1007/s00423-015-1298-7
85. Melin C, Mićk R, Young NA, Ortiz J, Balasubramanian M. Approach to intraoperative consultation for donor liver biopsies. *Arch Pathol Lab Med.* (2013) 137(2):270–4. doi: 10.5858/arpa.2011-0689-RA
86. Vogel T, Szardenings C, Becker F, Jordan S, Katou S, Morgul H, et al. Viability assessment and transplantation of extended criteria donor liver grafts using normothermic machine perfusion. *Surgery.* (2024) 176(3):934–41. doi: 10.1016/j.surg.2024.05.025
87. Fukazawa K, Nishida S. Size mismatch in liver transplantation. *J Hepatobiliary Pancreat Sci.* (2016) 23(8):457–66. doi: 10.1002/jhbp.371
88. Brige P, Hery G, Chopinet S, Palen A, Azoulay D, Gregoire E. Morbidity and mortality of hepatic right lobe living donors: systematic review and perspectives. *J Gastrointest Liver Dis.* (2018) 27(2):169–78. doi: 10.15403/jgld.2014.1121.272.mor
89. Sakai T, Ko JS, Crouch CE, Kumar S, Little MB, Chae MS, et al. Perioperative management of adult living donor liver transplantation: part 1 - recipients. *Clin Transplant.* (2022) 36(6):e14667. doi: 10.1111/ctr.14667
90. Miller CM, Quintini C, Dhawan A, Durand F, Heimbach JK, Kim-Schluger HL, et al. The international liver transplantation society living donor liver transplant recipient guideline. *Transplantation.* (2017) 101(5):938–44. doi: 10.1097/TP.0000000000001571
91. Trotter JF, Wisniewski KA, Terrault NA, Everhart JE, Kinkhabwala M, Weinrieb RM, et al. Outcomes of donor evaluation in adult-to-adult living donor liver transplantation. *Hepatology.* (2007) 46(5):1476–84. doi: 10.1002/hep.21845
92. Pomfret EA, Lodge JP, Villamil FG, Siegler M. Should we use living donor grafts for patients with hepatocellular carcinoma? Ethical considerations. *Liver Transpl.* (2011) 17(Suppl 2):S128–32. doi: 10.1002/lt.22356
93. Shazi L, Abbas Z. Ethical dilemmas related to living donor liver transplantation in Asia. *Ir J Med Sci.* (2019) 188(4):1185–9. doi: 10.1007/s11845-019-01989-7
94. Barr ML, Belghiti J, Villamil FG, Pomfret EA, Sutherland DS, Gruessner RW, et al. A report of the Vancouver forum on the care of the live organ donor: lung, liver, pancreas, and intestine data and medical guidelines. *Transplantation.* (2006) 81(10):1373–85. doi: 10.1097/01.tp.0000216825.56841.cd
95. Rössler F, Sapisochin G, Song G, Lin YH, Simpson MA, Hasegawa K, et al. Defining benchmarks for Major liver surgery: a multicenter analysis of 5202 living liver donors. *Ann Surg.* (2016) 264(3):492–500. doi: 10.1097/SLA.0000000000001849
96. Lee JG, Lee KW, Kwon CHD, Chu CW, Kim BW, Choi DL, et al. Donor safety in living donor liver transplantation: the Korean organ transplantation registry study. *Liver Transpl.* (2017) 23(8):999–1006. doi: 10.1002/lt.24778
97. 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(4):650–7. doi: 10.1097/SLA.0000000000006895
98. Adcock L, Macleod C, Dubay D, Greig PD, Cattral MS, McGilvray I, et al. Adult living liver donors have excellent long-term medical outcomes: the university of Toronto liver transplant experience. *Am J Transplant.* (2010) 10(2):364–71. doi: 10.1111/j.1600-6143.2009.02950.x
99. Gordon EJ. Informed consent for living donation: a review of key empirical studies, ethical challenges and future research. *Am J Transplant.* (2012) 12(9):2273–80. doi: 10.1111/j.1600-6143.2012.04102.x
100. Soin AS, Chaudhary RJ, Pahari H, Pomfret EA. A worldwide survey of live liver donor selection policies at 24 centers with a combined experience of 19 009 adult living donor liver transplants. *Transplantation.* (2019) 103(2):e39–47. doi: 10.1097/TP.0000000000002475
101. Jackson WE, Kaplan A, Saben JL, Kriss MS, Cisek J, Samstein B, et al. Practice patterns of the medical evaluation of living liver donors in the United States. *Liver Transpl.* (2023) 29(2):164–71. doi: 10.1002/lt.26571
102. Li Y, Nieuwenhuis LM, Voskuil MD, Gacesa R, Hu S, Jansen BH, et al. Donor genetic variants as risk factors for thrombosis after liver transplantation: a genome-wide association study. *Am J Transplant.* (2021) 21(9):3133–47. doi: 10.1111/ajt.16490
103. Mas VR, Fisher RA, Maluf DG, Wilkinson DS, Garrett CT, Ferreira-Gonzalez A. Hepatic artery thrombosis after liver transplantation and genetic factors: prothrombin G20210A polymorphism. *Transplantation.* (2003) 76(1):746–57. doi: 10.1097/01.TP.0000072017.19075.2E
104. Zhang KY, Tung BY, Kowdley KV. Liver transplantation for metabolic liver diseases. *Clin Liver Dis.* (2007) 11(2):265–81. doi: 10.1016/j.cld.2007.04.002
105. Song W, Chen C, Huang Y, Gu G. Living donor liver transplantation for pediatric patients with metabolic disease vs. Deceased donation. *Asian J Surg.* (2021) 44(4):629–35. doi: 10.1016/j.asjsur.2020.11.016
106. Dorwal P, Gautam D, Sharma D, Singh DR, Raina V. Donor biopsy in living donor liver transplantation: is it still relevant in a developing country? *Malays J Pathol.* (2015) 37(1):39–43.
107. Ayvazoglu Soy EH, Boyvat F, Ozdemir BH, Haberal N, Hilmioglu F, Haberal M. Liver biopsy results in potential donor evaluation in living related liver transplant. *Exp Clin Transplant.* (2018) 16 Suppl 1(Suppl 1):35–7. doi: 10.6002/ect.TOND-TDTD2017.O5
108. Testa G, Nadalin S, Klair T, Florman S, Balci D, Frola C, et al. Optimal surgical workup to ensure safe recovery of the donor after living liver donation—a systematic review of the literature and expert panel recommendations. *Clin Transplant.* (2022) 36(10):e14641. doi: 10.1111/ctr.14641
109. Samaha C, Chaaban H, Simsek C, Danis N, Lin JS, Gurakar A. Practice patterns and considerations in liver transplantation from living donors with high BMI: a review. *Hepatology Forum.* (2023) 4(3):145–9. doi: 10.14744/hf.2023.2023.0030
110. Yoshizumi T, Taketomi A, Soejima Y, Uchiyama H, Ikegami T, Harada N, et al. Impact of donor age and recipient status on left-lobe graft for living donor adult liver transplantation. *Transpl Int.* (2008) 21(1):81–8. doi: 10.1111/j.1432-2277.2007.00561.x
111. Enkhbold C, Morine Y, Utsunomiya T, Imura S, Ikemoto T, Arakawa Y, et al. Dysfunction of liver regeneration in aged liver after partial hepatectomy. *J Gastroenterol Hepatol.* (2015) 30(7):1217–24. doi: 10.1111/jgh.12930
112. Ono Y, Kawachi S, Hayashida T, Wakui M, Tanabe M, Itano O, et al. The influence of donor age on liver regeneration and hepatic progenitor cell populations. *Surgery.* (2011) 150(2):154–61. doi: 10.1016/j.surg.2011.05.004
113. Izzy M, Brown RS, Eguchi S, Hwang S, Matamoros MA, Quintini C, et al. Optimizing pre-donation physiologic evaluation for enhanced recovery after living liver donation - systematic review and multidisciplinary expert panel recommendations. *Clin Transplant.* (2022) 36(10):e14680. doi: 10.1111/ctr.14680
114. Qi Q, Weinstock AK, Chupetlovska K, Borhani AA, Jorgensen DR, Furlan A, et al. Magnetic resonance imaging-derived proton density fat fraction (MRI-PDFF) is a viable alternative to liver biopsy for steatosis quantification in living liver donor transplantation. *Clin Transplant.* (2021) 35(7):e14339. doi: 10.1111/ctr.14339
115. Satkunasingham J, Nik HH, Fischer S, Menezes R, Selzner N, Cattral M, et al. Can negligible hepatic steatosis determined by magnetic resonance imaging-proton density fat fraction obviate the need for liver biopsy in potential liver donors? *Liver Transpl.* (2018) 24(4):470–7. doi: 10.1002/lt.24965
116. Goldaracena N, Barbas AS. Living donor liver transplantation. *Curr Opin Organ Transplant.* (2019) 24(2):131–7. doi: 10.1097/MOT.0000000000000610
117. Song GW, Lee SG, Hwang S, Kim KH, Ahn CS, Moon DB, et al. ABO-Incompatible adult living donor liver transplantation under the desensitization protocol with rituximab. *Am J Transplant.* (2016) 16(1):157–70. doi: 10.1111/ajt.13444
118. Yoon YI, Song GW, Lee SG, Hwang S, Kim KH, Kim SH, et al. Outcome of ABO-incompatible adult living-donor liver transplantation for patients with hepatocellular carcinoma. *J Hepatol.* (2018) 68(6):1153–62. doi: 10.1016/j.jhep.2018.02.002
119. Song GW, Lee SG, Moon DB, Ahn CS, Hwang S, Kim KH, et al. Dual-graft adult living donor liver transplantation: an innovative surgical procedure for live liver donor pool expansion. *Ann Surg.* (2017) 266(1):10–8. doi: 10.1097/SLA.0000000000001776
120. Kim SH, Song GW, Hwang S, Ahn CS, Moon DB, Ha TY, et al. Feasibility of ABO-incompatible adult living donor liver transplantation for acute-on-chronic liver failure. *Hepatobiliary Pancreat Dis Int.* (2017) 16(6):662–4. doi: 10.1016/S1499-3872(17)60060-2
121. Yamamoto H, Uchida K, Kawabata S, Isono K, Miura K, Hayashida S, et al. Feasibility of monotherapy by rituximab without additional desensitization in ABO-incompatible living-donor liver transplantation. *Transplantation.* (2018) 102(1):97–104. doi: 10.1097/TP.0000000000001956
122. Kim SH, Lee EC, Shim JR, Park SJ. A simplified protocol using rituximab and immunoglobulin for ABO-incompatible low-titre living donor liver transplantation. *Liver Int.* (2018) 38(5):932–9. doi: 10.1111/liv.13614
123. Gan K, Li Z, Bao S, Fang Y, Wang T, Jin L, et al. Clinical outcomes after ABO-incompatible liver transplantation: a systematic review and meta-analysis. *Transpl Immunol.* (2021) 69:101476. doi: 10.1016/j.trim.2021.101476
124. Xu YB, Bai YL, Min ZG, Qin SY. Magnetic resonance cholangiography in assessing biliary anatomy in living donors: a meta-analysis. *World J Gastroenterol.* (2013) 19(45):8427–34. doi: 10.3748/wjg.v19.i45.8427
125. Qadri S, Vartiainen E, Lahelma M, Porthan K, Tang A, Idilman IS, et al. Marked difference in liver fat measured by histology vs. Magnetic resonance-proton density fat fraction: a meta-analysis. *JHEP Rep.* (2023) 6(1):100928. doi: 10.1016/j.jhepr.2023.100928
126. Hakeem AR, Mathew JS, Aunés CV, Mazzola A, Alconchel F, Yoon YI, et al. Preventing small-for-size syndrome in living donor liver transplantation: guidelines from the ILTS-iLDLT-LTSI consensus conference. *Transplantation.* (2023) 107(10):2203–15. doi: 10.1097/TP.0000000000004769
127. Kow AWC, Liu J, Patel MS, De Martin E, Reddy MS, Soejima Y, et al. Post living donor liver transplantation small-for-size syndrome: definitions, timelines, biochemical, and clinical factors for diagnosis: guidelines from the ILTS-iLDLT-LTSI consensus conference. *Transplantation.* (2023) 107(10):2226–37. doi: 10.1097/TP.0000000000004770
128. Cullen JM, Conzen KD, Pomfret EA. Living donor liver transplantation: left lobe or right lobe. *Surg Clin North Am.* (2024) 104(1):89–102. doi: 10.1016/j.suc.2023.07.003

129. Masuda Y, Yoshizawa K, Ohno Y, Mita A, Shimizu A, Soejima Y. Small-for-size syndrome in liver transplantation: definition, pathophysiology and management. *Hepatobiliary Pancreat Dis Int.* (2020) 19(4):334–41. doi: 10.1016/j.hbpd.2020.06.015
130. Lee SD, Kim SH, Kim YK, Lee SA, Park SJ. Graft-to-recipient weight ratio lower to 0.7% is safe without portal pressure modulation in right-lobe living donor liver transplantation with favorable conditions. *Hepatobiliary Pancreat Dis Int.* (2014) 13(1):18–24. doi: 10.1016/s1499-3872(14)60002-3
131. Kaido T, Mori A, Ogura Y, Hata K, Yoshizawa A, Iida T, et al. Lower limit of the graft-to-recipient weight ratio can be safely reduced to 0.6% in adult-to-adult living donor liver transplantation in combination with portal pressure control. *Transplant Proc.* (2011) 43(6):2391–3. doi: 10.1016/j.transproceed.2011.05.037
132. Jo HS, Yu YD, Choi YJ, Kim DS. Left liver graft in adult-to-adult living donor liver transplantation with an optimal portal flow modulation strategy to overcome the small-for-size syndrome—a retrospective cohort study. *Int J Surg.* (2022) 106:106953. doi: 10.1016/j.ijsu.2022.106953
133. Fujiki M, Hashimoto K, Quintini C, Aucejo F, Kwon CHD, Matsushima H, et al. Living donor liver transplantation with augmented venous outflow and splenectomy: a promised land for small left lobe grafts. *Ann Surg.* (2022) 276(5):838–45. doi: 10.1097/SLA.0000000000005630 Erratum in: *Ann Surg.* 2023;277(4):e978. doi: 10.1097/SLA.0000000000005815.
134. Dayangac M, Taner CB, Yaprak O, Demirbas T, Balci D, Duran C, et al. Utilization of elderly donors in living donor liver transplantation: when more is less? *Liver Transpl.* (2011) 17(5):548–55. doi: 10.1002/lt.22276
135. Kim SH, Kim YK, Lee SD, Park SJ. Selection and outcomes of living donors with a remnant volume less than 30% after right hepatectomy. *Liver Transpl.* (2013) 19(8):872–8. doi: 10.1002/lt.23677
136. Kim SH, Kim KH, Cho HD. Donor safety of remnant liver volumes of less than 30% in living donor liver transplantation: a systematic review and meta-analysis. *Clin Transplant.* (2023) 37(9):e15080. doi: 10.1111/ctr.15080
137. Olthoff KM, Merion RM, Ghobrial RM, Abecassis MM, Fair JH, Fisher RA, et al. Outcomes of 385 adult-to-adult living donor liver transplant recipients: a report from the A2ALL consortium. *Ann Surg.* (2005) 242(3):314–23, discussion 323–5. doi: 10.1097/01.sla.0000179646.37145.ef
138. Roll GR, Parekh JR, Parker WF, Siegler M, Pomfret EA, Ascher NL, et al. Left hepatectomy versus right hepatectomy for living donor liver transplantation: shifting the risk from the donor to the recipient. *Liver Transpl.* (2013) 19(5):472–81. doi: 10.1002/lt.23608
139. Emond JC. Right versus left: progress but No conclusion in selecting donors for live donor liver transplantation. *Transplantation.* (2022) 106(12):2293–4. doi: 10.1097/TP.0000000000004214
140. Vargas PA, Golderacena N. Right vs left hepatectomy for LDLT, safety and regional preference. *Curr Transplant Rep.* (2022) 9(4):240–9. doi: 10.1007/s40472-022-00386-x
141. Sánchez-Cabús S, Cherqui D, Rashidian N, Pittau G, Elkrief L, Vanlander A, et al. Left-liver adult-to-adult living donor liver transplantation: can it be improved? A retrospective multicenter European study. *Ann Surg.* (2018) 268(5):876–84. doi: 10.1097/SLA.0000000000002897
142. Soejima Y, Shirabe K, Taketomi A, Yoshizumi T, Uchiyama H, Ikegami T, et al. Left lobe living donor liver transplantation in adults. *Am J Transplant.* (2012) 12(7):1877–85. doi: 10.1111/j.1600-6143.2012.04022.x
143. Halazun KJ, Przybyszewski EM, Griesemer AD, Cherqui D, Michelassi F, Guarrera JV, et al. Leaning to the left: increasing the donor pool by using the left lobe, outcomes of the largest single-center North American experience of left lobe adult-to-adult living donor liver transplantation. *Ann Surg.* (2016) 264(3):448–56. doi: 10.1097/SLA.0000000000001860
144. Acuna SA, Zhang W, Yoon PD, Ivanics T, Zhu MP, Claasen M, et al. Right lobe versus left lobe living donor liver transplantation: a systematic review and meta-analysis of donor and recipient outcomes. *Transplantation.* (2022) 106(12):2370–8. doi: 10.1097/TP.0000000000004213
145. Chen Z, Yan LN, Li B, Zeng Y, Wen TF, Zhao J, et al. Prevent small-for-size syndrome using dual grafts in living donor liver transplantation. *J Surg Res.* (2009) 155(2):261–7. doi: 10.1016/j.jss.2009.01.001
146. Lee S, Hwang S, Park K, Lee Y, Choi D, Ahn C, et al. An adult-to-adult living donor liver transplant using dual left lobe grafts. *Surgery.* (2001) 129(5):647–50. doi: 10.1067/msy.2001.114218
147. Yoon YI, Lee SG. Living donor liver transplantation for hepatocellular carcinoma: an Asian perspective. *Dig Dis Sci.* (2019) 64(4):993–1000. doi: 10.1007/s10620-019-05551-4
148. Elkoms BE, Abdo M, Mamdouh R, Abdelaal A. Can living donor liver transplantation provide similar outcomes to deceased-donor liver transplantation for hepatocellular carcinoma? A systematic review and meta-analysis. *Hepatol Int.* (2023) 17(1):18–37. doi: 10.1007/s12072-022-10435-3
149. Yadav SK, Saraf N, Choudhary NS, Sah JK, Sah SK, Rastogi A, et al. Living donor liver transplantation for acute-on-chronic liver failure. *Liver Transpl.* (2019) 25(3):459–68. doi: 10.1002/lt.25395
150. Kulkarni AV, Reddy R, Sharma M, Iyengar S, Rambhatla A, Gv P, et al. Healthcare utilization and outcomes of living donor liver transplantation for patients with APASL-defined acute-on-chronic liver failure. *Hepatol Int.* (2023) 17(5):1233–40. doi: 10.1007/s12072-023-10548-3
151. Wang YC, Yong CC, Lin CC, Alam H, Naseer F, Lin YH, et al. Excellent outcome in living donor liver transplantation: treating patients with acute-on-chronic liver failure. *Liver Transpl.* (2021) 27(11):1633–43. doi: 10.1002/lt.26096
152. Yuan D, Liu F, Wei YG, Li B, Yan LN, Wen TF, et al. Adult-to-adult living donor liver transplantation for acute liver failure in China. *World J Gastroenterol.* (2012) 18(48):7234–41. doi: 10.3748/wjg.v18.i48.7234
153. Gupta A, Asrani SK. Role of living donor liver transplantation in acute liver failure. *Liver Transpl.* (2019) 25(9):1308–9. doi: 10.1002/lt.25610
154. Ogura Y, Kabacam G, Singhal A, Moon DB. The role of living donor liver transplantation for acute liver failure. *Int J Surg.* (2020) 82S:145–8. doi: 10.1016/j.ijsu.2020.04.058
155. Shingina A, Ziogas IA, Vutien P, Uleryk E, Shah PS, Renner E, et al. Adult-to-adult living donor liver transplantation in acute liver failure. *Transplant Rev (Orlando).* (2022) 36(2):100691. doi: 10.1016/j.trre.2022.100691