Review

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Liver transplantation in Japan: Achievements, limitations, and future perspectives

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SUMMARY: Liver cirrhosis (LC) represents a substantial and growing global health burden, driving high mortality through liver failure and hepatocellular carcinoma (HCC), for which liver transplantation (LT) remains the only definitive and life-saving therapy. Despite continuous technical and perioperative advances, a critical unmet need persists due to the imbalance between organ demand and availability. In Japan, the practice of LT is uniquely shaped by the predominance of living donor transplantation and a marked epidemiological transition: the burden of viral hepatitis-related cirrhosis has declined with antiviral therapies, while metabolic dysfunction–associated steatohepatitis (MASH) and alcohol-associated liver disease (ALD) are emerging as leading indications. This paradigm shift necessitates refinement of transplant strategies, including improved candidate selection for HCC through integration of tumor biology and novel biomarkers and careful consideration of immunotherapy-related risks. Moreover, MASH introduces complex challenges related to obesity, disease recurrence, and the role and timing of metabolic interventions, whereas ALD raises ongoing clinical and ethical questions regarding early transplantation and relapse prevention. Future progress will depend on expanding the donor pool through innovations such as machine perfusion and xenotransplantation as well as expanding indications to selected non-HCC malignancies and adopting advanced surgical technologies. Collectively, LT is transitioning toward a precision-based, multidisciplinary, and innovation-driven paradigm.

Keywords: liver transplantation, living donor, hepatocellular carcinoma, metabolic dysfunction-associated steatohepatitis, bariatric surgery

1. Introduction

Cirrhosis is a consequence of chronic inflammation and diffuse fibrosis, in which regenerative hepatic nodules replace the normal hepatic structure. It will ultimately lead to failure of liver function (*1*). It involves various etiologies, including hepatitis B virus (HBV) or hepatitis C virus (HCV) infection, autoimmune liver diseases, alcoholic-related disease (ALD) and metabolic dysfunction-associated steatohepatitis (MASH) (*2*). HBV infection is one of the widespread causes of liver cirrhosis (LC) in Asia and Africa. HCV is responsible for LC in other areas.

Globally, the rates of LC have increased. About two million deaths worldwide annually are attributable to liver disease, with one million due to cirrhosis and the remaining one million due to hepatocellular carcinoma (HCC) (*3*). The high cirrhosis burden has increased the need for liver transplantation (LT). In 2021, 34694 liver transplants have been performed globally, marking an increase of 7% from 2020 and a 20% increase from 2015 (*4*).

Etiologies of cirrhosis leading to LT have changed over time in Japan. Data from 36 hospitals with datasets for 2008–2016 (n = 18,358) has indicated that HCV infection (48%) was the leading cause of cirrhosis. HBV infection (12%) was the third most common cause. During that period, the contribution of viral hepatitis to cirrhosis dropped from 73 to 50%. Since 2014, there has been a drastic decline in the number of patients who underwent LT for HCV as direct-acting antivirals have become available. In its place, cirrhosis due to ALD and MASH has increased markedly (from 14 to 25% and from 2 to 9%, respectively) during that period. Accordingly, the proportion of liver transplants for MASH increased from 1% in 2002 to 8% in 2016 (*5*).

2. Current challenges in LT

2.1. HCC

2.1.1. Epidemiology

HCC is the sixth most malignant tumor in the world.

More than 800,000 new cases are reported per year. The 5-year survival rate has remained low. There are about 900,000 deaths per year, making HCC the fourth most common cause of cancer deaths worldwide. The potential for LT to treat HCC, removing the tumor and restoring liver function, has long been anticipated. The first liver transplants were for HCC (*6*).

2.1.2. Japan criteria (5-5-500 rule)

A recent study (*7*) examined the 965 patients who underwent living donor liver transplantation (LDLT) for HCC between 1990 and 2005 in Japan. Of those patients, 664 met the Milan criteria while 301 did not. The criteria (the 5-5-500 rule) consisted of a tumor number ≤ 5, a tumor size ≤ 5 cm, and a serum alpha-fetoprotein level ≤ 500 ng/mL. Adoption of those criteria increased the number of LT candidates (n = 725) and resulted in a 5-year recurrence rate ≤ 10%. The cost of transplantation when the 5-5-500 rule for LDLT and deceased donor liver transplantation is adopted is now covered by the insurance system.

2.1.3. Current challenges in LT for HCC

Criteria for LT to treat HCC have basically consisted of the number and the size of HCC. The recurrence risk will increase with the level of alpha-fetoprotein, tumor size, and tumor number (*8*). Vascular endothelial growth factor (*9*), lens culinaris agglutinin-reactive AFP (AFPL3) (*10*), des-gamma-carboxy prothrombin (*11*), and neutrophil-to-lymphocyte ratio (*12*) are biomarkers that reflect tumor biology. Molecular biomarkers, such as circulating tumor cells, have been discussed in terms of predicting HCC recurrence. They may be useful in patient selection and post-LT management (*13*).

Another challenge is better understanding of how to manage HCC before LT. The emerging standards include vascular endothelial growth factor inhibitors and immune checkpoint inhibitors (ICIs) or a combination of both. However ICIs are associated with a risk of T cell-mediated rejection (*14*); that rejection is difficult to treated and often results in graft failure (*15-17*). Optimal doses of ICI and the duration between the administration of ICIs and LT are issues that require further analyses.

2.2. MASH as an indication for LT

2.2.1. Epidemiology

MASH is a manifestation of metabolic syndrome in the liver, which affects around 25% of the global population (*18*). MASH cases are estimated to total as many as 15 million (6% of adults) in the US. The number of those cases with ≥ F2 is estimated to be 7 million (*19*). According to the registry of United Network for Organ Sharing and Organ Procurement and Transplantation Network, the number of listed MASH patients has almost tripled in ten years. MASH is now one of the most common indications for LT (*20,21*).

A study by Hagström *et al*. (*22*) found that a liver suffering from MASH developed F0–1 fibrosis in 25 years, F2 in 9 years, F3 in 2 years, and F4 in 1 year. The MASH epidemic will presumably reduce the pool of donors, increase risk for LT recipients, increase the technical demands of surgery, and increase consequent complications (*23*).

2.2.2. Outcomes of LT

A recent analysis (*24*) of MASH and other conditions noted comparable outcomes of LT in terms of patient and graft survival. A point of note, however, is that obese LT candidates have a lower transplantation rate and a higher mortality rate while on the list. Recurrence of MASH post-LT is common and its management is challenging (*25*), which can unfavorably affect post-LT outcomes long-term (*26,27*).

2.2.3. Relationship between bariatric surgery (BS) and LT

LT and BS procedures are a reliable combination for weight loss. Sleeve gastrectomy is an effective therapy for weight loss (*23*) that will not cause malabsorption, it will not hamper an endoscopic approach to the bile ducts, and it will not affect the pharmacokinetics of immunosuppressive drugs. Complications include bleeding and leakage from the lines of the staple closure.

The most effective treatment for weight loss is *via* a small bowel Roux-en-Y bypass, which is more invasive but which will result in prolonged weight loss. In contrast to a sleeve gastrectomy, a Roux-en-Y bypass makes an endoscopic approach to the bile duct difficult and it affects the pharmacokinetics of immunosuppressive drugs. Malabsorption and sarcopenia are complications of the bypass procedure (*23*).

2.2.4. Timing: BS and LT

The ideal timing of BS - before, after, or at the same time as LT - has not established (*23*). Decompensated cirrhosis is a contraindication for BS because of the high risk of postoperative death (*28*). Outcomes are influenced by the degree of liver dysfunction and/or portal hypertension among individuals with compensated cirrhosis. Some patients with compensated cirrhosis have actually undergone BS successfully but with higher complication rates (*29*). A study (*30*) found that patients listed for LT who underwent laparoscopic sleeve gastrectomy had successful weight loss with no postoperative mortality. That study involved 32 patients who had an average Model for End-stage Liver Disease (MELD) score of 12.

In contrast, LT candidates who underwent BS beforehand (*n* = 78) had a higher waitlist mortality rate (33% *vs* 10%, *p* = 0.002) and a lower transplantation rate (49% *vs* 65%, *p* = 0.02) than a matched LT cohort not undergoing BS (*31*). A limitation of this strategy is that obesity is less prevalent among LT candidates than the general public (*32*). Postoperatively, one-third of recipients become obese. Whether BS prior to LT affects the natural course of obese patients is not clear.

Simultaneous BS and LT would reduce the number of surgeries required (*33,34*). In some series, satisfactory short- and long-term outcomes were reported. Those series have demonstrated that the procedure is safe and effective over the long term and that it reduces the rate of steatosis and diabetes recurrence (*35-37*). The procedure has the advantages of rapidly dealing with obesity and reducing comorbidities.

An advantage of BS after LT (*38,39*) is that LT survivors who become obese post-LT can be selected. The surgery is, however, technically demanding and an open approach has a high morbidity rate of up to 45% (*39*). The reoperation rate is as high as 33%. A total of 14% of patients died within one year of BS (*39*). A study of 15 patients who underwent sleeve gastrectomy after LT (median duration: 2 years) found that weight was effectively reduced with a lower complication rate (*40*).

2.2.5. Non-surgical strategy for weight loss

Treatments for weight loss other than surgery are playing a non-negligible role in the management of obese patients undergoing LT. Tirzepatide (an agent combining a glucose-dependent insulinotropic peptide receptor agonist and glucagon-like peptide-1 receptor agonist) results in body weight loss of about 25% (*41-43*). Tirzepatide is followed by semaglutide and liraglutide, which are solely glucagon-like peptide-1 agonists. A recent study (*44*) showed that endoscopic sleeve gastroplasty is more cost-effective compared to semaglutide in the treatment of obesity indicated by a body mass index (BMI) > 30. Nonetheless, there are no available data on the clinical use of these medicines in patients with decompensated cirrhosis or those post-LT.

2.3. Alcoholic cirrhosis

2.3.1. Epidemiology

ALD poses a substantial burden around the world. Of the 2.3 billion people who drink alcohol, approximately 40% are heavy drinkers. The number of younger people with ALD has increased. Due to liver disease's relationship with obesity (*18*), the severity of alcohol use disorder has increased and the incidence of ALD (*45*) has increased, along with increased hospital admissions for alcohol-associated hepatitis (AH) (*46*) and consequent alcohol- and liver disease-related deaths (*47*). Now, ALD accounts for around 40% of all liver transplants in North America, which is more prevalent than MASH or HCV cirrhosis (*48*).

2.3.2. Outcomes of LT

Patients with ALD who underwent LT have comparable survival post-LT compared to that for patients with other conditions (*49,50*). Diabetes was one of the prognostic factors for patients who underwent LT for alcoholic cirrhosis (*51*). Around the 50% of the recipients resumed consuming alcohol to some degree. However, only a small proportion of patient deaths is due to alcohol abuse. Patients who are abstinent for a prolonged period can be adequately selected for LT (*52*). The 6-month rule is not always evidence-based. Decisions on LT candidacy might not be decided solely on the duration of abstinence (*49*).

2.3.3. LT for AH

LT for severe AH has promising outcomes when highly selective (*52-55*). A multicenter study examined three groups of patients: 1. Transplant patients with severe AH, 2. Those with AH who were rejected for LT due to sociopsychological contraindications, and 3. Those with alcohol-associated cirrhosis who were abstinent pre-transplant for ≥ 6 months) (*55*). According to that study, patients who underwent LT for AH not responding to steroids had a better survival than those not undergoing LT (83% *vs* 28% at 2 years). The two-year survival after LT was comparable between patients with ALD cirrhosis who were abstinent for ≥ 6 months and those with AH (*55*). An American study (ACCELERATE-AH) showed that early LT for AH had satisfactory outcomes (*56*).

A concern when performing LT for severe AH (*57*) is that there are few predictors of outcome. Not all centers apply uniform criteria. The stringency of the criteria

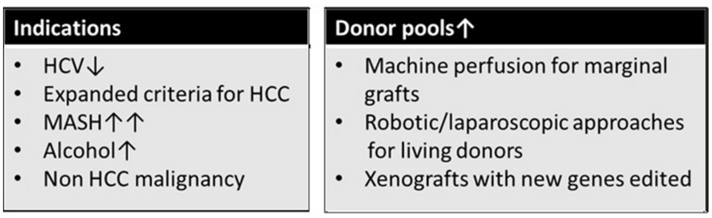

Figure 1. Changing indications and expanding donor pools. *Abbreviations*: HCV, hepatitis C virus; HCC, hepatocellular carcinoma; MASH, metabolic dysfunction-associated steatohepatitis.

will depend on the expertise in medical management, the existence of an infrastructure with multidisciplinary teams, and the evaluation process (*53*). Another concern is the difficulty in defining the best indicator of outcome. It may be survival or relapse. The difference between a slipup and sustained harmful drinking is important. Sustained harmful drinking is related to a poor prognosis (*58*).

If they do not undergo LT, patients with severe AH are at risk of a fatal outcome. A meta-analysis (*59*) showed that corticosteroids reduced mortality in patients with AH and a Maddrey score > 32. Patients with severe AH who did not receive them had a mortality of 35–40% in one month, while mortality decreased to 20% for those in the treatment arm with treatment (*60*). Patients with a MELD score of 25–39 had the best outcomes with corticosteroid therapy (*59*). Outcomes differed with the Lille score: patients with a score > 0.56 (1-month survival rate of 50%) had a poor outcome while those with a score of 0.16-0.56 had better survival (1-month survival rate of 79%) (*61*). The MELD score is better than the Maddrey score at predicting death post-LT in patients with AH. In addition, the MELD-Na score is not superior to the MELD score (*62*).

2.3.4. Long-term abstinence and relapse

AUD is a chronic disorder with remission and relapse. Sustained abstinence post-LT determines the outcome after LT. Several studies have shown that relapse rate was 10-25% within 2 to 3 years of LT (*55,63*). In patients with alcohol-associated cirrhosis who were abstinent for 6 months before LT, the rate was 25% (*61*). The rate of alcohol relapse was 22% in patients soon after LT while the rate of heavy alcohol relapse was 5%. The cumulative incidence of heavy alcohol consumption is reported to increase from 2% 1 year after LT to 29% after 10 years (*64*).

Instruments used to select patients for LT include the High-Risk Alcoholism Relapse (HRAR) scale and the Stanford Integrated Psychosocial Assessment for Transplant (*64,65*). They consist of items regarding psychosocial stability, psychosocial assessment, social support, abuse of other substances, and motivation. Experts in addiction and transplantation need to be involved in pre- and post-transplant settings. Effective therapies for AUD are offered after LT (*66*). Multidisciplinary teams including addiction specialists can help patients with long-term abstinence.

3. Future directions in LT

3.1. More donor organs

The demand for organs far exceeds the supply. The consequence of this disparity in organ needs versus availability has resulted in the deaths of many patients on the waiting list. Increasing the number of available deceased donors by reducing the rate of organ discard is crucial to increasing donors as well as expanding living donor LT.

3.1.1. Machine perfusion of deceased donor organs

With the standard criteria, the graft survival rate is around 90% 1 year after LT. However, it decreases when using after circulatory death (DCD) grafts and grafts from donors with high-risk indices. Organ preservation was conventionally done with static cold storage, which slows graft metabolism without completely stopping metabolism. Greater attention is being paid to advances in machine perfusion for organ preservation that enhance organ utility and improve graft survival (*67*).

Techniques for liver graft preconditioning, oxygenation systems, and graft perfusion with hypothermic (HMP) or normothermic machine perfusion (NMP) have garnered attention. HMP can be divided, from the point of oxygen supplementation, into hypothermic oxygenated machine perfusion (HOPE) (delivery of an oxygenated perfusion solution only through the portal vein) or dual HOPE (delivery simultaneously through both the hepatic artery and portal vein).

An NMP system consists of a circuit and a perfusate (a priming solution and a maintenance infusion) (*68*). NMP systems can be maintained for several hours without oxygen carriers, but most perfusates include a carrier to provide oxygenation. Benefits of these techniques are that they enable assessment of graft viability through measurement of glucose, lactate, flavin mononucleotide, and pH (*69*), they lower the non-anastomotic biliary stricture risk of DCD grafts (*70*), and they remove lipids from steatotic grafts (*71*).

3.1.2. Xenografting

Xenotransplantation has a relatively long history (*72*), but only recently has the field made progress. Due to acceptable similarities in genetics, similarities in organ size, and rapid maturation, pigs have been ideal donors (*73*). Genetically engineered pig kidney and heart (*74*) grafts have been successfully used in non-human primates. In contrast, pig liver grafts are not satisfactory (survival of non-human primate < one month) (*75,76*). Heterotopic auxiliary transplantation of a six-gene-edited pig liver graft into a brain-dead recipient took place in 2025 (*77*). Hemodynamics, immune and inflammatory responses, and graft function were monitored for 10 days after LT. A patient with a massive HCC underwent heterotopic auxiliary transplantation of a ten-gene-edited pig liver graft but died due to xenotransplantation-associated thrombotic microangiopathy on day 171 (*78*).

CRISPR/Cas-9 allows genetic knock-outs of highly immunogenic epitopes and engineered knock-ins, thus enabling the expression of human transgenes regulating the complement regulatory proteins and the coagulation cascade. Donor viability has been maintained in pigs that received multiple gene knockouts and knock-ins (*79*). In xenotransplantation, ethical considerations and safety are major issues. The welfare of animal donors is important and the animals must be reared in highly monitored settings. The risk of zoonotic infections by retroviruses in particular is a concern. Protocols for screening, prevention, and risk mitigation of recipients of xenografts are mandatory (*80*).

3.2. Non-hepatocellular carcinoma malignancy

3.2.1. Peri-hilar cholangiocarcinoma (CCA)

Patients with peri-hilar CCA undergo neoadjuvant chemoradiotherapy. Protocols include those from Toronto, Mayo, and the University of Michigan (*81*). LT for peri-hilar CCA in line with the Mayo protocol had a satisfactory outcome, with a disease-free survival rate of 62% at 5 years (*82,83*).

A MELD score exception for peri-hilar CCA is offered by the United Network of Organ Sharing (UNOS). The recurrence-free survival rate at 5 years was 65% according to 12 transplantation centers in the US (n = 287) (*84*). A prior malignancy or falling outside the UNOS criteria (tumor diameter > 3 cm, metastatic lesions) indicated a poor prognosis. The cumulative incidence of drop-outs from the waiting list was 13% at 6 months and 24% at 12 months (rates for HCC were 7% and 13%) (*85*). Eight Italian centers (*86*) reported on 25 patients who received neoadjuvant radio-chemotherapy and who underwent LT from 1986 to 2021. Recurrence-free survival was 91% at 1 year, 61% at 3 years, and 47% at 5 years.

3.2.2. Intrahepatic CCA

Another primary liver malignancy that LT is indicated for is early-stage intrahepatic CCA (single tumor, less than 2 cm in size) that is unresectable due to poor liver functional reserve or the location of the tumor. A multicenter study (*83*) of 48 patients found that 31% had an early-stage tumor (single tumor, less than 2 cm in size). The recurrence rate in patients with early-stage CCA was 7% at 1 year, 18% at 3 years, and 18% at 5 years versus 30% at 1 year, 47% at 3 years, and 61% at 5 years for patients with tumors in other stages. The median follow-up was 35 months. The 5-year survival rate was 65% in patients with an early-stage tumor, which was higher than the rate in patients with tumors in other stages (45%, p = 0.02).

A French study (*87*) compared the survival of patients who had intrahepatic CCA < 5 cm and who underwent LT (n = 49) or liver partial resection (n = 26). Patients who underwent LT had a higher 5-year recurrence-free survival (75% *vs* 36%; p = 0.004). Another study (*4*) examines the outcomes of 18 patients with intrahepatic CCA who received neoadjuvant therapy and who underwent LT. The overall survival rate was 100% at 1 year, 71% at 3 years, and 57% at 5 years. The recurrence rate was 39%.

A therapeutic protocol for patients with unresectable CCA was developed by a US center, which included normal functional liver, no extrahepatic lesions or vascular involvement, and gemcitabine-based neoadjuvant chemotherapy with a minimum of 6 months of radiographic response or stability before listing (*88*). Of 12 patients eligible for LT, a total of 6 underwent LT. The median time from diagnosis of CCA to LT was 26 months. The overall survival was 100% at 1 year and 83.3% at 3 years. The recurrence-free survival at 3 years was 50%.

3.2.3. Neuroendocrine tumor (NET)

The UNOS guidelines for NET [89] include lymph node metastatic lesions turning negative confirmed by a positron emission tomography scan at least 6 months before listing, and a recurrence-free duration > 3 months. A UNOS data-based study (*90*) showed that the overall survival rate of patients undergoing LT (n = 184) at 5 years was 49%. Adoption of the MELD score improved outcomes. After its adoption, the overall survival rate was 85% at 1 year, 65% at 3 years, and 58% at 5 years.

The European Liver Transplant Registry (ELTR) found that 213 patients underwent LT for NET over a period of 27 years. Of those patients, 83% underwent resection of the tumor before LT. The tumors were synchronous in 119 patients. Of the total patients, 76% received nonoperative treatment including somatostatin analogues and trans-arterial chemoembolization. The overall survival rate was 81%, 65% and 52% at 1, 3, and 5 years, respectively, and the disease-free survival rate was 65%, 40% and 30%, respectively.

A study by the University of Göteborg (*91*) examined 15 patients who underwent LT (n = 10) or multi-visceral transplantation (n = 5). The 5-year overall survival rate was 90% and the 1-year recurrence-free survival rate was 70%.

Mazzaferro *et al*. (*92*) reported that patients who were within the Milan NET criteria and who underwent LT (n = 42) had a 5-year overall survival rate of 97% and a disease-free survival rate of 89%. Lim *et al*. (*93*) found that patients with NET who underwent LT had a 5-year overall survival rate ranging from 41 to 71%, which was similar to the rate for patients with other conditions undergoing LT. In contrast, the recurrence rate (31–57%) was much higher than that for patients with other conditions.

A Spanish multi-center study (*94*) included 91 patients with NET who underwent LT. Of those patients, 71 met the Milan criteria while 20 did not. The recurrence rate was 57% and overall mortality was 52%.

Five-year overall survival was 71% among patients meeting the Milan criteria and 58% among those who did not meet those criteria. The 5-year disease-free survival rate was 59% among patients meeting the Milan criteria and 36% among those who did not meet those criteria.

3.2.4. Colorectal liver metastasis (CRLM)

In the SECA-I study (*95*) in Norway, 21 patients who underwent LT were compared to 47 patients receiving chemotherapy. The 5-year survival rate of LT recipients was higher than the rate of patients receiving chemotherapy alone (56% and 9%, $p < 0.001$). In contrast, there were no significant differences between the two groups in terms of median disease-free survival (10 and 8 months, respectively). In the patients who underwent LT, a better prognosis was related to a short duration between diagnosis of the primary tumor and LT, a tumor small in size (< 5.5 cm), stable disease or tumor shrinkage in response to neoadjuvant therapy, and a serum carcinoembryonic antigen level < 80 mg/L.

Rajendran *et al*. (*96*) reported on the outcomes of LDLT for CRLM ($n = 7$). Six patients had received chemotherapy and two underwent partial liver resection before LDLT. The Oslo score was 0–2. The recurrence-free survival rate was 86% 1 year after LDLT and 69% 3 years afterwards. Favorable prognostic factors included a long duration from diagnosis of the primary tumor to LT (> 2 years), a tumor < 5.5 cm in size, a carcinoembryonic antigen level < 80 mg/L, and stable disease or shrinkage in response to neoadjuvant chemotherapy.

A North American multi-center study (*97*) examined 10 patients who underwent LDLT for CRLM (9 with synchronous lesions and 1 with metachronous lesions). Three patients had undergone partial liver resection and three had receive trans-hepatic arterial chemotherapy before LDLT. The overall survival rate was 100% and the recurrence-free survival rate was 62%.

A French multi-center study (*98*) examined the outcomes of LT for extensive colorectal liver metastases in both lobes. The overall survival rate at 5 years was 84%, the recurrence-free survival rate was 24%, and the time to surgical failure was 61%.

3.3. Robotic surgery for LT

Robotic liver surgery is now playing a more important role in LT. A stable camera platform, elimination of tremors, enhanced dexterity, and improved ergonomics enable complex liver procedures that require accurate tissue dissection and hemostasis (*99*). Robotic surgery is performed in LT at some centers around the world. Eligible patients are now limited to those with low MELD scores.

In 2023, the King Faisal Specialist Hospital in Saudi Arabia performed robotic donor and recipient hepatectomy and liver graft implantation in three cases (*100*). The candidates for robotic LT include recipients with a liver graft less than 900 g as well as an anticipated graft-to-recipient weight ratio of more than 0.80%. Khan *et al*. (*101*) subsequently reported robotic LT. A whole graft from a deceased donor was transplanted into a 62-year-old man with HCV and HCC. Lisbon and Modena University (*102*) performed robotic LT in six cases using a whole liver from deceased donors. Eligible patients included those with low MELD scores.

Laparoscopic techniques in LT have also been highlighted by recent innovations. Lee *et al*. (*103*) reported a patient who underwent total laparoscopic hepatectomy followed by robot-assisted graft implantation. The living donor right hemi-hepatectomy was performed laparoscopically. Laparoscopic LT was also performed (*104*). The right side donor hepatectomy and implantation were done laparoscopically.

Successful outcomes and a full recovery of graft function indicate the feasibility of combining robotic and/or laparoscopic LT for selected recipients.

4. Conclusions

Better perioperative care and advances in surgical techniques have allowed surgeons to use grafts with extended criteria. The field of LT will continue to evolve.

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