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## Editorial

## Liver transplantation and hepatobiliary surgery in 2020

## ARTICLE INFO

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The year 2020 had a rough start with a global pandemic, the new Coronavirus Disease (COVID-19). The impact was so severe for long-time that many elective surgeries were cancelled, and numerous transplants were postponed, unless truly life-saving. Despite these hurdles in our daily practice, more than 100 expert academic physicians and surgeons from 22 different countries joined forces to form a Special Issue in Liver Transplantation and Hepatobiliary Surgery. This collection of 30 comprehensive articles, summarize the current status of liver transplantation (LT) and hepatobiliary surgery today, and what limits are being pushed and pursued in the future. One important goal of this Special Issue is to emphasize the close relationship of LT and hepatobiliary surgery, and how innovations in both fields align with one another. This central principle is also mirrored by the fact that the collaboration for each article has been established under the umbrella of both the International Society of Liver Surgeons (ISLS), and the International Liver Transplantation Society (ILTS).

In order to highlight the geographic variability in recent LT practices around the globe, the current status of liver transplantation in Asia [1], North America [2], Latin America [3], and Europe [4] have been reviewed by international LT experts. With the aim to expand the donor pool due to the shortage of transplantable livers, LT using marginal donors (elderly livers, steatotic livers, donation after circulatory death [DCD] livers, split livers) was extensively summarized [5]. Ongoing debates in deceased donor LT (DDLT) were further discussed by experts with particular focus on limits for an acceptable DCD graft [6], domino LT [7], as well as the role of hypothermic [8] and normothermic machine perfusion [9]. The use of machine perfusion technology is enhancing DDLT practice, since liver grafts deemed non-transplantable due to fatty or marginal nature were rescued and successfully transplanted with assistance of machine perfusion.

Another important focus of the Special Issue is dedicated to use of LT and hepatobiliary surgery to treat primary and secondary liver malignancies. The Milan criteria are the most commonly established selection criteria for LT in patients with hepatocellular carcinoma (HCC). A group of experts highlighted where we stand and what pre-

dictors we have when we perform LT in HCC patients beyond Milan Criteria [10]. In this regard, emerging biomarkers in order to predict HCC outcomes have also been highlighted [11]. One of the challenging indications for LT, cholangiocarcinoma (CCA), and its multidisciplinary treatment with or without LT has been reviewed with current developments in the field [12]. When LT is not a possibility in CCA, recently emerging surgical approach ‘Associating liver partition and portal vein ligation (ALPPS)’ for staged hepatectomy procedure could be life-saving [13]. ALPPS has been mainly performed for colorectal liver metastasis, and results have been steadily improving with better knowledge in how to select patients and when to proceed with stage 2 surgery [14]. Another newly introduced and developing surgical approach is LT for colorectal liver cancer metastasis [15]. A few years ago, this concept was considered an absolute contraindication to LT. However, emerging data appear to show that acceptable results can be achieved in high-risk cancer recipients with LT, far superseding survival with non-surgical approaches [15]. Although it is still experimental, the RAPID concept (i.e. resection and partial liver segment 2–3 transplantation with delayed total hepatectomy) represents another surgical innovation unifying elements of partial LT and ALPPS surgery in order to expand the donor pool [16]. The RAPID concept will have a greater impact in living donor LT (LDLT) by increasing the safety in living donors and providing a sufficient liver volume despite the transplantation of segments 2–3. With improving medical management of chronic liver failure, and the shortage of transplantable liver grafts, many patients present late stage for LT with high MELD (Model for End-stage Liver Disease) score and chronic kidney disease. In fact, in the last decade the number of patients requiring combined liver-kidney transplant (CLKT) has been steadily increasing, now making 10% of all LTs in the United States [17]. Another staged surgical procedure ‘delayed kidney transplantation in CLKT – Indiana Approach’ and other recent developments in CLKTs have been comprehensively reviewed [17].

DDLT is more common than DDLT in Asia [1], and it has been increasingly performed in Turkey, Europe [4] and other parts of the world. However, many fine surgical techniques should be mastered, and

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**Abbreviations**

ALPPS	Associating liver partition and portal vein ligation
CCA	cholangiocarcinoma
CLKT	combined liver-kidney transplantation
DCD	donation after circulatory death

HCC	hepatocellular carcinoma
DDLT	deceased donor liver transplantation
LDLT	living donor liver transplantation
LT	liver transplantation
PVT	portal vein thrombosis

many hurdles should be overcome in LDLT. Some ongoing discussions, such as right lobe versus left lobe [18], and small-for-size setting [19] in LDLT have been reviewed. The Achilles heels of LDLT, biliary reconstructions and complications, have been also discussed with recent evidences [20]. Although LDLT should be extensively planned in the donor and recipient, there is an increasing evidence that it can be offered for acute liver failure patients in an urgent setting with acceptable results [21]. With expertise and surgical advancement in LDLT, minimally invasive donor hepatectomy has been offered more often in order to minimize morbidity in living donors [22].

Other challenging issues in both DDLT and LDLT recipients have been broadly covered with particular attention to current management of portal vein thrombosis (PVT) [23] and indications for multivisceral transplantation when PVT cannot be managed either radiologically or surgically [24]. Recent developments and challenges in hepatobiliary surgery have been also extensively reviewed with particular attention to extended liver surgery for gallbladder cancer [25], liver resections in cirrhotic patients [26], laparoscopic major liver resections [27] with laparoscopic postero-superior segment liver resections [28], robotic liver resections [29], and parenchyma sparing liver resections [30].

We, the guest editors, are proud to present top reviews from this global network of expert liver surgeons, making this Special Issue as one of the top references in liver transplantation and hepatobiliary surgery.

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**Declaration of competing interest**

None.

**References**

- [1] T. Hibi, A.K.W. Chei, A. Chan, P. Bhangui, Current status of liver transplantation in Asia, *Int. J. Surg.* (2020).
- [2] V. Kirchner, N. Goldaracena, G. Sapisochin, R. Hernandez-Alejandro, S.A. Shah, Current status of liver transplantation in North America, *Int. J. Surg.* (2020).
- [3] A. Contreras, L. McCormack, W. Andraus, E. Fernandes, Current status of liver transplantation in Latin America, *Int. J. Surg.* (2020).
- [4] P.C. Muller, G. Kabacam, E. Vibert, G. Germani, H. Petrowsky, Current status of liver transplantation in Europe, *Int. J. Surg.* (2020).
- [5] N. Goldaracena, J.M. Cullen, D.S. Kim, B. Ekser, K.J. Halazun, Expanding the donor pool for liver transplantation with marginal donors, *Int. J. Surg.* (2020).
- [6] C.A. Kubal, G. Roll, B. Ekser, P. Muiesan, Donation after circulatory death liver transplantation: what are the limits for an acceptable DCD graft? *Int. J. Surg.* (2020).
- [7] H.P. Marques, I. Barros, J. Li, S.D. Murad, F. Di Benedetto, Current update in domino liver transplantation, *Int. J. Surg.* (2020).
- [8] S. Karangwa, G. Panayotova, P. Dutkowski, R.J. Porte, J.V. Guarrera, A. Schlegel, The role of hypothermic machine perfusion in liver transplantation, *Int. J. Surg.* (2020).
- [9] P.N. Martins, J.E. Buchwals, H. Mergental, L. Vargas, C. Quintini, The role of normothermic machine perfusion in liver transplantation, *Int. J. Surg.* (2020).
- [10] K.J. Halazun, G. Sapisochin, D. von Ahrens, V. Agopian, P. Tabrizian, Predictors of outcome after liver transplantation for hepatocellular carcinoma beyond Milan criteria, *Int. J. Surg.* (2020).
- [11] H.P. Marques, S. Gomes da Silva, E. De Martin, V. Agopian, P.N. Martins, Emerging biomarkers in hepatocellular carcinoma patients: current status, *Int. J. Surg.* (2020).
- [12] G. Sapisochin, T. Ivanics, V. Subramanian, M.B. Doyle, J.K. Heimback, J.C. Hong, Multidisciplinary treatment for hilar and intrahepatic cholangiocarcinoma, *Int. J. Surg.* (2020).
- [13] D. Balci, Y. Sakamoto, J. Li, F. Di Benedetto, E.O. Kirimker, H. Petrowsky, Associating liver partition and portal vein ligation for staged hepatectomy procedure for cholangiocarcinoma, *Int. J. Surg.* (2020).
- [14] R. Hernandez-Alejandro, L.I. Ruffolo, R. Alikhanov, B. Bjornsson, O.J.M. Torres, A. Serrablo, Associating liver partition and portal vein ligation for staged hepatectomy procedure for colorectal liver metastasis, *Int. J. Surg.* (2020).
- [15] P.D. Line, L.I. Ruffolo, C. Toso, S. Deuland, S. Nadalin, R. Hernandez-Alejandro, Liver transplantation for colorectal cancer liver metastasis, *Int. J. Surg.* (2020).
- [16] S. Nadalin, U. Settmacher, F. Rauchfuss, D. Balci, A. Konigsrainer, P.D. Line, RAPID procedure for colorectal cancer liver metastasis, *Int. J. Surg.* (2020).
- [17] B. Ekser, A. Contreras, W. Andraus, T. Taner, Current status of combined liver-kidney transplantation, *Int. J. Surg.* (2020).
- [18] S. Yagi, A. Singhal, D.H. Jung, K. Hashimoto, Living-donor liver transplantation: right versus left lobe, *Int. J. Surg.* (2020).
- [19] T. Ikegami, D. Balci, D.H. Jung, J.M. Kim, C. Quintini, Living donor liver transplantation in small-for-size setting, *Int. J. Surg.* (2020).
- [20] D.H. Jung, T. Ikegami, D. Balci, P. Bhangui, Biliary reconstructions and complications in living donor liver transplantation, *Int. J. Surg.* (2020).
- [21] Y. Ogura, G. Kabacam, A. Singhal, D.B. Moon, The role of living donor liver transplantation acute liver failure, *Int. J. Surg.* (2020).
- [22] H.D. Cho, B. Samstein, S. Chaundry, K.H. Kim, Minimally invasive donor hepatectomy: systemic review, *Int. J. Surg.* (2020).

- [23] P. Bhangui, E. Fernandes, F. Di Benedetto, D.J. Joo, S. Nadalin, Current management of portal vein thrombosis in liver transplantation, *Int. J. Surg.* (2020).
- [24] A. Tekin, T. Beduschi, R. Vianna, R.S. Mangus, Multivisceral transplantation as the management of portal vein thrombosis in cirrhotic patients, *Int. J. Surg.* (2020).
- [25] O.J.M. Torres, R. Alikhanov, J. Li, A. Serrablo, A.C. Chan, E.S. Fernandes, Extended liver surgery for gallbladder cancer revisited: is there a role of hepatopancreato-duodenectomy? *Int. J. Surg.* (2020).
- [26] A. Chan, A.K. Chei, T. Hibi, F. Di Benedetto, A. Serrablo, Liver resection in cirrhotic liver: are there any limits? *Int. J. Surg.* (2020).
- [27] A.K.W. Chieh, A. Chan, F. Rotellar, K.H. Kim, Laparoscopic major liver resections: current standards, *Int. J. Surg.* (2020).
- [28] M. Abu Hilal, C. Tschour, C. Kummerli, M. Lesurtel, F. Rotellar, Laparoscopic posterior segmental liver resections: how I do it? Tips and pitfalls, *Int. J. Surg.* (2020).
- [29] F. Di Benedetto, H. Petrowsky, P. Magistri, K. Halazun, Robotic liver resection: hurdles and beyond, *Int. J. Surg.* (2020).
- [30] G. Torzilli, L. McCormack, T. Pawlik, Parenchyma sparing liver resection, *Int. J. Surg.* (2020).

Burcin Ekser\*

*Transplant Division, Department of Surgery, Indiana University School of Medicine, Indianapolis, IN, USA*  
E-mail address: [bekser@iupui.edu](mailto:bekser@iupui.edu).

Karim J. Halazun

*Department of Surgery, Division of Liver Transplantation and Hepatobiliary Surgery, Weill Cornell Medical College, New York, NY, USA*

Henrik Petrowsky

*Swiss HPB and Transplantation Center, Department of Surgery and Transplantation, University Hospital Zurich, Zurich, Switzerland*

Deniz Balci

*Department of Surgery and Liver Transplantation Unit, Ankara University School of Medicine, Ankara, Turkey*

\* Corresponding author.