



Original Research

Can Split Liver Transplantation be a Solution for Organ Shortage in Türkiye?

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Abstract

Objectives: First split liver transplantation (SLT) which was performed by Rudolph Pichlmayr in 1988, a great hope has arisen to reduce organ shortage. Split liver transplantation is a challenging procedure. Increased perioperative complications and allocation of the split organ affect the results. Selection of both a suitable donor and an appropriate recipient is essential to achieve successful results. We aim to review SLT outcomes performed at our center.

Methods: We have performed 3611 liver transplantations between February 2007 and May 2023. During this period 75 split livers were transplanted. We retrospectively analyzed the 75 split liver transplanted patients data and recorded the age, gender, the reason for liver transplantation, and the survivals.

Results: There were 75 patients. The median age was 12 (0-64). The main reason for liver transplantation was fulminant hepatic failure (47 %, n=35) The 5-year overall survival rate before 2016 was 33 % (n=69). After 2016, the 5-year overall survival rate was 67 % (n=6).

Conclusion: The splittable deceased organ number in our country is extremely low, so SLT will not be a solution for organ shortage in Türkiye. We believe that successful outcomes can only be achieved by performing an in situ split in the same center.

Keywords: Split, insitu, liver transplantation

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After the first split liver transplantation (SLT) which was performed by Rudolph Pichlmayr in 1988, great hope has arisen to reduce organ shortage in the transplant community.^[1] He has split a single cadaveric donor graft for a child and an adult. Same year Henry Bismuth performed full right and left SLTs for two adults.^[2] Data published since this date have shown that SLT increases biliary and vascular complications compared to whole liver transplantation (WLT) but does not change overall graft and patient sur-

vival.^[3] Although these efforts have the aim to increase the number of grafts needed to reduce waiting list mortality, it is a challenging procedure. Probably a good whole graft is converted into two marginal grafts which requires technical experience. Increased perioperative complications, the allocation, and the logistics of the split organ also affect the results. Selection of both a suitable donor and an appropriate recipient is essential to achieve successful results. We aim to review SLT outcomes performed at our center.

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Methods

Patient Selection

We have performed 3611 liver transplantations between February 2007 and May 2023. There were 500 deceased donor liver transplantations in the same time frame. During this period 75 split livers were transplanted.

Study Design

We retrospectively analyzed the 75 split liver transplanted patients data and recorded the age, gender, the reason for liver transplantation, and the survivals.

Statistical Analysis

Continuous (quantitative) variables were expressed as Median (range), and Mean \pm SD. Categorical (qualitative) variables were expressed as numbers and percentages. Kaplan-Meier survival estimate was used to determine the overall survival and disease-free survival of the patients.

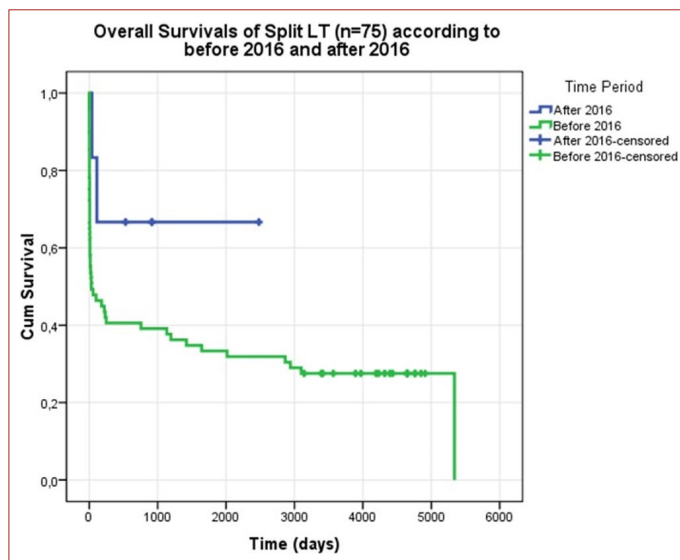


Figure 1. Overall survival of split LT.

Table 1. Demographic features and reason for liver transplantations

Parameters	n (%)
Age distribution, years (median)	0-64 (12)
Male/Female	36/39
Fulminant hepatic failure	35 (47)
Cryptogenic cirrhosis	13 (17)
Viral hepatitis	9 (12)
HCC	4 (0.5)
Biliary atresia	3 (0.4)
Alcoholic cirrhosis	2 (0.2)
Other reasons	9 (12)

The follow-up period was defined as the interval between LT until the date of the last visit to the outpatient department for living patients or until the date of death of the patient. Statistical tests were considered significant when the corresponding p-value was less than 5%. All statistical analyses are performed using Statistical Package for Social Sciences software version 25 (SPSS v25) (IBM, USA).

Results

There were 75 patients, 39 of them were female and the median age was 12 (0-64). The main reason for liver transplantation was fulminant hepatic failure (47 %, n=35). There were 44 pediatric and 31 adult patients. We lost 53 patients (30 pediatric and 23 adult) during the study period. Hospital mortality (< 90 days) was 50,6%. The 5-year overall survival rate before 2016 was 33 % (n=69). After 2016, the 5-year overall survival rate was 67 % (n=6) (Fig. 1).

Discussion

SLT can either be performed in situ or ex-situ (Fig. 2). Since Rogiers X. et al first described in situ liver splitting, published data has shown that the in situ splitting technique has some advantages over the ex-situ procedure.^[4] These advantages are shorter cold ischemia time, better exposure of the transection line, bleeding control, and prevention of bile leakage from the cut surface during the in situ splitting

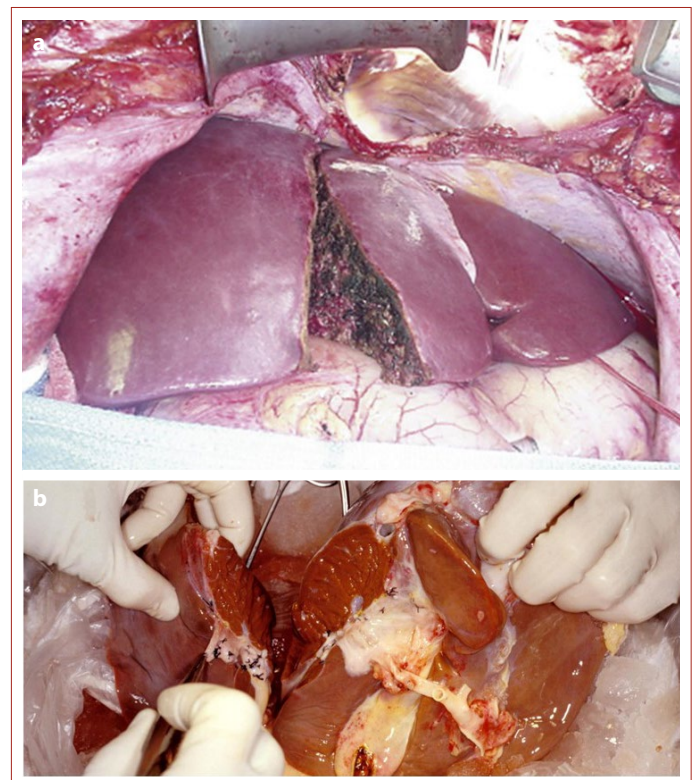


Figure 2. In situ (a) and Ex situ (b) splitting of the liver.

technique. Besides there are some disadvantages of in situ splitting such as longer procurement times (which is not suitable for unstable donors) and a lack of experienced surgeons in donor hospitals.^[5] In an analysis by the European Liver Transplant Registry (ELTR), 221 in situ and 159 ex situ SLTs were evaluated. Median cold ischemia time was found to be significantly longer in ex-situ split. (9.3h vs 7.2h) Ex situ split was found to be associated with early graft failure and this was attributed to prolonged cold ischemia.^[6] We believe that centers that perform living donor liver transplantations can easily achieve successful outcomes with in situ SLTs.

It is important to select a suitable donor for splitting. Ideal donors for splitting should have young age (<40 y), normal body weight (50-90 kg), length of stay in intensive care unit less than 5 days, no signs of sepsis, minimally impaired liver function tests (<2-3× normal), macrovesicular steatosis below 10% and low or no inotropic support.^[7]

We know that SLT reduces waitlist mortality in pediatric recipients.^[8] Meta-analyses have shown that SLT in adult patients increases biliary and vascular complications compared to WLT, but does not change overall graft and patient survival.^[9] However appropriate recipient selection is a key factor to achieve successful outcomes. MELD score-based allocation system may restrict the widespread use of SLT. A split graft may not be suitable for potential recipients with high MELD scores. Prolonged cold ischemia time, perioperative biliary and vascular complications, and relatively small grafts may be associated with primary nonfunction and posttransplant graft loss for patients with high MELD scores. Even emergent liver transplantation and retransplantation may not be suitable for SLT.^[10] Consequently, we believe that split liver transplantation may be more suitable for recipients with tumor or metabolic disease etiology, low MELD score, and without portal hypertension.

It is impossible to achieve better outcomes for ex-situ SLT in countries like ours with low deceased donation rates because none of these deceased organs meet the criteria for splitting. After 2016, we became very selective about performing SLTs. We became selective not only for donors but also tried to choose the appropriate patient for split grafts. We did not perform ex-situ splitting after 2016. We have performed in situ SLTs for only six patients. Thus, we achieved 67% 5-year overall survival rates in our series.

There are some limitations of our study. We did not meet all the splitting criteria both for donors and patients before 2016. Besides we can not reach all the data about the donors and grafts that we had split before 2016 for further investigation, because these donors and grafts were accepted from different centers.

Conclusion

We think that the splittable deceased organ number in our country is extremely low, so SLT will not be a solution for organ shortage in Türkiye. We believe that successful outcomes can only be achieved by performing an in situ split in the same center where the deceased organ came from.

Disclosures

Ethics Committee Approval: This study was approved by T.C. İnönü University Scientific Research and Publication Ethics Committee (Date: 26.12.2023, Number: 2023/5400).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept: F.O., S.Y.; Design: F.O., V.I.; Supervision: S.Y.; Data Collection: F.O.; Analysis and interpretation: V.I.; Writing: F.O.; Critical review: S.Y.

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