Risk of Reoperation Within 90 Days of Liver Transplantation: A Necessary Evil?

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BACKGROUND: The rate and consequences of reoperation after liver transplantation (LT) are unknown in the United States.

STUDY DESIGN: Adult patients (n = 10,295; 45% of all LT) undergoing LT from 2009 through 2012 were examined using a linkage of the University HealthSystem Consortium and Scientific Registry of Transplant Recipients databases providing recipient, donor, center, hospitalization, and survival details. Median follow-up was 2 years. Reoperations were identified within 90 days after LT.

RESULTS: Overall 90-day reoperation rate after LT was 29.3%. Risk factors for 90-day reoperation included recipients with a history of hemodialysis, severely ill functional status, government insurance, increasing Model for End-Stage Liver Disease score, and increasing donor risk index. Reoperation within 90 days was found to be an independent predictor of adjusted 1-year mortality (odds ratio = 1.8; 95% CI, 1.5−2.1), as was government-provided insurance and increasing donor risk index. Additionally, patients undergoing delayed reoperative intervention (after 30 days) were found to have increased risk of 1-year mortality compared with those undergoing early reoperative intervention (odds ratio = 1.96; 95% CI, 1.4−2.7; $p < 0.01$).

CONCLUSIONS: This is the first national study reporting that nearly one-third of transplant recipients undergo reoperation within 90 days of LT. Although necessary at times, reoperation is associated with increased risk of death at 1 year; however, it appears that the timing of these interventions can be critical, due to the type of intervention required. Early reoperative intervention does not appear to influence long-term outcomes, and delayed intervention (after 30 days) is strongly associated with decreased survival. (J Am Coll Surg 2016;222:419−428. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Liver transplantation (LT) remains the only curative intervention for patients with end-stage liver disease. However, due to operative complexity and a substantially debilitated patient population, complications after LT are common and expected.[1] The most frequently encountered complications are hemorrhage, hepatic artery thrombosis, hepatic vein stenosis or outlet obstruction, biliary leak or stricture, sepsis, and immunologic rejection.[2] Such complications range from minor events that require no intervention to severe complications that require operative intervention. Most reoperative complications in LT recipients are a direct result of surgery. Postoperative hemorrhage, which is the most common complication, requires reoperative intervention in 8% to 27% of patients.[3-6] When any reoperative intervention related to the initial transplantation is considered, reoperation rates increase to 29% to 44%.[5-7] DiNorcia and colleagues[6] reported significantly inferior 1-, 3-, and 5-year patient and graft survival rates in those patients undergoing relaparotomy within 30 days of LT; however, no data exist to define the risk associated with reoperation not limited to relaparotomy. Many surgical procedures after LT are not directly related to the index transplantation procedure,

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Abbreviations and Acronyms

LT = liver transplantation
MELD = Model for End-Stage Liver Disease
SRTR = Scientific Registry of Transplant Recipients
UHC = University HealthSystem Consortium

but are due to additional factors, such as a prolonged hospital stay, severely debilitated state before transplantation, patient comorbidities, and infection. One single-center study from the pre-Model for End-Stage Liver Disease (MELD) score era evaluated a more comprehensive rate of reoperative interventions after LT and reported a reoperation rate of 43%, with 48% of those due to "other" complications not related to vascular, biliary, bowel, or septic complications.[7]

All previous data on reoperations after LT have been limited to single-institution case series. Therefore, we used a national cohort to identify a comprehensive 90-day reoperation rate and to identify predictors for reoperation and 1-year mortality. Additionally, we aimed to evaluate whether the timing of reoperations is important in determining risk of 1-year mortality.

METHODS

Study population

A retrospective cohort study was performed for LT recipients transplanted in the United States between January 1, 2009 and December 31, 2012. Data for this analysis were acquired from 2 separate sources. First, clinical data for recipient and donor characteristics were obtained from the Scientific Registry of Transplant Recipients (SRTR) Standard Analysis File. These data were then linked to recipient clinical and hospital encounter-specific data obtained from the University HealthSystem Consortium (UHC) Clinical Data Base/Resource Manager. The UHC is an alliance of 118 academic medical centers and 298 of their affiliated hospitals representing approximately 95% of the nation's major not-for-profit academic medical centers. The clinical data base/resource manager is an administrative database wherein patient demographic, financial, ICD-9 diagnosis, and procedure data are provided by the member medical centers. Hospital charges are reported for each patient encounter and are converted to cost estimates using institution-specific Medicare cost-to-charge ratios, and federally reported area wage indexes are used to normalize regional variation in labor cost.[8-10] All costs were adjusted to 2012 dollars using the overall Consumer Price Index to account for inflation, as described previously.[11]

From January 2009 to December 2012, there were 23,016 LTs from 131 centers identified from the SRTR database. During the same time period, 14,907 LTs from 67 centers were identified from the UHC clinical data base/resource manager database.[12,13] A linkage of patients within the 2 datasets was performed using recipient age, procedure date, sex, and transplantation center. If patients did not match on all 4 variables they were excluded. Recipients aged younger than 18 years (n = 829) were excluded from this dataset before linkage. The final matched cohort consisted of 10,295 LT recipients from 62 transplantation centers representing 44.7% of the LTs performed nationally during the 4-year period. This dataset was found to be similar to the overall SRTR LT cohort with regard to donor and recipient characteristics as well as liver disease etiology, severity of disease, and survival after LT. Through the linkage of these 2 independent datasets, we were able to assess transplant-specific outcomes, including patient and graft survival and hospital-level outcomes, including 30-day readmission, discharge disposition, length of stay, reoperative intervention, and cost of index admission.

Reoperation was defined as any operative procedure occurring within 90 days of index transplantation at the index transplantation center based on procedure date. Reoperations that occurred at another center were not captured. Exclusion criteria included procedures clearly unrelated to transplantation admission, such as cosmetic procedures, selected general surgery, orthopaedic, ocular, otology procedures, and others. Procedures such as gastrostomy tube placement and tracheostomy were included because they were necessary for patient care after LT. A total of 284 ICD-9 operative procedure codes were included in this analysis. Reoperative procedures were organized into 12 groupings based on organ system and used in subanalysis of this reoperative cohort. Only procedures that required return to the operating room were included. These groupings included hepatic (any operative procedure related to the liver, excluding transplantation), retransplantation (liver only or combined liver-kidney or liver-pancreas), biliary, vascular, bowel (any operative procedure involving the gastrointestinal tract, excluding feeding access), respiratory tract (any operative procedure involving the respiratory tree, excluding tracheostomy), tracheostomy, feeding access, cardiac, amputation, other laparotomy, and other nonlaparotomy. It should be noted that procedures included within the "vascular" grouping were varied and consisted of those procedures related to control of hemorrhage as well as stent placement, fistula creation, and vascular repair.

Subanalyses were performed comparing the timing of operative interventions by placing the reoperation cohort