Preemptive Thoracic Drainage to Eradicate Postoperative Pulmonary Complications after Living Donor Liver Transplantation

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BACKGROUND: Thoracic fluid retention after living donor liver transplantation (LDLT) has various negative consequences, including atelectasis, pneumonia, and respiratory distress or failure.

STUDY DESIGN: We analyzed the clinical impact of preemptive thoracic drainage in 177 patients undergoing adult-to-adult LDLT for chronic liver diseases at a single center. Recipients were divided into 2 time periods. The earlier cohort (n = 120) was analyzed for risk factors for postoperative atelectasis retrospectively; the later cohort (n = 57), with a risk factor for postoperative atelectasis, underwent preemptive thoracic drainage prospectively. The incidence of postoperative pulmonary complications was compared between these 2 cohorts.

RESULTS: Independent risk factors for atelectasis in earlier cohort were body mass index $\geq$27 kg/m^2 ($p < 0.001$), performance status $\geq$3 ($p = 0.003$) and model for end-stage liver disease score $\geq$23 ($p = 0.005$). The rates of atelectasis (21.1% vs 42.5%, $p = 0.005$) and pneumonia (1.8% vs 10.0%, $p = 0.049$) were significantly lower in later than in earlier cohort. Moreover, the mean durations of ICU stay (3.6 $\pm$ 0.2 days vs 5.7 $\pm$ 0.6 days, $p = 0.038$) and postoperative oxygen support (5.1 $\pm$ 0.8 days vs 7.1 $\pm$ 0.5 days, $p = 0.037$) were significantly shorter in the later than in the earlier cohort. There were no significant differences in the incidence of adverse events associated with thoracic drainages between these 2 cohorts.

CONCLUSIONS: Preemptive thoracic drainage for transplant recipients at high risk of postoperative atelectasis could decrease morbidities after LDLT. (J Am Coll Surg 2014;219:1134−1142. © 2014 by the American College of Surgeons)

Owing to poor preoperative clinical conditions, the extensive surgical field, long operating times, and massive blood loss and blood transfusions, liver transplant recipients are susceptible to postoperative pulmonary complications.[1-3] The most frequent are immediate postoperative pulmonary complications, including pleural effusions and atelectasis.[1,2,4] However, infectious complications, which often complicate the former, are much more serious and are responsible for a significant part of the mortality.[3,5-7]

Atelectasis is an important predisposing factor for postoperative pneumonia.[8-10] In general, if a pulmonary segment remains atelectatic for longer than 72 hours, pneumonia is almost certain to develop.[11] Thoracic fluid retention increases the risk of atelectasis by compressing the lungs.[10,12] Postoperative thoracic fluid retention will usually clear with diuresis, but this process may take a considerable period of time.[13] Moreover, postoperative fluid control is difficult after living donor liver transplantation (LDLT) owing to the small graft volume.[14] Therefore, thoracic drainage of pleural effusions may be effective in preventing postoperative atelectasis after LDLT.

This study was designed to evaluate the impact of preemptive thoracic drainage on LDLT recipients at risk for postoperative atelectasis. Additionally, the clinical impact of and risk factors for postoperative atelectasis were analyzed.

METHODS

Patients

Between January 2008 and December 2013, 177 consecutive adult-to-adult LDLTs for chronic liver diseases were

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Abbreviations and Acronyms

AUC = area under the curve
DDLT = deceased donor liver transplantation
FiO_2 = fraction of inspired O_2
LDLT = living donor liver transplantation
MELD = Model for End-stage Liver Disease
OR = odds ratio
PaO_2 = partial pressure of arterial O_2
POD = postoperative day

performed at Kyushu University Hospital. All operations were performed after obtaining informed consent from the patients and approval from the Liver Transplantation Committee of Kyushu University.

Groups and study design

Risk factors for and clinical impact of postoperative atelectasis

The 177 recipients were divided into 2 groups based on the therapeutic strategy for postoperative pleural effusion adopted at Kyushu University Hospital. The earlier cohort, consisting of 120 LDLT recipients, underwent thoracic drainage when refractory pleural effusion occurred. The later cohort, consisting of 57 recipients, underwent preemptive thoracic drainage if they had at least 1 risk factor for postoperative atelectasis (Fig. 1). Recipients with preoperative pleural effusions of grade ≥ 2[1] underwent preemptive thoracic drainage during both time periods. Thoracic drainage was performed by inserting a thoracic tube under mini-thoracotomy.

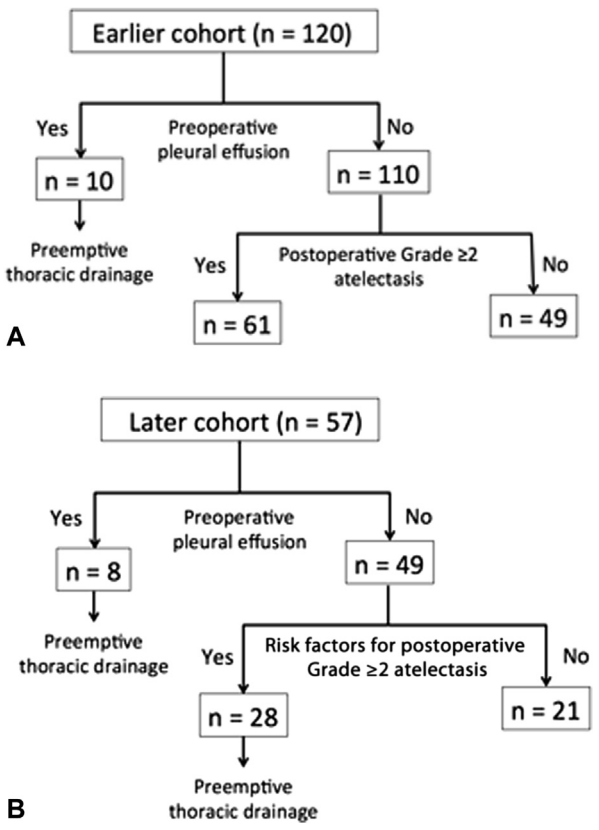

Figure 1. Schematic presentation of the 2 recipient groups of living donor liver transplant recipients. (A) Earlier cohort; (B) later cohort.

Risk factors for and the clinical sequelae of grade ≥ 2 postoperative atelectasis were examined retrospectively in the earlier cohort. Of these 120 patients, 10 had grade ≥ 2 preoperative pleural effusion; these 10 patients were excluded from analysis of risk factors and clinical effects of postoperative pleural effusion.

Validation of preemptive drainage

The incidence of postoperative pulmonary complications was compared in the 2 cohorts to validate our policy of preemptive thoracic drainage in the later cohort. Subgroup analysis was performed to assess characteristics that influenced between-group differences in clinical outcomes. Patients in each cohort were divided into 3 subgroups: those with preoperative pleural effusion, and those with and without risk factors for postoperative atelectasis. Performance status was determined using the Eastern Cooperative Oncology Group performance status scale.[15]

Preemptive thoracic drainage

Between January 2008 and April 2012, only recipients with pleural effusions of grade ≥ 2, detectable before LDLT, underwent preemptive thoracic drainage. Since May 2012, however, preemptive thoracic drainage has been performed in patients with a risk factor for postoperative atelectasis grade ≥ 2, as well as in patients with preoperative pleural effusions. All thoracic drainages in both cohorts were performed under mini-thoracotomy, in which we coagulated and divided intercostal muscles and parietal pleura along the superior edge of the rib using an electric scalpel to prevent unexpected bleeding (Supplementary video, online only). A 12-Fr catheter (Covidien Japan) was placed bilaterally under sterile aseptic conditions, with full barrier precautions. The tubes were placed in the anterior axillary line, and the catheter was attached to a closed drainage system with -10 cm water pressure suction. Chest radiography was performed after the procedure. Thoracic tubes remained in place until fluid removal over 24 hours was less than 100 mL.

Graft selection criteria and surgical procedures

The graft selection criteria for adult-to-adult LDLT[16] and the surgical procedures in both donors and recipients[17]