



Clinical feasibility of modified extended left hemihepatectomy in advanced perihilar cholangiocarcinoma

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Curative resection is undoubtedly the most important prognostic factor in perihilar cholangiocarcinoma (1). The current consensus of surgical resection of perihilar cholangiocarcinoma consists of hemihepatectomy, including caudate lobectomy and aggressive lymphadenectomy, depending on the extent of bile duct invasion. Critical decisions on whether to resect the right or left liver and whether to perform an extended hepatectomy or trisectionectomy are all aimed at obtaining negative radial and longitudinal margins (2,3). Most surgeons tend to focus on retaining a longitudinal bile duct resection margin in advanced hilar cholangiocarcinoma due to its technical challenges. However, liver transection margin (LTM) is also an important prognostic factor that should be further emphasized (4). The authors focused on the prognostic efficacy with particular consideration for LTM of extended left hemihepatectomy (LH) in advanced hilar cholangiocarcinoma (5).

The biggest strength of this study is that they obtained a sufficient margin of 9 mm through a small additional liver resection in the extended LH group (5). Although the proportion of positive LTM and radial margin did not show statistical differences between the groups, an additional 6 mm of LTM at the expense of partial hepatic congestion is an impressive result. Nevertheless, the surgical technique

of extended LH introduced in this study could be hard to standardize. The authors defined extended LH as an LH with *en bloc* resection of middle hepatic vein (MHV) and left parts of segments 5 and 8. During the conventional LH, the liver transection plane is determined according to the ischemic color change of the liver surface after dividing the left hepatic artery and portal vein. However, when we transected the right liver according to the line 1 to 2 cm away from the Rex-Cantlie line described in the manuscript and *Fig. 1*, we could inevitably encounter much more vascular branches in the transection plane compared to the conventional LH; it could induce prolonged parenchymal transection time and more intraoperative bleeding. Since the epicenter of perihilar cholangiocarcinoma is located in the hilum, preserving segment 8 with V8, which drains segment 8 to the MHV, could be suggested even in case of liver invasion. Preserving segment 8 in extended LH is expected to reduce the extent of hepatic congestion without affecting the LTM. The results show that patients undergoing extended LH recovered well despite hepatic congestion in the early postoperative period without 90-day mortality. The authors' extensive experiences have led to these excellent surgical outcomes (6). However, considering that partial congestion could have deleterious effects on hepatic functional recovery and volumetric regeneration (7,8)

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and more than one-quarter of patients are over 75 years of age, preserving segment 8 could contribute to minimizing hepatic congestion in the remaining liver.

The risk factor analysis for positive LTM according to the radiologic tumor stage in this study is constructive and helpful in deciding whether to perform the extended LH. Perihilar cholangiocarcinoma is often diagnosed as an advanced stage in which the tumor is not confined to the bile duct but invades the adjacent liver, portal vein, and hepatic artery (9). Portal vein invasion and tumor diameter longer than 18 mm were significant risk factors for positive LTM in patients with Bismuth type III or above. However, the complex anatomical relationship of the various structures in the hepatic hilum makes it difficult to determine the accurate extent of the tumor before the operation (10). When confined to advanced tumors, obtaining enough LTM is often difficult with conventional LH because the distance between the tumor extending to the liver and the MHV is shorter than expected. It should be noted that LTM was positive in 24.4% of the conventional LH group, whereas no patients in extended LH experienced positive LTM; it is relatively higher than expected because extended LH was performed when a significant tumor invaded or approximated the MHV. Conversely, although the tumor was not close to the MHV in radiologic evaluation, the positive LTM rate in pathologic examination was significant in the conventional LH group. Therefore, we should actively consider extended LH in patients with advanced perihilar cholangiocarcinoma with vascular or liver parenchymal invasion (Blumgart T3 and/or Union for International Cancer Control T4).

In conclusion, the modified extended LH introduced in this study is an oncologically feasible approach to obtaining sufficient LTM for advanced perihilar cholangiocarcinoma. An advanced understanding of liver anatomy and improving meticulous surgical techniques could make it possible. However, extended LH should be carefully performed according to the tumor extent and surgeon's experience, considering it is more technically demanding and has the potential for surgical morbidity.

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