



High volume transplant experience is beneficial but not mandatory for the performance of complex liver resections

Reed Ayabe¹^, Jean-Nicolas Vauthey², Hop S. Tran Cao²

¹Department of Surgical Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; ²Hepato-Pancreato-Biliary Section, Department of Surgical Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA

Correspondence to: Hop S. Tran Cao. Hepato-Pancreato-Biliary Section, Department of Surgical Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA. Email: hstran@mdanderson.org.

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Liver resection plays a central role in the curative-intent treatment of both primary and metastatic liver tumors. While small, peripheral tumors can often be extirpated with non-anatomic limited resections, larger, centrally located lesions and certain histologies may require extended hepatectomies with biliary and/or vascular reconstruction. These complex liver resections constitute some of most challenging operations performed by hepatopancreatobiliary (HPB) surgeons. A classic example is extended hemihepatectomy with bile duct and caudate lobe resection for perihilar cholangiocarcinoma, which is associated with short-term mortality rates exceeding 15% in some series (1,2).

The optimal way to prepare HPB surgeons for the technical challenges of these operations is a matter of ongoing discussion. Chan *et al.* recently evaluated the association between liver transplant experience and perioperative outcomes after complex liver resection performed by 13 surgeons at the University of Hong Kong. Their study included a total of 222 operations, including 52 central hepatectomies, 60 extended hepatectomies with biliary reconstruction, 41 associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) procedures, 47 right hepatectomies with vascular reconstruction, and 22 combined hepato-pancreatoduodenectomies. The authors demonstrate an inverse association between the operating surgeon's transplant experience and complications, operating

time, and transfusion requirements during/after complex liver resections. Furthermore, surgeons who performed more than 100 liver transplants were more likely to take on complex liver resections without compromising short-term outcomes (3).

We congratulate the authors for their expertise in liver transplant and complex liver resection and for their manuscript's appropriate focus on the technical aspects of hepatobiliary surgery and short-term perioperative outcomes. While impossible to assign causation in a retrospective study such as this, it makes intuitive sense that the skills gained in transplant surgery are useful for resectional liver surgery. Techniques routinely used by transplant surgeons, such as hepatic vascular isolation, venovenous bypass, and biliary anastomosis lend themselves well to complex liver resections, particularly in the case of unexpected hemorrhage or extensive involvement of the biliary radicals. For this reason, many HPB fellowships, including our own, include a liver transplant experience (4,5).

Chan *et al.* propose that the training of future liver surgeons should include a 1–2-year transplant experience and that centralization of all complex liver operations to transplant centers should be considered. While we agree that a transplant experience is beneficial, we disagree with this broad recommendation. Many non-transplant HPB surgeons perform complex liver resections and achieve excellent outcomes. For example, all liver resections at our institution, including extended hepatectomies with biliary

^ ORCID: 0000-0001-8612-8272.

reconstruction, are performed by non-transplant HPB surgeons with low rates of perioperative complications and morbidity (6-9). Our experience, and that of other high-volume programs across the world, suggests that it is adequate exposure to these complex operations rather than to liver transplant per se that produces improved outcomes (10). In addition, precise intrahepatic dissection along the Walean sheaths and hepatic veins during parenchymal transection requires specific expertise in centers performing high volume resectional surgery. Major contributions of non-transplant surgeons to operative techniques (air leak test, two-surgeon technique, R1 dissection) resulting in improved outcomes (low transfusion rate, reduced organ space infection, parenchymal preservation) attest to the value of specialized expertise in resectional surgery (11-14).

There are multiple pathways to competency in complex liver resections. In North America, fellowships offered by the Americas Hepatopancreatobiliary Association (AHPBA), the American Society of Transplant Surgeons (ASTS), and Complex General Surgical Oncology (CGSO) all provide instruction and training in liver resection with varying degrees of exposure to liver transplant (5,15). While the optimal training paradigm remains a matter of debate, it is clear that HPB surgeons must be familiar with all of the surgical options available to their patients, as well as the systemic and liver-directed therapies provided in a multidisciplinary setting.

Liver transplant will undoubtedly continue to play a major role in the surgical treatment of liver tumors, both in providing resectional liver surgeons with an expanded toolkit and as a primary surgical treatment option, especially in the burgeoning era of transplant oncology. We congratulate Chan and colleagues for their study and look forward to their ongoing contributions to the fields of hepatopancreatobiliary surgery and transplant oncology.

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