



Difficult procedures, better outcomes

Davit L. Aghayan^{1,2,3^}, Airazat M. Kazaryan^{1,2,3,4,5,6,7^}, Åsmund Avdem Fretland^{1,3,8^}, Bjørn Edwin^{1,3,8^}

¹The Intervention Centre, Oslo University Hospital-Rikshospitalet, Oslo, Norway; ²Department of Surgery N1, Yerevan State Medical University after M. Heratsi, Yerevan, Armenia; ³Institute of Clinical Medicine, Medical Faculty, University of Oslo, Oslo, Norway; ⁴Department of Gastrointestinal and Pediatric Surgery, Oslo University Hospital-Ullevål, Oslo, Norway; ⁵Department of Surgery, Østfold Hospital Trust, Grålum, Norway; ⁶Department of Faculty Surgery N 2, I.M. Sechenov First Moscow State Medical University, Moscow, Russia; ⁷Department of Surgery, Fonna Hospital Trust, Odda, Norway; ⁸Department of HPB Surgery, Oslo University Hospital-Rikshospitalet, Oslo, Norway

Correspondence to: Davit L. Aghayan, MD, PhD. The Intervention Centre, Oslo University Hospital-Rikshospitalet, P.O. Box 4950 Nydalen, N-0424 Oslo, Norway; Department of Surgery N1, Yerevan State Medical University after M. Heratsi, Yerevan, Armenia; Institute of Clinical Medicine, Medical Faculty, University of Oslo, Oslo, Norway. Email: dr.aghayan@gmail.com.

Comment on: Ratti F, Cipriani F, Fiorentini G, *et al.* Have we really understood when the efforts of laparoscopic liver resection are justified?—a complexity-based appraisal of the differential benefit. *Hepatobiliary Surg Nutr* 2022;11:363-74.

Keywords: Liver resection; laparoscopic liver surgery; minimally invasive liver surgery; complex procedures

Submitted Jun 21, 2023. Accepted for publication Jul 02, 2023. Published online Jul 11, 2023.

doi: 10.21037/hbsn-23-302

View this article at: <https://dx.doi.org/10.21037/hbsn-23-302>

Despite the initial skepticism and challenges, minimally invasive liver surgery especially laparoscopic liver resections (LLR), has become a first-choice surgical treatment for various liver tumors in many specialized centers worldwide (1-3). It is a safe alternative to open surgery thanks to advantages such as reduced blood loss and complication rates, shorter hospital stay, and better quality of life (4-7). However, laparoscopy requires relatively long learning, and complex procedures are limited to high-volume expert centers (8).

We read with great interest a recently published article by Ratti and coauthors, where they assessed the differential benefit of LLR over open surgery according to technical complexity (9). The study is based on a single high-volume expert center's experience from San Raffaele Hospital in Milan, Italy (one of the pioneer centers in LLR). It includes data on 2,971 (1,939 open and 1,032 LLRs) procedures performed between 2004 and 2019. The whole study population (both open and LLR) was stratified into three groups (low-, intermediate-, and high-difficulty) according

to the technical complexity, which was determined using the Difficulty Scoring System developed for LLR by Ban and coauthors in 2014 (10). After that, propensity score matching was applied to compare open and LLR in each group, and it showed that laparoscopy was associated with significantly less blood loss, lower postoperative transfusion rate, lower postoperative complication rate, and shorter hospital stay in all three levels of technical difficulty.

Besides, the authors calculated the differential benefit of one technique over the other in the individual difficulty group and used intraoperative blood loss and postoperative 90-day morbidity as outcome indicators. Remarkably, it showed that LLR provided a greater advantage in terms of both blood loss and morbidity in high-difficulty procedures than in low- and intermediate-difficulty procedures.

As early adopters of LLR (from 1998), we support the findings provided by Ratti and coauthors; however, the readers should interpret these results cautiously. These results originate in a high-volume expert center with extensive experience in both laparoscopic and open liver

[^] ORCID: Davit L. Aghayan, 0000-0001-7051-3512; Airazat M. Kazaryan, 0000-0001-9960-0820; Åsmund Avdem Fretland, 0000-0002-0945-5189; Bjørn Edwin, 0000-0002-3137-6225.

surgery, an ideal situation for testing both techniques and cannot be applied in centers with less expertise. The surgeon's experience/learning curve as a variable included in the analyses might have helped to explain the advantages of LLR in high-difficulty procedures. Before starting with complex procedures, the surgeon must already have mastered low and intermediate-difficulty resections, which we believe is one of the possible explanations. A multicenter study comparing the practice and outcome of LLR between high-volume expert and nationwide low-to-medium volume centers reported significantly better perioperative outcomes in high-volume centers for the total cohort and in three levels of complexity when stratifying patients by the difficulty of procedures, and the difference was more pronounced for high-risk, complex procedures (8).

There are limitations also highlighted by the authors. The Ban Difficulty Scoring System was applied to stratify both open and laparoscopic procedures by complexity; however, one should be aware that this scoring system was developed for pure laparoscopic liver resections, and its employment in open liver resections implies some limitations. The authors justify this approach by normalizing the bias related to patient and tumor background via difficulty grouping, propensity score matching, and bootstrapping, although 3 (tumor location, extent of liver resection, tumor size) out of 5 parameters of the scoring system were also used in the propensity score matching. This, we believe, might increase the risk of excluding a number of important patients from the open surgery groups.

Despite the limitations above and the biases raised by the authors, the current study provides substantial evidence on LLRs and supports the further spread and implementation of this patient-friendly procedure.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Hepatobiliary Surgery and Nutrition*. The article did not undergo external peer review.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://hbsn.amegroups.com/article/view/10.21037/hbsn-23-302/coif>).

The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Cite this article as: Aghayan DL, Kazaryan AM, Fretland ÅÅ, Edwin B. Difficult procedures, better outcomes. *HepatoBiliary Surg Nutr* 2023;12(4):634-636. doi: 10.21037/hbsn-23-302