

Randomized controlled trials for robot-assisted vs laparoscopic liver surgery: a quest on timing and endpoints

Jony van Hilst^{a,b,*} and Rutger-Jan Swijnenburg^{a,b}

^aDepartment of Surgery, Amsterdam UMC, University of Amsterdam, Cancer Center Amsterdam, the Netherlands

^bCancer Center Amsterdam, the Netherlands



The introduction of robot-assisted surgery announced a new era in minimally invasive surgery. Possible advantages of robot-assisted surgery are 3D vision, enhancement of dexterity and improved ergonomics for the surgeon. Compared to laparoscopy, robot-assisted surgery also has some downsides: the availability of the console is often limited when shared with other disciplines and the technique is associated with higher costs. Therefore, hospitals and health care providers are demanding that the effectiveness of the robot should be studied to justify its use and to allocate this treatment to patients that benefit most. Studies comparing robot-assistance to laparoscopy are therefore warranted.

In recent years, the popularity of robot-assisted hepatectomy (RH) increased but studies comparing outcomes to laparoscopic hepatectomy (LH) remain scarce. A recent international multicenter propensity score matched study including over 10,000 patients showed less blood loss, a decrease in conversions and, improved postoperative outcomes after RH compared to LH.¹ Until recently, randomized controlled trials (RCT) comparing RH to LH were not available.

Fortunately, the ROC'N'ROLL trial is published in this issue of the *Lancet Regional Health—Europe*.² Birgin and colleagues from Ulm University Medical Center in Germany performed a single-centre, patient-blinded, superiority trial comparing RH to LH for liver malignancies in 80 patients (41 RH and 39 LH). Primary outcome of the trial is mean quality of life (QOL) measured by the role functioning scale of the EORTC QLQ-C30 questionnaire which showed to be comparable after RH and LH (mean [SD], 74.3 [23.3] vs 79.6 [22.3]; $p = 0.547$). The comprehensive complication index and other perioperative outcomes were also comparable between groups. Birgin and colleagues conclude that RH is a safe alternative to LH.

We applaud the efforts of the authors for performing this very first RCT comparing RH to LH. In general, RCTs comparing robot-assisted to laparoscopic surgery are scarce and therefore this trial is of great value. The study is performed in an experienced center and

patients and outcome assessors were blinded, which increases the quality. Furthermore, QOL is an under-reported outcome measure in surgical research and the use of this outcome is an important contribution.

But what are the implications of the ROC'N'ROLL trial? It is interesting that the benefits of RH shown in the previously mentioned non-randomized study are not reflected in this RCT. Annual volume and learning curve are considered important factors that can influence surgical outcome.³ Surgeons participating in the ROC'N'ROLL trial had to perform at least 50 minimally invasive hepatectomies annually (LH or RH) and a minimum of 25 RH in total. Case-splitting was allowed when two primary surgeons performed distinct resections during the same session. During the 1.5 year time frame of the trial, 80 patients received RH or LH by 3 surgeons. These numbers suggest that during the trial the annual surgeon volume was below the required 50, which could have influenced the outcomes. This lower annual volume might be caused by the 1:1 randomization ratio which results in a halving of the number of RH procedures during the trial. Therefore, even higher annual volumes are needed to maintain an adequate annual volume of the new technique. This effect of 1:1 randomization was also shown in the Dutch LEOPARD-2 trial where annual numbers of laparoscopic pancreatoduodenectomy decreased significantly which has possibly influenced the adverse outcome of this RCT.⁴ Moreover, the timing of a surgical RCT for a new intervention is deemed important, if the RCT is performed too early, the study outcome reflects the stage of development and learning curve instead of the actual therapeutic effect.⁵ As a consequence a possible advantage of robotic liver surgery is at that point not yet shown.

Although we affirm the importance of QOL as a patient-centered outcome measure, one could question if robot-assisted surgery will improve QOL when compared to laparoscopy. So far, no studies comparing QOL in RH and LH were published and the sample size of the ROC'N'ROLL trial was small and based on a difference in QOL after laparoscopic and open hepatectomy.⁶ Determining which outcome measure is most important when comparing robot to laparoscopy remains difficult. However, a primary outcome focused on complications, cost-effectiveness or survival would, in our opinion, have improved the relevance in this early phase of the implementation of RH.

In conclusion, the ROC'N'ROLL trial is the first to compare RH to LH for liver malignancies and showed

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*Corresponding author. Department of Surgery, Amsterdam UMC, University of Amsterdam, Cancer Center Amsterdam, the Netherlands.

E-mail address: j.vanhilst@amsterdamumc.nl (J. van Hilst).

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comparable outcomes for both groups. This trial is a valuable contribution in the debate between robot-assisted vs laparoscopic surgery. However, future studies should focus on safety outcomes, oncologic benefit and cost-effectiveness to be able to guide and justify the further implementation of robot-assisted hepatectomy.

Contributors

Jony van Hilst and Rutger-Jan Swijnenburg drafted the manuscript together and approved the final version. All authors are fully aware of this publication.

Declaration of interests

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