# Three-dimensional vision laparoscopy: hype or hope for gastric cancer surgery?

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Laparoscopic gastric cancer surgery has evolved from experimental techniques to commonly accepted procedures. This was mostly facilitated by the technological advances in various devices including energy sources, staplers, and optics, which have made the laparoscopic surgeries more efficacious and easier to perform. A method of three-dimensional (3D) laparoscopic visual systems have been developed to overcome the drawback of two-dimensional (2D) laparoscopy. The lack of stereoscopic vision causes visual misperceptions based on the loss of depth perception, thus the surgeons must invest substantial amount of time to overcome steep learning curve for laparoscopic surgery.

A 3D laparoscopic visual system was first introduced in the early 1990s, however this primitive device had several shortcomings such as the heavy eyewear (active shutter type) and the poor quality in the 3D imaging, which caused headaches, ocular fatigue, and dizziness (1). High purchase cost was another roadblock hampering the widespread use of 3D laparoscopy. Recently, these shortcomings were remarkably alleviated by the technological advances, and the 3D laparoscopic systems are now rapidly adopting to many institutions in Korea. The strong points of 3D vision are the perception of depth and spatial arousal, which may allow surgeons to reduce technical error, procedural time during laparoscopic suturing and knotting, and to improve safety of laparoscopic surgery consequently (2-5). To date, however, the results of the related studies have been contradictory and mostly limited to the dry lab experiments or preclinical studies: no randomized trial was performed to validate its efficacy in gastric cancer surgery.

Lu *et al.* (6) presented the first randomized controlled trial comparing the short-term of 3D laparoscopic surgery with the 2D laparoscopic surgery for patients with gastric cancer. All three surgeons from a single center, who had performed more than 100 cases of laparoscopy-assisted radical gastrectomy, participated in this trial, which ensuring surgeon expertise and removing the learning curve-stemmed bias. This study aimed to enroll 438 patients with early or locally advanced gastric cancer. The primary endpoint was the operation time, and secondary endpoints included not only the postoperative outcomes but also 3-year overall survival and disease-free survival. This study was registered to ClinicalTrials.gov (NCT02327481). In this study, the authors found that operation time, numbers of the harvested lymph nodes, complication rates, and the postoperative recovery course were not different between 2D and 3D groups. However, the mean blood loss was significantly larger in the 2D group (78 mL in 2D *vs.* 58 mL in 3D, P=0.047), and a trend of less intraperitoneal hemorrhage in the 3D group was observed (3.6% in 2D *vs.* 0% in 3D, P=0.064). These results imply that 3D laparoscopic system may be helpful to identify the vessels more accurately during gastric cancer surgery than conventional 2D laparoscopy.

Unfortunately, this study failed to prove the benefit of 3D laparoscopy on reducing operation time which was the primary endpoint of the trial. However, several interesting issues are raised by this work, including the reappraisal of benefit of robot surgical platform. There has long been debate that robotic surgery is little beneficial in gastric cancer surgery unlike other cancers. Many previous studies reported less blood loss as the most common benefit of robotic surgery for gastric cancer, compared to 2D laparoscopic surgery. Interestingly, Lu *et al.*'s study also showed similar results (6). Although which component of robotic surgical platform affected this surgical outcome has not yet been understood, the results of Lu *et al.*'s study implied that the 3D vision of robotic surgical platform was the key role to improve the surgical outcomes in gastric cancer surgery (7). From a cost-efficiency point of view, the 3D visual laparoscopic system may be a good alternative to the robotic surgical system, which can have the same clinical benefit while reducing operation time and cost.

Another important issue is whether the steep learning curve in laparoscopic gastric cancer surgery can be shortened by the 3D visual laparoscopic system. In the previous studies, about 40–60 patients for laparoscopic distal gastrectomy and about 100 patients for laparoscopic total gastrectomy are required to improved laparoscopic skills and surgical outcomes (8-10). In fact, these numbers are not small especially for the Western countries, where there are few high-volume centers that can achieve these learning curves in a year; thereby, the feasibility of the laparoscopic approach may be questioned due to the low incidence of gastric cancer and high numbers of learning curve. In this respect, the 3D visual laparoscopic system may be a solution to shorten learning curve. Surgeon may save the times to be accustomed to visual clues such as object interposition, relative instruments motion under laparoscopic view, and the size of anatomical structures as in the 2D laparoscopic surgery (11).

In summary, Lu *et al.* (6) have demonstrated, in the first randomized clinical trial in gastric cancer, that the 3D laparoscopic surgery was helpful to reduce intraoperative blood loss compared to 2D laparoscopy. This trial is expected to provide perspectives on role of the 3D visual laparoscopic system in gastric cancer surgery. Therefore, we await the final results and analysis of this study.

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