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EDITORIAL – GASTROINTESTINAL ONCOLOGY

Technology Beats the Current Standard: Is Robotic Gastrectomy Becoming the Standard Treatment Option for Gastric Cancer?

"Surgical Outcomes After Open, Laparoscopic, and Robotic Gastrectomy for Gastric Cancer," by Kim, Hyuong-Il, et al.

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Surgical resection remains the only curative treatment option for gastric cancer (GC), and regional lymphadenectomy is recommended as part of radical gastrectomy.[1] For advanced GC (AGC), D2 gastrectomy is recommended.[2] However, D2 lymphadenectomy, especially when combined with splenectomy or pancreaticosplenectomy, is reported to increase morbidity and mortality.[3–5]

Minimally invasive surgery (MIS), launched in the late 1980s, has been characterized by minimal access using a laparoscope with carbon dioxide (CO_2) insufflation.[6] Since the first report of conventional laparoscopic gastrectomy (LG) for GC by Kitano et al.[7] in 1994, it has been increasingly used because of its beneficial short-term effects compared with open gastrectomy (OG).[8]

The advantages of LG include better cosmetic outcomes, less pain, reduced blood loss, faster recovery, potential for decreased risk of wound infection and incisional hernia, and improved quality of life (QoL).[8,9] Although it has been assumed that both laparoscopically enhanced anatomy and improved hemostasis using pneumoperitoneal pressure may contribute to a reduction in early postoperative complications and improvement in long-term outcomes, such effects have not been clearly shown to date, at least partly due to the disadvantages of LG including a longer operation time, a technically more demanding nature, and a longer learning curve.[8–10] Therefore, LG, except for laparoscopic distal gastrectomy for clinical stage I disease, has been recognized as an investigational treatment even for early GC (EGC) but not as a standard treatment option.[2]

Robotics were applied to surgery in the 1970s as a military project endorsed by the National Aeronautics and Space Administration (NASA) and funded by the Defense Advanced Research Project Administration (DARPA), with the aim of replacing the surgeon's physical presence and providing care to astronauts in spacecrafts or to soldiers on battlefields.[9] Himpens et al.[11] reported the first successful clinical implementation of telepresence surgery in 1998 after these authors performed a laparoscopic cholecystectomy using a prototype of the da Vinci Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA, USA) in March 1997.

The da Vinci Surgical System not only provides surgeons with a three-dimensional, tenfold magnified view of the operating field, but also restores the natural hand–eye coordination axis as a result of the ergonomically designed surgeon's console, offers a high degree of freedom through its articulating surgical instruments, filters tremors of the surgeon, and scales motion.[9] As a result, this robotic system facilitates intuitive precise dissection in a confined surgical field with impressive dexterity.[9] Thus, in the field of gastric surgery, most laparoscopic surgeons have expected that the use of the da Vinci Surgical System may attenuate the technical difficulties of both D2 gastrectomy and LG, improving their safety and reproducibility, at least with preservation of long-term outcomes.[12,13]

However, the only large nonrandomized prospective study (NCT01309256), recently reported from Korea, demonstrated that the use of the da Vinci Surgical System,

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compared with LG, increased operative time and cost, whereas no difference in morbidity was observed, suggesting that the use of the da Vinci Surgical System might even deteriorate cost effectiveness.[14] In other words, the greatest problem with robotic gastrectomy (RG) is a lack of clear benefits with the robotic system, which would balance the longer operation time and higher cost.[14]

In the meantime, most of the enrolled patients in the aforementioned study had stage I disease, and the outcomes were considerably affected by the imbalance in each operating surgeon's experience with LG and RG. The possibility of selection bias, which may be caused by a more expensive copayment with RG, should also be considered.[14] Thus, the advantages of RG for AGC conducted by fully trained robotic surgeons have never been clarified.[9]

Recently, Yang et al.[15] at Yonsei University, one of the world's highest- volume centers for robotic surgery, have reported potential advantages of RG. In their study, a single surgeon (Professor Hyoung-Il Kim, the first author in reference 14) performed 241 OGs, 511 LGs, and 173 RGs.[15] Whereas OG was recommended for AGC, LG or RG was recommended for EGC.[15] In their study, RG was introduced only after surgeons had performed 35 OGs and 41 LGs, suggesting the well-balanced experience for the three approaches.[15] Robotic gastrectomy was associated with the lowest rate of surgical failure, defined as conversion to LG or OG, in-hospital major postoperative complications, readmission, margin involvement, or an inadequate number of retrieved lymph nodes.[15] Such good surgical outcomes after RG were observed with the robotic approach from the beginning of its use.[15]

According to our retrospective analyses, RG compared with LG (EGC vs. AGC: 57 vs. 43%) reduced morbidity down to one fifth, including postoperative pancreatic fistula, leading to further improvement in the short-term postoperative course.[12] In that study, a considerable number of patents in the RG (11.4%) and LG (10%) groups underwent total gastrectomy with D2 lymphadenectomy in combination with splenectomy or pancreaticosplenectomy.[12] Multivariate analyses clearly demonstrated that LG (nonuse of the surgical robot), total gastrectomy (vs. distal gastrectomy), and D2 lymphadenectomy (vs. D1+) were significant independent risk factors determining postoperative complications.[12] Moreover, the greater the extent of gastric resection and lymph node dissection, the more effective was the use of the robot.[12] The 3-year overall survival rate did not change between RG and LG.[13] These data suggest that the best indication for the use of the robot might be RG for AGC accompanied by D2 dissection.[12]

Since the beginning of October 2014, we have been conducting a multi-institutional single-arm prospective study to determine the impact that RG compared with LG used to treat resectable GC has on short-term outcomes, mainly focusing on postoperative complications, long-term outcomes, and cost [9,13] (UMIN 000015388). The specific hypothesis of this study is that the use of the robot for patients with stage I or II disease reduces morbidity (Clavien-Dindo Grade ≥IIIa) from 6.4% (historical LG) to 3.2% (prospective RG).[9,13] Patient enrollment of this study was completed in January 2017, and its short-term outcomes, which may open the door to medical insurance coverage of RG, will be released soon.

Technologic progress has always made a huge impact on medicine. We continue to pursue the possibility that further improvement in the robotic technologies combined with our best efforts to use these fully will change the standard treatment for AGC from OG to RG.

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