10.5005/jp-journals-10033-1315

REVIEW ARTICLE

Can Robotic Gastrectomy be considered as Gold Standard for Upcoming Surgeons? A Multi-institutional Comparative Review

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ABSTRACT

Surgical techniques have evolved tremendously over this past century. Minimally invasive surgery for gastric cancer is not a new research field, but still an important problem remains regarding the selection of the appropriate technique for a given gastric cancer case. Although evidence is limited, the use of the robotic surgery platform is far assessed as a feasible and safe procedure, which is also easier to learn as less than 10 cases of robotic surgery are needed to become proficient therein. This review will however cover in-depth review of retrospective reports, analyzing the pros and cons of robotic surgery and highlighting the remaining study questions.

Keywords: Gastrectomy, Gastric cancer surgery, Minimally invasive surgery, Robotic surgery.

How to cite this article: Singhal A, Garg S, Mishra RK, Chowhan JS. Can Robotic Gastrectomy be considered as Gold Standard for Upcoming Surgeons? A Multi-institutional Comparative Review. World J Lap Surg 2017;10(3):98-101.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Surgery is unanimously considered the mainstay curative treatment in gastric cancer. Technically, the possibilities range from open surgery to minimally invasive methods, such as laparoscopy or robotic surgery. Although minimally invasive surgery for gastric cancer has evolved rapidly, it has increased in popularity during the last two decades mainly in the Far East and for patients with early-stage tumors.[1,2] A number of trials and meta-analyses have confirmed that laparoscopic surgery for gastric cancer can improve short-term results and the patient's quality of life when compared with open surgery.[3-7] While in the Western world, development of laparoscopic gastrectomy (LG) has been very slow and is not yet considered an acceptable alternative to standard open surgery.[8] This skepticism is basically due to the technical complexity of LG and concerns about the feasibility of an oncologically acceptable lymphadenectomy. For these reasons, LG is considered one of the most difficult operations, requiring a long learning curve of about 40 to 50 cases.[9]

Robotic systems include operator-controlled three-dimensional cameras that ensure steady and effective surgical fields of view with motion scaling and tremor suppression, multiple degrees of freedom with instrument flexibility, and improved ergonomics.[10-13] It is believed that this technological evolution can assist the surgeon with complex surgical procedures that are required in radical gastrectomy, such as precise lymph node dissection and intracorporeal anastomoses.[4]

However, the number of robotic gastrectomies performed per year has been increasing, particularly in East Asia where the incidence of gastric cancer is high and approximately half of the cases are diagnosed as early gastric cancer. The use of the robotic platforms in general surgery did not enjoy the same success as it did in urologic surgery, and the field of gastric cancer is no exception. Robotic surgery till now has only proven its safety and feasibility in early gastric cancer.[11] The current challenge for robotic surgery in gastric cancer is to prove its effectiveness and benefit as a treatment option, ideally in the form of a survival advantage and steep learning curve as compared with open and conventional laparoscopic surgery.

MATERIALS AND METHODS

Literatures that published in English in years 2016 and 2017 were searched in PubMed and Knowledge Genie, using the search terms "robotic gastrectomy" (RG) and "gastric cancer" along with their synonyms or abbreviations. Then all titles, abstracts, or related citations were scanned and reviewed, and the references of each identified articles were also evaluated. Large-scale prospective cohort studies, retrospective case–control studies, and case series were also reviewed of which lastly five articles were selected for the review.

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Table 1: Summary of intraoperative outcomes in various studies

Intraoperative data	*Cianchi et al*[15]	*Parisi et al*[16]	*Hong et al*[17]	*Shen et al*[18]	*Kim et al*[19]
Operative time	RG > LG	RG > LG	RG > LG	RG > LG	RG > LG
Blood loss	RG < LG	RG < LG	RG < LG	RG = LG	RG < LG
Lymph nodes	RG > LG	RG > LG	RG = LG	RG > LG	RG = LG
Margin status	RG = LG	RG = LG	RG = LG	NA	NA
Surgeons ease	RG > LG	RG = LG	RG > LG	RG > LG	NA

NA: Not applicable

The data were extracted and critically appraised. Operative time, blood loss, number of harvested lymph nodes, proximal resection margin to assess the effectiveness of the procedures, and surgeons comfort to the type of procedure were extracted. The analgesic medication, first flatus day, first oral intake, and hospital stay were used to compare the postoperative recovery of the procedures. Lastly, the postoperative complications including wound infection, anastomotic leakage, anastomotic stenosis, postoperative ileus, pneumonia, pancreatitis, intra-abdominal abscess, and adhesive bowel obstruction wherever available were also compared.

RESULTS

Table 1 shows the description about the surgical performances of different surgeons and their intraoperative outcomes, suggesting that operative time taken in robotic surgery is definitely more than that taken in laparoscopic surgeries, and few studies which also included open surgery in their report did suggest the same that time taken in robotic surgery is significantly higher than that taken in an open laparoscopic surgeries.

While it was not same in respect to total blood loss which is definitely less in robotic group than in open or laparoscopic groups, even number of lymph nodes harvested in robotic group were more in most of the studies although not significantly but were never less than that harvested in laparoscopic or open groups. Margin status did not show any significant difference, but surgeon's ease in doing the surgery with robotic console was much more even though it required them to learn a newer technique.

Immediate postoperative results are also compared in Table 2[15-19] which included analgesic requirement, first flatus day, first oral intake, and hospital stay, and none of the following showed significant difference between robotic and laparoscopic groups although laparoscopy has already proven its significance in comparison with the open in all the fields. Similarly, in Table 3, postoperative complications were evaluated and there was no significant difference between the two groups.

Table 2: Summary of studies comparing the postoperative outcome of robotic and laparoscopic gastrectomy

Postoperative data	*Cianchi et al*[15]	*Parisi et al*[16]	*Hong et al*[17]	*Shen et al*[18]	*Kim et al*[19]
Analgesic	R = L	R > L	R = L	NA	NA
First flatus day	R = L	R < L	R = L	NA	NA
First oral intake	R = L	R = L	R = L	NA	NA
Hospital stay	R = L	R < L	R = L	R = L	R = L

R: Robotic; L: Laparoscopic; NA: Not applicable

DISCUSSION

The clinical efficacy and advantages of the laparoscopic technique in the treatment of gastric cancer have already been recognized[20] and indeed are associated with improved postoperative outcomes and oncological results.[3,4,21,22] However, LG has several drawbacks, such as limitation in the movement range of forceps coupled with the fulcrum effect, inherent tremor, and two-dimensional surgical view available to operating surgeons, and prolongs the learning curve especially for large-scale procedures, such as gastrectomy. Though recent technological advancements have facilitated this to some degree, still there have been serious shortcomings of the procedure.

Robotic gastrectomy may enable us to overcome these shortcomings. Using the da Vinci® Surgical System (Intuitive Surgical, Sunnyvale, California, USA), surgeons were

Table 3: Main complications reported using robotic and laparoscopic surgery

Complications	*Cianchi et al*[15]	*Parisi et al*[16]	*Hong et al*[17]	*Shen et al*[18]	*Kim et al*[19]
Wound infection	NA	R < L	R > L	R = L	R = L
Anastomotic leak	R < L	R = L	R = L	R = L	R = L
Anastomotic stenosis	NA	R < L	R < L	R = L	R = L
Ileus/obstruction	R > L	R < L	R = L	R = L	R = L
Pneumonia	NA	R > L	R < L	R = L	R = L
Pancreatitis	R < L	NA	NA	R = L	R = L
Abscess	NA	R = L	R = L	R = L	R = L

NA: Not applicable

able to attain a three-dimensional surgical view enabling depth perception, the EndoWrist® technology which allows for seven degrees of freedom, tremor suppression and filtration, and improved ergonomics.[10-13] Additionally, images can be enlarged enabling the performance of delicate steps, such as lymph node dissection along great vessels which are essential in achieving a D2 dissection, suturing, or knotting. These features could enable the performance of relatively complicated procedures, such as function-preserving gastrectomy or extended resections for advanced gastric cancer using a minimally invasive method.[23]

Encouraging results are being published using the robotic technique, but the lack of homogeneous study groups in terms of staging, comorbidities, and adjuvant and neoadjuvant therapies makes it hard to establish a clear indication for RG in gastric cancer. Carefully weighing the treatment options is especially important since there are more and more groups publishing acceptable results with the robotic technique.

Nonetheless, there are a series of shortcomings of the robotic platform explaining this situation. First of all, the lack of robotic staplers and robotic seal and cut devices, such as LigaSure™ is a considerable inconvenience. Second, due to the costs and duration of the procedures, the robotic platform cannot be used to cover the whole spectrum of procedures normally performed by a general surgeon.[21]

CONCLUSION

Within the limitation of a small-sized, nonrandomized analysis, our study confirms that robot-assisted gastrectomy is a feasible and safe surgical procedure. When compared with conventional laparoscopy, robotic surgery shows evident benefits in performing lymphadenectomy with a higher number of retrieved and examined lymph nodes, and also the use of robotics is a good option for the upcoming surgeons since only less than 10 cases of robotic surgery are needed to become proficient in gastric cancer surgery.

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