Review paper

Current perspective and review of literature on robotic gastrectomy and oncological outcomes

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Gastroenterology Rev
DOI: https://doi.org/10.5114/pg.2023.124148

Key words: gastric cancer, robotic gastrectomy, laparoscopic gastrectomy, oncological outcomes, disease-free survival, overall survival.

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Abstract

Gastric cancer (GC) is a malignant tumour that develops in the gastric epithelial tissue. It is now one of the commonest reported malignant tumours worldwide. Gastrectomy is the most effective GC treatment. The introduction of minimally invasive gastrectomy was done over thirty years ago to reduce related burden among patients. Nowadays, minimally invasive gastrectomy is becoming more widely accepted as a viable treatment option for gastric cancer. Although recent research implies that robotic application has some advantages over traditional laparoscopy, the significance of robotic surgery in clinical practice is yet unknown. However, most studies revealed that robotic gastrectomy (RG) and laparoscopic gastrectomy (LG) have analogous oncological results in gastric cancer treatment, and general inferences on whether RG offers greater benefit over LG are still tough to draw. Furthermore, to assess the possible advantages and hazards related to RG for gastric cancer, policymakers and surgeons require a complete evaluation of the strength and depth of scientific data. Therefore, in this narrative literature review, we aimed to describe and delineate the present perspective of RG and its oncological outcome in gastric cancer subjects. Also, we intended to provide surgeons with a revised as well as updated summary of present evidence and to bring surgical practice more in line with present evidence.

Introduction

Gastric cancer (GC) is a malignant tumour that develops in the gastric epithelial tissue. It is now one of the commonest reported malignant tumours worldwide. Globally, GC ranked fourth most cancer-specific cause of death, with a growing tendency to strike younger people [1]. With a crude incidence of 13.5/100,000 in the populace, GC is the fifth most commonest cancer worldwide. The disease's incidence varies greatly amongst continents, with the prevalence of the condition being significant in the Far East. To exemplify, the crude gastric cancer incidence in the Netherlands is 10/100,000, whereas in Japan it is 90/100,000. Worldwide, gastric cancer is the third most lethal cancer yearly [2].

Lymphadenectomy and surgical resection, without or with (neo) adjuvant treatment, are the mainstays of curative therapeutic options, depending on disease stage as well as subject co-morbidity. So far, the standard gastrectomy with D2 lymphadenectomy has been the surgical technique of choice for patients with resectable gastric cancer [3]. German, Korean, Japanese, British, and Italian national guidelines, as well as the ESMO (European Society for Medical Oncology) and joint European Society of Surgical Oncology – ESMO – European Society of Radiotherapy and Oncology guidelines, all recommend the D2 method as a standard of surgical intervention with curative intent [4].

Numerous research has shown that laparoscopic surgery for gastric cancer is safe technically and produces superior short-term results compared to traditional open gastrectomy for early-stage gastric cancer in recent decades [5–14]. However, a safer D2 spleen-preserving laparoscopic gastrectomy (LG) for treating advanced gastric cancer did not achieve similar success and is presently accessible in high-volume centres only. Technical challenges associated with D2 lymphadenectomy and total gastrectomy, necessitates node stations' removal along the left gastric artery, celiac trunk and

hepatic pedicle are supported as limiting factor of laparoscopic surgery diffusion [15, 16].

A few authors advocate a robotic technique in the modern surgical oncology era to overcome some inherent shortcomings of conventional laparoscopy, claiming that it can support complex reconstruction after gastrectomy as well as dissection of lymph nodes, ensuring oncologic safety even in advanced gastric cancer subjects [17–19]. Several observational researchers have described the safety and effectiveness of robotic gastrectomy (RG) since Hashizume and Sugimachi [20] published their first study [21–25]. Previous meta-analyses [26–28] found that the robotic technique group had lower rates of complications and bleeding than the laparoscopic approach group. Furthermore, the control system also filters vibrations of the hand, allows remote operation, lowers surgeon fatigue, and enhances operational stability [29]. As a result, the method is widely employed in a variety of medical sectors, like colon surgery, stomach surgery, gallbladder surgery, and other abdominal surgery types [30–32].

Although RG has been used for almost 2 decades, there is no better way to assess the long-term treatment of gastric cancer. Pan *et al*. stated in 2017 that there was no considerable variation amongst LG and RG groups in disease-free survival or overall survival [15]. Furthermore, recent indication effectively signifies non-inferiority of RG to standard LG, but general inferences on whether RG offers clear benefits over LG are still unclear, because accessible data are primarily obtained from low-level assessment, returning exceedingly variable outcomes [33–36]. Moreover, for assessment of the possible advantages and hazards linked to RG for gastric cancer, policymakers and surgeons need a complete evaluation of the strength and depth of scientific data.

Therefore, this narrative literature review study aimed to describe and delineate the present perspective of RG and its oncological outcome in gastric cancer subjects. Also, we intended to provide a revised and updated summary of present proof for surgeons and to bring surgical practice more in line with present proof.

Robotic gastrectomy: surgical procedure

The oncological principles used in minimally invasive gastrectomy are the same as those used in open surgery. The detailed surgical procedure followed for both total and distal gastrectomy utilizing da Vinci 4-arm system (Intuitive Surgical Inc., Sunnyvale, CA, USA) is described below:

Subjects are commonly positioned supine at 15° anti-Trendelenburg. In both quadrants, 4 robot ports and 1 assistant port are positioned above the abdomen midline. Robotic surgery promises to alleviate several of laparoscopy's visual and ergonomic drawbacks. The operational field is magnified tenfold, giving the main (console) surgeon improved optical control via a HD (high-definition) 3-D view from a mounted, stabilized, surgeon-controlled camera, decreasing the need for an assistant surgeon. Furthermore, tools of robotic surgery permit flexible, endo-wristed movement proficiencies, self-assistance and retraction via the third operational arm of the robot. The robot's enhanced surgical ergonomics and dexterity are because of the instrument's 540° of rotation, 90° of articulation, and 7° of freedom, allowing manipulation in small areas. Even though this is especially important in spaces that are confined like the hiatal dissection, chest and lymphadenectomy on the superior border of the pancreas are also facilitated by this [37].

As per many investigations, the robot can improve dexterity by 65%, minimize skill-based errors by up to 93%, and shorten the time it takes to accomplish a task by up to 40% [38, 39]. The earlier da Vinci system had a confined operative space that could be achieved without additional placement of a port and/or re-docking. On the other hand, gastrectomy necessitates abdominal surgical accessibility from a deeper position into the diaphragmatic hiatus, duodenum, splenic hilum, and retro-colic region. Principally, this necessitates robotic access to 3 quadrants of the abdomen, which has proven difficult in the past. The new Xi system, with its rotating boom and slim arms, as well as upcoming technologies like the Verb [40] and Versius [41], which have either table-mounted or independent arms, are promoted to allow for multi-quadrant usage and increased access range.

Oncological outcomes

The largest single-centre study of robotic-assisted gastrectomy in the Far East highlights the circumstance that early detection of gastric cancer results in lower T stages and the majority of N0 cases [42]. This is in comparison to the majority of Stage III illnesses (35%) in the biggest accessible single European cohort [43].

Songun *et al*. reported survival benefits for spleen-preserving D2 lymphadenectomy, but linked to higher perioperative morbidity as well as death [44]. However, with regards to robotic-assisted gastrectomy, the yield of lymph nodes has not been considerably different in any of the meta-analyses issued in comparison to laparoscopic-assisted gastrectomy or open gastrectomy. The only cohort study that revealed a discrepancy in favour of robotic-assisted gastrectomy was from Cianchi *et al.* [45], and, in the setting of spleen-preserving D2 total gastrectomy, a rise in splenic artery nodes [18].

Lee *et al.* showed an advantage in obese subjects with respect to enhanced yield of lymph node, but the mean body mass index in this cohort was 27 [46]. Hyun *et al*., on the other hand, found reduced yield of the lymph node in obese subjects undergoing robotic-assisted gastrectomy [47]. A reduced yield of lymph node was reported by Caruso *et al.* [48] for robotic-assisted gastrectomy in comparison with open gastrectomy.

Shin *et al.* recently presented the findings of a propensity score-weighted analysis of over 2000 GC patients who underwent either LG or RG with the goal of curing their disease [49]. After subjects were matched, there were no disparities in the overall number of lymph nodes extracted, although the number of supra-pancreatic lymph nodes harvested was greater in the RG group. Surprisingly, there is no substantial statistical distinction between laparoscopic and RG in terms of overall survival or disease-free survival in weighted as well as unweighted analyses on the basis of oncological results. Li *et al.* reported on long-term oncological findings of RG vs. LG in treating subjects with locally advanced gastric cancer and found similar results [50]. Their research involved over 1200 subjects, whose results were compared utilizing 1 : 1 propensity score matching between RG and LG. The 3-year disease-free rates of survival favoured RG (76%) compared to LG (70%) with no statistical importance (p = 0.07). As for 3-year overall survival, there was a non-significant advantage following RG (77%) in comparison with LG (73%).

The research publication of Wu *et al.* revealed that there was a nonsignificant OR of 0.98 and 0.53 supporting RG over LG with regards to 3-year and 5-year overall survival, respectively, in the most recent meta-analysis comparing oncological results of LG vs. RG. Likewise, the 2 treatment groups did not vary substantially in terms of recurrences (OR = 0.88) [35]. It is well known that the number of lymph nodes harvested and the number of surgical margins are presently the best indicators of oncologically adequate resections [51]. In most RG vs. LG analyses, the median number of extracted lymph nodes after RG is higher than that of LG [36, 52–55]. Presently, 2 accessible randomized trials support that in comparison to LG, RG is more beneficial in lymphadenectomy [53, 56]. Other investigations and numerous meta-analyses have found similar findings in obese subjects [51, 54, 55, 57, 58].

Furthermore, Choi *et al.* recently published research comparing the long- and short-term results of laparoscopic, open, and robotic radical gastrectomy in obese subjects with D2 lymphadenectomy. Of the 185 subjects with 26.5 kg/m^2 median body mass index, there were 54 robotic, 62 laparoscopic, and 69 open procedures performed. In comparison to open and LG, RG led to a higher mean number of lymph nodes retrieved as well as an increase in the rate of lymph node harvest compliance [55]. Moreover, Guerrini *et al.* performed the largest meta-analysis presently available, including the findings of 40 retrospective research studies and around 18,000 subjects who had undergone robotic or laparoscopic minimally invasive gastrectomy [51]. With respect to oncological findings, RG showed a significant increase in the yielded mean lymph node numbers in comparison to LG.

Conclusions

There has possibly been too much excitement around the introduction of robots in surgical practice in recent years. The median number of harvested lymph nodes is high during RG compared to LG. Furthermore, RG showed a significant increase in the mean amount of lymph nodes yielded in comparison with LG. Robotic gastrectomy assisted in the detection of gastric cancer earlier, with consequently lower T stages and majority being N0.

Future prospectives

The evidence available to date reveals that RG is a safe and oncologically sound substitute to LG or open gastrectomy. However, the advantages of RG so far have been comparatively minor and seem to incur greater costs as well as longer time of operation. Furthermore, accessible data from randomized controlled trials are limited, and most retrospective reports are still biased by confounding variables. Consequently, the question of whether RG offers a considerable benefit over traditional LG for gastric cancer remains an opportunity for further investigation.

Conflict of interest

The authors declare no conflict of interest.

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Received: 30.05.2022
Accepted: 30.08.2022