



Specific complications related to the approach in minimally invasive gastric surgery and impact on survival: a narrative review

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Objective: This narrative review tackles the oncological consequences and the specific complications of minimally invasive gastric surgery.

Background: Radical gastrectomy surgery associated with lymphadenectomy is still a very important step in the treatment process of gastric cancer, despite admirable and astonishing improvements in non-surgical procedures. Radical gastrectomy and lymphadenectomy for cancer have always been the basic steps of training for general surgery. That is precisely why there has been an attempt of centralisation in a few countries and in recent times only. The fact that in many surgical centres—especially in Western countries—the number of stomach cancer surgeries is below 10 cases brings about a higher complication rate and post-surgical deaths than pancreatic and liver surgery, which, on the contrary, are normally centralised in surgical centers with a minimum threshold of cases per year. In recent years, minimally invasive techniques have come about in radical gastric surgery, both due to an irrefutable demonstration of feasibility and a few important publications that have certified oncological non-inferiority compared to open surgery. However, this has been accompanied by a partial worsening of results of post-surgical mortality, with particular reference to total gastrectomy. Thus, it should be easy to understand how these results translate into a worsening of oncological results.

Methods: Difficulties and controversies introduced by minimally invasive surgery in radical gastrectomy with lymphadenectomy for gastric cancer are inspected and analysed.

Conclusions: The topic of gastric cancer surgery has been fully conquered by minimally invasive surgery. To date, the only critical element remains the jejunal oesophagus anastomosis, while all the other technical steps have proven to be easily reproducible with the same results.

Keywords: Minimally invasive gastric surgery; complication; survival

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Introduction

Gastric cancer is one of the leading causes of death worldwide (1,2). Despite improvements in non-surgical procedures, radical gastrectomy surgery associated with lymphadenectomy is still a very important step in the treatment process (3).

Gastric surgery has always been fundamental to general surgery (4). That is why the concept of centralisation has only been developed and accepted in a few countries; consequently, many surgical centres (especially in Western countries) report less than 10 cases per year of radical gastrectomy. Historically, a significant morbidity-mortality rate encumbers this operation (5,6), second only to

oesophageal surgery and above pancreatic and liver surgery, which are more frequently centralised.

For many years now, the field of gastric surgery has also embraced the introduction of minimally invasive surgery, thanks to a scientifically irrefutable demonstration of oncological non-inferiority in terms of the most commonly performed surgery: partial gastrectomy. Many experienced surgeons have crossed the barrier of total gastrectomy in daily practice, which has thus become a routine operation (7). However, this transition has also been accompanied by worsening short-term post-surgical outcomes compared to other sectors, such as colorectal surgery (8-12). The rationale of this review is analyzing the controversies and the complication caused by the introduction of the minimally invasive technique, how those issues could affect the oncological outcome and how and which of those criticalities have been overcome in the last years. We present the following article in accordance with the Narrative Review reporting checklist (available at <https://ales.amegroups.com/article/view/10.21037/ales-21-43/rc>).

Methods

This narrative review analyses the critical surgical steps in radical gastrectomy and lymphadenectomy for cancer focusing on problems and complications introduced by the mini-invasive technique, describing the critical aspects and the strategies used to obtain the best oncological result.

A MEDLINE and PubMed research was performed using the terms “laparoscopic gastrectomy”, “gastric cancer” and “outcomes” from 1990 through July 2021; only articles in English were considered.

Discussion

The unstoppable avalanche: how the minimally invasive procedure has conquered gastric surgery.

When investigating complications in minimally invasive gastric surgery two main limitations emerge: the lack of prospective controlled studies and the fact that surgical complications after gastric surgery are occasionally not recorded in a standardized fashion (13).

Minimally invasive surgery first entered into the field of gastrointestinal cancer surgery through colorectal surgery. In particular, due to the technical difficulty of performing a correct lymphadenectomy, gastric surgery has been the most difficult area to conquer. The first attempts of minimally invasive gastric cancer surgery date back to the 90's (14),

but these were sporadic reports by pioneering surgeons with particular expertise. Since 2010, minimally invasive stomach cancer surgery has been completely normalised following the publication of works by the Japanese (Japan Clinical Oncology Group) (15,16), the Korean group KLASS (Korean Laparoendoscopic Gastrointestinal Surgery Study) (17) and the Chinese group CLASS (Chinese Laparoscopic Gastrointestinal Surgery Study) (18). KLASS is a group of very well coordinated South Korean surgeons who, after a period of rigorously certified training via the re-evaluation of unedited videos by a centralised panel, collected scientifically solid data on post-surgical morbidity-mortality rates and the oncological surgery quality of distal gastrectomy, firstly in early gastric cancer (EGC) and then in advanced gastric cancer (AGC) (19). Data collection for total gastrectomy is still ongoing (19,20). The same work team has launched an interesting study on organ-sparing surgery in EGC. A few years later, prospective controlled and non-controlled studies on minimally invasive gastrectomy have also started in the West (21,22). A second powerful push for the development of minimally invasive gastric cancer surgery later came from the standardisation and dissemination of enhanced recovery after surgery (ERAS) protocols, which are also based on a minimally invasive approach. Thanks to solid data, distal gastrectomy for EGC is now a standard treatment, and many guidelines even include the possibility of treating advanced neoplasms with the minimally invasive technique. With that said, minimally invasive total gastrectomy is still considered experimental.

Problem number 1: esophagojejunal anastomosis

Until 2015, minimally invasive total gastrectomy with esophagojejunal anastomosis was the prerogative of only a few particularly skilled surgeons; from a scientific point of view, almost exclusively Oriental publications were recorded, all of which included retrospective analyses of individual cases (23). In the following years, a couple of prospective studies were released and then published in the last 2 years. We discuss at least four of such studies, respectively the Japanese, Korean, Chinese and Dutch ones (JCOG-1401, Klass03, Class02, Stomach trial). The percentage of anastomotic leak was less than 2% in the first 3 trials at Eastern centres and 8.5% in the Dutch trial; however, another Japanese study with results recorded in a national registry rather than in a prospective study like JCOG-1401 reports an anastomotic leak rate of 5.6% (24).

Similarly, a Dutch study provides a snapshot of reality outside these prospective studies by reporting a leak percentage of as much as 17% (25).

The personal experience of many surgeons in real life shows a high complication rate for minimally invasive esophagojejunal anastomosis. The incidence of anastomotic leaks varies between 5–6% and 20–25%, with average values of around 10–15%. This percentage is significantly higher than historically accepted parameters for open surgery, which are around 5%. Many laparoscopic and robotic reconstruction techniques show that the ideal technical solution has not yet been identified. A meta-analysis (26) evaluates 9 comparison works, 3 of which are prospective of the totally minimally invasive technique and the laparoscopic-assisted technique, and no difference is reported. Another interesting literature review (27) analyses the different techniques of esophagojejunal anastomosis in 25 papers for 1,170 patients. It concludes that the functional end-to-end anastomosis (FETEA) and Overlap techniques have a lower complication rate (1.1% and 2.3%) than the single stapling technique (SST), double stapling technique (DST), hemi-double stapling technique (HDST), hand sewn (HS), which vary between 6% and 7%. However, only a few hundred cases are involved in each technique, which means that there are only a handful of complicated patients.

Another debiscence: duodenal stump and its surroundings

Dehiscence of the duodenal stump after a total or partial gastrectomy is a rare, yet feared occurrence of gastrectomy. In fact, the duodenum is not a very mobile organ as it is retroperitoneal with a thick wall and receives a large amount of highly corrosive secretions, such as bile and pancreatic juice. The incidence of duodenal stump leakage is historically less than 2%. The minimally invasive approach to cancer gastrectomy is not a risk factor in itself, since the section and suture techniques are substantially similar to those commonly used in open surgery (28). The introduction of the minimally invasive approach has led to a greater use of linear tri-staplers, known for their improved technical features compared to classic linear staplers, which are more commonly used in open surgery due to their cost. At the same time, the minimally invasive procedure makes it more difficult to add manual reinforcement to the mechanical suture, a technique normally used by many surgeons in open surgery. Furthermore, there are some reports on the increased risk of pancreatitis from direct trauma caused by laparoscopic instruments to the pancreatic

gland, which could result in a leakage of pancreatic enzymes, thus increasing the risk of enzymatic digestion of the duodenal suture (29). Other possible sources of biliary fistula during minimally invasive surgery include burns to the biliary tract during lymphadenectomy of the hepatic pedicle with Energy Devices or traumatic lesions to the posterior aspect of the pancreatic head during a Kocher manoeuvre, which is notoriously less comfortable with a minimally invasive approach than with open surgery (30). In any case, there is no available literature showing an increased risk of duodenal leak or biliary fistula associated with minimally invasive surgery (31).

The other leaks: once upon a time, there was a safe gastro-entero anastomosis

For many years, the gastro-jejunum anastomosis has been considered to have a low-risk for leaks. However, there was a higher incidence of leaks and stenosis in the initial phase of the minimally invasive experience than in the past (31). Nonetheless, more recent reports, influenced by increased experience and improved technique, return to report an extremely low risk of anastomotic complications.

The pancreas puzzle

At the moment, the trauma of the pancreatic gland is a topic with a debated and unclear literature (32). In fact, some early Eastern papers reported an increased number of acute post-surgical pancreatitis and “biochemical leaks” due to the evidence of an increased dosage of pancreatic enzymes in the post-surgical period (33). A possible explanation could be related to the pancreas body mobilisation during the lymphadenectomy of stations 8 and 11 (34); another possible explanation could be referred to the difficulty often encountered during the separation of the layers near the pancreatic head, the transverse mesocolon, the lymphatic tissue, the fat tissue near station 6, and the pancreatic capsule (35,36). However, some more recent series have disavowed this trend and, in some cases, even overturned it (37,38).

Some incredible (but true) things

Anecdotal cases describe complete transections of the hepatic and splenic arteries during lymphadenectomy with a minimally invasive technique, evidently linked to the safe use of Energy Devices. On the other hand, numerous case report

of late pseudoaneurysms from heat injury (39,40). Cases of intestinal short circuit have also been described due to an error in the choice of the jejunal tract to be anastomosed to the stomach, especially in obese patients in whom the minimally invasive seeking of the Treitz angle can be difficult.

The unpleasant question of re-interventions: open vs. redo laparoscopy

After a surgery conducted with a minimally invasive technique, if the patient needs a re-operation for major complications, is it sensible to start the re-operation employing again a minimally invasive technique or, in principle, is it more appropriate to switch to an open technique? This question has no sure answer. Over time and with the accumulation of experience, more and more surgeons venture with a minimally invasive approach even in the case of re-surgery (41). Certainly, this attitude cannot be criticised *a priori*, especially where the problem can be easily recognized as well as solved, and the minimally invasive technique offers the patient fewer respiratory complications, fewer wound complications, and an adequate toilet of the peritoneal cavity.

Back to the past?

For a long time, using the Roux-en-Y technique with transmesocolic passage of the jejunal loop was considered ideal for the reconstruction of gastrointestinal continuity after subtotal gastrectomy. With the advent of minimally invasive gastrectomy, it was realized that the reconstruction with antecolic passage of the jejunal loop according to Billroth II represents an easier solution and bears fewer complications; this technique, formerly used for fast reconstructions in open surgery, is thus back in vogue (42-45). However, such technique is accompanied by an internal anastomosis to prevent biliary reflux (46). A newly introduced technique, the "uncut" technique, also provides the terminalisation of the loop without a section of the meso (47).

Long-term oncological results of complicated patients

As in other areas of gastrointestinal cancer surgery, post-surgical complications inevitably lead to the worsening of mean and long-term oncological results. This could be linked to relatively transient immunosuppression, but also to reduced or delayed accessibility to adjuvant therapies (48,49). On the contrary, in patients with a regular postoperative course, it is shown that the oncological results

are ultimately comparable to those of open surgery (50).

Cui prodest? And who loses?

In reality, we must consider that the real goals of a surgically treated patient suffering from stomach cancer are a radical cure of the disease, as well as an intervention with no residual disease both on the tissue and in the lymph nodes. Whether these goals are achieved with an open or a minimally invasive technique, in the long term it does not matter, and even less for the specific needs of this type of patient than in other areas of abdominal pathology. To date, there are no certain demonstrations of the superiority of the minimally invasive approach compared to the open one on the truly relevant parameters, such as global survival and quality of life with particular reference to nutrition. Precisely because having a smaller incision is not the goal, it is not frequent among gastric cancer patients to specifically ask for a minimally invasive approach.

Do not forget: time and cost

Certainly, in the initial phase of the laparoscopic experience the minimally invasive intervention increases the operating times by at least 30%, and at the same time it certainly does not reduce the costs of the material. On the contrary, these costs are more frequently increased by the minimally invasive approach regarding the use of Energy Devices and the preparation of the anastomoses, which invariably happens by mechanical suturing machines and high-cost self-locking stitches (51). On the other hand, it is certainly true that in the context of an ERAS protocol, the minimally invasive approach allows a partial reduction in costs related to postoperative hospitalisation, as it is demonstrated that, in the absence of complications, on average it allows discharge one day earlier than an open intervention (52,53).

Despite the increase in experience, minimally invasive gastric surgery remains burdened by a high rate of complications, especially when total gastrectomy is required (54).

Further studies are required to assess the length of the learning curve for minimally invasive gastrectomy, in order to understand when a surgeon is proficient in performing minimally invasive gastric surgery without proctoring.

Conclusions

There is no doubt that the topic of gastric cancer surgery has also been fully conquered by minimally invasive surgery.

To date, the only critical element remains the jejunal oesophagus anastomosis, while all the other technical steps have proven to be easily reproducible with the same results, without involving specific complications.

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Footnote

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