Review Article

A narrative review of minimally invasive techniques for treatment of gastric gastrointestinal stromal tumors

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Background and Objective: Minimally invasive approach for small gastric gastrointestinal stromal tumors (GISTs) (<5 cm) is widely accepted according to National Comprehensive Cancer Network (NCCN) and European Society for Medical Oncology (ESMO) guidelines published in 2010. During last 15 years, many different techniques were proposed with the intent to reduce invasiveness ensuring adequate oncological radicality. In this chapter, we describe the laparoscopic, robotic and laparoscopic-endoscopic cooperative techniques for the treatment of this type of neoplasms. Our technique is also described.

Methods: We have conducted a literature review from 01.01.2008 to 06.31.2021 on PubMed database for studies regarding laparoscopic, robotic and endoscopic techniques for treatment of gastric GISTs. The medical search headings (MeSH) "gastric GIST", "laparoscopic GIST", "robotic GIST", "minimally invasive surgery", "laparoscopic and endoscopic cooperative surgery procedures" and combinations of these were used. The lists of articles identified were examined to find relevant studies cited in this article. These studies compared sometimes different approaches (laparoscopic, robotic, laparoscopic and endoscopic cooperative surgery procedures), dividing the GISTs according to their gastric site and different types of resection. We analysed review, systematic review, and meta-analyses, restricting to English-language publications.

Key Content and Findings: The choice of the best approach is related to GIST site (gastroesophageal junctional, fundus and body, antrum and pylorus) and configuration (exophytic or endophytic). The principal intent is to obtain margin-free (R0) resections avoiding the rupture of the lesion. For these, many tips and tricks to perform "no touch" technique and minimize the risk of dissemination and strategy to avoid post-operative complication are descripted.

Conclusions: Minimally invasive surgery to resect GISTs is safe and oncologically effective. Techniques described should be part of the armamentarium of surgeons dedicated to this type of neoplasms. The collaboration of surgeons and the endoscopists allow to apply these techniques in the best way for each specific case.

Keywords: Gastrointestinal stromal tumors (GISTs); minimally invasive surgery; robotic gastric surgery; laparoscopic gastric surgery

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Introduction

Gastrointestinal stromal tumors (GISTs) arise from the interstitial cells of Cajal and are the most common mesenchymal tumor of the gut. It has been estimated that there are 3,300 to 6,000 new GISTs per year in the United States (1). GISTs can be diagnosed at any age, but they occur predominantly in men over 50 years old (2). The stomach is the most frequent site for GISTs (60%) (3) where they are mainly located in the fundus (4). GISTs can be subcentimetric lesions or massive tumors (greater than 10 cm) challenging to remove. Many GISTs express a protooncogene protein c-KIT (CD117) (5) and the availability of selective tyrosine kinase inhibitor (Imatinib, Gleevec™, Novartis Pharma, Switzerland) has improved resectability, inducing tumor shrinkage, and prognosis of large tumors (6). Surgery remains the treatment of choice for potentially resectable tumors, but neoadjuvant therapy should be administered in case of borderline resectable GISTs or when extensive surgery is needed to achieve margin-free (R0) margins and to obtain prolonged survival (7). Surgery aims at R0 resection with microscopically negative surgical margins; this should be obtained without intraoperative tumor's rupture which could lead to peritoneal sarcomatosis (8). Lymphatic spread is rare and systematic lymph node dissection can be avoided (9). According to National Comprehensive Cancer Network (NCCN) guidelines (10) all gastric GISTs ≥2 cm and lesions <2 cm with suspicious endoscopic ultrasound (EUS) features such as anechoic (cystic) spaces, irregular border, heterogeneity and ulceration, should be excised (11). In the last years, minimally invasive surgery has gained acceptance for the treatment of GISTs (12); initially this approach was limited to small tumors according to NCCN and European Society for Medical Oncology (ESMO) guidelines (13-15); more recently minimally invasive surgery has become accepted also for larger tumors (16). Laparoscopy is a safe and acceptable technique not only for GISTs less than 5 cm, but also for grater neoplasms (17). The extension of surgery and the reconstructive technique can massively influence postoperative complications and quality of life. According to this element less invasive and function preserving techniques have been developed. Few scan data on the role of robotic surgery for GISTs treatment are reported in the literature (18,19). It has been speculated that robotic surgery may allow a safer tumor's manipulation with less risk of rupture.

To plan surgery for GISTs is necessary to consider many different factors: tumor location (anterior or posterior wall, lesser or greater curvature); tumor growth (endophytic or exophytic); distance from gastroesophageal junction and the pylorus (>2 cm or not); local tumor proliferation (located or locally advanced with the contact to surrounding structure); risk of lesion of GIST pseudocapsule.

According to these considerations, the best approach associated to the best technique should be identified. At present the different approaches available are: open, endoscopic, laparoscopic, robotics, laparoscopic and endoscopic cooperative surgery. All these options have been widely compared in the current literature. The different techniques are: wedge, transgastric, intragastric resections and total or partial gastrectomies. We will focus attention on the different techniques and those factors essential in planning surgery (*Table 1*). Our technique will be described as well. We present the following article in accordance with the Narrative Review reporting checklist (available at https://gist.amegroups.com/article/view/10.21037/gist-21-22/rc).

Methods

We have conducted a literature review from 2008 to 2021 on PubMed database for studies regarding techniques of minimally invasive surgery for gastric GISTs. The medical search headings (MeSH) "gastric GIST", "laparoscopic GIST", "robotic GIST", "minimally invasive surgery", "laparoscopic and endoscopic cooperative surgery procedures" and combinations of these were used. The reference list of the identified articles was examined to find relevant studies explaining operative technique and highlightening the feasibility of minimally invasive procedures (*Table 2*).

Approaches

Laparoscopic

The patient is positioned in supine position. A 30-degree 10-mm camera is generally used. Surgeon stands between patient's legs and an assistant on the left side. Nathanson® (Mediflex®, Islandia, NY, USA) or similar liver retractor is used to push aside the liver especially for esophagogastric junction (EGJ) (20) and tumors of the fundus. Depending on the site of GISTs, trocars may be placed in different positions. Usually, their position is the typical one adopted to approach sovramesocolic organs. CO_2 insufflation is generally maintained at a pressure of 12 mmHg.

Table 1 Summary of approaches and techniques

Approach	Technique	Advantages	Disadvantages
Laparoscopic	Stapled wedge resection	Cost-effectiveness	Trocars placed in different positions depending on the GISTs' site
	Non-anatomic full-thickness 'disk' resection	Advantage over the more advanced minimally invasive surgical technique of the robotic approach	
	Anatomic gastrectomy		
	Laparoscopic transgastric resection		
	Laparoscopic intragastric resection		
Robotic	The techniques are similar to laparoscopy	3D image magnification and precise robotic arm movements with tremor filtering may help to obtain a R0 resection	Increase in operating time
			Cost-effectiveness remain a major obstacle to the widespread adoption of robotic approach
LECS	Classical LECS	Avoid excessive gastric resection	Risk of spillage of gastric contents into the abdominal cavity
		Not affected by tumor location, such as near of the EGJ junction or pyloric ring	
	Inverted LECS	Useful for preventing tumor seeding into peritoneal cavity	A slight risk of gastric content contamination
			Few limitations for tumor's size or location
	LAEFR	Monitoring and backup from the laparoscopic team in case of accidental perforation	Suitable for small lesions with intraluminal expansion
			Requires advanced endoscopy skills
	CLEAN-NET	Preserve the continuity of the mucosa as a barrier	Specimen's size
		Technically simpler comparing to the others	Accuracy of mucosal resection
			Technical difficulties to place the stapling device in large intraluminal GISTs
	NEWS	Avoids excessive gastric resection	More complicated
		An artificial perforation of the gastric wall is not required and the specimen is removed by transoral route	Requires more time
			Technically difficult with tumors >3 cm

GISTs, gastrointestinal stromal tumors; R0, margin-free; LECS, laparoscopic-endoscopic cooperative surgery; EGJ, esophagogastric junction; LAEFR, laparoscopic assisted endoscopic full-thickness resection; CLEAN-NET, combination of laparoscopic and endoscopic approaches to neoplasia with a non-exposure technique; NEWS, non-exposed endoscopic wall-inversion surgery.

As described by Mazer *et al.* (21) many different type of techniques of resection are available: stapled wedge resection; non-anatomic full-thickness 'disk' resection by ultrasonic energy device; anatomic gastrectomy [distal gastrectomy, total gastrectomy, proximal gastrectomy with double tract reconstruction (DTR)]; laparoscopic transgastric resection; laparoscopic intragastric resection.

Stapled wedge resection is the most used technique for exophytic GISTs. Once the tumor is visualized, a lot of care should be taken to avoid direct manipulation and accidental capsule disruption (21). In special cases the stomach can be fixed to the abdominal wall limiting the manipulation. To note, the stapler should be applied to the stomach perpendicularly and an articulated surgical stapler may be helpful.

Non-anatomic full-thickness 'disk' resection is indicated when stenosis is at high-risk. The tumor can be removed with a small healthy margin with cautery or ultrasonic

Table 2 The search strategy summary

Items	Specification
Date of search	We conducted the search in July and August 2021
Databases and other sources searched	PubMed
Search terms used	The MeSH "gastric GIST", "laparoscopic GIST", "robotic GIST", "minimally invasive surgery", "laparoscopic and endoscopic cooperative surgery procedures" and combinations of these were used
Timeframe	From 01.01.2008 to 06.31.2021 on PubMed database
Inclusion and exclusion criteria	We analysed review, systematic review, and meta-analyses, restricting to English-language publications
Selection process	We conducted the selection independently

MeSH, medical search headings; GIST, gastrointestinal stromal tumor.

surgical instrument. The gastrostomy is closed with a full-thickness running suture. We generally use ultrasonic surgical instruments (Harmonic® HD 1000i Shears, Ethicon, USA) and barbed sutures (V-Loc™ Wound Closure Device, Medtronic, USA). Furthermore, Lee *et al.* (22) suggested to add fundoplication in order to prevent reflux, when the lower esophagus may have damaged.

Anatomic gastrectomy (distal gastrectomy, total gastrectomy, proximal gastrectomy with DTR) can be necessary in case of large GISTs or when they are localized near EGJ or antrum (23). In case of distal gastrectomy, antecolic Roux-en-Y reconstruction to prevent post-operative reflux (24), while in case of total gastrectomy a laparoscopic side to side esophago-jejunal anastomosis is done using a 30 mm linear stapler and loop of jejunum passed in a retrocolic fashion. Proximal gastrectomy with DTR (25) is a function-preserving surgery for upper third gastric cancer. It was first introduced in 1988 (26) and can increase the reservoir volume so that chyme enters the small intestine decreasing dumping syndrome occurrence and gastric emptying disorders. Moreover, patients who undergo DTR, tend to have better short-term nutritional status (27). Ahn *et al.* (28) reported a less incidence of stricture and reflux after proximal gastrectomy with DTR.

Laparoscopic transgastric resection is another technique to perform a posterior wall resection. Initially the stomach is insufflated and the tumor identified; a gastrotomy is made at the anterior wall and a full thickness resection of posterior wall is performed through the gastrotomy.

Laparoscopic intragastric resection represents another option (29). During first step of intervention a carboperitoneum is obtained. Stomach is fixed with some polypropylene stitches (Prolene®, Ethicon) to the abdominal wall and the stomach is insufflated by the endoscopist and surgeon places the trocars into the gastric lumen. It's necessary to place 3 balloon-trocars. Small bowel gas distention can be prevented by clamping the jejunum. Using the two working ports, normal tissue below the tumor's edge is exposed and a laparoscopic linear stapler is fired intragastrically underneath the base of the mass until it is completely freed (30). In our clinical practice, we use ultrasonic devices to perform the resection and remove perorally the specimen. If the tumor is larger than 3 cm, a gastrotomy is performed and the bag removed. The defect is closed by an intragastric and extragastric running barbed sutures. At the end, the suture is examined by endoscopy to prevent leakage. Recently, several surgeons have reported a single-incision intragastric approach too (31).

Robotic

Robotic surgery provides the surgeons a 3D-amplified view and an increased ability to control the precision of instruments, allowing more security of tumor manipulation and making easier procedures (32). This overcomes the limits of laparoscopy such as difficulty in instrument movement and 2D-vision. Robotic approach has a very undefined role in GIST surgery: in literature, studies about robotic approach for GISTs are very few, contrary to laparoscopic approach (33,34). Buchs *et al.* (18) published the first robotic series of gastric GIST in 2010, who established the feasibility and the safety. Desiderio *et al.* (35) demonstrated that robotic resection can be safely adopted for its advantages of minimally invasive surgical technique and favourable perioperative outcome (earlier return of bowel function and shorter post-operative hospitalization)

without compromising oncologic safety. de'Angelis *et al.* (36) published the first size- and location-matched comparison about robotic and laparoscopic approaches for gastric GISTs >5 cm and showed that these approaches appear to be equally safe and oncologically feasible. Moriyama *et al.* (37) and more recently Al-Thani *et al.* (38) suggested that the robotic approach could have an important role in tumor located at the EGJ as well as the posterior gastric wall, which usually are difficult to treat laparoscopically because of the risk of narrowing of the gastric outlet or access to target anatomical site.

Our operating team is equipped with a robot "Da Vinci Xi" Surgical System® (Intuitive Surgical Inc., Sunnyvale, CA, USA). During robotic procedures, patients are positioned supine with arms along their body. After pneumoperitoneum induction through the left upper abdomen (i.e., Palmer's point) Veress needle, 5 trocars are generally employed: 4 robotic trocars and a 12 mm trocar (assistant port). In our department robotic surgery for gastric GISTs is reserved for highly selected patients (e.g., obese patients or when associated complex surgical procedures are required), particularly due to limited availability of the robot. About the different techniques described for robotic approach no differences are reported rather than the laparoscopic one.

Laparoscopic-endoscopic cooperative surgery (LECS)

LECS consists of endoscopic surgery in the form of endoscopic mucosal incision associated to laparoscopic surgery (39). Hiki *et al.* reported the first LECS in 2008 (40); it was named "classical LECS" to distinguish it from subsequent modified methods. Other options are represented by "inverted LECS" (41), "laparoscopic assisted endoscopic full-thickness resection" (LAEFR) (42), a "combination of laparoscopic and endoscopic approaches to neoplasia with a non-exposure technique" (CLEAN-NET) (43) and "non-exposed endoscopic wall-inversion surgery" (NEWS) (44). Currently, NCCN Guidelines recommend LECS as a treatment for gastric GISTs less than 50 mm in diameter regardless of the tumor's location (3).

The current literature reported advantages of endoscopic resection over laparoscopy in reducing operating time, hospital stay and intraoperative blood loss, without any compromise in success rate or increased complications (45,46). A general anesthesia is used and the endoscope is inserted through the oropharynx taking care not to infuse too much air into the stomach.

The "classical LECS" begins with preparation of the blood vessels around the tumor that are ligated with an ultrasonic shear device. Endoscopic mucosal incision associated to laparoscopic three-quarters seromuscular incision are carried out. The lesion is turned over toward the abdominal cavity and the resection completed with a laparoscopic stapler. The defect of the gastric wall is usually closed by a laparoscopic stapler or, in some cases, by a laparoscopic hand-suturing. The main advantage of the classical LECS procedure is to avoid excessive resection of the gastric wall. The resection is accurate and minimal (47). Classical LECS is technically easier than the modified LECS procedures (48) and not affected by tumor location, such as near of the pyloric ring or EGJ (49). The dissection of the esophageal wall is required for tumors close to the EGJ. It should be limited to less than one-third of the esophageal circumference to reduce the risk of complications after reconstruction. Another major limitation of classical LECS is needed to open the gastric wall during the dissection with the risk of spillage of gastric contents (40).

During the "inverted LECS" technique, the gastric wall around the tumor is pulled up by several stitches and pulled out of the abdominal cavity using the Endo Close™ site-closure device (Covidien, Tokyo, Japan) and fixed at skin level. A full-thickness incision is carried out laparoscopically and endoscopically. The tumor is inverted to face the intragastric cavity to prevent gastric juice contamination. After the tumor has been resected, it is put in an endoscopic retrieval bag and removed endoscopically. Inverted LECS is useful for securing the visual field and preventing the risk of tumor cell seeding into peritoneal cavity. However, with this method, a slight risk of gastric content contamination cannot be ruled out. Inverted LECS is less complicated and has few limitations for tumor's size or location, comparing to the other modified LECS procedures (40).

The LAEFR method consists of endoscopic full-thickness resection (EFTR) with a circumferential mucosal/submucosal incision around the lesion, further seromuscular layers are dissected endoscopically and then laparoscopic handsewn closure of the gastric wall defect is performed (50).

CLEAN-NET was firstly described in 2012 by Inoue *et al.* (43) to completely prevent the risk of cancer cell dissemination. This technique preserves the continuity of the mucosa as a barrier (a clean net) by using a seromuscular incision. Then the mucosal tissue is pulled out toward the outside of the stomach, thus maintaining a sufficient epithelial margin around the cancer tissue and a full-layer resection with a laparoscopic linear stapling device is

performed to complete the resection (51). For these reasons, the CLEAN-NET is technically simpler comparing to the other laparoscopic and endoscopic cooperative surgery. There are three main disadvantages in CLEAN-NET: the specimen's size, which is limited to <3 cm to avoid mucosal laceration (47), the accuracy of mucosal resection, especially for tumors with an intraluminal growth pattern because the incision line is determined from the serosal side (52) and technical difficulties to place the stapling device in large intraluminal GISTs.

NEWS was firstly performed in an *ex-vivo* porcine model by Goto *et al.* in 2011 (53). First of all, mucosal markings are placed around the tumor, followed by laparoscopic circumferential seromuscular incision. The seromuscular layers are linearly sutured with the lesion inverted into the inside of the stomach. Finally, the circumferential mucosal and submucosal tissue incisions are made around the inverted lesion by endoscopy. The tumor is retrieved endoscopically and the mucosal edges are closed with endoscopic clips. After this experimental procedure, some case reports and observational studies have been reported without short-term complications (54,55). As LECS procedure, the NEWS procedure avoids excessive resection of the gastric wall (56). An artificial opening of the gastric wall is not required and the specimen is removed by transoral route. NEWS has some limitations: it is more complicated than other procedures, it requires more time and it is technically difficult with tumors >3 cm, because they can't be retrieved perorally (52).

Key pearls

In our department LECS is performed less than laparoscopic or robotic approaches. A close cooperation between surgeon and endoscopist is required when it's performed. The setting for laparoscopic time is similar to laparoscopic approach; the laparoscopic ports are inserted into the abdomen under carboperitoneum of 12 mmHg and the surgeon stands between patient's legs and an assistant on the left side. The endoscopist is positioned at the top of the patient's head.

Classical-LECS is started with laparoscopic preparation of blood vessels around the tumor avoiding an excessive blood vessel harvesting. The endoscopic mucosal and submucosa incision is carried out a needle knife after injection of epinephrine into the submucosal layer to facilitate the separation of the layers. An artificial perforation is created by endoscopist so that the ultrasonic device is inserted into the gastric hole to perform the seromuscular incision. Finally, the specimen is lifted up using forceps by the assistant and resected with a laparoscopic stapler. We prefer to use purple EndoGIA™ stapler (Endo GIA Tri-staple™ Technology, Medtronic) and to close the gastric wall defect with laparoscopic handsewn suture.

When we perform inverted-LECS, we place several stitches around the tumor and pull out of the abdomen using Endo Close™ site-closure device. The incision is carried out laparoscopically by ultrasonic device and endoscopically by a needle knife. The resection line is closed by laparoscopic handsewn suture.

LAEFR consists of a series of procedures: a saline solution with epinephrine is injected into the submucosa and then a circumferential incision of the submucosal layer is done by the endoscopist with a needle knife and an insulation-tipped diathermic knife inserted into this slit. Similar to classical-LECS, an endoscopic full-thickness perforation is created under laparoscopic supervision to complete endoscopically the further seromuscular dissection. The gastric wall defect is closed by laparoscopic handsewn suture.

CLEAN-NET and NEWS are two techniques that uses a "close first, cut later". We perform a laparoscopic incision with hook and ultrasonic surgical instruments to make a dissection as precise as possible and then use a laparoscopic EndoGIA stapler to complete the resection in CLEAN-NET. During NEWS we perform a laparoscopic circumferential seromuscular incision and hand-sewn suture closure; after that the endoscopic circumferential muco-submucosal incision is completed by a needle knife and the defect is closed with endoscopic clips.

Techniques according to the gastric site

EGJ

EGJ is perhaps the most difficult zone to approach via minimally invasive technique. Several surgical procedures have been proposed to manage EGJ GISTs. Radical surgery is considered safer than wedge resections, because in the conservative approach, to get adequate resection margins could result in stenosis of EGJ. Even if laparoscopic proximal gastrectomy was introduced in 1990s, most surgeons have performed total gastrectomy avoiding laparoscopic procedures due to late complications, such as reflux esophagitis or stricture. Another potential strategy is partial gastrectomy with DTR (57). Intragastric or

transgastric approach is a useful option too. If the tumor is located on the anterior side near the EGJ, a simple exogastric stapled resection is feasible for some small exophytic GISTs and the endoscopy is kept in the EGJ to prevent stenosis (58,59). Another possibility is LECS and its modified methods. The most advantage of endoscopic dissection is the precise resection margin as demonstrated by Tsujimoto *et al.* (60). Vicente *et al.* described case-report robot-assisted resection for gastric GISTs in the EGJ (32) but more experience to determine the exact role of robot-assisted surgery is needed.

Body and fundus (anterior and posterior wall), greater and lesser curvature

For these sites the pattern of growth (exophytic or endophytic) can significantly influence the choice of technique. Exophytic GISTs of the anterior wall of the body and fundus are usually treated with a wedge resection according to the favourable site (anterior wall and greater curvature). Ultrasonic devices allow to control the margins reducing the wall defect and consequently the suture line length. This type of resection represents our common approach for GISTs placed in these locations. The application of stapler is widely reported in current literature as well.

For exophytic GISTs of the posterior wall of the fundus the main goal is to expose this part to allow a safe and easy resection. First step is represented by the section of gastrophrenic ligament associated to the division of two or more short gastric vessels. Secondly, the mobilized fundus can be fixed with some stitches to the abdominal wall to complete wedge resection.

For lesions located on the lesser curvature (exophytic or endophytic) is necessary to evaluate the real distance between them and EGJ or pylorus. Endoscopic intraoperative cooperation is a valid tool to plan the best technique of resection for these tumor's locations. It's important to pay attention to not grab the lesion but the adjacent health tissue to avoid tumor rupture. When there is a strong risk of narrowing, a gastrotomy can be performed proximally or distally to the tumor everting the mucosa out of the stomach ("eversion technique"). The resection can be completed by the application of stapler or ultrasonic excision (61,62).

For the endophytic lesions, transgastric or intragastric techniques represent two valid options as described above (63,64). For this pattern of growth our technique is preferably the intragastric one.

Antrum and pylorus

Similar to EGJ, GISTs in antrum/prepyloric region are challenging neoplasms to resect via minimally invasive techniques. In case of significant risk of narrowing of the gastric lumen or inadequate margins, in agreement with literature, we prefer to perform a distal gastrectomy and a reconstruction with Roux-en-Y as described by Hwang *et al.* (65). If the tumor appears at least 2 cm from the pylorus, it may be candidate to wedge resection. Many authors recommended manual resection using ultrasonic coagulating shears to perform a full-thickness disk resection without use of stapler to avoid stenosis and to limit the healthy tissue loss, and then primarily closure with a running suture (66). Arseneaux *et al.* (67) demonstrated the feasibility of robotic gastric GISTs resection in difficult locations, resulted in R0 resection without complications or stenosis.

Conclusions

Gastric GISTs are a wide spectrum of tumors and resection requires tailored strategies and flexibility of techniques, sometimes with the help of endoscopy. Due to the rising incidence of these tumors, a wide array of surgical approaches has been proposed. Minimally invasive surgery for gastric GISTs is safe and oncologically effective but should be only performed by surgeons skilled in to manage this type of cancer and surgery (68). As a matter of fact, in expert hands, minimally invasive surgery can be potentially safe extended to tumors regardless of size or particular locations, obtaining R0 resection and minimizing the risk of tumor's rupture. For large GISTs, with a diameter more than 5 cm, the application of minimally invasive approaches is still debated and more prospective analyses must be conducted to define its role. The knowledge of the different techniques and types of resections allows to successfully manage even the most difficult cases. At the end of the gastric resection, regardless of whether a suture or stapled resection is performed, an endoscopic evaluation should be employed with a double intent: Principally to check the absence of stricture particularly for EGJ and pylorus and secondary to evaluate the integrity of the suture with intraoperative air test.

In our common clinical practice, laparoscopy represents the gold standard for tumors lower than 5 cm. In all the

other cases, open, laparoscopic or robotic approach is tailored to the specific features of each single case during the multidisciplinary meeting. Robotic approach is intended for highly selected cases, but we are convinced that with the increasing diffusion of robotic surgery, the decreasing of costs and consequently its wider application more interesting technical results will be achieved especially for GISTs in difficult locations. According to our deep and long experience in minimally invasive surgery, the main contraindication for mini-invasive approaches remains represented by large tumors involving adjacent organs and requiring multivisceral resections.

The studies cited in this article have widely demonstrated good results of minimally invasive techniques also for what concerns perioperative results and long-term oncological outcomes reporting a wide spectrum of different procedures for the same tumor's location. The principal limits of these studies are represented by the retrospective nature of the analyses and small sample size for each tumor's location. For the future, randomised prospective analyses should be proposed to define the best approach according to each location and pattern of growth.

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Footnote

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