



Robotic Gastrointestinal Stromal Tumors Surgery - Initial Results

Valentin Ivanov^{1,2}, Luboslav Dimov^{3,4}, Strahil Strashilov⁵, Denis Milkov⁶, Nikolai Dzalov⁷, Lyubomir Chervenkov⁸

¹ Medical Simulation Training Center at the Research Institute of Medical University of Plovdiv, Medical University of Plovdiv, Plovdiv, Bulgaria

² Department of Surgery, Kaspela University Hospital, Plovdiv, Bulgaria

³ Department of Endocrinology, Faculty of Medicine, Medical University of Plovdiv, Plovdiv, Bulgaria

⁴ Department of Endocrinology, Kaspela University Hospital, Plovdiv, Bulgaria

⁵ Department of Surgery, Faculty of Medicine, Medical University, Pleven, Bulgaria

⁶ Department of Otorhinolaryngology, Kaspela University Hospital, Medical University of Plovdiv, Plovdiv, Bulgaria

⁷ Surgical Clinic, Faculty of Medicine, Medical University of Plovdiv, Kaspela University Hospital, Plovdiv, Bulgaria

⁸ Medical University of Plovdiv, Plovdiv, Bulgaria

Corresponding author: Valentin Ivanov, Department of Surgery, Kaspela University Hospital, 64 Sofia St., Plovdiv, Bulgaria; Email: surgery.ivanov@gmail.com; Tel.: +359 888 244 798

Received: 9 Aug 2022 ♦ **Accepted:** 15 Sep 2022 ♦ **Published:** 31 Dec 2022

Citation: Ivanov V, Dimov L, Strashilov S, Milkov D, Dzalov N, Chervenkov L. Robotic gastrointestinal stromal tumors surgery - initial results. *Folia Med (Plovdiv)* 2022;64(6):884-888. doi: 10.3897/folmed.64.e91448.

Abstract

Introduction: Gastrointestinal stromal tumors (GISTs) usually present as an exophytic mass localized in stomach. Years ago, conventional surgery was the only option. Laparoscopic and robotic procedures have risen to prominence in recent decades as technology and surgical techniques have advanced.

Aim: The aim of this study was to evaluate the safety and feasibility of robotic surgery of GIST.

Materials and methods: All patients who underwent robotic surgery for a GIST in the University Hospital Kaspela-Plovdiv between November 2021 and April 2022 were included. Post-operative course and short oncological outcomes were analyzed.

Results: Four patients with gastric GIST, median size 50 mm [40–70 mm], underwent robotic surgery. Conversion to open surgery not occurred. We have two cases with localization in corpus, one in antrum and one in the fundus. We have registered one complications-anastomotic leakage after proximal resection treated conservatively. In others, the post-operative period was uneventful. The average hospital stay was 8.2 (4-11) days. The median operating time was 255 min (220–320 min).

Conclusions: On basis of this initial results, we can conclude that robotic gastrointestinal tumors surgery is safe, feasible, and oncological sustained. Of course, one of the weakest sides of this surgery is prolonged operative time and increased expenses.

Keywords

gastrointestinal stromal tumors, robotic gastric resection

INTRODUCTION

Gastrointestinal stromal tumors (GIST) are the most common mesenchymal tumors of the gastrointestinal tract

(20/1000000). They occur mainly in the stomach (50-60% of cases), followed by the small intestine(20-30%), rectum (about 10%), and are usually asymptomatic. They are often discovered after prophylactic imaging or endoscopic examinations, or during surgery on another occasion. In symp-

omatic cases, they commonly present with bleeding from the gastrointestinal tract, abdominal discomfort, pain, or signs for intestinal obstruction.^[1]

The mainstay of treatment is radical surgical resection with clean resection margins and avoidance of disease dissemination, especially for tumors ≥ 2 cm.^[2,3] This condition can be fulfilled using different surgical techniques and extent of surgery—local excision, wedge resection for small masses, proximal and distal resections, and even total gastrectomies, depending on the size and location of the formation.

In the early development of minimally invasive surgery, the limiting factors for its application in these tumors include limitations caused by their size, and the risk of injury with subsequent peritoneal dissemination. The first consensus decision^[4] by the 2004 Consensus Conference limited the laparoscopic approach for tumors >2 cm in size (National Comprehensive Cancer Network – NCCN). With time and further development of surgical techniques, the contraindications caused by the size of the tumor disappeared, while retaining the recommendations based on oncological principles. (ESMO Gastrointestinal stromal tumors: ESMO EURACAN GENTURIS Clinical Practice Guidelines for diagnosis, treatment and follow-up).^[5]

In the last decade, robotic surgery began to occupy a significant portion of surgical interventions in abdominal surgery, thanks to the advantages it has over open and laparoscopic techniques, offering equivalent oncological results in the treatment of malignant neoplasms.^[6,7]

AIM

The aim of this study was to evaluate the safety and feasibility of robotic surgery of gastro intestinal stromal tumors.

MATERIAL AND METHODS

From November 2021 to April 2022, four patients with proven gastric GIST passed through the Department of Surgery at University Hospital Kaspela, Plovdiv, Bulgaria. All of them were confirmed preoperatively using immunohistochemical examination of biopsy material taken by esophagogastroduodenoscopy, staged by computed tomography and surgically treated using the da Vinci robotic system (Intuitive Surgical, Inc., Sunnyvale, CA). The definitive staging and postoperative diagnosis confirmation of GIST was once again performed using the immunohistochemical examination of CD117 (KIT) positive cells.

The position of the patients on the operating table was supine, with arms tucked by the side of the body. A Veress needle was inserted through a small supraumbilical incision and an initial CO₂ insufflation was performed, at a pressure of 12 mmHg. Next, the first robotic 8 mm trocar was inserted through the incision. The remaining three robotic trocars were placed under direct vision, in line with

the first, two to the right of the umbilicus and one to the left, at a distance of about 7-8 cm from each other. An infraumbilical assistant port, near the lateral edge of the rectus abdominis muscle on the left, was additionally placed, representing the air seal cannula. After positioning all of the trocars, the patient was placed in the reverse Trendelenburg position.

A laparoscopic exploration of the peritoneal cavity to rule out the presence of peritoneal or liver metastases was then performed. This was followed by the docking of the robotic system and beginning of surgery (Fig. 1).



Figure 1. Docking of the robotic system.

RESULTS

The characteristics of the patients are presented in **Table 1**. The compared indicators include tumor location, tumor growth type and size, Fletcher's score, postsurgical morbidity and length of hospital stay.

These initial results include four patients – three women and one man, diagnosed with GIST and undergoing robotic gastric resection of varying extents. The average age of the patients was 64.3 years (53-72 years). In three of the cases, the disease was asymptomatic, and was detected during routine GIT examinations, and in the fourth, complaints of abdominal discomfort and dyspepsia were presented. In all patients, an intraoperative ultrasound was performed, with biopsy of the tumor formations, proving the latter preoperatively by immunohistochemical examination. The lesions were located in the region of the corpus, along the anterior wall in two patients, in the antrum in one, and in the cardia, in the area near the esophago-gastric junction in one patient. All of the tumors had an endophytic growth and its average size was 5 cm (4-7 cm). According to their extent the surgical procedures included two distal resections, in cases with location in the corpus,

one proximal resection, due to GIST in the cardia, and one antrumectomy. No conversion was required in any of the cases. We did not register intraoperative complications, tumor rupture or dissemination. The average blood loss in this initial group of patients was about 70 ml (80-120 ml), and for this reason the patients did not need hemotransfusions in the postoperative period. Histopathological examination according to the Fletcher criteria classified one of the tumors as low risk and the other three as intermediate. The average operative time in all of the cases was 255 minutes (220-320 minutes).

As a complication, we observed a low-flow fistula in the patient with the proximal resection, which closed spontaneously and was classified as grade I according to the Clavien-Dondo classification. The average hospital stay in our group was 8.2 days (4-11 days). The follow-up period of the patients was 9.75 months (8-11 months), and no recurrence was recorded during this short interval.

DISCUSSION

The most common location of gastrointestinal stromal tumors is the stomach. They are characterized by exo- and endophytic growth patterns, and their biological behavior and tendency to metastasize varies.^[8] Lymph node involvement by metastatic disease is very rare, and for this reason lymph node dissection is not recommended. Recurrences are usually due to translocation of cells at the contact of the tumor formation with adjacent abdominal structures, most often the peritoneum, and in a very small percentage of cases due to unclean resection margins. The pseudocapsule covering tumors growing towards the peritoneal cavity protects them from dissemination, but it is thin and easily ruptures spontaneously in case of rapid growth, trauma or rough handling intraoperatively.^[9-13]

A resection margin of 1-2 cm in healthy tissue is considered oncological safety, with low local recurrence rate. Therefore, with an appropriate location, wedge resection is the method of choice for most of the GISTs. However, the possibility of different gastric resections and even gastrectomies for certain tumor sizes and locations remains.^[14] A series of studies and meta-analyses have proven the safety of minimally invasive surgery in the treatment of these tumors. The main limiting factor was tumor size above 2 cm,

considering the risk of tumor rupture during the surgery, with its subsequent dissemination, resulting in recurrence and deterioration of survival.^[15]

Liao et al. found out that laparoscopic surgery (LS) for intestinal GISTs led to oncological outcomes that were comparable to those of laparotomy after a long-term follow-up and that LS was associated with favorable perioperative outcomes and a shorter hospital stay compared to laparotomy. With strict oncological precautions and protection, laparoscopic treatment may be a safe and effective procedure for small- and medium-sized intestinal GISTs.^[16]

Recently, minimally invasive surgery is increasingly being utilized for resection of gastric and small bowel GIST, with improved postoperative outcomes, where overall survival after minimally invasive or open surgery was comparable, even in challenging scenarios of neoadjuvant treatment or large tumors (≥ 10 cm).^[17]

Gevorkian et al. consider that the utilization of robotic-assisted resections of GI cancers is rapidly increasing with more frequent use in younger and healthier patients, where with the utilization of robotic-assisted resections, perioperative outcomes and oncologic safety have not been compromised.^[18]

In our initial group, the average size of the tumors was 5 cm, and we recorded no cases of injury and dissemination, due to the experience of the surgical team in laparoscopic surgery and correct instrument selection. These results coincide with modern minimally invasive and robotic approaches in the treatment of GIST, relying on the safety and reliability of surgical techniques, proven by a number of multicenter studies.^[19-21] In our patients, the main factors were location and the determination of macroscopically clean resection margins.

CONCLUSIONS

Based on the short-term results of our first few cases with gastrointestinal stromal tumors operated robotically, we can conclude that this type of surgery is safe and oncologically equivalent to conventional procedures. The benefits of robotic over laparoscopic surgery are well-known, but there are also disadvantages related mainly to the extended operative time and increased cost of the procedure..

Table 1. Patients characteristics

Patient	Sex	Age	Symptoms	Location	Tumor growth	Tumor size (cm)	Fletcher's score
1	M	63	Asymptomatic	Cardia	Endophytic	7	Intermediate risk
2	F	53	Asymptomatic	Corpus	Endophytic	4	Intermediate risk
3	F	69	Asymptomatic	Corpus	Endophytic	4	Low risk
4	F	72	Abdominal discomfort and dyspepsia	Antrum	Endophytic	5	Low risk

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

The paper is not based on a previous communication to a society or meeting.

Funding for research

None

Conflict of Interest

The authors have no conflicts of interest to declare.

Ethical Statement

The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Institutional Review Board of Kaspela University Hospital-Plovdiv (IRB No. 2022-01-04).

REFERENCES

1. Marcella C, Shi RH, Sarwar S. Clinical overview of GIST and its latest management by endoscopic resection in upper GI: a literature review. *Gastroenterol Res Pract* 2018; 2018:6864256.
2. Gertsen EC, van Boxel GI, Brosens LAA, et al. Minimally invasive resection of large gastric gastrointestinal stromal tumors. *Dig Surg* 2020; 37:441–6.
3. Kankerregistratie N. Incidence of gastric GISTs 2019; 2018–20: Available from: <https://www.cijfersoverkanker.nl/selecties/dataset>.
4. Demetri GD, Benjamin RS, Blanke CD, et al. NCCN Task Force report: management of patients with gastrointestinal stromal tumor (GIST)—update of the NCCN clinical practice guidelines *J Natl Compr Canc Netw* 2007; 5(Suppl. 2):S1–29; quiz S30.
5. Casali PG, Blay JY, Abecassis N, et al. Gastrointestinal stromal tumours: ESMO-EURACAN-GENTURIS Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 2022; 33(1):20–33.
6. Haverkamp L, Brenkman HJ, Seesing MF, et al. Laparoscopic ver-
7. Kostov G, Doykov M, Dimov R. Robotic-assisted colorectal surgery - initial results. *Folia Med (Plovdiv)* 2022; 64(3):388–92.
8. Lai EC, Lau SH, Lau WY. Current management of gastrointestinal stromal tumors a comprehensive review. *Int J Surg* 2012; 10:334–40.
9. Huang CM, Chen QF, Lin JX, et al. Can laparoscopic surgery be applied in gastric gastrointestinal stromal tumors located in unfavorable sites? A study based on the NCCN guidelines. *Medicine* 2017; 96(14):e6535–8.
10. Fong Y, Coit DG, Woodruff JM, et al. Lymph node metastasis from soft tissue sarcoma in adults. Analysis of data from a prospective database of 1772 sarcoma patients. *Ann Surg* 1993; 217(1):72–7.
11. Cirocchi R, Farinella E, La Mura F, et al. Efficacy of surgery and imatinib mesylate in the treatment of advanced gastrointestinal stromal tumor: a systematic review. *Tumori* 2010; 96(3):392–9.
12. Kostov GG, Dimov RS, Doykov MI. Prophylactic central lymph node dissection in differentiated thyroid cancer - benefits and risk. *Folia Med (Plovdiv)* 2022; 64(3):430–6.
13. Kostov G, Dimov R, Doykov M. Diverting ileostomy in low anterior resection: single center retrospective analysis; *Pol Przegl Chir* 2022; 94:(1–6).
14. Desiderio J, Trastulli S, Cirocchi R, et al. Robotic gastric resection of large gastrointestinal stromal tumors. *Int J Surg* 2013; 11(2):191–6.
15. Bischof DA, Kim Y, Dodson R, et al. Open versus minimally invasive resection of gastric gist: a multi-institutional analysis of short- and long-term outcomes. *Ann Surg Oncol* 2014; 21(9):2941–8.
16. Liao CH, Yeh CN, Wang SY, et al. Surgical option for intestinal gastrointestinal stromal tumors – perioperative and oncological outcomes of laparoscopic surgery. *Anticancer Research* 2015; 35(2):1033–40.
17. Loureiro Mde P, Almeida RA, Claus CM, et al. Laparoscopic resection of gastrointestinal stromal tumors (Gist). *Arq Bras Cir Dig* 2016; 29(1):1–4.
18. Gevorkian J, Le E, Alvarado L, et al. Trends and outcomes of minimally invasive surgery for gastrointestinal stromal tumors (GIST). *Surg Endosc* 2022. doi: 10.1007/s00464-022-09014-2.
19. Masoni L, Gentili I, Maglio R, et al. Laparoscopic resection of large gastric GISTs: feasibility and long-term results. *Surg Endos* 2014; 28(10):2905–10.
20. Doykov M; Kostov G, Doykova K. Factors affecting residual stone rate, operative duration, and complications in patients undergoing minimally invasive percutaneous nephrolithotomy. *Medicina* 2022; 58:422.
21. Lai IR, Lee WJ, Yu SC. Minimally invasive surgery for gastric stromal cell tumors: intermediate follow-up results. *J Gastrointest Surg* 2006; 10(4):563–6.

Роботизированная хирургия гастроинтестинальных стромальных опухолей – первые результаты

Валентин Иванов^{1,2}, Любослав Димов^{3,4}, Страхил Страшилов⁵, Денис Милков⁶, Николай Дзалов⁷, Любомир Червенков⁸

¹ Медицинский симуляционный центр при Научно-исследовательском институте Медицинского университета – Пловдив, Пловдив, Болгария

² Отделение хирургии, УМБАЛ „Каспела“, Пловдив, Болгария

³ Кафедра эндокринологии, Факультет медицины, Медицинский университет – Пловдив, Пловдив, Болгария

⁴ Отделение эндокринологии, УМБАЛ „Каспела“, Пловдив, Болгария

⁵ Кафедра хирургии, Факультет медицины, Медицинский университет – Плевен, Болгария

⁶ Отделение оториноларингологии, УМБАЛ „Каспела“, Медицинский университет – Пловдив, Пловдив, Болгария

⁷ Хирургическая клиника, Факультет медицины, Медицинский университет – Пловдив, УМБАЛ „Каспела“, Пловдив, Болгария

⁸ Медицинский университет – Пловдив, Пловдив, Болгария

Адрес для корреспонденции: Валентин Иванов, Отделение хирургии, УМБАЛ „Каспела“, ул. „София“ № 64, Пловдив, Болгария; Email: surgery.ivanov@gmail.com; Тел.: +359 888 244 798

Дата получения: 9 августа 2022 ♦ **Дата приемки:** 15 сентября 2022 ♦ **Дата публикации:** 31 декабря 2022

Образец цитирования: Ivanov V, Dimov L, Strashilov S, Milkov D, Dzalov N, Chervenkov L. Robotic gastrointestinal stromal tumors surgery – initial results. Folia Med (Plovdiv) 2022;64(6):884-888. doi: 10.3897/folmed.64.e91448.

Резюме

Введение: Гастроинтестинальные стромальные опухоли (ГИСО) обычно представляют собой экзофитную массу, локализованную в желудке. Несколько лет назад традиционная хирургия была единственным вариантом. Лапароскопические и роботизированные процедуры приобрели известность в последние десятилетия по мере развития технологий и хирургических методов.

Цель: Целью данного исследования было оценить безопасность и осуществимость роботизированной хирургии ГИСО.

Материалы и методы: Были включены все пациенты, перенёвшие роботизированную операцию по поводу ГИСО в Университетской клинике Каспела – Пловдив в период с ноября 2021 г. по апрель 2022 г. Проанализированы послеоперационное течение и ближайшие онкологические исходы.

Результаты: Четырём пациентам с ГИСО желудка со средним размером 50 мм [40–70 мм] была проведена роботизированная хирургия. Конверсии на открытую операцию не произошло. У нас есть два случая с локализацией в теле, один в антральном отделе и один в глазном дне. Нами зарегистрировано одно осложнение – несостоятельность анастомоза после проксимальной резекции, леченной консервативно. У остальных послеоперационный период протекал гладко. Средняя продолжительность пребывания в стационаре составила 8.2 (4-11) дней. Среднее время операции составило 255 мин (220–320 мин).

Заключение: На основании этих первоначальных результатов мы можем сделать вывод, что роботизированная хирургия опухолей желудочно-кишечного тракта безопасна, осуществима и онкологически устойчива. Конечно, одной из самых слабых сторон этой операции является удлинение времени операции и увеличение затрат.

Ключевые слова

гастроинтестинальные стромальные опухоли, роботизированная резекция желудка