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Original Article

Comparison of Short Term Results Following Robotic and Laparoscopic Total Gastrectomy and D2 Lymph Node Dissection

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Abstract

Introduction: In the last decade, there has been a progressive shift from open to mini-invasive operative techniques for surgical resection of gastric cancer. Advanced equipment of surgical robots, with its 3D visualization, steady camera view, flexible instrument tips, attracts more and more practitioners in performing robotic gastrectomy with D2 dissection in gastric cancer patients. Thus, the comparison of some basic oncological as well as some surgical variables related to laparoscopic and robotic gastrectomy and D2 lymphadenectomy is necessary.

Aim: The aim of the study was to compare our initial short-term results after robotic and laparoscopic gastrectomy.

Materials and methods: A retrospective cohort study was performed. For a period of four years between January 2018 and August 2022, a total number of 110 patients with total gastrectomy and D2 lymphadenectomy due to gastric cancer operated in Department of General Surgery, Kaspela University Hospital, Plovdiv, were included into the study. They were separated in two groups: thirty-eight patients with robotic surgery and 72 with laparoscopic assisted procedure.

Results: The oncological variables such as location of tumor, nodal status, number of lymph nodes removed, and pathological tumor showed no statistically significant differences between robotic and laparoscopic group. The demographic variables as age, sex, BMI, as well as ASA score also demonstrated no remarkable difference in both groups (p>0.05). The overall complication rate were similar (p=0.983).

Conclusion: We found no significant advantages of robotic over laparoscopic gastric surgery in our patients. However, we think that robotic surgery is effective, safe, and promising approach to the treatment of gastric cancer capable of correcting some of the disadvantages of laparoscopy.

Keywords

gastric cancer, robotic gastrectomy, laparoscopic gastrectomy

INTRODUCTION

Gastric cancer is the second most common cause of cancer-related death after colorectal malignancies. Surgical resection with D2 lymph nodes dissection remains the gold standard of treatment in the last years. In this century, we have noted a significant change in the surgical approach from conventional to mini-invasive due to development of medical technologies and surgical techniques.[1]

Robotic surgery has been in use since 2000, after its approval by the US Food and Drug Administration (FDA). It offers several advantages over laparoscopic surgery including better ergonomics, motion scaling, less fatigue, tremor filtering, wrist-like multiple axis motion, and three-dimensional vision.[2]

During the past two decades, several studies have demonstrated the benefits of minimally invasive over conventional surgery, including reduced blood loss, less pain, low percentage of postoperative wound infection, earlier recovery and hospital discharge of patients. Many authors in order to collect solid evidence for the benefits of minimally invasive surgery for gastric cancer are focused on short and long-term outcomes of conventional, laparoscopic and robotic surgery. Advances in mini-invasive surgery (laparoscopic and robotic gastrectomy) enable the improvement of surgical results, the quality of life of patients, but without compromising oncologic safety.[3]

With its advanced equipment, robotic gastrectomy gives a major advantage over the laparoscopic approach, especially in performing the D2 lymph node dissection and in reconstructive part after. A variety of reports and meta-analysis have demonstrated the safety and feasibility of this technique.[4,5]

AIM

The aim of the study was to compare our initial short term results after robotic and laparoscopic gastrectomy.

MATERIALS AND METHODS

From January 2018 to August 2022, 38 patients underwent robotic total gastrectomy with D2 lymph node dissection and 72 patients - laparoscopic assisted total gastrectomy with D2 lymph node dissection for gastric cancer at the department of General Surgery, Kaspela University Hospital, Plovdiv. The patients with the following criteria were excluded from the study: 1) gastric stump cancer; 2) advanced T-stage: pT4b; 3) present of distant metastasis; 4) evidence of malignant spread in other organs; 5) emergency surgery; 6) high ASA score (cardiovasculary, respiratory disorders, and hepatic or renal failure).

The inclusion criteria were: 1) Histologically proven gastric cancer; 2) No evidence of distant metastases; 3) No involvement of the nearest structures or organs; 4) No severe co-morbidity.

Several factors were observed and compared between the two groups: sex, age, body mass index (BMI), TNM classification, tumor location and American Society of Anesthesiologists (ASA) score. Also, short term outcomes: blood loss, operation time, time-to-first flatus, postoperative morbidity, hospital stay, pathological results, the visual analogue pain score at 24 hours after surgery.

Surgical procedures

All of the Robotics total gastrectomy's and lymph node dissection (RTGLND) and Laparoscopic assisted total gastrectomy and lymph node dissection (LATGLND) were performed by the same team with experience in laparoscopic gastrointestinal surgery. All procedures were performed under general anesthesia and endotracheal intubation. Patients were placed in the supine and reverse Trendelenburg position with the legs elevated approximately 15°-20° and separated. Most of the operative steps in the Robotic group (RG) were the same as those in the Laparoscopic group (LG). Both procedures used five trocars, adopts "same line" **(Fig. 1)** in the Robotic and "U type" in the Laparoscopic group **(Fig. 2)**.

The robotic 8 mm camera port was inserted in the infra-umbilical area by the closed method. Pneumoperitoneum was established with an intra-abdominal pressure of 12 mmHg. Additional three 8-mm trocars for the first, third and fourth robotic arm and one 12 mm for the assistant were placed. In laparoscopic cases 10 mm camera port was inserted above the umbilicus and additional 12-mm trocar for surgeon and one 5-mm were situated in the left and right anterior axillary line just 2 cm below subcostal. Standard D2 lymphadenectomy was performed in all procedures in accordance with the Japanese Gastric Cancer Treatment Guidelines **(Fig. 3)**.

Afterward, in RG, the specimen was removed and placed into retrieval bag and left above the right liver lobe. Through an enlargement of incision of assistant port 21 mm circular stapler was introduced and Omega esophagojejunostomy was performed. Additional two layers Braun anastomosis was done intra corporally **(Fig. 4)**.

In LG, small 6-7 cm midline incision was made and after specimen removal a mechanical Omega esophagojejuno anastomosis with circular stapler was created, with subsequent two layers intestinal (Braun) anastomosis. Finally, two drainage tubes were placed near the duodenal stump and splenic recess respectively, close to the anastomosis. All abdominal openings greater than 5 mm were closed. The criteria to remove drainage tubes were: 1) drainage volume less than 10 ml per day; 2) no smell; 3) patients without fever or peritonitis symptoms.

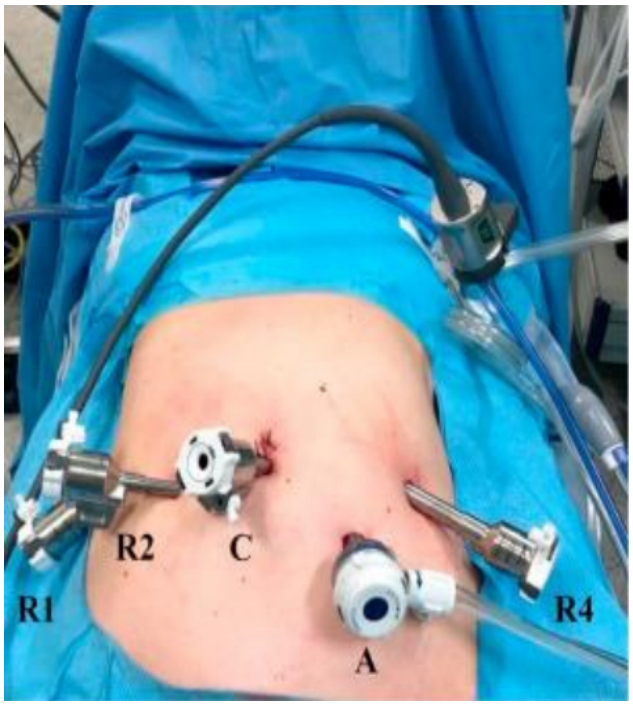

Figure 1. Port placement in robotic gastrectomy.

Figure 2. Port placement in laparoscopic gastrectomy.

Figure 3. View after robotic gastrectomy and D2 lymph node dissection.

Figure 4. Intracorporal Braun anastomosis creation.

Statistical analysis

SPSS 22.0 was used for the data analysis in the present study. Continuous variables were presented as mean ± SD when variables are normally distributed. If normal distribution failed to be assumed, the variables were presented as median and range. Continuous variables in normal distribution were compared between two groups using the t-test, otherwise Mann-Whitney U-test. For categorical variables presented as numbers and percentages, chi-squared test or Fisher's exact test was used. $P<0.05$ were considered as statistically significant.

RESULTS

Table 1 showed the demographic and clinical findings in patients with RTGLND and LATGLND groups. Fifty-seven male and 53 female patients with the average age of 67 years (range 44 to 82 years) were included in the present study. Sex, age, body mass index, tumor location and diameter, and ASA score showed no significant differences between the Robotic and Laparoscopic group ($p>0.05$).

Table 2 showed the intraoperative and postoperative outcomes and complications for the patients in the two groups. The RTGLND group was related with non-sig-

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Table 1. Demographics and clinical findings in patients with RTGLND and LATGLND

	RATG n=38	LATG n=72	
Sex (n, %)			
Male	24 (63.1)	33 (45.8)	
Female	14 (36.9)	39 (54.2)	
Age (mean ± SD, years)	63.1±11.7	62.1±7.3	0.658
Body mass index (median and range, kg/m^2)	23.6 (17.1–28.3)	23.9 (19.5–27.9)	0.641
Location of neoplasm (n, %)			
Corpus	21 (55.3)	44 (61.1)	
Fundus ventriculi	17 (44.7)	28 (38.9)	
Tumor stage (n, %)			0.691
2	12 (31.6)	21 (29.1)	
3	20 (52.6)	39 (54.2)	
4	6 (15.8)	12 (16.7)	
Nodule stage (n, %)			0.913
0	12 (31.7)	23 (31.9)	
1	16 (41.9)	31 (43.0)	
2	6 (15.9)	11 (15.4)	
3a	4 (10.5)	6 (8.3)	
3b	-	1 (1.4)	
ASA score (n, %)			0.925
1	13 (34.2)	24 (33.3)	
2	22 (57.9)	43 (59.8)	
3	3 (7.9)	5 (6.9)	

ASA: American Society of Anesthesiologists classification

Table 2. Postoperative outcomes and complications

Operative outcomes	RATG n=38	LATG n=72	*P* value
Operative time	258.9±38.4	188.6±21.3	0.046
Blood loss (mL)	173.5±19.3	189.8±45.0	0.104
Time to remove abdominal drainage tube (days)	8.0 (5.0–31.0)	8 (6.0–22.0)	0.491
Numbers of retrieved lymph nodes (n)	27.4±5.0	24.2±3.8	0.131
Visual analogue pain score at 24 h after operation (scores)	6.0 (4.0–8.0)	5.0 (2.0–7.0)	0.457
Time to first flatus (hours)	55.5±6.0	56.2±7.5	0.448
Complications (n, %)	7, (18.4%)	14, (19.4%)	0.983
Wound infection	-	2	0.463
Pneumonia	2	1	0.824
Esophagojejunostomy anastomotic bleeding	1	1	0.682
Duodenal stump leakage	1	2	0.483
Esophagojejunostomy anastomotic leakage	3	7	0.491
Heart failure	0	1	0.884
Postoperative length of stay (days)	9.0 (6.0–34.0)	9.0 (7.0–37.0)	0.872

nificant less blood loss (173.5±19.3 vs. 188.6±21.3 mL) (p=0.104) and longer operation time (258.9±38.4 vs. 188.6±21.3 min) (p=0.046) as compared with the LATGLND group. The time to remove abdominal drainage tube was also equal in both groups 8.0 (4.0–31.0) vs. 8.0 (6.0–32.0) days, (p=0.491). Furthermore, the number of harvested lymph nodes was more in the Robotic group (27.4±5.0 vs. 24.2±3.8) (p=0.131).

However, the postoperative length of stay, the time to first flatus, and the visual analogue pain score at 24 h after surgery were comparable between the two groups (p>0.05). The overall postoperative complication rates also were similar (p=0.983), with 18.4% and 19.4% in the RATG and LATG groups, respectively. There were two complications in the RATG and fourteen in the LATG group.

DISCUSSION

The surgery time in the RG group was significantly longer than in the LG group. The same results were demonstrated by many researchers and meta-analyses.[6] The longer time results from the robotic set-up, docking time, and time consuming camera cleaning. Some procedures were performed by the first assistant, such as creating field, lifting structures, suction, applying clips and endo GIA, which also increased the duration of surgery.[7]

The blood loss was insignificantly lower in the robotic group. Several authors, like Huang et al., have reported similar results.[8] This could be due to the advantages of robotic systems that reduced operator tremor, provided clear 3D view and high degrees movement of the endo-wrist, which lead to avoiding injuries to blood vessels especially in the inferior pyloric and superior pancreatic area during D2 lymph node dissection.[9]

Some physicians think that robotic gastrectomy could decrease the drainage output and shorten the time to their removal. This could be again due to better visualization of surgical field, anatomical structures and advanced movement of instruments. This advantages reduce the residuals of adipose, lymphatic tissue and vessels near the stomach. Many researchers think this is the main factors for high drainage lymphatic output in post-op period.[10] In our study, we did not notice significant differences in the two groups.

Most patients with gastric cancer have varied degrees of lymph node metastasis during the initial diagnosis. D2 lymphadenectomy is one of the crucial steps in this procedure.[11] The number of obtained lymph nodes and evaluation of their involvement is very important for the accurate staging and prognosis.[12] Dissection of some nodes is difficult to be performed mini invasively, especially that around the common hepatic artery, the splenic vessels at the hilum, and the hepatoduodenal ligament. Our research revealed that robotic D2 lymph node dissection had the ability to retrieve more lymph nodes compared to the laparoscopic group. The reasons for that are again the advantages of robotic systems which allowed the surgeon to reach deep-seated vessels and the delicate areas more easily. Traction, counter traction, exposure, and the vision is clearer and camera more stable than laparoscopy and this may facilitate the "difficult" lymph node dissection in above areas.[13,14] Several other studies like Cianchi et al., Junfeng et al., have similar results.

The postoperative hospital stay, the pain evaluated by visual analogue score at 24 h after surgery and the time to first flatus did not show significant difference between two groups (p>0.05). There is also no difference in the length of hospital stay due to the requirements of national health system (minimal hospital stay 7 days).

Postoperative pain was mainly caused by the abdominal wall incision. In the laparoscopic group, we removed the specimen and anastomosis were created by a 6 to 7 cm median abdominal incision. In the robotic group, we extracted the specimen by 3-4 cm incision in the area of the assistant port. This is a possible reason why visual analogue pain score at 24 h after the operation did not differ significantly.

The postoperative complications are very important when assessing the quality and safety of surgery. In the current study, complications rate was found to have no significant difference between the robotic and laparoscopic gastrectomy. The same results were described by various surgeons such as Isogaki et al., D'Annibale et al., and Song et al.[15-17] This could be because of our major experience in mini invasive and especially in upper GI surgery that was collected in the past decade.

The limitations of the current study include its retrospective and nonrandomized nature of the study and the small amount of patients in the robotic group.

CONCLUSIONS

In our patients, we did not find any significant advantages of robotic over laparoscopic gastric surgery. However, we think that robotic surgery is effective, safe, and promising approach to the treatment of gastric cancer and capable of correcting some of the disadvantages of laparoscopy. More randomized trials are essential to further evaluation of the robotic gastric surgery.

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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

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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: 2021-01-04).

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Сравнение краткосрочных результатов после роботизированной и лапароскопической тотальной гастрэктомии и диссекции лимфатических узлов D2

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Резюме

Введение: В последнее десятилетие произошёл прогрессивный переход от открытых к малоинвазивным оперативным методам хирургической резекции рака желудка. Передовое оснащение хирургических роботов с их 3D-визуализацией, устойчивым обзором камеры, гибкими наконечниками инструментов привлекает всё больше практикующих врачей к выполнению роботизированной гастрэктомии с диссекцией D2 у больных раком желудка. Таким образом, необходимо сравнение некоторых основных онкологических, а также некоторых хирургических переменных, связанных с лапароскопической и роботизированной гастрэктомией и лимфаденэктомией D2.

Цель: Цель исследования состояла в том, чтобы сравнить наши первоначальные краткосрочные результаты после роботизированной и лапароскопической гастрэктомии.

Материалы и методы: Проведено ретроспективное когортное исследование. В течение четырёх лет, с января 2018 г. по август 2022 г., в исследование было включено в общей сложности 110 пациентов с тотальной гастрэктомией и лимфаденэктомией D2 по поводу рака желудка, прооперированных в отделении общей хирургии Университетской больницы Каспела, Пловдив. Они были разделены на две группы: 38 пациентов с роботизированной хирургией и 72 пациента с лапароскопической поддержкой.

Результаты: Онкологические переменные, такие как расположение опухоли, статус узлов, количество удалённых лимфатических узлов и патологическая опухоль, не показали статистически значимых различий между роботизированной и лапароскопической группой. Демографические переменные, такие как возраст, пол, ИМТ, а также оценка ASA, также не продемонстрировали заметной разницы в обеих группах ($p>0.05$). Общая частота осложнений была одинаковой ($p=0.983$).

Заключение: Мы не обнаружили у наших пациентов существенных преимуществ роботизированной хирургии желудка перед лапароскопической. Однако мы считаем роботизированную хирургию эффективным, безопасным и перспективным подходом к лечению рака желудка, способным исправить некоторые недостатки лапароскопии.

Ключевые слова

рак желудка, роботизированная гастрэктомия, лапароскопическая гастрэктомия