European Review for Medical and Pharmacological Sciences 2024; 28: 3041-3047

Robotic gastrectomy is safe in geriatric patients with gastric cancer: a retrospective cohort study

S. YÜKSEL[1], U. TOPAL[1], M.Z. SONGUR[1], B. YILMAZ ÖZGÜVEN[2], E. KARAKÖSE[1], Z. TEKE[1], H. BEKTAŞ[1]

[1]Department of General Surgery, University of Health Sciences, Başakşehir Çam and Sakura City Hospital, Başakşehir, Istanbul, Turkey
[2]Department of Pathology, University of Health Sciences, Başakşehir Çam and Sakura City Hospital, Başakşehir, Istanbul, Turkey

Abstract. – OBJECTIVE: The efficacy of robotic surgery in oncological operations has been demonstrated, but its applicability in the elderly population (≥70 years) is limited in studies. This study aims to investigate the feasibility, safety, and short-term outcomes of robotic surgery in gastric cancer surgery in geriatric patients.

PATIENTS AND METHODS: Patients who underwent robotic surgery for gastric cancer between July 2021 and September 2023 were included in the study. Patients were divided into two groups: the elderly group (≥70 years) and the younger group (<70 years). Demographic data, clinical findings, perioperative outcomes, and pathology results were analyzed and compared between the two groups.

RESULTS: 63 patients were included in our study. Group 1, the younger patients (<70 years), consisted of 44 patients, while Group 2, the older patients (>70 years), consisted of 19 patients. The male gender was dominant in both groups (70.5% *vs.* 78.9%, *p*=0.486). ASA 2 was the most common score in both groups (70.5% *vs.* 52.6%, *p*=0.261). Group 2 had lower hemoglobin (11.3 *vs.* 10.1, *p*=0.017) and albumin levels (39.9 *vs.* 37.6, *p*=0.049). The average operation times were similar in both groups (255 min *vs.* 242 min, *p*=0.457). The median postoperative hospital stay was 5 days in both groups. The distributions of postoperative complications according to the Clavien-Dindo classification were similar. Postoperative 30-day mortality was observed in one patient in Group 2. The 90-day hospital readmission rates were similar (11.3% *vs.* 10.6%, *p*=0.459). The average tumor diameters were similar (38 mm *vs.* 48 mm, *p*=0.165), as were the numbers of dissected lymph nodes (35 *vs.* 34, *p*=0.796). According to pathology results, T4a tumors were most common in Group 1 and T0 tumors in Group 2 (34.1% *vs.* 31.6%, *p*=0.149). The most common lymph node involvements were N0 in Group 1 and N1 in Group 2 (36.4% *vs.* 36.8%, *p*=0.515).

CONCLUSIONS: Robotic surgery in gastric cancer is considered a safe and feasible method in the elderly population due to its successful early outcomes, suggesting its reliability and effectiveness.

Key Words:
Gastric cancer, Robotic Surgery, Age, Complications, Mortality.

Introduction

Gastric cancer remains the fifth most common cancer worldwide and the second leading cause of cancer-related deaths. Radical gastrectomy with lymph node dissection continues to be the curative and primary method for treating gastric cancer[1,2]. With the global trend of increasing life expectancy, the number of elderly individuals undergoing gastrectomy for radical treatment of gastric cancer is rising. Elderly patients, compared to younger ones, often have one or more comorbid conditions and are generally considered frail, with a higher risk of morbidity and mortality. Approaches involving less surgical trauma and a milder acute inflammatory response are recommended[3-5] in elderly patients.

Minimal-invasive surgical approaches for gastric cancer have been used as a tool to improve postoperative outcomes in patients undergoing gastrectomy due to gastric cancer. Reduced postoperative pain, decreased risk of complications, less blood loss, shorter hospital stays, and quicker return to normal daily activities are some demonstrated advantages. With the advancement of surgical techniques, the gradual introduction of the da Vinci robotic surgical system (Intuitive Surgical Inc., Sunnyvale, CA, USA) into the sur-

Corresponding Author: Sercan Yüksel, MD; e-mail: drsercanyuksel@gmail.com

gical field is taking minimally invasive surgery into a new era. However, critical issues need to be addressed for the more frequent application of robotic gastrectomy for gastric cancer, including its use in patients with high morbidity, cost considerations for advanced cancer and frequently debated oncological safety[6,7].

The reliability and validity of robotic surgery as an alternative to laparoscopic and open surgery for various malignancies have been established in various studies[8-11]. However, data on the safety and feasibility of robotic gastrectomy in elderly patients are lacking. The same concerns about potential dangers to elderly patients, including prolonged operation time and pneumoperitoneum, which were raised when laparoscopic gastrectomy was first introduced, are now being raised for robotic gastrectomy.

There are a few studies[3,12] in the literature on this topic. Therefore, this study aimed to evaluate the safety and feasibility of robotic gastrectomy in elderly patients (>70 years) by comparing its surgical outcomes with those in younger patients undergoing robotic gastrectomy.

Patients and Methods

Following the approval from the local Ethics Committee with the reference number KAEK/2022.12.408, the study was planned as a single-center retrospective analysis. Due to the retrospective nature of the study, patient consent was waived in accordance with IRB approval. Patients who underwent robotic surgery for gastric cancer between July 2021 and September 2023 were included in the study. Patients who underwent laparoscopic and conventional surgery, those with multiple primary cancers, non-adenocarcinoma pathology, and patients under 18 years of age were excluded. Clinical and follow-up data of all patients undergoing robotic surgery in our clinic are prospectively recorded. These records are created using patient electronic files, pathology results, and nurse observation forms. Analyses were performed using this created dataset.

Patients were divided into groups based on age 70, as referenced in previous studies[12-15]: Group 1 (<70 years) and Group 2 (≥70 years). In these groups, patients' demographic characteristics, the American Society of Anesthesiologists (ASA) score, preoperative hemoglobin and albumin levels, tumor markers, neoadjuvant treatment status, tumor location, surgical treatment procedures performed, intraoperative complications, operation time, tumor diameter, number of dissected lymph nodes, number of metastatic lymph nodes, postoperative complications, postoperative hospital stay duration, reoperation, postoperative 30-day mortality, 90-day unplanned hospital readmission, and adjuvant therapy status were compared.

All patients diagnosed with carcinoma were discussed in a multidisciplinary tumor board to decide on treatment methods. To determine the clinical stage and diagnosis before surgery, endoscopy, endoscopic ultrasonography, computed tomography, abdominal ultrasonography, and, when necessary, PET-CT, were performed. The pathological diagnosis was determined according to the World Health Organization (WHO) classification[16], and the disease stage was determined using the 8th Edition of the TNM Classification[17]. The Clavien-Dindo classification[18] was used for postoperative complications.

Surgical Technique

All operations were performed by the same surgeon (HB) using the Da Vinci Xi Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, USA). In consideration of the neoplasm's anatomical positioning, the surgical intervention entailed either a distal subtotal gastrectomy or a total gastrectomy accompanied by a D2 lymphadenectomy, as determined by the surgeon's clinical judgment. The surgical procedure was conducted in accordance with the methodology previously delineated in the literature[19].

Statistical Analysis

Statistical analyses were conducted using SPSS v. 22.0 software (IBM Corp., Armonk, NY, USA). The normal distribution of numerical data used in this research was assessed using the Shapiro-Wilk test. Numerical variables were expressed with mean and standard deviation for those conforming to normal distribution and with median and minimum-maximum values for those not conforming. To determine the differences between groups, the Independent Samples *t*-test was used for numerical variables conforming to normal distribution and the Mann-Whitney U test for those not conforming. Categorical variables were expressed in percentages and numbers, and the Chi-Square test was preferred for intergroup analyses. In all analyses, the level of statistical significance was set to an alpha of 0.05..

Table I. Characteristics of patients.

		Group 1 <70 (n=44)	Group 2 ≥70 (n=19)	p
Age (mean±SD)		59.4±7.2	72.9±3.5	**<0.001**
Gender	Male	70.5% (31)	78.9% (15)	0.486
	Female	29.5% (13)	21.1% (4)	
ASA score	1	2.3% (1)	0	0.261
	2	70.5% (31)	52.6% (10)	
	3	27.3% (12)	47.4% (9)	
Neoadjuvant chemotherapy	No	27.3% (12)	31.6% (6)	0.728
	Yes	72.7% (32)	68.4% (13)	
Hemoglobin gr/dl [mean±SD (min-max)]		11.3±1.9 (5.2-15.2)	10.1±1.4 (8.0-13.9)	**0.017**
Albumin gr/l [mean±SD (min-max)]		39.9±4.49 (27.0-49.0)	37.6±3.1 (31.0-44.0)	**0.049**
CEA [median (min-max)]		3.04 (1.09-40.40)	2.73 (1.55-29.50)	0.712
Ca 19.9 [median (min-max)]		13.5 (2.0-936.0)	17.50 (2.0-683.0)	0.929

ASA: American Society of Anesthesiologists, CEA: carcinoembryonic antigen.

Results

Our study included 63 patients, with 44 in Group 1 and 19 in Group 2. The male gender was dominant in both groups (70.5% *vs.* 78.9%, p=0.486). ASA 2 was the most frequently observed score in both groups (70.5% *vs.* 52.6%, p=0.261). Group 2 had lower hemoglobin (11.3 *vs.* 10.1, p=0.017) and albumin levels (39.9 *vs.* 37.6, p=0.049), but tumor marker levels were similar. Demographic and clinical data are shown in Table I.

The average duration of operations was similar in both groups (255 minutes *vs.* 242 minutes, p=0.457). Postoperative mortality was observed in one patient in Group 2. Total gastrectomy was the most performed procedure (77.3% *vs.* 73.7%, p=0.759). The median postoperative hospital stay was 5 days for both groups. In Group 2, one patient underwent surgery for anastomosis stricture. The distribution of postoperative complications according to the Clavien-Dindo classification[18] was similar. Postoperative 30-day mortality was observed in 1 patient in Group 2. The 90-day hospital readmission rate was similar (11.3% *vs.* 10.6%, p=0.459). Perioperative period data are presented in Table II.

Tumors were most frequently located in the cardia in Group 1 (34.1%) and in the antrum in Group 2 (31.6%). The average tumor diameters were similar (38 mm *vs.* 48 mm, p=0.165). The number of dissected lymph nodes was similar (35 *vs.* 34, p=0.796). The most common tumor stages were T4a in Group 1 (34.1%) and T0 in Group 2 (31.6%, p=0.149). The most common lymph node

Table II. Intraoperative and postoperative outcomes.

		Group <70 (n=44)	Group 2 ≥70 (n=19)	p
Operation length (minutes)		255.4±64.3	242.6±56.8	0.457
Intraoperative complications		0	0	-
Postoperative mortality		0	5.3% (1)	0.125
Operation type	Total	77.3% (34)	73.7% (14)	0.759
	Subtotal	22.7% (10)	26.3% (5)	
Conversion to open		11.4% (5)	10.5% (2)	0.923
Postoperative length of stay (days) [median (min-max)]		5 (3-14)	5 (3-25)	0.455
Reoperation		0	5.3% (1)	0.125
Clavien dindo complication grade	1	79.5% (35)	72.2% (13)	0.115
	2	15.9% (7)	5.6% (1)	
	3b	4.5% (2)	16.7% (3)	
	5	0	5.6% (1)	
90-day hospital readmission	Inadequate oral intake	4.5% (2)	5.3% (1)	0.459
	Acute kidney failure	2.3% (1)	0	
	Myocardial Infarction (MI)	0	5.3% (1)	
	Surgical site infection	4.5% (2)	0	

involvement was N0 in Group 1 (36.4%) and N1 in Group 2 (36.8%, p=0.515). Lymphovascular invasion (p=0.667), perineural invasion (p=0.889), and mixed-type adenocarcinoma (p=0.859) were similar in both groups. Pathological data are shown in Table III.

Discussion

In this study evaluating the safety, feasibility, and short-term outcomes of robotic gastrectomy in the geriatric patient group, it was observed that patients over the age of 70, despite having lower albumin and hemoglobin levels, exhibited similar postoperative short-term outcomes and oncological reliability as younger patients. The implementation of robotic surgical techniques did not result in an escalation of postoperative complications or mortality rates within the cohort of patients classified as medically fragile.

Elderly patients have high rates of comorbidities and postoperative complications due to the general decrease in functional reserve capacity, making the application of gastric cancer surgery in this group high-risk[15]. Historically, it has been shown[20] that 90-day post-gastrectomy mortality is higher in elderly patients. Advances in anesthesia techniques, intensive care, surgical devices, and less invasive surgical techniques have reduced the occurrence of surgical complications, thereby improving short-term outcomes in elderly patients. Consequently, recent studies[21,22] have demonstrated that postoperative morbidity and mortality are comparable between elderly and younger patients. We hypothesized the safety of elderly patients considering these technological advancements and the development of minimally invasive approaches.

Robotic surgery in randomized studies[23,24] has shown short-term outcomes equivalent to laparoscopy in gastric cancer surgery. Potential benefits, such as less blood loss, accurate removal of extra gastric lymph nodes, fewer postoperative complications, a faster recovery process, and earlier initiation of adjuvant chemotherapy, are expected to lead to better oncological outcomes[23]. Another systematic review[24] in the literature compared the outcomes of conventional surgery with robotic surgery. It was demonstrated that the application of the robotic surgery system in radical gastrectomy can effectively reduce blood loss, duration of hospital stay, and the incidence of postoperative complications.

In their study focusing on the safety and feasibility of robotic gastric surgery in elderly pa-

Table III. Characteristics of tumors

		Group 1 <70 (n=44)	Group 2 ≥70 (n=19)	p
Tumor localization	Antrum	27.3% (12)	31.6% (6)	0.499
	Cardia	34.1% (15)	26.3% (5)	
	Corpus	31.8% (14)	21.1% (4)	
	EGJ	2.3% (1)	5.3% (1)	
Tumor length (mm)		38.6±25.3	48.8±22.8	0.165
Total number of lymph nodes removed [mean±SD (min-max)]		35±13 (0-61)	34±17 (11-68)	0.796
Number of positive lymph nodes [median (min-max)]		2 (0-36)	2 (0-19)	0.896
pT	0	11.4% (5)	31.6% (6)	0.149
	1	20.5% (9)	5.3% (1)	
	2	9.1% (4)	10.5% (2)	
	3	25.0% (11)	26.3% (5)	
	4a	34.1% (15)	21.1% (4)	
	4b	0	5.3% (1)	
pN	0	36.4% (16)	31.6% (6)	0.515
	1	18.2% (8)	36.8% (7)	
	2	15.9% (7)	5.3% (1)	
	3a	18.2% (8)	15.8% (3)	
	3b	11.4% (5)	10.5% (2)	
Lenfovascular invasion		63.6% (28)	57.9% (11)	0.667
Perineural invasion		45.5% (20)	47.4% (9)	0.889
Mixed type adenocarcinoma		9.1% (4)	10.5% (2)	0.859

EGJ: esophagogastric junction.

tients, Garbarino et al[3] showed that robot-assisted surgery for gastrectomy performed with oncological principles in elderly patients was not inferior to open techniques in terms of perioperative outcomes and overall 5-year survival. They also concluded that the longer operation time did not correlate with adverse outcomes in the fragile patient group. This study implies that the positive impact of minimally invasive surgery is evident in elderly patients. In another study in the literature, Chen et al[25] demonstrated that compared to open surgery, laparoscopic-assisted radical gastrectomy is relatively safe and even effective in elderly gastric cancer patients, capable of reducing postoperative surgical complications and severe complication rates, shortening hospital stays, and lowering readmission rates. Considering both robotic and laparoscopic surgery, we can infer that minimally invasive surgery is not inferior to open surgery in the elderly population, suggesting the potential benefits of minimally invasive techniques are also realized in this age group.

In the study by Okumura et al[12], which compared robotic gastrectomy outcomes in young and elderly patients, 370 patients participated in their cohorts. The elderly robotic group showed more accompanying comorbid diseases compared to the young robotic group. Except for the number of lymph nodes removed (36.5 *vs.* 41.5, p=0.007), short-term surgical outcomes, including pathological parameters, were comparable between the two robotic groups. The complication rate in the elderly robotic gastrectomy group was not different from that in the younger robotic gastrectomy group (14.3% *vs.* 11.8%, p=0.639). The severity of complications measured according to the Clavien-Dindo classification was also similar between the groups (p=0.633). The older robotic group showed comparable disease-specific survival to the younger robotic group but demonstrated poorer overall survival.

A rational assessment suggests that it is not difficult to surmise that the parameter affecting survival is not the surgical approach itself. The conclusion drawn from this study is that age alone does not affect outcomes in the group undergoing robotic surgery. This finding was similarly observed and corroborated within our own series of cases. Contrary to our initial expectations that diminished levels of albumin and hemoglobin in elderly patients would adversely affect clinical outcomes, this anticipated correlation did not manifest in the observed results. We found comparable outcomes in both young and elderly patients. Age did not worsen postoperative quality indicators either.

Limitations

Retrospective studies like ours might seem like limitations, but the patients were followed up carefully and prospectively, and the study concept eliminated this limitation. The limited number of patients is a constraint, considering the few studies on this topic in the literature. Our study contributes to the literature.

Conclusions

In this study, we have demonstrated that robotic surgery is safe and feasible for elderly gastric cancer patients, with short-term outcomes and oncological resectability comparable between young and elderly patients. Therefore, we believe that robotic gastrectomy can be utilized in the treatment of elderly patients with gastric cancer. To obtain more reliable results, there is a need for multicenter randomized prospective studies providing long-term oncological outcomes.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethics Approval

The study was conducted following the Helsinki Declaration and was approved by the Ethics Committee of Basaksehir Çam and Sakura City Hospital, Istanbul, Turkey (approval number: KAEK/2022.12.408).

Informed Consent

All subjects provided informed consent.

Data Availability

The data associated with the paper are available from the corresponding author upon reasonable request.

Funding

None.

ORCID ID

Sercan Yüksel: 0000-0002-9069-7774
Ugur Topal: 0000-0003-1305-2056
Mehmet Zişan Songur: 0000-0002-7903-6393
Banu Yılmaz Özgüven: 0000-0002-3540-4772
Erdal Karaköse: 0000-0003-1491-0526
Zafer Teke: 0000-0001-8869-6476
Hasan Bektaş: 0000-0002-6307-6075

Authors' Contributions

Conceptualization, methodology, writing the original draft: S.Y., U.T.; Data curation, resources, writing the original draft: M.Z.S.; Project administration, validation, supervision: E.K.; Conceptualization, methodology, project administration: Z.T.; Investigation, validation, visualization: B.Y.Ö and H.B.

References

1) Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin 2021; 71: 209-249.
2) Guideline Committee of the Korean Gastric Cancer Association (KGCA); Development Working Group & Review Panel. Erratum: Korean Practice Guideline for Gastric Cancer 2018: an Evidence-based, Multi-disciplinary Approach. J Gastric Cancer 2019; 19: 372-373.
3) Garbarino GM, Costa G, Frezza B, Biancafarina A, Balducci G, Mercantini P, De Prizio M, Laracca GG, Ceccarelli G. Robotic versus open oncological gastric surgery in the elderly: a propensity score-matched analysis. J Robot Surg 2021; 15: 741-749.
4) Paredero-Pérez I, Jimenez-Fonseca P, Cano JM, Arrazubi V, Carmona-Bayonas A, Covela-Rúa M, Fernández-Montes A, Martín-Richard M, Gironés-Sarrió R. State of the scientific evidence and recommendations for the management of older patients with gastric cancer. J Geriatr Oncol 20233; 11: 101657.
5) Cammarota G, Cesaro P, Cazzato A, Cianci R, Fedeli P, Ojetti V, Certo M, Sparano L, Giovannini S, Larocca LM, Vecchio FM, Gasbarrini G. The water immersion technique is easy to learn for routine use during EGD for duodenal villous evaluation: a single-center 2-year experience. J Clin Gastroenterol 2009; 43: 244-248.
6) Son T, Hyung WJ. Laparoscopic gastric cancer surgery: Current evidence and future perspectives. World J Gastroenterol 2016; 22: 727-735.
7) Alhossaini RM, Altamran AA, Seo WJ, Hyung WJ. Robotic gastrectomy for gastric cancer: Current evidence. Ann Gastroenterol Surg 2017; 1: 82-89.
8) Lu J, Zheng CH, Xu BB, Xie JW, Wang JB, Lin JX, Chen QY, Cao LL, Lin M, Tu RH, Huang ZN, Lin JL, Zheng HL, Huang CM, Li P. Assessment of Robotic Versus Laparoscopic Distal Gastrectomy for Gastric Cancer: A Randomized Controlled Trial. Ann Surg 2021; 273: 858-867.
9) Ojima T, Nakamura M, Hayata K, Kitadani J, Katsuda M, Takeuchi A, Tominaga S, Nakai T, Nakamori M, Ohi M, Kusunoki M, Yamaue H. Short-term Outcomes of Robotic Gastrectomy vs Laparoscopic Gastrectomy for Patients With Gastric Cancer: A Randomized Clinical Trial. JAMA Surg 2021; 156: 954-963.
10) Yüksel S, Topal U, Songür MZ, Çalıkoğlu İ, Karaköse E, Ercan E, Teke Z, Bektaş H. Comparison of clinical outcomes of robotic-assisted and video-assisted esophagectomy for esophageal cancer. J Cancer Res Ther 2024; 20: 410-416.
11) Yüksel S, Topal U, Batur E, Karaköse E, Çalıkoğlu İ, Ercan E, Teke Z, Bektaş H. An early experience with the Da Vinci Xi surgical system in colorectal surgery. A single-center study. Ann Ital Chir 2023; 94: 425-432.
12) Okumura N, Son T, Kim YM, Kim HI, An JY, Noh SH, Hyung WJ. Robotic gastrectomy for elderly gastric cancer patients: comparisons with robotic gastrectomy in younger patients and laparoscopic gastrectomy in the elderly. Gastric Cancer 2016; 19: 1125-1134.
13) Ushimaru Y, Kurokawa Y, Takahashi T, Saito T, Yamashita K, Tanaka K, Makino T, Yamasaki M, Nakajima K, Mori M, Doki Y. Is Laparoscopic Gastrectomy More Advantageous for Elderly Patients Than for Young Patients with Resectable Advanced Gastric Cancer? World J Surg 2020; 44: 2332-2339.
14) Sheng S, Chen Y, Li C. Outcomes of Laparoscopic Total Gastrectomy for Elderly Gastric Cancer Patients. J Cancer 2018; 9: 4398-4403.
15) Mikami K, Hirano K, Futami K, Maekawa T. Gastrectomy with limited surgery for elderly patients with gastric cancer. Asian J Surg 2018; 41: 65-72.
16) Nagtegaal ID, Odze RD, Klimstra D, Paradis V, Rugge M, Schirmacher P, Washington KM, Carneiro F, Cree IA; WHO Classification of Tumours Editorial Board. The 2019 WHO classification of tumours of the digestive system. Histopathology 2020; 76: 182-188.
17) Weiser MR. AJCC 8th Edition: Colorectal Cancer. Ann Surg Oncol 2018; 25: 1454-1455.
18) Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004; 240: 205-213.
19) Yuksel S, Topal U, Nalbantlar Y, Karakose E, Calıkoglu I, Ercan E, Teke Z, Bektas H. Short-term surgical outcomes of robotic gastrectomy. A single center/single surgeon experience. Ann Ital Chir 2023; 94: 448-453.
20) Katai H, Sasako M, Sano T, Maruyama K. The outcome of surgical treatment for gastric carcinoma in the elderly. Jpn J Clin Oncol 1998; 28: 112-115.
21) Orsenigo E, Tomajer V, Palo SD, Carlucci M, Vignali A, Tamburini A, Staudacher C. Impact of age on postoperative outcomes in 1118 gastric cancer patients undergoing surgical treatment. Gastric Cancer 2007; 10: 39-44.
22) Saif MW, Makrilia N, Zalonis A, Merikas M, Syrigos K. Gastric cancer in the elderly: an overview. Eur J Surg Oncol 2010; 36: 709-717.
23) Jeong SA, Lee IS. Current status of robotic gastrectomy for gastric cancer: A review of recent

randomized controlled trials. Int J Gastrointest Interv 2022; 11: 50-55.

24) Chen L, Wang Q, Liu Y, Wang Y, Li Y, Dan J, Wang J. A meta-analysis of robotic gastrectomy versus open gastrectomy in gastric cancer treatment. Asian J Surg 2022; 45: 698-706.

25) Chen WZ, Dong QT, Zhang FM, Cai HY, Yan JY, Zhuang CL, Yu Z, Chen XL. Laparoscopic versus open resection for elderly patients with gastric cancer: a double-center study with propensity score matching method. Langenbecks Arch Surg 2021; 406: 449-461.