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Comparative safety of intracorporeal versus extracorporeal anastomoses in laparoscopic right colectomy

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Abstract

Aim – to assess the safety of a hand-sewn intracorporeal ileo-transverse anastomosis.

Material and methods. The retrospective study included patients from the Omsk Regional Cancer Registry from 2015 to 2023. It included patients with colon cancer (ICD-10 C18), who underwent a laparoscopic right colectomy. In the study group patients had hand-sewn intracorporeal anastomoses dene under an original method, terminus-terminal invagination ileo-transverse anastomosis; in the control group patients had hand-sewn 'side-to-side' extracorporeal anastomoses.

Results. 89 patients were enrolled: 42 in the study group and 47 in the control group. No cases of anastomotic leakage were found in the study group versus 2 (4.3%) in the control group (p=0.496). Grade 3 and higher surgical morbidity was equal in both groups: 2 (4.8%) versus 5 (10.7%), p=0.550.

Conclusion. The hand-sewn original intracorporeal anastomosis is safe and can be considered by experienced laparoscopic surgeons. Further study is needed for a detailed comparative analysis with established techniques.

Keywords: colon cancer, right colectomy, intracorporeal anastomosis, laporoscopic surgery.

Conflict of interest: nothing to disclose.

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Сравнение безопасности интракорпоральных и экстракорпоральных анастомозов при лапароскопической правосторонней гемиколэктомии

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Аннотация

Цель – оценка безопасности формирования ручного интракорпорального илеотрансверзоанастомоза.

Материал и методы. Данная работа является ретроспективным исследованием, материалом для которого послужил онкологический регистр Омской области за период с 2015 по 2023 гг. В исследование включали всех пациентов с диагнозом «рак ободочной кишки», кодом по МКБ-Х С18, которым была выполнена лапароскопическая правосторонняя гемиколэктомия. В исследуемой группе формировали интракорпоральные анастомозы с использованием авторской методики – термино-терминальный инвагинационный илеотрансверзоанастомоз, в контрольной группе формировали ручной экстракорпоральный анастомоз «бок в бок».

Результаты. В исследование вошли данные 89 пациентов: 42 – в исследуемой и 47 – в контрольной группе. Случаев развития несостоятельности анастомоза в исследуемой группе не отмечено, в контрольной группе – у 2 (4,3%) пациентов (p=0,496). Общая частота послеоперационных осложнений 3 степени и выше также не различалась: у 2 (4,8%) и 5 (10,7%) пациентов соответственно (p=0,550).

Выводы. Предложенный нами метод формирования илеотрансверзоанастомоза безопасен и может быть рассмотрен для применения хирургами, прошедшими кривую обучения малоинвазивной колоректальной хирургии. Требуются дальнейшие исследования для оценки воспроизводимости полученных результатов и сравнения с другими техниками на более крупных исследуемых группах.

Ключевые слова: рак ободочной кишки, правосторонняя гемиколэктомия, интракорпоральный анастомоз, лапароскопическая хирургия.

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НА – несостоятельность анастомоза; ПГ – правосторонняя гемиколэктомия.

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INTRODUCTION

Anastomotic leak (AL) is the most hazardous complication of the right colectomy (RC). The incidence of the complication may vary significantly from clinic to clinic and from one surgical technique to another [1]. According to the data from the Australian and New Zealand registers, the AL incidence rate was 2% among 13,512 patients who had undergone right colectomy [2]. The multicenter study EAGLE, which engaged numerous clinics from developing countries, found that the incidence of leaks of ileo-transverse anastomosis reached 12.2% at the initial evaluation of complications incidence prior to training of surgeons [3].

Laparoscopic surgery provided a new approach towards performance of the resection stage of surgery; it provided a better cosmetic effect and improved patient rehabilitation. It became, therefore, a preferred method of treatment in clinical recommendations [4]. At the same time, the first studies did not modify the method of anastomosis formation vs. methods of open surgery [5]. Formation of an intracorporal anastomosis provides a potential of a fuller implementation of minimally invasive surgery based on a free choice of the zone of minilaparotomy incision or removal of the preparation through natural orifices. The meta-analysis of 7 randomized clinical trials found no differences in the incidence rate of AL development in the formation of intra- or extracorporal anastomoses [6]. At the same time, the method of anastomosis formation in these studies was not standardized. The classic intracorporal anastomosis is formed mechanically. The analysis of data of the Denmark national register shows that the use of staplers doubles the risk of AL in right colectomies, from 2.4 to 5.4% (p=0.004).

AIM

To evaluate safety of a hand-sewn intracorporeal ileo-transverse anastomosis.

MATERIAL AND METHODS

This retrospective study used the material from the Omsk regional cancer register for the period from 2015 to 2023 including all patients diagnosed with ‘colon cancer’ (C18 in the ICD-10) who had undergone laparoscopic right colectomy. The following patients were excluded: patients who had laparoscopic right colectomy with mechanical anastomosis, patients who had right colectomy not related to cancer of the right section of the colon, and patients who had palliative surgeries (bypass anastomosis), surgeries in the volume of colectomy, resection of the transverse colon, and surgeries without formation of the ileo-transverse anastomosis.

The patients were divided into two groups. In the study group, the anastomosis was formed using the author’s original method (official filing receipt for the invention No.2018111234 dated 29.03.2018 “Method of formation of the intracorporal laparoscopic terminus-terminal invagination ileo-transverse

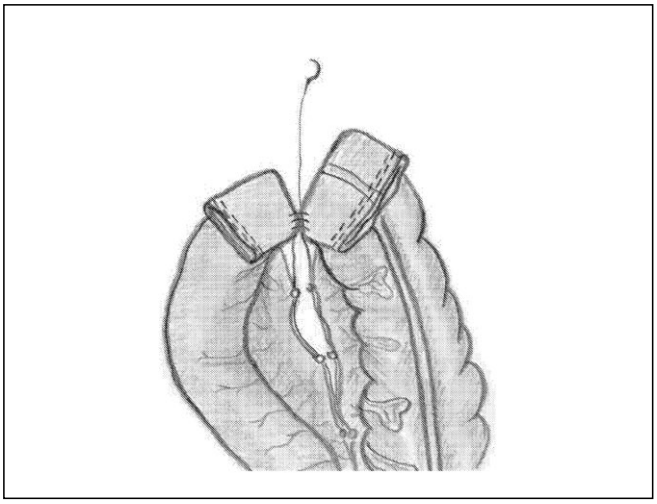

Figure 1. *Formation of the external posterior row of ileo-transverse anastomosis (side view).*

Рисунок 1. *Формирование наружного заднего ряда илеотрансверзоанастомоза (вид сбоку).*

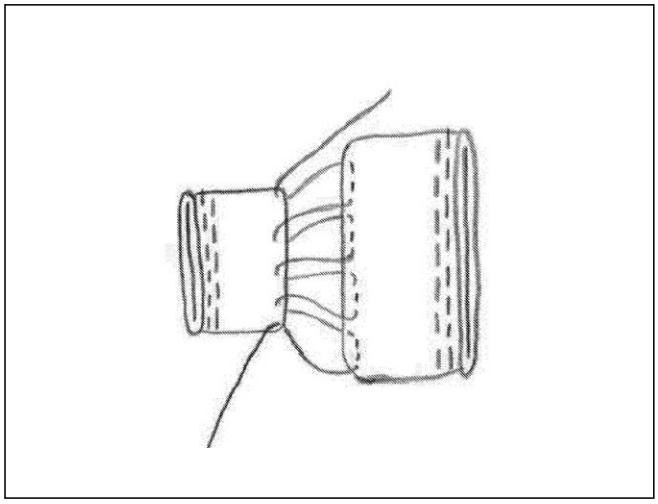

Figure 2. *Formation of the external posterior row of ileo-transverse anastomosis (top view).*

Рисунок 2. *Формирование наружного заднего ряда илеотрансверзоанастомоза (вид сверху).*

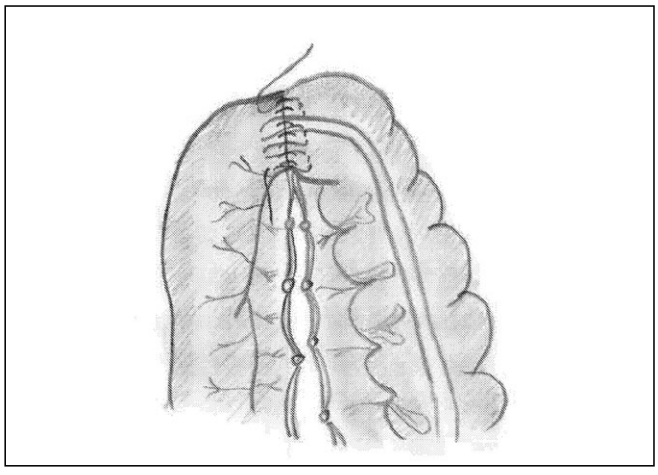

Figure 3. *Final appearance of the anastomosis formed with the use of the author's technique.*

Рисунок 3. *Окончательный вид анастомоза, сформированного по авторской методике.*

anastomosis"). Complete mobilization of the right colon was performed laparoscopically. At the operating surgeon's discretion, the middle colic vessels were transsected at the base or only the fight branch of the meddle colic artery was transsected. D3 or D3 lymphadenectomy was also performed at the operating surgeon's discretion. After transsecting the mesentery, the ileum and the colon were transsected at the line of adequate vascular supply using the linear stapler. Following that, the exterior posterior wall of the anastomosis was formed with barbed absorbable sutures; at the same time, to ensure adaptation of diameters, the interval between the punctures was made larger than on the ileum (**Fig. 1, 2**).

After that, the lines of staples of the transverse colon and the ileum were sheared opening the lumens to form the interior wall of the anastomosis. The continuous intracorporal seam was formed with a polyfilament thread: the anterior curve with the Multanovsky suture, the posterior, with the Schmieden suture. The anterior curve of the exterior wall of the anastomosis was formed with barbed absorbable sutures, similar to the posterior wall. In this way, the invagination ileo-transverse 'end-to-end' anastomosis was formed (**Fig. 3, 4**). The choice of the area for the minilaparotomic access was at the operating surgeon's discretion.

In the control group, the resection phase of the surgery was performed in the same way as that in the study group; however, the transverse colon and the ileum were not transsected. After mobilization, a minilapatoromic incision was made, through which the resected section of the colon was removed from the abdominal cavity. The preparation was removed, and a hand-sewn extracorporal ileo-transverse 'side-to-side' anastomosis was formed.

The main assessed parameter was the incidence rate of the anastomotic leak. Additionally, the general incidence of post-surgery complications using the Clavien – Dindo was assessed [7], time of the operation, intraoperative blood loss, time of hospitalization.

Statistical processing of material was performed in the IBM SPSS v.23 software suite. To compare categorical variables, 2×2 tables and the Chi-square test were used. To compare continuous variables, the medians were compared and the Mann-Whitney test was used.

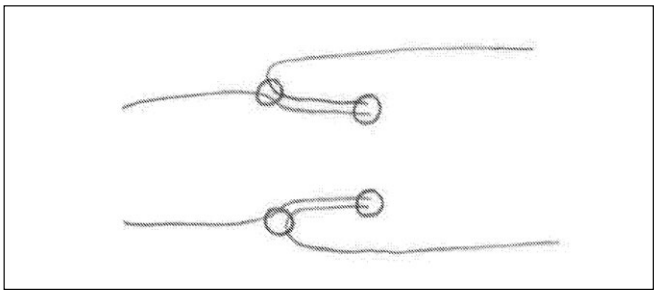

Figure 4. *Final appearance of the anastomosis formed with the use of the author's technique (schematic image).*

Рисунок 4. *Окончательный вид анастомоза, сформированного по авторской методике (схематичное изображение).*

RESULTS

The search query in the archive for the specified period returned 2114 entries. After removal of duplicating records (cases of readmission of the same patient), 1991 records remained. After removal of information on palliative surgeries and data of patients not diagnosed with colon cancer, 1729 records remained. 1050 patients were excluded due to localization of the tumor in the left sections of the colon. 493 patients were excluded due to open surgery performed on them. 14 patients were excluded, for a mechanical intracorporal anastomosis was formed for them. 9 patients were excluded because they had undergone colectomies, 74 patients were excluded due to resections of the colon. Thus, our study included the data of 89 patients: 42 in the study group, and 47 in the control group.

The general characteristics of the observed groups are shown **in Table 1**.

It follows from Table 1, there were less patients with the tumor localized in the hepatic flexure of the colon in the study group, 6 (14.3%) vs. 19 (40.4%) in the control group and there

Parameter	Study group N=42 (100%)	Control group N=47 (100%)	P
Sex			
Male	16 (34.0%)	13 (31.0%)	0.823
Female	31 (66.0%)	29 (69.0%)	
Age			
Under 65	15 (35.7%)	14 (29.8%)	0.652
65 and older	27 (64.3%)	33 (70.2%)	
Tumor localization			
Cecum	15 (35.7%)	11 (23.4%)	0.023
Ascending colon	21 (50%)	17 (36.2%)	
Hepatic flexure of the colon	6 (14.3%)	19 (40.4%)	
Stage (UICC TNM. 7th revision)			
I	7 (16.7%)	6 (13.0%)	0.191
II	15 (35.7%)	26 (56.5%)	
III	18 (42.9%)	11 (23.9%)	
IV	2 (4.8%)	3 (6.5%)	
Residence			
Rural area	15 (31.9%)	11 (26.2%)	0.643
City	32 (68.1%)	31 (73.8%)	
Body mass index (BMI)			
Below 30 kg/m^2	24 (57.1%)	36 (76.6%)	0.070
30 kg/m^2 and higher	18 (42.9%)	11 (23.4%)	

Table 1. *Characteristics of the study groups*
Таблица 1. *Характеристика исследуемых групп*

Parameter	Study group N=42 (100%)	Control group N=47 (100%)	P
Surgery time, min.			
Median	120	105	0.580
Min. and max.	75–205	40–270	
Q1-Q3	90–140	80–152	
Blood loss			
Median	50	50	0.132
Min. and max.	10–150	50–200	
Q1-Q3	50–100	50–100	
Bed days			
Median	9	10	0.013
Min. and max.	4–20	6–21	
Q1-Q3	7–11	9–11	

Table 2. *Characteristics of the operations performed*
Таблица 2. *Характеристика выполненных операций*

were more patients with BMI 30 kg/m2 and higher, 18 (42.9%) vs. 11 (23.4%). In other criteria, the studied groups did not show significant differences. The intraoperative characteristics are shown **in Table 2**.

No postoperative lethality was found in the studied groups. The general rate of complications and incidence rate of development of anastomotic leak did not differ between the groups. In the study group, no cases of anastomotic leak were registered. One patient in the study group had an iatrogenic damage of the small intestine that resulted in the development of peritonitis and a recurrent operation. In another patient, the seroma of the abdominal cavity developed that required drainage under X-ray control. In the control group, there were four recurrent operations: two related to anastomotic leak, one, to postoperative hemorrhage, and one, to eventration of the minilaparotomic wound.

DISCUSSION

Within this retrospective study, we demonstrated the safety of hand-sewn intracorporal ileo-transverse anastomosis using the original method suggested by us. It is to be noted also, that 42.9% patients in the study group were obese, which shows the feasibility of the operation in a difficult category of patients.

In the study group, no cases of development of anastomotic leak were registered, which was the most significant parameters we assessed. We did not find significant differences in the main postoperative parameters in comparison to the extracorporal anastomosis group, except reduction of the number of post-operative bed-days by one day. Earlier, M. Widmar et al. (2020) in their single-center retrospective study also reported reduction of the number of post-operative bed-days by one day after formation of intracorporal anastomoses, also with no effect on the risk of postoperative complications [8]. Similar data was obtained by R. Cleary et al. (2018) in a larger study with pseudo-randomization, where the majority of surgeries were performed using robotic surgery [9]. In both these studies, the intracorporal anastomosis was formed 'side-to-side' using linear staplers, and in them, like in our study, no cases of development of anastomotic leak were registered. E.M. Romanova et al. (2024) performed a randomized study that compared safety of intracorporal mechanical and extracorporal hand-sewn anastomosis in right colectomy in 79 patients. One case (2.6%) of anastomotic leak was registered, the general rate of incidence of complications between groups not being different [10].

Parameter	Study group N=42 (100%)	Control group N=47 (100%)	P
Clavien – Dindo 3a	1 (2.4%)	1 (2.1%)	0.550
Clavien – Dindo 3b	0	2 (4.3%)	
Clavien – Dindo 4a	1 (2.4%)	2 (4.3%)	
Anastomotic leak	0	2 (4.3%)	0.496

Table 3. *Postoperative complications*
Таблица 3. *Послеоперационные осложнения*

The most convincing evidence was obtained in the meta-analysis of 21 retrospective studies performed by A. Squillaro et al. (2023). The formation of the intracorporal anastomosis did not influence the risk of postoperative complications. Differences were identified between the groups of robot-assisted intracorporal anastomosis and laparoscopic extracorporal anastomosis: they were in the duration of postoperative period and amounted to one day [11].

Manual sowing of the intracorporal anastomosis is only rarely implemented in clinical practice. All studies included in the meta-analysis of A. Squillaro et al. used the mechanical method of 'side-to-side' anastomosis formation. An alternative method was suggested by H. Su et al. (2019): in their retrospective study of 36 patients they described the technique of delta-shaped formation of ileo-transverse anastomosis using three linear staplers, no cases of anastomotic leak were registered [12]. No randomized studies compared various techniques of formation of intracorporal anastomosis. Manual formation of the anastomosis is technically simpler and is more frequently performed in using robot-assisted techniques. However, the meta-analysis of 30 studies that focused on the results of robot-assisted right colectomies, no differences were shown in the rate of development of complications following the manual and mechanical sowing of the anastomosis [13]. Regardless of the surgical method used, the mechanical formation of the ileo-transverse anastomosis was related in the Cochrane systematic review (2011) with a reliably lower risk of development of the leak, OR 0.48 [95%CI 0.24; 0.95] p=0.03 [14].

The advantage of our study is the analysis of a new and novel method of formation of ileo-transverse anastomosis in a representative population of patients. Its limitations are its retrospective character, lack of standardization of techniques of anastomosis formation in the control group, some differences in the clinical characteristics of patients. It is to be remembered that intracorporal anastomosis was formed, in all cases, by one surgeon completing the training curve in minimally invasive surgery. In the control group, this parameter was not taken into account.

CONCLUSION

Thus, the method of formation of ileo-transverse anastomosis proposed by us is safe and may be regarded for use by surgeons completing the training curve in minimally invasive colorectal surgery. To assess the reproducibility of obtained results and comparison with other techniques in larger studied groups, further research is needed.

ADDITIONAL INFORMATION	ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ
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Conflict of interest. The authors declare that there are no obvious or potential conflicts of interest associated with the content of this article.	***Конфликт интересов.*** Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с содержанием настоящей статьи.
Contribution of individual authors. M.P. Salamakhin: development of the research concept, direct conduct of the research, statistical calculations, preparation, creation and design of the manuscript. O.V. Leonov, Z.Z. Mamedli: editing of the manuscript. A.Z.Milovanova: collection and processing of data. The authors gave their final approval of the manuscript for submission, and agreed to be accountable for all aspects of the work, implying proper study and resolution of issues related to the accuracy or integrity of any part of the work.	***Участие авторов.*** М.П. Саламахин – разработка концепции исследования, непосредственное проведение исследования, статистические расчеты, подготовка, создание и оформление рукописи. О.В. Леонов, З.З. Мамедли – редактирование рукописи. А.З. Милованова – сбор и обработка данных. Все авторы одобрили финальную версию статьи перед публикацией, выразили согласие нести ответственность за все аспекты работы, подразумевающую надлежащее изучение и решение вопросов, связанных с точностью или добросовестностью любой части работы.

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