# GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 1 (370) Январь 2026

ТБИЛИСИ - NEW YORK


ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

**GEORGIAN MEDICAL NEWS**

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press. Published since 1994. Distributed in NIS, EU and USA.

**GMN: Georgian Medical News** is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

**GMN: Медицинские новости Грузии -** ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

**GMN: Georgian Medical News –** საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

**WEBSITE**

www.geomednews.com

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

**При нарушении указанных правил статьи не рассматриваются**.

## REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.**

## ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

*GEORGIAN MEDICAL NEWS*
*NO 1 (370) 2026*

*Содержание:*

*GEORGIAN MEDICAL NEWS*
*No 1 (370) 2026*

# LEFT HEMICOLECTOMY IN PATIENTS WITH COLORECTAL CANCER: SURGICAL VIEW ON INFERIOR MESENTERIC ARTERY ANATOMY VARIABILITY

**Kirill I. Seurko, Roman A. Sokolov, Alexandr N. Kosenkov, Elena V. Stolarchuk, Kseniya I. Seurko, Elena N. Belykh, Mikhail I. Bokarev, Magomed E. Shakhbanov, Alexandr I. Mamykin, Andrew I. Demyanov, Omari V. Kanadashvili.**

*Sechenov University, Moscow, Russia.*

## Abstract.

**Background and Objectives:** Vascular structures may be damaged during laparoscopic surgery for colorectal cancer. One of the major reasons is the variant anatomy of the inferior mesenteric artery. It could lead to intraoperative massive bleeding and also postoperative intestinal ischemia. Thus, preoperative study of the inferior mesenteric artery variant anatomy is very important.

**Aim:** Our aim is to develop a clinical - based and useful classification of inferior mesenteric artery variability for healthcare practitioners.
**Materials and Methods:** From December 2019 to March 2023, 214 abdominal computed tomograms (CT) with contrast were analyzed. We studied the inferior mesenteric artery variant anatomy.
**Results:** The 15 inferior mesenteric artery anatomical types were identified in previous studies. But due to the complexity of using this in practice - new classification of inferior mesenteric artery anatomy and its branches was developed: type I - several colonic branches by separate trunks (54.2%); type II – all colonic branches from one point in the form of a "crow's foot" (25.2%); type III - a single trunk which is divided into colonic branches throughout its length (20.6%).
**Conclusions:** The new inferior mesenteric artery classification is developed and been induced in practice. By using this classification and CT angiography with 3D reconstruction surgeons could perform operations on colorectal region with minimal risk of complications.

**Key words.** CT angiography, inferior mesenteric artery, anatomy, laparoscopy.

## Introduction.

The colorectal cancer (CRC) consists about 10% of all diagnosed oncology diseases per year [1]. It takes the 3rd place in oncology diseases frequency in male and 2nd in female. In women, morbidity and mortality are in 25% lower than in men. It is predicted that in progressive countries the incidence of CRC will increase up to 2.5 million of new cases by 2035 [1,2]. Trends towards stabilization and decline of illness are usually observed only in developed countries. This is due to screening programs and an increased number of diagnostic colonoscopies, lifestyle and diet changes can also play role [3]. Nowadays, there is an alarming increase in the number of patients younger than 50 years with CRC, especially rectal cancer and cancer of the left half of the colon [4-7].

There are different methods cancer treatment [8-10]. Radical surgery remains the main treatment method. The principles of minimally invasive surgery performed by laparoscopic access are increasingly used. Laparoscopic surgery in colorectal cancer is safe and provides good long-term relapse-free and general survival rates [11-13]. Performing surgery of colorectal cancer, it could be necessary to cross the inferior mesenteric artery. It could be performed in two ways. The first method of inferior mesenteric artery crossing is its high ligation and crossing in the base area. The 2nd way - low ligation - is used during crossing distally to the left colic artery (LCA) [14]. High inferior mesenteric artery (IMA) ligation simplifies the removal of paraaortic lymph nodes and makes the left half of the colon more mobile. Low inferior mesenteric artery ligation allows to maintain good intestinal blood supply and avoid ischemia in the proximal part of the colon and at the site of anastomosis [15,16]. In a meta-analysis by Zeng J., Su G., 2018, was reported - low inferior mesenteric artery ligation compared to a high does not affect general survival and mortality rates and the rate of recurrence of the oncological process. But at the same time the frequency of anastomosis failure decreases [17]. From this point of view performing a low inferior mesenteric artery ligation with skeletonization is better since the sufficient blood supply to the remaining part of the colon [18,19].

To perform a low inferior mesenteric artery ligation and D3-lymph nodes dissection surgeons perform lymph nodes dissection around the main trunk of the inferior mesenteric artery up to the superior rectal artery with a accurate cutting of the small and large intestine mesentery vessels [20-23]. This method takes a lot of time due to technical difficulties, different variant anatomy of the inferior mesenteric artery and the lack of tactile sensations during laparoscopic surgery [24]. The risk of vascular structures damage supplying the left half of the colon increases and this can lead to massive bleeding and intestinal ischemia. In colorectal cancer surgery the main step is to save colorectal region sufficient vascular supply. Therefore, the preoperative study of the variant anatomy of the inferior mesenteric artery is very important. Surgeons can decide for it in advance: this will ensure fast and safe vascular ligation at the required level and lymph nodes dissection [25-30].

The main non-invasive method used to study the variant inferior mesenteric artery anatomy is CT angiography [31,32].

Modern classifications of inferior mesenteric artery anatomy are very difficult to clinical apply. The well-known classification by W. Zebrowski [33] describes 8 types of inferior mesenteric artery branching. But this classification has no practical value for surgery. Similar study in China has results that cannot be applicable in surgical practice [34]. There were several studies in Russia of variant celiac trunk and the superior mesenteric artery anatomy [35-39]. But no information about variable inferior mesenteric artery anatomy. In this regard there is a need to optimize the classification of the vascular anatomy variability with focus on the practical approach.

Moreover, we haven't find body of evidence of the accuracy of inferior mesenteric artery anatomy presented by CT-angiography V/S intraoperative data. To bring new in classification of inferior mesenteric artery vascular anatomy variability focusing on the practical surgery the following tasks were set:

1. To study inferior mesenteric artery anatomy presented by multispiral computed tomography with contrast V/S intraoperative data.
2. To evaluate the accuracy of abdominal MSCT with intravenous contrast by comparing the results with intraoperative data.
3. To study the relationship between the inferior mesenteric vein (IMV) and the left colic artery at the level of the base of the inferior mesenteric artery.
4. To develop a classification of inferior mesenteric artery vascular anatomy variability for practical surgery usage.

## Materials and Methods.

The presented retrospective study included patients with left half colon cancer which were treated at the Yudin State Clinical Hospital in Moscow from December 2019 to March 2023. The study group included 214 patients (113 women and 101 men) aged from 19 to 91 years with left half colon cancer (Tables 1-4). All patients underwent segmental colon resection with D3 lymph nodes dissection.

**The criteria for inclusion in the study were:**

1) the age of patients from 18 to 92 years;
2) gender: male, female;
3) the established diagnosis: "left half colon cancer" (colon cancer of the splenic flexure, cancer of the descending colon, cancer of the sigmoid colon, cancer of the rectosigmoid colon);
4) the presence of preoperative abdominal CT scan with intravenous contrast (for diagnosis and planning of surgery);
5) absence of distant metastases;
6) performed surgical intervention: segmental colon resection with D3 lymph nodes dissection.

**The exclusion criteria were:**

1) the age of patients younger than 18 and older than 92 years;
2) absence of preoperative abdominal CT scan with intravenous contrast;
3) performing surgery without segmental colon resection with D3 lymph nodes dissection;
4) patients who have previously undergone surgical interventions in the basins of inferior mesenteric artery and inferior mesenteric vein.

Methods of preoperative abdominal CT scan with intravenous contrast and intraoperative photographs were used to study the vascular structure.

CT studies were performed on a 160-slice Aquillion Prime SP scanner (Canon, Japan), a 160-slice Aquillion Prime scanner (Toshiba, Japan) and a 40-slice Somatom Sensation scanner (Siemens, Germany). Scanning was carried out according to a standard four-phase protocol: before the introduction of intravenous contrast agent - the native phase; after the introduction of intravenous contrast agent - the arterial phase (the beginning of scanning was performed automatically when

***Table 1.*** *General patients characteristics.*

| **Age** | **Sex** | | **Total** |
|---|---|---|---|
| | **Male** | **Female** | |
| < 30 y.o. | 1 | 1 | 2 |
| 31 – 40 y.o. | 2 | 3 | 5 |
| 41 – 50 y.o. | 6 | 5 | 11 |
| 51 – 60 y.o. | 21 | 18 | 39 |
| 61 – 70 y.o. | 35 | 45 | 80 |
| 71 – 80 y.o. | 23 | 36 | 59 |
| 80 – 90 y.o. | 12 | 5 | 17 |
| > 91 y.o. | 1 | 0 | 1 |
| Total | 101 | 113 | 214 |

***Table 2.*** *Tumor localization.*

| **Tumor localization** | **Number of patients (%)** |
|---|---|
| Splenic flexure | 15 (7%) |
| Descending colon | 18 (8,4) |
| Sigmoid colon | 109 (50,9%) |
| Rectosigmoid colon | 72 (33,6%) |

***Table 3.*** *Surgical access type.*

| **Surgical access** | **Number of patients (%)** |
|---|---|
| Laparotomy | 72 (33,64%) |
| Laparoscopic surgery | 142 (66,36%) |

***Table 4.*** *Cancer stage.*

| **Cancer stage** | **Number of patients (%)** |
|---|---|
| I-II | 47 (22%) |
| III | 167 (78%) |

***Table 5.*** *Patients characteristics.*

| **Characteristic** | **Type I (*n* = 116)** | **Type II (*n* = 54)** | **Type III (*n* = 44)** | ***p*** |
|---|---|---|---|---|
| Age | 66 (19–77) | 71 (39–91) | 58 (46–71) | p > 0.05 |
| Sex ratio (male: female) | 12:8 | 5:0 | 14:7 | p > 0.05 |
| BMI (kg/m2) | 20.8 ± 2.87 | 23.7 ± 2.25 | 21.8 ± 2.78 | p > 0.05 |
| | | | | |
| ASA | 2.11 ± 0.51 | 2.01 ± 0.54 | 2.12 ± 0.31 | p > 0.05 |
| | | *Tumor localization* | | |
| Splenic flexure | 15 | - | - | p > 0.05 |
| Descending colon | 10 | - | 8 | |
| Sigmoid colon | 52 | 48 | 9 | |
| Rectosigmoid colon | 39 | 6 | 27 | |
| | | *Cancer stage* | | |
| 0 | - | - | - | p > 0.05 |
| I | 8 | 3 | 7 | |
| IIA, IIB, IIC | 18 | 7 | 9 | |
| IIIA, IIIB, IIIC | 90 | 44 | 28 | |
| IVA, IVB | - | - | – | |

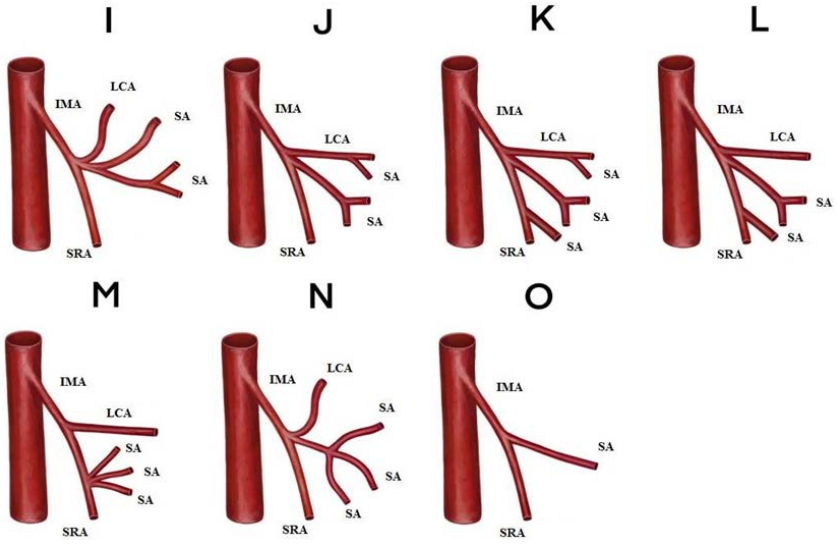


***Figure 1.*** *Additional types of inferior mesenteric artery anatomy. inferior mesenteric artery – 198 inferior mesenteric artery; LCA – left colic artery; SA – sigmoid artery; SRA – superior rectal artery.*

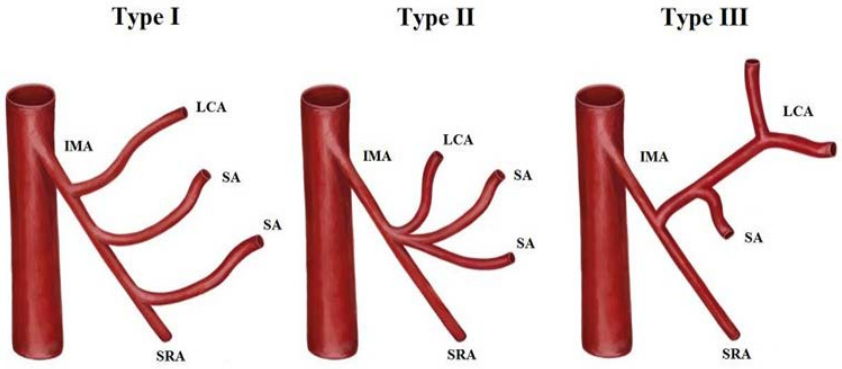


***Figure 2.*** *New classification of inferior mesenteric artery anatomy. inferior mesenteric artery – 214 inferior mesenteric artery; LCA – left colic artery; SA – sigmoid artery; SRA – superior rectal artery.*

the threshold density of 180 Hounsfield units was reached in the lumen of the abdominal aorta due to the use of bolus monitoring technology), venous-parenchymal phase (65 seconds after contrast agent administration), delayed (5 minutes after contrast agent administration). Nonionic iodine-containing preparations were used as a contrast agent: Yogexol (350 mgI/ml), Yopromide (370 mgI/ml), Yomeprol (400 mgI/ml), the rate of administration was 3.5-4.0 ml/s. The volume of contrast agent administered was determined in accordance with the patient's weight at the rate of 1.0-1.5 ml per 1 kg of body weight. For bolus administration of the contrast agent, an automatic two-column Stellant CT injection system (MEDRAD) was used, the administration of the contrast agent was followed by the subsequent administration of a saline solution (30-50 ml).

The standard scanning protocol included the following parameters: 120 kV tube voltage, automatic current modulation depending on the human constitution was carried out in the range of 80-500 mA with a standard deviation of 12.5 for a cut thickness of 5.0 mm; collimation of 0.5x80 and 1.2x16 with subsequent reconstruction with a cut thickness of 0.5–1.2 mm. Further processing of the obtained images for the best visualization of mesenteric arteries and veins was performed at workstations (Vitrea, Syngo) with the transformation of the obtained images in the modes of multiplanar reconstruction (MPR), maximum intensity projection (MIP) and the construction of three-dimensional images Volume Rendering 3D and Global Illumination (GIR) for the purpose of a detailed assessment of vascular architectonics.

The assessment of the location of the main branches of the inferior mesenteric artery was carried out according to the Zebrowski classifications [33].

Thus the relative position of inferior mesenteric artery trunks with the IMV with its branches was evaluated as the inferior mesenteric artery trunks positioning and structure. The data obtained were also classified in accordance with K. Murano [40], in which, firstly, the medio-lateral interposition of IMV and LCA in the projection of the inferior mesenteric artery foundation level is estimated. Secondly, the anteroposterior location of the vein in relation to the artery. To do this, the arterial and venous phases of contrast were studied.

In addition, the accuracy of the abdominal CT scan was analyzed by comparing intraoperative photographs with data from preoperative abdominal CT data.

**Statistical analysis:**

Statistical processing of the results was carried out using the SPSS Statistics 22 software. Quantitative variables were described using the median. The $\chi^2$ - test and Fisher's test are used to assess the correlation with patient data. The unpaired t-test and Fisher's test were used to compare different variants of vascular anatomy. at $p<0.05$ were considered statistically significant.

## Results.

In addition to the 8 types described by W. Zebrowski [33] we discovered 7 new additional types of inferior mesenteric artery which in continuation of W. Zebrowski's classification were assigned from I to O (Figure 1).

1. I – the superior rectal artery (SRA), 2 sigmoid arteries (SA) and the left colic artery; (LCA) depart from the same point;
2. J – SRA, SA and LCA depart rosette-like from one point, one SA departs from the LCA;
3. K – SRA, SA and LCA depart rosette–like from one point, one SA departs from the LCA, the second - from the SRA;
4. L – SRA, SA and LCA depart rosette-like from one point, one SA departs from the LCA;
5. M – 3 SA depart from the SRA in the form of a "crow's foot";
6. N – SRA, LCA and a common trunk with three SA depart rosette-like from one point;
7. There is no type O;

Thus, the total number of described types was 15.

This classification with 15 types is quite difficult to apply. Thus, a new classification was proposed based on the principle of the separation of the colic branches from the main trunk of the inferior mesenteric artery. 3 surgically significant types of vascular branching were identified (Figure 2). Type I – several branches depart from the inferior mesenteric artery in separate trunks; type II – all branches depart from the inferior mesenteric artery forming a "crow's foot"; type III – a single trunk departs from the inferior mesenteric artery which is divided into branches throughout its length. According to this approach to the inferior mesenteric artery anatomy the frequency of identified 3 types of vascular branching is as follows: type I occurs in 54.2% of cases; type II – in 25.2%; type III – in 20.6% of cases.

After analyzing the patient data there were no significant differences in the clinical characteristics of patients between types I (n=116), II (n=54), III (n=44). (Table 5).

An inferior mesenteric artery anatomy presented by multispiral computed tomography with contrast V/S intraoperative data were compared. 9/214 patients had an additional small- caliber sigmoid artery which was detected only intraoperatively and was not visualized earlier with abdominal multispiral computed tomography performed for diagnosis and surgery planning. The sensitivity of the method was 95.8% (true-positive indicator in 205 patients, false- negative indicator in 9 patients), specificity – 100% (false-positive indicator in 0 patients, true- negative indicator in 214 patients). Thus, the accuracy of the method was 97.9%.

The decrease in sensitivity of the method is due to the small diameter of the inferior mesenteric artery branches, which led to their weak contrast. The presence of an additional sigmoid artery affected the sensitivity and accuracy of the method, the W. Zebrowski classification [24] with additional variants (15 types), but did not affect the proposed practical classification (3 types).

According to the classification of K. Murano, the antero-posterior positional relationship of LCA and inferior mesenteric vein (IMV) was evaluated at the level of the inferior mesenteric artery foundation. LCA passed in front of the IMV in 163 (76%) patients, as in the remaining 51 (24%) patients, it was located behind the IMV (Figure 6).

The schemes of positional relationship between the LCA and the IMV at the base level of the inferior mesenteric artery are shown in Figure 7. Type A – LCA is located medial to the IMV;

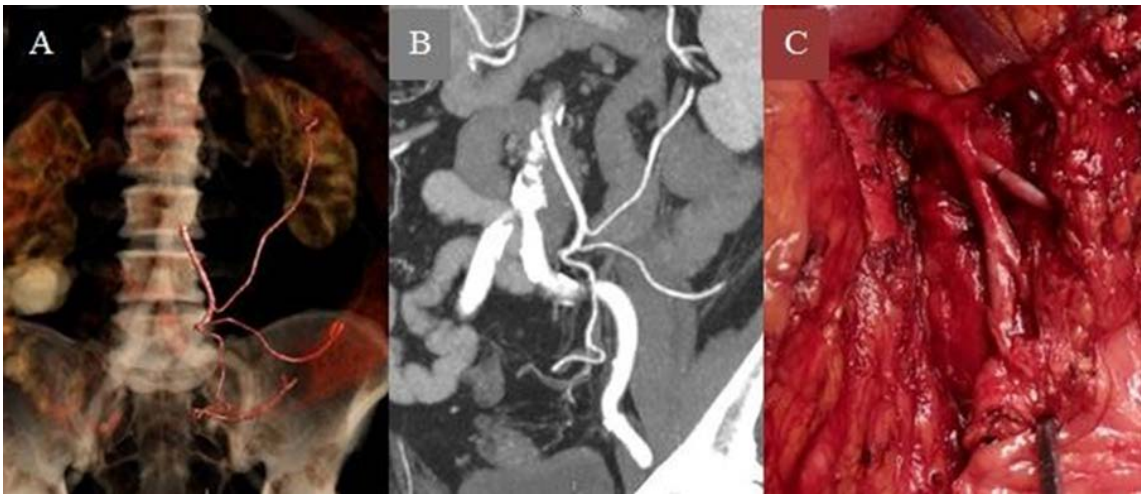


***Figure 3.*** *Type I by new classification of inferior mesenteric artery anatomy. Reconstructions of 232 GIR (A) and MIP images (B), intraoperative photograph (C).*

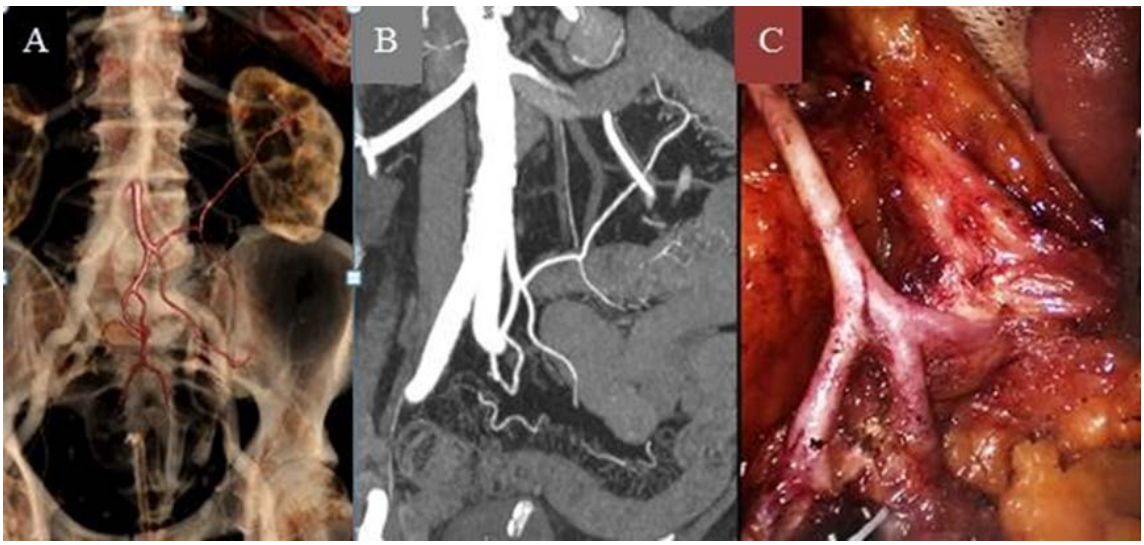


***Figure 4.*** *Type II by new classification of inferior mesenteric artery anatomy. Reconstructions of GIR (A) and MIP images (B), intraoperative photograph (C).*

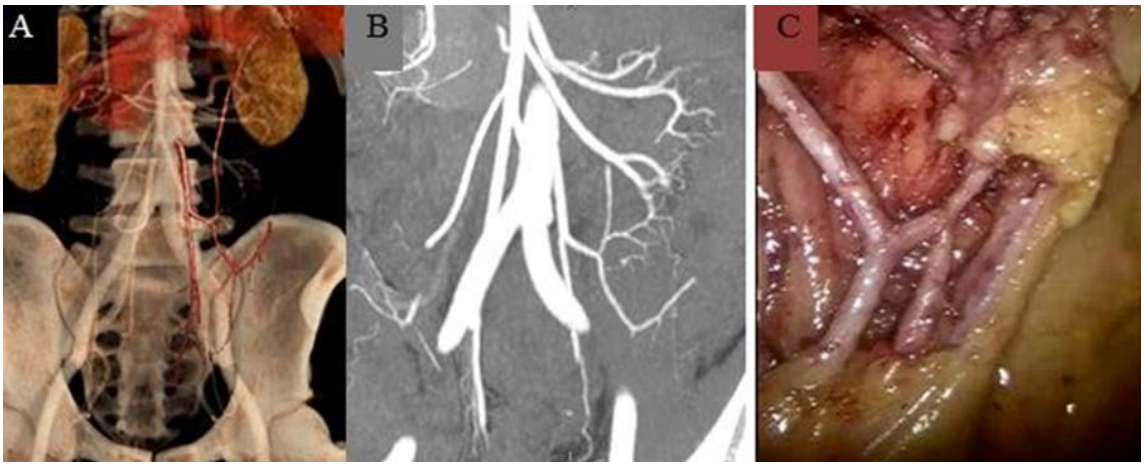


***Figure 5.*** *Type III by new classification of inferior mesenteric artery anatomy. Reconstructions of GIR (A) and MIP images (B), intraoperative photograph (C).*

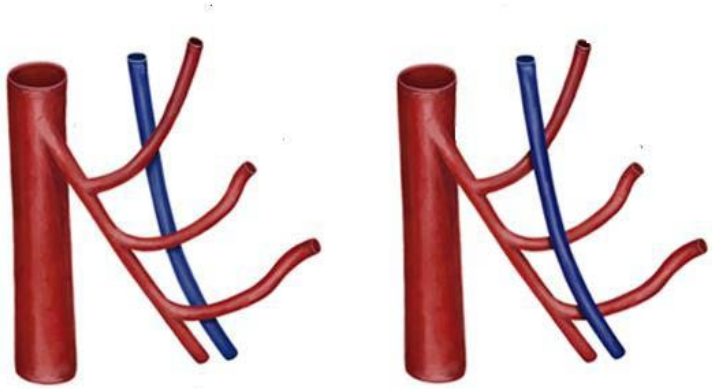

***Figure 6.*** *Intersectional patterns of the left colic artery and inferior mesenteric vein. IMV – inferior mesenteric vein, LCA – left colic artery, IMA – inferior mesenteric artery, SA – sigmoid artery, SRA – superior rectal artery. Vein was goigng anteriorly to inferior mesenteric artery in 24% of cases and posteriorly – in 76%.*

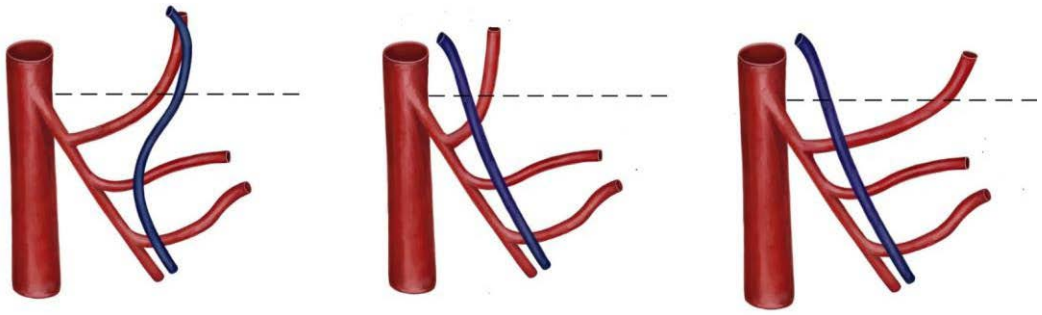

***Figure 7.*** *Positional relationship between the left colic artery and inferior mesenteric vein at the level of origin of the inferior mesenteric artery was evaluated in the axial view. IMV – inferior mesenteric vein, LCA – left colic artery, IMA – inferior mesenteric artery, SA – sigmoid artery, SRA – superior rectal artery. Type A was found in 31% of cases, type B – 53% and type C -16%*

type B – LCA was located laterally to the IMV; type C – LCA was located away from the IMV and the inferior mesenteric artery. Among the 214 analyzed patients, type B was most common – in 114 (53%) patients, while type A was found in 66 (31%) patients, and type C – in 34 (16%) patients (Figure 7).

## Discussion.

In surgical practice 2 methods of crossing the inferior mesenteric artery in colorectal cancer patients are described. First - high ligation in which the inferior mesenteric artery is crossed immediately in the base area. Second - low ligation in which the inferior mesenteric artery is crossed distally to the LCA [14]. High ligation simplifies the removal of paraortic lymph nodes and makes the left half of the colon more mobile. Low ligation allows maintaining a good blood supply to the intestine and avoiding ischemia in the proximal part of the colon and at the site of anastomosis [15,16].

In the meta-analysis by Mou-Bo Si et al., did not observed any advantages of high inferior mesenteric artery ligation over low inferior mesenteric artery ligation with apical lymph dissection around the inferior mesenteric artery. The number of removed lymph nodes, both the total number and the number around the inferior mesenteric artery root, did not differ. Mou-Bo Si et al. compared two different methods of low inferior mesenteric artery ligation with and without apical lymph node dissection around the inferior mesenteric artery. The authors concluded that the total number of lymph nodes removed in the group with low inferior mesenteric artery ligation without apical lymph dissection was significantly less than in the group with high inferior mesenteric artery ligation, which apparently reflects the advantage of high ligation. There was no difference between the groups with low inferior mesenteric artery ligation with apical lymph dissection around the main trunk of the inferior mesenteric artery and the group with high inferior mesenteric artery ligation [41]. This modified technique of low inferior mesenteric artery ligation with apical lymph dissection was originally used in clinical practice in Japan [41].

Anastomosis failure (frequency is 10%) is a serious postoperative complication that occurs in patients who have undergone radical surgery [42]. Anastomosis failure is also associated with subsequent local relapse and distant metastasis, as well as with an increase in the level of postoperative mortality [42]. Thus, reducing the likelihood of it is crucial for good surgical results. There are many risk factors for anastomosis failure [40]. However, surgeons' attention to the blood supply and tension of the anastomosis, since intestinal anastomosis without tension and with good blood supply is crucial for best result of colorectal cancer radical resection [42]. Fan et al. reported that the frequency of anastomosis failure was significantly higher in the group with high inferior mesenteric artery ligation compared with low one [43]. In a meta–analysis by Jinshui Zeng and Guoqiang Su was pointed that it was 9.8% in patients with high inferior mesenteric artery ligation compared to 7.0% in patients with low inferior mesenteric artery ligation [44].

Damage to the autonomic nerves is another common postoperative complication of colon cancer surgery. Lumbar

visceral nerves, which are responsible for the functions of the bladder, are located at the place where the inferior mesenteric artery departs from the aorta. Thus, the frequency of urinary system dysfunction in the group with low inferior mesenteric artery ligation will be lower [41].

In recent years researchers in Japan have proved that during surgery for colorectal cancer the safe distance for removing the mesentery is a 10 cm from the tumor. Therefore, left-sided hemicolectomy is performed extremely rarely since the concept of selective ligation of tumor-feeding vessels is used. When performing segmental resections of the colon the choice of the border of the intersection of the colon is based on the determination of the pathways of lymphogenic metastasis. The regional lymph nodes of the mesentery are located along the feeding vessels, therefore, when performing an extended lymph dissection, the principle of crossing the inferior mesenteric artery at its base can be used. However, such tactics can lead to a violation of the blood supply to the left half of the colon and this will require a cancer unjustified expansion of the volume of resection. The solution to this problem is to perform vascular skeletonization with selective removal of only some branches of inferior mesenteric artery. In this case the volume of lymph dissection will remain identical as with high inferior mesenteric artery ligation. This approach allows not only to remove all regional lymph nodes but also to maintain adequate blood supply to the left half of the colon. For example, if the tumor is located in the splenic flexure the left colic artery is bandaged at the place of its departure from the inferior mesenteric artery; if the tumor is located in the descending colon the left colic and sigmoid arteries are ligated preserving the last sigmoid and upper rectal arteries. When the tumor is located in the middle third of the sigmoid colon, all the sigmoid arteries are ligated with the preservation of the left colic and upper rectal arteries; if the tumor is located in the distal part of the sigmoid intestine the inferior mesenteric artery is ligated immediately after the departure of the left colic artery.

To perform optimal removal of lymph nodes during segmental resection of the colon the technique of vessel skeletonization is used which is technically difficult since it is necessary to work along the arterial wall [29,31]. During laparoscopic surgery for colorectal cancer vascular structures may be incorrectly identified and damaged due to ignorance of the variant anatomy of the inferior mesenteric artery and the inferior mesenteric vein, lack of tactile sensations and a narrowed field of vision which leads to complications such as massive bleeding and intestinal ischemia [24]. Therefore, the preoperative study of the variant inferior mesenteric artery anatomy is so important. Knowing the variant anatomy of the vessels before surgery it is possible to make an operation [25-29,31].

It is extremely important for surgeons to know the features of blood vessels anatomy before surgery.

Modern classifications of variant inferior mesenteric artery anatomy are very difficult to apply. The most known classification by W. Zebrowski describes 8 types of inferior mesenteric artery branching but they have no practical value for surgery [33]. In this regard optimization of the inferior mesenteric artery anatomy variability meeting the requirements of operating surgeons.

As a result of the study 15 types of variant inferior mesenteric artery anatomy were identified but due to the complexity of using this knowledge in classification this will be of little use in practice. A new classification was proposed which was based on the principle of separation of the branches from the main trunk of inferior mesenteric artery on the basis of which 3 surgically significant types of vascular branching were identified. Classification, provided by Zeng S., et al., 2022 has similar principle to our study which make problem of inferior mesenteric artery branching more relevant [45]. This principle is very important when performing inferior mesenteric artery skeletonization since it is carried out along the main trunk of the inferior mesenteric artery and it is important for the surgeon to know how the branches depart from the inferior mesenteric artery. The most frequent variant of the inferior mesenteric artery branching is type I.

The new classification, consisting of three types, was similar to that of Hirokazu Yada et al., except that the author examined the variability of the inferior mesenteric artery's anatomy using an invasive imaging method—angiography—which is currently not applicable for preoperative planning. We, however, examined vascular anatomy using computed tomography with intravenous contrast [46].

Preoperative assessment of the relationship between the LCA and the inferior mesenteric vein (IMV) is important at the level of the base of the inferior mesenteric artery, especially in laparoscopic surgery. Since it is at the level of the inferior mesenteric artery root there is the mesentery resection zone and the upper border of lymph dissection in sigmoid and rectal cancer are located.

Thus, abdominal CT angiography allows to clearly visualize mesenteric vessels and their collaterals which helps in preoperative planning of laparoscopic surgery for colorectal cancer.

## Conclusion.

1. The classification of inferior mesenteric artery anatomy has been developed for practical usage - 3 surgically significant types have been identified.

2. The accuracy 97.9% for abdominal CT angiography has been determined by comparing the results of studies with intraoperative data. The sensitivity of the method 95.8%, the specificity 100%.

3. When analyzing the anterior-posterior vascular relationship, the left colon artery passed anteriorly in relation to the inferior mesenteric vein in 76% of patients. When analyzing the medio-lateral arrangement of vessels, the most common variant was when the left colon artery passed laterally to the inferior mesenteric vein at the level of the base of the inferior mesenteric artery (53%). In 16% of cases, the left colon artery passed away from the inferior mesenteric vein and the inferior mesenteric artery.

## REFERENCES

1. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68:394-424.

2. Arnold M, Sierra M.S, Laversanne M, et al. Global patterns and trends in colorectal cancer incidence and mortality. Gut. 2017;66:683-691.
3. Ouakrim D.A, Pizot C, Boniol M, et al. Trends in colorectal cancer mortality in Europe: retrospective analysis of the WHO mortality database. BMJ. 2015:351.
4. Siegel R.L, Fedewa S.A, Anderson W.F, et al. Colorectal Cancer Incidence Patterns in the United States, 1974-2013. J Natl Cancer Inst. 2017;109.
5. Bailey C.E, Hu C.Y, You Y.N, et al. Increasing disparities in the age-related incidences of colon and rectal cancers in the United States, 1975-2010. JAMA Surg. 2015;150:17-22.
6. Wolf A.M.D, Fontham E.T.H, Church T.R, et al. Colorectal cancer screening for average-risk adults: 2018 guideline update from the American Cancer Society. CA Cancer J Clin. 2018;68:250-281.
7. Kasi P.M, Shahjehan F, Cochuyt J.J, et al. Rising Proportion of Young Individuals with Rectal and Colon Cancer. Clin Colorectal Cancer. 2019;18:e87-95.
8. Tikhonov S, Morozova N, Plutinskaya A, et al. N-Heterocyclic Carbenes and Their Metal Complexes Based on Histidine and Histamine Derivatives of Bacteriopurpurinimide for the Combined Chemo- and Photodynamic Therapy of Cancer. Int J Mol Sci. 2022:23.
9. Fedotova M.K, Usachev M.N, Bogdanova E.V, et al. Highly purified conjugates of natural chlorin with cobalt bis (Dicarbollide) nanoclusters for pdt and bnct therapy of cancer. Bioengineering. 2022:9.
10. Tikhonov S, Ostroverkhov P, Suvorov N, et al. Tin Carboxylate Complexes of Natural Bacteriochlorin for Combined Photodynamic and Chemotherapy of Cancer è. Int J Mol Sci. 2021:22.
11. Conticchio M, Papagni V, Notarnicola M, et al. Laparoscopic vs. open mesorectal excision for rectal cancer: Are these approaches still comparable? A systematic review and meta-analysis. PLoS One. 2020:15.
12. Kellokumpu I.H, Kairaluoma M.I, Nuorva K.P, et al. Short- and long-term outcome following laparoscopic versus open resection for carcinoma of the rectum in the multimodal setting. Dis Colon Rectum. 2012;55:854-863.
13. McKay G.D, Morgan M.J, Wong S.K.C, et al. Improved short- term outcomes of laparoscopic versus open resection for colon and rectal cancer in an area health service: a multicenter study. Dis Colon Rectum. 2012;55:42-50.
14. Bertrand M.M, Delmond L, Mazars R, et al. Is low tie ligation truly reproducible in colorectal cancer surgery? Anatomical study of the inferior mesenteric artery division branches. Surg Radiol Anat. 2014;36:1057-1062.
15. Park M.G, Hur H, Min B.S, et al. Colonic ischemia following surgery for sigmoid colon and rectal cancer: a study of 10 cases and a review of the literature. Int J Colorectal Dis. 2012;27:671-5.
16. Tsujinaka S, Kawamura Y.J, Tan K.Y, et al. Proximal bowel necrosis after high ligation of the inferior mesenteric artery in colorectal surgery. Scand J Surg. 2012;101:21-25.
17. Zeng J, Su G. High ligation of the inferior mesenteric artery during sigmoid colon and rectal cancer surgery increases the risk of anastomotic leakage: a meta-analysis. World J Surg Oncol. 2018:16.
18. Zhang W, Yuan W.T, Song J.M. Ileum Interposition for Low Rectal Anastomosis in Rectal Cancer Surgery: Is It a Remedial Option? Dis Colon Rectum. 2015;58:708-709.
19. Fan Y.C, Ning F.L, Zhang C.D, et al. Preservation versus non-preservation of left colic artery in sigmoid and rectal cancer surgery: A meta-analysis. Int J Surg. 2018;52:269-277.
20. Malakorn S, Sammour T, Bednarski B, et al. Three Different Approaches to the Inferior Mesenteric Artery during Robotic D3 Lymphadenectomy for Rectal Cancer. Ann Surg Oncol. 2017;24:1923.
21. Miyamoto R, Nagai K, Kemmochi A, et al. Three-dimensional reconstruction of the vascular arrangement including the inferior mesenteric artery and left colic artery in laparoscope-assisted colorectal surgery. Surg Endosc. 2016;30:4400-4.
22. Yasuda K, Kawai K, Ishihara S, et al. Level of arterial ligation in sigmoid colon and rectal cancer surgery. World J Surg Oncol. 2016:14.
23. Goh N, Fong S.S, How K.Y, et al. Apical lymph node dissection of the inferior mesenteric artery. Colorectal Dis. 2016;18:O206-9.
24. Chen J, Wang M, Chen Y, et al. A clinical study of inferior mesenteric artery typing in laparoscopic radical resections with left colonic artery preservation of rectal cancer. World J Surg Oncol. 2022:20.
25. Ke J, Cai J, Wen X, et al. Anatomic variations of inferior mesenteric artery and left colic artery evaluated by 3-dimensional CT angiography: Insights into rectal cancer surgery - A retrospective observational study. Int J Surg. 2017;41:106-111.
26. Zhang W, Yuan W.T, Wang G.X, et al. Anatomical study of the left colic artery in laparoscopic-assisted colorectal surgery. Surg Endosc. 2020;34:5320-6.
27. Cirocchi R, Randolph J, Cheruiyot I, et al. Systematic review and meta-analysis of the anatomical variants of the left colic artery. Colorectal Dis. 2020;22:768-778.
28. Voynovskiy A.E, Seurko K.I. The role of variant anatomy of the left colon artery and inferior mesenteric vein in planning resections of the left colon for colorectal cancer. Bulletin of Pirogov National Medical & Surgical Center. 2022;17:36-40.
29. Seurko K.I, Vinokurov I.A, Kasymov M.U. The role of variant anatomy of the inferior mesenteric artery in segmental colon resections with lymphodissection in patients with colorectal cancer. Hirurg (Surgeon). 2022;6-13.
30. Lan P, He XS, Zhang ZJ, et al. Critical issues in surgical treatment for colorectal cancer. Zhonghua Wei Chang Wai Ke Za Zh. 2025;28:21-27.
31. Hiroishi A, Yamada T, Morimoto T, et al. Three-dimensional computed tomographic angiography with computed tomographic colonography for laparoscopic colorectal surgery. Jpn J Radiol. 2018;36:698-705.
32. Mari F.S, Nigri G, Pancaldi A, et al. Role of CT angiography with three-dimensional reconstruction of mesenteric vessels in laparoscopic colorectal resections: a randomized controlled trial. Surg Endosc. 2013;27:2058-67.
33. Żebrowski W, Augustyniak E, Zajac S. Variations of origin and branching of the interior mesenteric artery and its

anastomoses. Folia Morphol (Warsz). 1971;30:575-583.
34. Wang Y, Shu W, Ouyang A, et al. The New Concept of Physiological "Riolan's Arch" and the Reconstruction Mechanism of Pathological Riolan's Arch After High Ligation of the Inferior Mesenteric Artery by CT Angiography-Based Small Vessel Imaging. Front Physiol. 2021;12.
35. Kriger A.G, Pronin N.A, Dvukhzhilov M.V, et al. Surgical glance at pancreatic arterial anatomy. Annals of HPB Surgery. 2021;26:112-122.
36. Acar G, Cicekcibasi A.E, Koplay M, et al. Anatomical Variations of the Celiac Trunk and Hepatic Arteries with a New Classification, Based on CT Angiography. J Coll Physicians Surg Pak. 2022;32:9-14.
37. Rubtsova N.A, Pheduleev M.N, Nerestyuk Y.I, et al. Arterial blood supply to the liver, celiac and mesenteric pool (literature review). Medical Visualization. 2021;25:74-83.
38. Yang Y, Shi B, Duan Y, et al. Anatomic morphology and clinical significance of intraforaminal ligaments of the cervical spine. Clinical Anatomy. 2019;32:654-60.
39. Kuzu M.A, Güner M.A, Kocaay A.F, et al. Redefining the collateral system between the superior mesenteric artery and inferior mesenteric artery: a novel classification. Colorectal Dis. 2021;23:1317-1325.
40. Murono K, Kawai K, Kazama S, et al. Anatomy of the inferior mesenteric artery evaluated using 3-dimensional CT angiography. Dis Colon Rectum. 2015;58:214-219.
41. Si M.B, Yan P.J, Du Z.Y, et al. Lymph node yield, survival benefit, and safety of high and low ligation of the inferior mesenteric artery in colorectal cancer surgery: a systematic review and meta- analysis. Int J Colorectal Dis. 2019;34:947-962.
42. Tanaka J, Nishikawa T, Tanaka T, et al. Analysis of anastomotic leakage after rectal surgery: A case-control study. Ann Med Surg (Lond). 2015;4:183-186.
43. Fan YC, Ning FL, Zhang CD, et al. Preservation versus non-preservation of left colic artery in sigmoid and rectal cancer surgery: A meta-analysis. Int J Surg. 2018;52:269-277.
44. Fan Y.C, Ning F.L, Zhang C.D, et al. Preservation versus non-preservation of left colic artery in sigmoid and rectal cancer surgery: A meta-analysis. Int J Surg. 2018;52:269-277.
45. Zeng S, Wu W, Zhang X, et al. The significance of anatomical variation of the inferior mesenteric artery and its branches for laparoscopic radical resection of colorectal cancer: a review. World J Surg Oncol. 2022:20.
46. Yada H, Sawai K, Taniguchi H, et al. Analysis of Vascular Anatomy and Lymph Node Metastases Warrants Radical Segmental Bowel Resection for Colon Cancer. World J. Surg. 1997;21:109-115.