

How to Cite:

Gadzhiev, G. A., & Vasiliev, P. V. (2022). Colon cancer surgery. *International Journal of Health Sciences*, 6(S6), 10763–10769. <https://doi.org/10.53730/ijhs.v6nS6.12895>

Colon cancer surgery

Gadzhi Akhadovich Gadzhiev

1-year PhD student in surgery, Khanty-Mansyisk State Medical Academy, Russia

Pavel Valerievich Vasiliev

Candidate of Medical Sciences, Associate Professor of the Department of General and Faculty Surgery, Khanty-Mansyisk State Medical Academy, Russia

Abstract---Colon cancer is one of the most common types of cancer with the mortality rate of up to 9.4%. Late diagnosis and occurrence of life-threatening complications greatly entangle surgical intervention in this area. Anatomical complexity and tendency to lymphogenous dissemination impose high demands on the standards of surgeries. Currently, two concepts of the implementation of surgical interventions for colon cancer, described in the literature as “German” and “Japanese” standards, dominate. Both directions have their advantages and comparable results of surgery. The purpose of this article is to highlight the problem of surgical treatment of colon cancer, taking into account the established modern standards.

Keywords---cancer, mesocolonectomy, colon, lymph node dissection.

Introduction

Recent decades are characterized by the increased frequency of colon cancer which takes the 3rd position after the prostate cancer in men, breast cancer in women and pulmonary cancer in both sexes. In 3-5% of cases colon cancer (CC) occurs in connection with hereditary burden and it is very often diagnosed in the patients with Lynch syndrome, family adenomatous polyposis and MutYH-associated polyposis [1]. The other CC cases have sporadic character and are mainly diagnosed in elderly people. Apart from colon cancer (CC) incidence rate observed all over the world, the adverse circumstance is the fact that in 60%-90% of patients complications of the underlying disease are diagnosed, among which ileus, peritonitis, abdominal sepsis prevail [2]. All of this considerably threatens patients' lives and requires immediate surgery. There are certain challenges in selecting the surgery tactics connected with the lack of well-defined standard technique of tumor resection in the considered localization. Nevertheless the attempts of such standardization are made, which will definitely result in decreasing the risk of complications, mortality and amount of CC recurrences. The aim of this article is to investigate the existing surgical approaches to colon cancer treatment.

Prevalence and risk factors of colon cancer

According to GLOBOCAN data, 1,931,590 new cases of colorectal cancer were diagnosed all over the world in 2020 and this is 10% of tumors of all possible localizations. The colorectal cancer mortality in the same year was in 953,173 cases, i.e. 9.4% from the total oncological mortality [3]. Colorectal cancer is the most “westernized” cancer types with high disease rates in North America, Australia, New Zealand and Europe (>40 cases for 100,000 people) and the lowest disease incidence in rural regions of Africa (<5 cases for 100,000 people) and Asia (high variation). The highest incidence rates are registered in Alaska population and are over 100 cases for 100,000 people [4]. The colon cancer incidence rate in the Russian Federation in 2019 was 30.85 for 100,000 of population. In men this index equaled 29.09, and in women – 32.38 for 100,000 people. Nearly in half of these cases the colon cancer was diagnosed in stages III-IV [3].

Among CC risk factors much attention is paid to the components of daily food ration. In metanalytical study it was demonstrated that the risk of colorectal cancer development sufficiently increases (in 1.29 times) at daily red and processed meat consumption. At the same time, healthy nutrition with sufficient amount of fruit, vegetables, fish, calcium decreased CC risk [5]. According to WHO data, every 50 grams of meat eaten every day increase the risk of colorectal cancer development by 18% [6]. Intestinal microflora can considerably contribute to colon carcinogenesis. It was demonstrated that the amount of certain intestinal bacteria (for example, Fusobacteria, Alistipes, Porphyromonadaceae, Coriobacteridae, Staphylococcaceae, Akkermansia spp. and Methanobacteriales) increases with colorectal cancer, at the same time, the content of other ones significantly decreases (Bifidobacterium, Lactobacillus, Ruminococcus, Faecalibacterium spp., Roseburia and treponeme).

The increased content of amino acids and bacterial metabolites was also noted, as well as the decreased concentration of anticarcinogenic agent butyrate, which is referred to short-chain fatty acids formed as a result of microbiome fermentative activity [7]. Besides, it was found out that the behavioral factors, such as smoking, hypodynamia, salty food abuse were connected with the increased frequency of colon cancer disease [8]. Considering the reasons of early CC development with young people, E.M. Stoffel et al. highlighted the following CC risk factors: burdened family history, obesity, bad habits (smoking, alcohol), abundance of red and processed meat in the ration, non-optimum diet, calcium and vitamin D deficiency, insufficient physical activity, diabetes mellitus, intake of antibiotics (risk of dysbacteriosis) and other medications [9].

Colon cancer diagnostics

The colon cancer clinical picture greatly varies depending on the tumor process localization. The oncological search starts with such symptoms as stomachache, blood in the feces, change in the feces character, intoxication symptoms. The temperature is usually subfebrile. The pain is detected in the tumor location when palpating the abdomen, rebound sensitivity is positive. If abscess is burst, the peritonitis symptoms are observed [10]. Sometimes the disease is asymptomatic until advanced stages and considerable complications. Leser-Trelat

syndrome (eruptive seborrheic keratosis), which is often combined with adenocarcinoma in digestive tract, can signal about the occult tumor [11]. Cancer alertness is exercised in case of colon chronic inflammatory diseases, in respect of elderly patients, with burdened family history. The diagnostic program usually comprises the following investigations:

- colonoscopy;
- fecal occult blood testing;
- flexible sigmoidoscopy;
- CT-colonography (“X-ray colonography”);
- fecal immunochemical test (FIT) [12].

In case of acute situation, within 2 hours after hospitalization the abdomen and breast plain radiography, UST of abdominal cavity, ECG are made, blood clinical and biochemical analyses, clinical urine analysis, general practitioner’s consultation are assigned. Colonic pneumatosis, and in case of peritonitis development – colonic (and enteric) levels, intestinal arches are mostly defined in the X-ray picture. UST is used as an additional, supplementary method of diagnostics, which allows revealing infiltrates, abscesses [10].

Surgical treatment of colon cancer

For a long time the lack of standardization in colon cancer surgical treatment has been leading to unsatisfactory results, high frequency of postsurgical complications and oncological process recurrence. “German” and “Japanese” directions in surgery technique standardization, which allow solving the above problems, have been formed in recent decades and are rapidly spreading. The main practices of these standards are connected with the tissue volume to be resected, volume of lymph node dissection and ligation of vessels feeding the tumor [13]. Both systems use own rules of coding surgery details, and, to some extent, they converge with each other.

“German” standardization principle was introduced by N. West and W. Hohenberger who proposed to carry out the complete mesocolonectomy (CME) with the ligation of central feeding vessel and lymph node dissection volume, which depends on tumor invasion degree [14, 15]. In the paper by W. Hohenberger et al. it was demonstrated that the use of CME principles resulted in 5-year survivability increase from 82.1% up to 89.1% in comparison with colon resection [14]. CME principle was based on anatomic-topographic constitution of colon and surrounding tissues. The colon is surrounded by tissue, lymph node system and is covered with ventral and dorsal fasciae forming kind of envelope. It was assumed that “envelope” resection would result in better clinical result and decrease in the number of recurrences. Additional central vessel ligation (CVL) blocks the lymph efflux zone from the colon affected region [16]. With tumors of descending colon the scheme CME+CVL corresponds to the classical left-side hemicolectomy, however, it is also proposed to skeletonize superior mesenteric vein, mobilize pancreas head, duodenum and carry out dissection in the system of right gastroepiploic vessels and Henle’s trunk [13].

When defining the lymph node dissection volume, the position of lymph nodes, which are subdivided into D1 (epicolic and paracolic), D2 (mesocolic or intermedial) and D3 (apical or main) groups, is taken into account. "Japanese" classification marks lymph nodes with three-digit number with the following meanings:

- first digit – defines belonging to large intestine and for colon it equals 2;
- second digit – defines the sector fed by the corresponding artery, where: 0 – ilioocolic artery; 1 – right colic artery; 2 – middle colic artery; 3 – left colic artery; 4 – sigmoid; 5 – proctal arteries;
- third digit – defines the remoteness degree from the colon, where 1 - D1; 2 – D2; 3 – D3-groups of lymph nodes.

The lymph node dissection degree is defined in compliance with the notions of TNM-staging of the oncological process. With N-negative variant the tumor invasion depth is oriented at. Starting from stage T2, the lymph node dissection including D3-group is carried out [13]. Apart from vertical lymph node dissection, "Japanese" system specifies the rules of horizontal tissue resection, which is defined as the triangle base length with the apex in the great vessel ligation point. The rules also define the tissue resection with the allowance of 5-10 cm in both directions of the tumor. If within this allowance the lymph-vascular bundle is localized, then it is necessary to move back 5 cm more from it. The surgical resection volume was classified in accordance with the degree of horizontal (H0–H2) and vertical (V0–V2) lymph nodes dissection. All variants of dissection were split into seven categories (from HV0 to H2V2):

- HV0 – only horizontal (but not vertical) dissection of any degree was carried out;
- H0V1 – dissection of intermediary and epicolic lymph nodes less than 5 cm more distally and proximally from the tumor;
- H1V1 – includes dissection of intermediary, epicolic lymph nodes at the distance less than 5 cm more distally and proximally from the tumor, and epicolic lymph nodes at the distance more than 5 cm either from distal or proximal side of the tumor;
- H2V1 – dissection of intermediary, epicolic lymph nodes at the distance less than 5 cm more distally and proximally from the tumor, and epicolic lymph nodes at the distance more than 5 cm both from distal and proximal sides of the tumor;
- H0V2 – includes dissection of main, intermediary and epicolic lymph nodes at the distance less than 5 cm from distal and proximal sides of the tumor;
- H1V2 – dissection of main, intermediary and epicolic lymph nodes at the distance less than 5 cm more distally and proximally from the tumor, as well as epicolic lymph nodes at the distance more than 5 cm from distal or proximal sides of the tumor;
- H2V2 – dissection of main, intermediary and epicolic lymph nodes at the distance less than 5 cm more distally and proximally from the tumor, as well as epicolic lymph nodes at the distance more than 5 cm both from distal and proximal sides of the tumor [13, 17].

With all safety advantages, the decrease in the number of complications and risks of oncological process relapse, the use of “German” technique is followed by considerably greater tissue losses in comparison with “Japanese” one. Comparison of two standards of large intestine primary cancer in one European and two Japanese centers demonstrated that the frequency of resections of mesocolic plane was high in both cases, however, “Japanese” D3-samples were much shorter (162 mm vs. 324 mm, $p=0.001$) and the amount of mesentery resected was less (8309 vs. 17957 mm² $p=0.001$). The median amount of resected lymph nodes when applying D3-method was 18 vs. 32 during the resection with partial mesorectal excision ($p=0.001$). However, the distance from the place of the feeding vessel ligation to the bowel wall and amount of affected lymph nodes were comparable in both standards [15]. Thus, both systems demonstrate comparable results in relation to cancer resection effectiveness.

Although in domestic surgery there are attempts to standardize the colon cancer surgery technique, however, the work in this direction has only started, not having the character of completed system [18]. The occurrence frequency of intra-abdominal pyoinflammatory complications is still high, the frequency of which is up to 67% from the number of all operated patients. Abdominal peritonitis (38-65%) and abscesses (3.6-20.5%) prevail. The reason can be the mistakes at the final surgery stage, for example, during the formation of colonic anastomosis and emergency operations in patients with decompensated acute intestinal obstruction. The selection method in such patients can be the colostomy application [2]. In cases revealed during the diverticula operation it is not recommended to form intestinal anastomosis due to the risk of suture failure development [1]. The concept by W. Hohenberger in colon cancer treatment is successfully adapted in Russian hospitals and hemicolectomy is supplemented by lymph node dissection in D3-volume, moreover, the laparoscopic method provides better results than an open access [19]. Different methods for improving “German” technique are proposed, which result in decreasing the frequency of postsurgical complications and possibility of the disease recurrence [20].

Conclusion

Colon cancer is a topical problem in modern oncology and oncological surgery not only due to high incidence degree but also due to the dominating diagnostics at the late stages of the disease when the tumor process is spread quite broadly and lymph nodes are affected. Besides, complications dangerous for life are being developed in this period, which create certain difficulties for diagnosing and treating cancer of the localization considered. The availability of similar complications requires immediate surgery and thorough selection of the surgical technique. The development of surgical standards considerably facilitates the surgeon's work and allows significantly reducing the frequency of possible complications preserving the high quality level of the patient's care management. Both “German” and “Japanese” techniques of surgical intervention are widely adapted in clinical practice and their efficiency is proved by many presentations and publications. Despite the fact that the first method is the most radical one and is accompanied with the considerable amount of excision, the amount of resected lymph nodes affected by metastases is comparable, which does not give vivid advantages to one or another method. Nevertheless, domestic specialists

lean toward the concept proposed by W. Hohenberger due to high reliability of cancer recurrence prevention.

Conclusions

- At present, the concepts proposed by W. Hohenberger and Y. Hashiguchi are dominating in the colon surgery, which are conditionally defined as “German” and “Japanese” colon cancer surgery standards.
- Despite the difference in the resected tissue volume when implementing “German” and “Japanese” standards, the amount of lymph nodes affected by the oncological process does not credibly differ.
- In domestic surgery, when operating colon cancer the preference is given to complete mesocolic excision with the ligation of central feeding vessel and D3-lymph node dissection.

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