REVIEW

Research progress in colon cancer surgery

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ABSTRACT

Colon cancer is one of the top three malignant tumors in the world, in recent years, the incidence and mortality of this disease are increasing, which seriously threatens human life and health. At present, surgery is still the main treatment for colon cancer, combined with chemotherapy and other measures can effectively improve the survival of patients. Different surgical methods have different prognostic effects on patients. In terms of intraoperative lymph node dissection for colon cancer, lymph node dissection during total mesocolic resection and D3 radical resection has significantly improved prognosis for colon cancer. Lymph node metastasis of colon cancer is common, with the presence of skip metastasis, lymph node dissection is important for the prognosis of patients, tumor recurrence and tumor metastasis. Therefore, it is necessary to make clear the diagnosis and lymph node metastasis before surgery, determine the surgical procedure and the scope of lymph node dissection, so as to avoid postoperative complications caused by inadequate tumor recurrence or excessive clearance.

Key Words: Television archives, Content-based video retrieval, TV broadcast structuring, Video indexing

1. INTRODUCTION

According to the International Agency for Research on Cancer (IARC), colon cancer is one of the top three malignant tumors in the world. Although it has been studied for many years, it is still one of the leading malignancies causing death worldwide. It was reported by the National Cancer Registry Summary released by Ministry of Health, Labor and Welfare (Japan), that there were more than 150,000 colon cancer cases in Japan in 2016, ranking first in the incidence of malignant tumors in other parts of body. Colon cancer is the fourth most common cancer in the United States, but the second most deadly.[1] In view of the data provided by the Fondation Registre du Cancer from 2010 to 2020, the incidence has decreased slightly, but in the past ten years, most of the deaths counted have occurred within one year after diagnosis. In recent years, with better screening tools and changes in the population's attitude towards early screening of malignant tumors, the mortality rate of colon cancer is decreasing accordingly, and the change of the living environment of the population will also further reduce the incidence of colon cancer. However, between 1973 and 2005, 7,661 cases of colon cancer in the United States were all diagnosed in patients around the age of 40, and the statistics on colon cancer from 1990 to 2010 clearly shows that the incidence of the disease has been increased by 2.2%, and the occurrence of the disease has increased as well in patients over 40 years of age. With a large population of 1.4 billion in China, there are relatively more patients with colon cancer.

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According to the 2019 data provided by the World Health Organization (WHO) Classification of Tumors released by IARC, colon cancer in China ranks 5th and the incidence is also increasing.[2]

2. ANATOMICAL AND PHYSIOLOGICAL CHARACTERISTICS OF COLON CANCER

The colon is artificially divided into two positions, the left hemicolon and the right hemicolon, which have their own unique differences in anatomy, embryonic origin and physiology. The left hemicolon originated in the posterior intestine during the embryonic period, including the one-third of the distal end of the transverse colon, the descending colon and the sigmoid colon. The right hemicolon begins in the midgut during the embryonic period, is homologous with the jejunum and ileum, and covers two-thirds of the ileocecal junction, the ascending colon and the transverse colon.[3]

2.1 Colonic physiological differences

The physiological functions of the left and right hemicolons have obvious physiological differences due to their different anatomical positions, shapes and sizes. The right hemicolon is physiologically responsible for the absorption of water, sodium and chloride ions, as well as the secretion of potassium and bicarbonate; participates in anion exchange and passively absorbs short-chain fatty acids.[4] The left hemicolon has more of a function of transporting feces. The concentration of bile salts in the right hemicolon was significantly higher than that in the left hemicolon. Therefore, some studies have found that the risk factors for carcinogenesis of the right hemicolon after cholecystectomy are increased. The metabolic abnormalities of the colon during carcinogenesis have significant characteristics, in which tumor cells will preferentially use aerobic digestion to decompose glucose, thereby changing the metabolic pathways and providing essential substances and energy necessary for proliferation.[5] Some studies have shown that the biotransformation in the gastrointestinal tract is associated with gastrointestinal tumors, among which cytochrome P450 family (CYP), glutathione S-transferase (GST) family, and UDP-glucuronosyltransferase (UGT) family are related to different stages of the decomposition of human carcinogens.[3]

2.2 Colic lymph nodes

Firstly, the lymphatic reflux pathway of the colon converges in the submucosal layer of the intestinal wall to form a capillary lymphatic network, then to the colonic wall and paracolonic lymph nodes, and finally to the lymph nodes around the mesenteric vessels and at the mesenteric roots. According to the consensus proposed by Chinese experts, the naming and metastasis routes of colonic lymph nodes are classified into: (1) paracolic lymph nodes; (2) intermediate lymph nodes; (3) primary lymph nodes; (4) primary and central lymph nodes; Clinically, lymph nodes in each region of the colon are usually named with three digits starting with 200, with the hundredth digit representing the colon, the tenth digit representing the colonic innervating artery, and the single digit indicating the lymph node substation; According to the "Guidelines for the Treatment of Colorectal Cancer", the lymph node dissection is divided into three stations in detail; In addition, there are some out-of-area lymph nodes, such as perihilar lymph nodes, gastric curvature lymph nodes, and gastric subpyloric lymph nodes.

2.3 Mode of lymph node metastasis

The metastasis of most colon cancers follows the principle of proximal to distant, generally occurs near the peri-intestinal lymph nodes adjacent to the lesion, and then spreads to the primary lymph nodes located in the distant intermediate lymph nodes for tuberculosis.[6] Therefore, according to the Japanese guidelines for the treatment of colorectal cancer, lymph node dissection is also divided into three stations from near to far according to the stage of colon cancer tumor.

Lymph node skipping metastasis (LNSM): some patients may have distant lymph node involvement after the detection of the tumor, and there is no positive lymph node metastasis in the vicinity, and this type of metastasis has been not only found in colon cancer, according to years of research and case statistics, but also has been confirmed in breast cancer,[7] cervical cancer,[8] gastric cancer,[9] and its related risk factors are associated with the prognosis. In the TNM stage of colon cancer after surgery, pT1-2 and pN1 are independent risk factors for skipping metastasis in colon cancer.[10]

2.4 Tumor staging

TNM staging, proposed by Pierre Denoix, is a commonly used clinical staging method for epithelial malignancies. Clinically, T, N and M indicate primary tumor lesion, lymph node involvement and distant circulatory metastasis respectively.

Tumors can be divided into A stage, B stage, C stage and D stage according to the location of tumor invasion by means of the Dukes staging method.

The probability of lymph node metastasis in T1 stage is 19 percent,[11] and the incidence of lymph node metastasis in colon cancer is high, and skipping metastasis may occur as well. Lymph node dissection is very important in the treatment of any malignant tumor, and it is of relevant significance for the postoperative prognosis in patients with recurrence and tumor metastasis.

3. DIFFERENCES BETWEEN COLON CANCER RADICAL SURGERY AND LYMPH NODE DISSECTION

3.1 D3 colon cancer radical surgery

According to the 2019 Guidelines for the Treatment of Colorectal Cancer compiled by the Japanese Colon and Rectal Cancer Association (JSCCR),[10] it is emphasized that lymph nodes should be thoroughly dissected at the peribowel, mesentery, and mesenteric artery roots at the same time as colon cancer lesions are resected. In surgery, the degree of lymph node dissection is determined based on the clinical diagnosis and the likelihood of lymph node metastasis observed during surgery. D1 radical resection is performed to dissect paracolic lymph nodes, D2 radical resection is to dissect the innervated arterial intermediate lymph nodes, and D3 radical resection is to thoroughly dissect the paracolic lymph nodes located near the marginal artery and near the intestinal wall of the arterial nucleus, the intermediate lymph nodes located around the colonic artery, and the primary lymph nodes located around the superior and inferior mesenteric arteries during the perioperative period and after the possibility of lymph node metastasis is found during the perioperative period.

If no suspected lymph node involvement is found, lymph node dissection is necessary according to the stage of the tumor, and carcinoma in situ is not accompanied by lymph node metastasis, so lymph node dissection is not necessary if the tumor is carcinoma in situ. However, in order to completely eliminate the risk near the tumor, D1 lymph node dissection is usually performed at the same time as intestinal resection is conducted; The probability of T1 lymph node metastasis is 10%, so D2 lymph node dissection is necessary when the tumor invasion reaches T1. When the tumor and invasion of the muscularis propria reach T2 stage, D2 lymph node dissection or D3 lymph node dissection can be performed to avoid the omission of lymph node skipping metastasis. At the same time, this procedure achieves a sufficient range of lymph node dissection, which is of positive significance for the prognosis in patients, tumor recurrence and metastasis.

3.2 Complete mesocolic excision (CME)[12]

The procedure involves sharp dissection of the anatomical plane between visceral fascia and parietal fascia, emphasizing the complete excision of the mesangium and the integrity of the specimen, while fully exposing the roots of the colonic artery and ligation, and completing the dissection of the mesenteric root lymph nodes. This procedure achieves adequate lymph node dissection and reduces the risk of metastasis and recurrence, which has positive prognosis implications for patients.

3.3 Indocyanine green and carbon nanoparticles staining lymph node dissection[13]

The procedure will be to prepare indocyanine green (ICG) before surgery and follow the principles of CME to remove lymph nodes in the fluorescently colored lymph node group of non-chromogenic tuberculosis with obvious enlargement. This operation follows the surgical methods and principles of CME, and the dissection site has reached a sufficient extent of lymph node dissection.

4. CONTROVERSY OVER LYMPH NODE DISSECTION

Compared with D3 radical resection, CME resected more mesentery and bowel, which increased the number of lymph nodes detected, but did not fundamentally increase the number of positive lymph nodes.[14] Stained lymph node dissection does increase the number of positive lymph nodes, but at the same time, there is a possibility of metastasis or skipping metastasis. Therefore, the optimal surgical procedure for colon cancer is uncertain, and requires more controlled clinical studies.

In the clinical analysis of left hemicolonic carcinoma during surgical treatment, it was found that the incidences of No.222 lymph node metastasis, No.223 lymph node metastasis and No.253 lymph node metastasis were 14.6%, 7.3% and 2.4%, while No.223 lymph nodes in the descending colon segment and sigmoid colon segment were not found, and the No.253 lymph node metastasis rates were 4.1% and 5.9%, respectively. However, in the surgical treatment of right hemicolonic carcinoma, the controversy is whether to remove the subpyloric lymph nodes (No.206 lymph nodes). According to studies, the metastasis rate of No.206 lymph nodes for hepatocolonic carcinoma is 3%-17%.[15] However, in the following studies, the metastasis rate of No.206 lymph nodes is reported to be different, but the general metastasis rate is related to the T stage of tumor and tumor location.[16]

In recent years, the choice of CME or D3 radical resection for patients with colon cancer has been one of the hot spots for surgeons, and these two surgeries have significantly improved the prognosis of colon cancer. At the same time, there is controversy about whether to perform routine lymph node dissection during D3 radical resection. In general, No. 206 is recommended for radical right hemicolonic carcinoma resection, but this part is not the part of the lymph nodes in the colon region, and it is not included in the mesocolon. Simultaneous dissection of No.223 and No.206 increases the potential for injury to the superior mesenteric artery and vein, and increases the risk of intraoperative bleeding and

postoperative chyle leakage.[17] At the same time, there is still no agreement on when D2 and D3 dissection should be performed and whether to dissect No. 223 and No. 206 lymph nodes. As a complete resection of the colorectum and its mesangium under the anatomical plane, CME improves the surgical efficiency and reduces the local recurrence rate, and the 5-year related survival rate of the tumor increases by 7%. Different mesangial dissection lymphatic dissection and vascular ligation are required according to different sites, but the extended lymph node dissection may also cause different degrees of postoperative complications.

According to the study of Zhang W,[18] an increase in the number of lymph nodes dissected during surgery has a positive effect on improving the prognosis in patients, and as the number of lymph nodes are detected, the disease stage is more accurate and the patient prognosis is better.

5. Outlook

Lymph node metastasis is more common in colon cancer, in addition to the presence of skip metastasis, lymph node dissection is relevant to the prognosis in patients with tumor recurrence and tumor metastasis. Therefore, it is necessary to determine the diagnosis of lymph node metastasis in patients before surgery to determine the scope of lymph node dissection. The selection of surgical methods can avoid the recurrence of tumor caused by inadequate cleaning and the postoperative complications caused by excessive cleaning. In addition, whether the lymph nodes No.223, No.206 and No.253 are routinely dissected in different parts of the colon, different degrees of tumor differentiation and different depths of invasion still need to be further studied, and whether indocyanine green staining is in place for lymph node dissection needs to be further observed and postoperative follow-up.

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Authors contributions

Yueli Yu is responsible for the overall idea and review of the article, Aersileng is responsible for data collection and writing, both authors read and approved the final manuscript.

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