

# Progress in the study of metastatic mechanism of colorectal cancer in vivo

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**Abstract.** The main object of this paper is colorectal cancer (CRC). Colorectal cancer is a malignant tumor that occurs in the colon or rectum. It is one of the most common cancers in the digestive system in the world. Its pathogenesis is complex and is related to many factors, including genetic factors and lifestyle habits. Mild cases can be treated and have a high probability of recovery, but severe tumors can even be fatal. For CRC, this paper includes its pathogenesis, metastasis mechanism, and corresponding intervention measures. Through research on these aspects, it aims to have a more comprehensive understanding of the causes, development process, and treatment strategies of CRC. The pathogenesis of CRC is usually affected by many different factors. This article will mainly discuss the factors of genetics, diet, and lifestyle. In terms of metastasis mechanism, tumor immune microenvironment, epithelial-mesenchymal transition (EMT), and vascular growth factors play a decisive and key role. Then this article also discusses intervention measures for CRC, including inhibiting the formation of new blood vessels, immunotherapy, and the use of chemotherapy agents.

**Keywords:** Colorectal cancer, pathogenesis, mechanisms, interventions.

## 1. Introduction

Colorectal cancer (CRC) is one of the most common types of tumors in the world, and its incidence is gradually increasing. Although there are some effective treatments for CRC in the early stages of its development, tumor metastasis remains a problem that is difficult to eradicate in the current medical community. There are many different types of causes for CRC metastasis, such as gene mutations, genetic factors, and poor postoperative intervention.

At present, research on CRC has made continuous breakthroughs. For example, studies have found that the interaction between cancer cells and stromal cells, as well as treatments that inhibit tumor growth through anti-angiogenesis, have shown good application prospects. The research process and results of CRC are of great significance because this can not only improve the quality of life of patients, but also may prolong their survival. Research on the mechanism of CRC metastasis emphasizes the important role of the tumor microenvironment in the development of cancer. In the microenvironment, by observing the interactions between cells, it can be seen that gradually learn more about strategies to inhibit the growth and metastasis of cancer cells. When enough information about the mechanism of CRC metastasis is accumulated, the medical system can develop more effective preventive measures and treatment plans. This will not only enable people to have a deeper understanding of CRC, but also reduce its incidence.

This article will describe the current research progress around the risk factors, metastasis mechanisms, and intervention measures for CRC.

## **2. Pathogenesis**

### *2.1. Genetic factors*

Among the probability of CRC, genetic factors have a relatively large impact on the incidence of this cancer. First of all, family history is one of the main reasons for CRC to be passed on to future generations. Through statistics and research, people have found that compared with people without a family history of CRC, people with relatives suffering from CRC have more than twice the risk [1]. If a close relative, such as a direct relative, suffers from CRC, the risk of CRC being passed on to future generations will be very high. If CRC is inherited for many generations in the family, or if the age of individuals diagnosed with CRC in this family is getting younger and younger, it means that the probability of this family developing the disease due to genetic factors is increasingly higher.

In addition to the history of CRC in the family, single nucleotide polymorphisms (SNPs) also have a certain impact on the incidence of CRC [2]. SNPs refer to genetic mutations caused by changes in a single nucleotide at a certain gene site. SNPs can be passed on to offspring through inheritance. The human genome contains many SNPs, and most of them do not have any malignant effects on the body. However, the location of some SNPs has a great impact on the expression of gene function, thereby increasing the risk of diseases such as CRC. Although studies have found specific SNPs associated with the incidence of CRC by comparing the genomes of patients with normal people, since these SNPs are usually located in malignant areas such as tumor areas, they may even increase the incidence of CRC through pathways such as DNA replication and repair.

### *2.2. Diet*

Unhealthy diet is one of the factors that lead to CRC. To start with, a high-sugar diet, especially excessive intake of trans fatty acids, may lead to the occurrence of chronic diseases. This eating habit is very likely to lead to obesity, which is considered to be one of the causes of CRC. The reason why obesity indirectly leads to CRC is mainly because the human body will cause a lot of chronic inflammation in the body and interfere with metabolism when it is obese. These irregular and abnormal manifestations are the reasons that ultimately promote CRC. In addition, alcohol is also an indirect factor that leads to the onset of CRC. Frequent and heavy drinking is very likely to increase the risk of CRC, especially high concentrations of alcohol. In the process of natural metabolism in the human body, alcohol will seriously put strong pressure on the metabolism of the liver. The acetaldehyde produced after liver metabolism can cause unpredictable mutations in DNA or lead to incorrect gene expression, thereby increasing the chance of cancer [3].

### *2.3. Life habits*

Different daily living habits between people will also slowly change everyone's physical health. Bad living habits may cause a healthy body to gradually become weaker and weaker, thus leading to CRC. To begin with, the habit of almost no exercise will also cause a person's physical function to decrease. For example, some students or office workers develop a habit of long-term sitting due to busy studies or work, which leads to almost no exercise every day. The result of lack of exercise is that people's intestinal peristalsis slows down, making it difficult for feces to be discharged in time [4]. If the feces in the intestines are not discharged out of the intestines in time, the harmful substances in the feces may damage the intestines and promote the occurrence of cancer.

Moreover, psychological stress is closely related to the health of the intestines. The stress level and mental health status felt by people can be reflected in the health of the stomach and intestines. High-intensity stress has a high probability of affecting intestinal peristalsis and causing constipation or diarrhea. In addition, excessive stress may cause the microbial flora in the intestine to lose balance, such as high stress leading to the growth of more harmful bacteria and the survival of beneficial bacteria [5].

If the number of microbial flora in the intestines is greatly different for a long time, it will gradually lead to the occurrence of cancer.

### **3. Metastatic mechanisms**

#### *3.1. Tumor immune microenvironment*

The tumor immune microenvironment refers to the complex and comprehensive environment formed by the combination of immune cells, stromal cells, blood vessels, extracellular matrix, and signaling molecules around tumor cells [6]. For the occurrence, growth, and metastasis of CRC, changes in the tumor immune microenvironment and interactions with molecules can lead to the improvement or reduction of the ability of cancer cells. In the tumor immune microenvironment, macrophages occupy a large part of the structure. Among them, there is a special tumor-associated macrophage (TAM), which plays a very special role in the growth and metastasis of CRC.

For most macrophages, their role is to eliminate foreign pathogens and specific cells by engulfing them in the immune system. The reason why TAMs are special is that in the tumor immune microenvironment, macrophages that are beneficial to tumor suppression will be converted into TAMs, which in turn help the growth of tumors. TAMs can secrete growth factors and cytokines to promote tumor angiogenesis, thereby providing cancer cells with nutrients that are beneficial to their growth and providing channels for tumor metastasis [7]. In addition, TAMs can also effectively inhibit the function of the immune system. They suppress the function of T cells by secreting a large number of inhibitory cytokines, causing the immune system to lose balance and fail to coordinate the activities of other immune cells. Finally, TAMs help tumor cells escape the suppression and attack of the immune system as much as possible.

#### *3.2. Epithelial-mesenchymal transformation (EMT)*

EMT is one of the key processes in the development of CRC. EMT refers to the process in which epithelial cells gradually lose the characteristics of epithelial cells and acquire the characteristics of mesenchymal cells through a series of changes in gene expression [8]. After this process, the cells will have stronger invasive ability and are likely to promote tumor growth. Cells in epithelial cells usually have a structure that is tightly connected to each other, has a stable morphology, and does not move easily [9]. In contrast, in mesenchymal cells, there are fewer connections between cells and stronger motility [10]. In CRC, EMT gives cancer cells stronger motility, which makes it easier for tumors to invade surrounding cells or matrix. The main reason is that this invasive ability makes the connection between cells looser, allowing tumor cells to easily invade other surrounding tissues. EMT not only allows tumor cells to invade other surrounding cells more easily, but also allows tumor cells to survive longer. This is because compared with epithelial cells, mesenchymal cells can better inhibit apoptosis signals [11]. For instance, even if their living environment is relatively harsh, they can still survive.

#### *3.3. Vascular growth factor (VEGF)*

In CRC, VEGF is one of the processes that can help tumors metastasize. The main function of VEGF is to induce cell growth by binding to receptors to form new blood vessels [12]. These blood vessels are flexible and breathable, which helps to provide tumor cells with enough nutrients and oxygen to grow [13]. When a tumor begins to grow larger and larger due to growth, the original blood vessels on the tumor will not be able to meet the requirements of sufficient nutrients and oxygen to ensure their continued growth if they do not grow with it. When more blood vessels are generated, tumor cells can get more blood supply and energy to promote their continued growth. And because the newly grown blood vessels are thinner, tumor cells can more easily penetrate other surrounding tissues or enter the blood.

#### 4. Interventions

For CRC, not only are some effective treatment methods and measures important, but postoperative intervention measures to prevent cancer recurrence are also essential. The main intervention point for most cancer patients after surgery is to prevent cancer cell metastasis. A common method of treating tumor metastasis is to inhibit angiogenesis [14]. Avastin is a drug currently used in the treatment of CRC. It blocks the proliferation and metastasis of endothelial cells by binding to vascular endothelial growth factor receptors [15]. In addition, immunotherapy is also an effective treatment for colon cancer. The use of PD-1/PD-L1 immune checkpoint inhibitors restores the activity of T cells and prevents tumor cells from escaping attacks from the immune system [16]. Clinically, immunotherapy is often combined with preventive measures such as chemotherapy to more consistently control tumor growth and metastasis. Finally, having patients take specific chemical agents is also a way to delay the growth of cancer cells. Most drugs reduce the development and metastasis of cancer cells by reducing inflammatory responses in specific areas.

#### 5. Conclusion

In conclusion, for CRC, more research is needed to deeply understand its pathogenesis, metastasis mechanism, and intervention measures. This article mainly explains and discusses these aspects, showing the phenomena that may occur during the generation, growth, and metastasis of CRC in the body. First, the pathogenesis of CRC usually includes multiple factors instead of just one. This paper mainly introduced several risk factors that may trigger the onset of CRC, including the influence of genetics, diet, and lifestyle on the development of this disease. Second, the metastasis mechanism of CRC is a key point in the treatment of patients. In the metastasis process of tumor cells, the environment where the tumor is located and the immune system around it, tumor cells through EMT, and angiogenesis all contain many complex mechanisms. Among the three aspects mentioned, if one of them is not taken seriously, there is a great possibility that it will accelerate the growth of tumor cells or specialize in other organs or even blood. Last, in response to these mechanisms that may promote tumor growth, this article continues to explore intervention measures for CRC, including inhibiting the formation of new blood vessels, immunotherapy, and the use of chemotherapy. These CRC-specific interventions are primarily used after patients have undergone surgery, with the primary goal of preventing tumor regrowth and metastasis.

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