

Clinical nutrition approach to colon cancer

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Abstract

Colon cancer is a type of cancer that affects the large intestine or rectum, with risk increasing with age. It typically shows no symptoms in its early stages and is often diagnosed in advanced stages, where treatment options are limited. In 2020, there were approximately 1.9 million new colorectal cancer cases and over 930,000 deaths worldwide. Colorectal cancer is the third most common cancer globally and the second leading cause of cancer-related deaths.

Colon polyps are precancerous lesions identified through colonoscopy. The size, surface structure, and number of polyps are associated with the risk of colon cancer. Colonoscopy is an effective method for detecting and removing adenomatous polyps, thus preventing death from colorectal cancer.

The treatment of colon cancer, including surgery and other methods, can lead to various metabolic and digestive complications. Nutrition plays a crucial role in cancer treatment and prevention. A balanced diet can improve treatment outcomes and quality of life. Nutritional support is essential alongside surgical or pharmacological treatments.

Oral Nutritional Supplements (ONS) are recommended for cancer patients with inadequate oral intake. Studies have shown that nutritional supplementation before and after surgery can improve recovery and walking capacity in colorectal cancer patients.

Enteral Nutrition (EN) is used to provide essential nutrients in individuals with insufficient oral intake. It is recommended postoperatively as soon as the gastrointestinal tract is active, reducing complications and improving recovery.

Parenteral Nutrition (PN) is crucial when oral or enteral nutrition is not feasible. PN, particularly Total Parenteral Nutrition (TPN), is beneficial in severely malnourished patients and those undergoing major surgery, reducing infection risk and improving overall nutritional status.

In conclusion, the effective use of enteral and parenteral nutrition strategies in colon cancer treatment improves patients' quality of life and increases treatment success rates. Integrating nutritional therapy into cancer treatment protocols is of great importance.

Keywords: Colon; Cancer; Nutrition; Enteral; Parenteral

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1. Introduction

1.1. Colon cancer

Colorectal cancer is a type of cancer that affects the large intestine or rectum, the risk increases with age and mostly affects older people, usually those aged 50 and over. It is usually asymptomatic in the early stages of the disease and is usually diagnosed in advanced stages when treatment options are limited. Colon cancer is the third most common cancer worldwide, accounting for about 10% of all cancer cases and is the second leading cause of cancer-related deaths worldwide. It is estimated that more than 1.9 million new colorectal cancers and more than 930,000 deaths from colorectal cancer will occur worldwide in 2020. Large geographical variations in mortality and incidence rates have been reported. Europe, Australia and New Zealand were reported to have the highest incidence rates and Eastern Europe the highest mortality rates. In 2040, colorectal cancer is projected to cause 3.2 million new cases and 1.6 million deaths annually. The incidence of colorectal cancer in high-income countries is declining substantially as a result of effective screening programs (1).

1.2. Polyp

Polyps in the colon are commonly known precancerous lesions identified by colonoscopy. Although most polyps are benign, their size, surface structure and number are associated with colon cancer risk (2).

Patients with polyps have a higher risk of developing advanced neoplasia. The National Polyp Study reported that colonoscopy is an effective tool for the detection of colorectal polyps and removal of adenomatous polyps by colonoscopy will prevent death from colorectal cancer (CRC). The location, size and degree of polyp dysplasia are related to the risk of malignant development. Therefore, polyp morphology is an important factor for determining the endoscopic treatment or surgical method (3).

1.3. Effects on metabolism and digestive system

The treatment processes and methods for colon cancer vary depending on the type and stage of cancer, with a particularly wide range of complications reported due to the complexity of tumor removal surgeries. Intestinal adhesions are the most reported complication of laparoscopy, affecting almost 95% of cases, and are the main cause of small bowel obstruction (SBO). Approximately 10% of colorectal surgery results in SBO with postop peritoneal adhesions (4).

Chronic diarrhea has been reported in 13-50% of patients for 10 years after treatment. Those who underwent anterior resection and survived reported frequent bowel movements per day, inability to distinguish feces from gas, and evacuation difficulties. These symptoms were the most commonly reported symptoms during the first year after resection. Both pre- and postoperative radiation for rectal cancer increases the risk of long-term bowel dysfunction (5).

The colon has an important role in the absorption of electrolytes, water and short-chain fatty acids and, consequently, colon resection can cause changes in bowel function. Increased bowel frequency or nocturnal defecation, loose stools, occur in one in five patients after right-sided colectomy. In adults after surgery, bowel adaptation occurs in the first 2 years and usually some of the symptoms may resolve spontaneously over time (6).

2. Cancer and nutrition

Nutrition is an important risk factor in the treatment and prevention of cancer because an unbalanced diet increases the risk of developing cancer, while malnutrition negatively affects the effectiveness of cancer treatment. Cancer patients need appropriate nutritional support in addition to surgical or pharmacological treatment. Adequate and balanced nutrition can improve both treatment outcomes and quality of life, even for cancers with unfavorable prognosis (7).

Recent studies support the need for nutritional assessment in cancer care. Body composition assessment is reported to be decisive for interventions and outcomes. Nutritional intervention is an adjunct to any treatment as it improves body composition, nutritional parameters, quality of life, symptoms and ultimately survival. Proactive assessment of clinical changes in cancer is essential to choose an adequate nutritional intervention with the most favorable impact on body composition, nutritional status, efficacy of treatment, reducing complications and improving survival (8).

In a study, the prognostic value of Body Mass Index (BMI) was investigated in stage II and III Colon CA patients, and an obese Colon CA patient with BMI > 30 kg/m² treated with adjuvant chemotherapy was found to be an independent predictor of overall survival (OS) and recurrence-free survival (RFS). (Debora Basile et al. emphasized that adiposity and body composition measurements are a prognostic factor and that the prognostic impact of adiposity and body composition measurements should be taken into account to improve risk assessment and better stratify patients with high visceral fat (9).

Another study investigated the relationship between insulin load in the diets of stage III colon cancer patients with cancer recurrence and survival and reported that patients with resected stage III colon cancer who were fed a high amount of insulinogenic diet had a high risk of mortality and recurrence and that dietary management is important after colon cancer resection (10).

Another study evaluated the relationship between dietary intake with high insulinemic potential and survival in patients with stage III colon cancer and reported that the empirical dietary index for higher hyperinsulinemia (EDIH) was not associated with mortality or recurrence risk of colon cancer in patients with stage III colon cancer (11).

3. Oral nutritional supplements

Oral Nutritional Supplements (ONS) are ready-made products containing calories, balanced nutrients and proteins to supplement inadequate oral intake. The European Society for Clinical Nutrition and Metabolism (ESPEN) and guidelines in Australia, Europe, Great Britain and the USA recommend oral nutritional supplements (ONS) during treatment to increase oral intake in malnourished cancer patients (12).

According to a study, the results of multimodal prehabilitation to improve functional capacity and reduce postoperative complications in colorectal cancer patients were investigated and it was shown that the administration of nutritional supplements four weeks before and after surgery improved preoperative recovery and walking capacity of patients undergoing colorectal resection for cancer. In addition, dopamine release during exercise has been reported to improve psychology and affect smoking cessation behavior (13).

In another study, the effects of preop immunonutrition on the outcomes of colon CA surgery were examined and it was reported that preop immunonutrition (arginine and ω -3 fatty acids) was not related to infectious complications in patients undergoing colon CA surgery and that it was not necessary to routinely administer immunonutrition before colon CA surgery (14).

A study investigated the effects of dietary synbiotics (oligofructose-enriched inulin (SYN1) + *Lactobacillus rhamnosus* GG (LGG) and *Bifidobacterium lactis* Bb12 (BB12)) for cancer risk factors in colon cancer and polypectomized patients and found that synbiotic intervention caused significant changes in fecal flora, It has been reported that fecal water and colorectal proliferation significantly reduce the capacity to induce necrosis of cells in the colon and that synbiotic consumption increases interferon γ production in cancer patients and inhibits the increased secretion of interleukin 2 from peripheral blood mononuclear cells in polypectomized patients (15).

Another study investigated the safety and tolerability of a dietary supplement based on *Rosmarinus officinalis* supercritical fluid extract enriched with phenolic diterpenes (RE) and shark liver oil enriched with alkylglycerols (AKG) as a bioactive lipid mediator in the treatment of colorectal cancer, and concluded that this dietary supplement could improve innate immune response activation, (Cedrón et al. have shown that this response provides positive immunonutritional effects through an anti-inflammatory cytokine profile that can potentially sustain the immune response against effector anti-tumor cells and its polarization against phagocytic, effector and cytotoxic cells (16).

Another study evaluated the relationship between omega-3 fatty acid intake and survival of stage III colon cancer and reported that high doses of marine omega-3 polyunsaturated fatty acids (MO3PUFAs) were significantly associated with better survival for DNA repair-induced (dMMR) and wild-type (KRAS) tumors in stage III colon cancer patients (17).

Another study investigated whether consumption of pomegranate extract (PE) alters MicroRNA (miR) expression in surgical colon tissues compared to biopsies from Colorectal Cancer (CRC) patients and concluded that PE consumption appears to specifically affect miRs in colon tissue, but not the surgical procedure, miR levels are critically altered, preventing the discrimination of important differences caused by dietary factors and the identification of true differences between normal tissues and malignant biomarkers, and further studies are needed (18).

In another study, the Protective Role of Arachidonic Acid Metabolites Against Advanced Colorectal Adenoma was investigated and it was reported that Selenium supplementation was associated with a non-significant increase in the levels of 5-hydroxyeicosatetraenoic acid (5-HETE), an oxylipin derived from Arachidonic acid (ARA), after 12 months, but other results were not statistically significant (19).

In another study, the relationship between ω -3 polyunsaturated fatty acids (ω -3 PUFAs) and neurotoxicity in patients receiving oxaliplatin in combination with capecitabine for colon cancer was examined and it was reported that ω -3 PUFAs reduced the severity and incidence of oxaliplatin-associated neurotoxicity, may improve the quality of life of patients and may be a neuroprotective agent for the treatment of oxaliplatin-induced neurotoxicity (20).

Another study investigated whether beef jerky modulates cancer biomarkers in humans and whether calcium and α -tocopherol can suppress cured meat-induced preneoplastic lesions in rats and cancer biomarkers in humans and rats, increased lipoperoxidation and nitrozo compounds in human feces, adding α -tocopherol to cured meat or calcium carbonate to the diet may reduce the risk of colorectal cancer associated with cured meat intake (21).

In another study, the effects of Aquamin, a calcium and magnesium-rich multimineral derived from red marine algae, on colonic microbial community and related metabolomic profile were investigated and it was found that Aquamin supplementation caused an overall reduction in bile acids, including potentially carcinogenic secondary bile acids or their precursors, and intestinal microbial numbers, It has been reported to have a more pronounced effect on bile acid levels and gut microbial populations than calcium alone, and the combination of calcium with additional minerals may be associated with a lower risk of colorectal cancer (22).

Another study investigated the association of serum interleukin-6 (IL-6) concentrations, a proinflammatory cytokine, with recurrence of colorectal adenoma and flavonol intake and reported that a decrease in IL-6 concentrations and high flavonol intake reduced the risk of recurrence of progressive forms of adenoma and provided higher benefit to those with both (23).

In another study, the association of vitamin D and calcium with colorectal adenoma risk was investigated and it was reported that there was no significant association between any of the variables for adenoma recurrence and dietary or total calcium intake, consumption of low- or high-fat dairy products or dietary vitamin D intake, vitamin D intake was inversely associated with recurrence, and there was an inverse association between both vitamin D and calcium supplementation and single and multiple adenoma recurrences (24).

In another study, the effects of vitamin D3 and calcium on metabolism in normal mucosa of colorectal adenoma patients were investigated and it was found that vitamin D3 and calcium supplementation, in combination and alone, may increase calcium receptor (CaR), vitamin D receptor (VDR), vitamin D expression and 25(OH)D-1 α -hydroxylase (CYP27B1) expression. It has been reported that the anti-carcinogenesis effects of supplemental D3 and calcium may be due in part to the ability of these agents to positively modulate CaR, VDR, CYP27B1 and 25-hydroxyvitamin-D-24-hydroxylase (CYP24A1) expression in the colonic mucosa (25).

Another study investigated the clinical effects of highly purified whey proteins in patients affected by colorectal cancer and undergoing chemotherapy and reported that nutritional supplementation with highly purified whey protein may improve nutritional status, reduction in musculoskeletal tissue and lean body mass (LBM) and Skeletal Muscle Index (SMI) and may be a valid therapeutic option to prevent toxicity, especially during chemotherapy (26).

Another study investigated the effects of folic acid supplementation on genomic DNA methylation in patients with colorectal adenoma and reported that DNA hypomethylation can be reversed by physiologic folic acid intake and that inadequate folate consumption may lead to hypomethylation and thus play an active role in the etiology of colorectal cancer (27).

3.1. Enteral nutrition

Enteral nutrition (EN) is used to provide critical macro- and micronutrients in individuals whose oral intake is not sufficient to meet their nutritional needs. Inability to swallow due to mechanical ventilation and altered mental status are common conditions requiring the use of EN. EN can be long or short term and can be given gastrically or post-pylorically (28).

The European Society for Parenteral and Enteral Nutrition (ESPEN) and the Enhancement of Recovery After Surgery (ERAS) Society guidelines recommend that patients receive enteral nutrition (EN) as soon as possible after surgery if

the gastrointestinal tract is active. EN has been reported to be associated with lower postop infection, length of stay and mortality in patients undergoing major abdominal surgery compared with PN. Generally, postoperative energy requirements in patients using EN alone are lower than estimated for various reasons (29).

In a study, immune and inflammatory responses and bowel function of patients fed with fortified enteral formulas in the perioperative period were examined and it was reported that administration of fortified enteral formula in the perioperative period significantly improved bowel function and positively modulated inflammatory and immunosuppressive responses in the postoperative period (30).

3.2. Parenteral nutrition

Total parenteral nutrition (TPN) via central venous catheter has been shown to significantly affect postoperative outcomes in severely malnourished patients. PN, due to its direct central venous administration, can rapidly improve nitrogen balance and thus allow faster healing of lymphocytes and wounds. The addition of vitamins and trace elements has been shown to reduce infectious and non-infectious complications (31).

Parenteral nutrition (PN) is a very important intervention for patients for whom oral or enteral nutrition (EN) cannot be provided. The main components of PN are carbohydrates, amino acids, lipids, vitamins, electrolytes, water and trace elements. PN should be provided through a central line due to its hypertonic nature. However, peripheral PN (larger volume and lower nutrient content) can also be administered through a convenient and decentralized line (32).

In a study, the effect of total parenteral nutrition enriched with glutamine supplementation on T-lymphocyte response in surgical patients undergoing colorectal resection operation was investigated and the preop T-cell response was suppressed in the study group compared to the healthy control group and early enteral nutrition was the best possible option, Although the routine use of parenteral nutrition in uncomplicated postoperative patients is not considered appropriate, it has been reported that glutamine supplementation may be a valid method to enhance the T cell response in patients who are immunocompromised prior to major surgery and at strong risk of postop sepsis (33).

4. Conclusion

In this study, the effects of enteral and parenteral nutrition methods on colon cancer patients were examined. The study aimed to reveal the effects of nutritional interventions on the treatment processes and general health status of patients.

Enteral Nutrition: It has been observed that the application of enteral nutrition, especially in the early period after surgery, accelerates the healing process of patients and reduces postoperative complications. Enteral nutrition allows the use of the gastrointestinal system, contributing to the protection of intestinal health and supporting the immune system.

Parenteral Nutrition: Total parenteral nutrition (TPN) is used as an important treatment option in cases of severe malnutrition or when enteral nutrition is not possible. It has been determined that TPN has positive effects such as reducing the risk of infection in the postoperative period, accelerating wound healing and improving general nutritional status.

The findings obtained in the study show that both nutritional methods provide significant benefits when used in appropriate patients. However, it is emphasized that nutritional treatment should be planned individually and managed with a multidisciplinary approach.

As a result, the effective use of enteral and parenteral nutrition strategies in the treatment of colon cancer improves the quality of life of patients and increases treatment success rates. Therefore, it is of great importance to integrate nutritional therapy into cancer treatment protocols.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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