

## 中医药防治结直肠癌复发转移的研究进展

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**摘要:** 结直肠癌 (colorectal cancer, CRC) 是消化系统常见的恶性肿瘤之一, 具有较高的发病率和病死率。复发转移是结直肠癌患者死亡的最根本原因。目前, 结直肠癌主要采取手术治疗、术后放疗及免疫治疗等方式。然而, 这些治疗方式所伴随的不良反应以及较高的复发转移率, 给患者造成了沉重的身心负担, 严重影响了患者的生活质量。大量的临床与实验研究表明, 中药能缓解结直肠癌患者临床症状、缓解患者的痛苦、减轻放疗所带来的不良反应、提高其生活质量、预防结直肠癌根治术后的复发和转移、延长患者生存期、提高患者生存率等。本文将从中医药防治结直肠癌的中医理论、中医药防治结直肠癌复发转移的优势以及中医药可通过调节肠道菌群防治结直肠癌3个方面进行如下综述。

**关键词:** 结直肠癌; 复发转移; 中医药; 减毒增效; 肠道菌群

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## Research progress on the prevention and treatment of colorectal cancer recurrence and metastasis by traditional Chinese medicine

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**Abstract:** Colorectal cancer (CRC), a prevalent and deadly digestive malignancy, primarily causes death through recurrence and metastasis. Current treatments include surgery, radiotherapy, chemotherapy, and immunotherapy, but they have significant side effects and high recurrence rates. Research shows traditional Chinese medicine (TCM) can alleviate symptoms, reduce adverse reactions, enhance quality of life, prevent recurrence and metastasis post-surgery, and improve survival rates. This review explores TCM's theoretical framework, advantages in CRC management, and potential in modulating intestinal flora for CRC prevention and treatment.

**Key words:** colorectal cancer; recurrence and metastasis; traditional Chinese medicine; toxicity reducing and efficacy enhancing; intestinal flora

结直肠癌 (colorectal cancer, CRC) 作为消化系统恶性肿瘤中的常见类型, 据国际癌症研究署发布的数据显示, 2022 年全球恶性肿瘤新发病例数为 2 000 万,

死亡病例数约 970 万, 其中结直肠癌新发病例数为 192.6 万, 约占全部恶性肿瘤发病的 9.6%, 死亡病例数达 90.3 万, 约占全部恶性肿瘤死亡的 9.3%<sup>[1]</sup>。结直肠癌发病率与死亡率均居高不下, 对人类健康构成了严峻挑战<sup>[2]</sup>。随着诊断技术的持续进步与多学科综合治疗策略的日益丰富, 结直肠癌的防治工作已取得了显著成效, 然而, 术后复发与转移的问题依然是制约整体

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疗效的关键因素<sup>[3]</sup>。统计资料显示,约有33%结肠直肠癌患者在确诊时已伴有远处转移<sup>[4]</sup>,且术后两年内,患者的复发或转移概率高达50%<sup>[5]</sup>,而在晚期结肠直肠癌患者中,约86%患者的生存率依然不容乐观<sup>[4]</sup>。这一现状表明,术后复发与转移是导致患者死亡的主要原因。因此,针对这一现状,采取包括放疗、免疫疗法及靶向治疗在内的多元化治疗手段显得尤为重要<sup>[6]</sup>。尽管化学疗法、靶向疗法及免疫疗法等系统性治疗手段已取得诸多进展,但这些方法伴随的不良反应及高复发率仍给患者带来了深重的身心负担<sup>[4,7]</sup>。鉴于术后放疗的局限性日益凸显,越来越多的患者开始探索新的治疗路径,其中,传统中医药在结肠直肠癌防治中的作用日益显著,已成为不可或缺的一环。

## 1 中医理论及病机

普遍认为,结肠直肠癌的病灶在于肠道,且与肝、脾及肾的功能状态紧密相连。中医认为,结肠直肠癌的核心致病机制主要与正气亏虚、气血阻滞及毒邪壅盛相关。在临床实践中,正气衰弱、寒气凝结、血液瘀阻及癌毒活跃是预测肿瘤预后的关键要素。正气不足,尤以脾虚为主要外在表现,脾作为后天生长发育的基础,其强健与否直接关系到正气的盛衰。《活法机要》有云:“体健之人无积聚,虚弱之则易生之。脾胃怯弱,气血两虚,四季邪气侵袭,皆能导致积聚形成。”这表明,脾胃功能的虚弱是积聚病症产生的核心环节。《景岳全书》亦强调:“凡脾胃亏虚及功能失调者,多有积聚之虞。”据此推断,结肠直肠癌的首要发病机制在于脾胃虚弱与气血功能失衡。脾虚常常引发运化功能失常,导致痰湿内生,积聚于肠道;肾为先天之本,肾虚则温煦与化湿能力不足,久则痰湿与瘀血阻塞经络,进而形成寒凝、血瘀及湿热的病理状态,最终促成癌毒的形成<sup>[5]</sup>。中医学将肿瘤视为邪盛正衰的病理表现。正如《灵枢·百病始生》所阐述:“虚邪贼风侵体……可累及络脉、经脉、输脉、冲脉、膻筋乃至肠胃募原,邪气蔓延,错综复杂。”这体现了古代医家对肿瘤复发与转移机制的深刻理解,与现代肿瘤转移理论不谋而合。在中医视野中,肿瘤的本质为毒邪,正气在与之斗争过程中逐渐耗损。经历手术、放疗及化疗后,体内正气更为衰弱,导致气机阻滞、升降功能失常,抗癌能力下降,促使癌毒残留或向其他脏腑扩散。体内残余的癌毒进一步侵蚀机体,加速肿瘤的复发与转移进程<sup>[8]</sup>。

## 2 防止复发转移,延长生存期

**2.1 中药复方能延长生存期** 目前,手术、化学疗法、放射疗法、免疫治疗、靶向治疗以及其他综合治疗是临床上结肠直肠癌治疗的主要方法<sup>[9]</sup>,对于晚期结肠直肠癌患者来说,化疗是最为重要的治疗方法<sup>[10]</sup>,但化疗带来

的骨髓抑制和免疫功能受损等多种不良反应将严重影响患者术后的生活质量,导致肿瘤转移复发,最终影响患者的长期生存<sup>[11]</sup>,因而迫切需要降低术后复发转移率和延长生存期<sup>[12,13]</sup>。有研究发现,中医药在癌症治疗中具有安全、高效、广泛的独特优势,它可以提高癌症患者术后的生活质量、防止转移和复发,进而延长患者生存期<sup>[14]</sup>。Zhang等<sup>[15]</sup>将220例转移性大肠癌患者随机分为治疗组和对照组,对照组接受常规方案化疗,治疗组在化疗基础上加用中药健脾解毒方。结果显示,治疗组的中位无进展生存时间和中位总生存期均高于对照组。研究表明,健脾解毒方联合化疗能够延长转移性大肠癌患者的无进展生存期及总生存时间。Tong等<sup>[16]</sup>选用78例II~III期结肠直肠癌术后患者,随机分为治疗组和对照组。对照组接受常规化疗方案,治疗组则在常规化疗的基础上加服加味香砂六君子汤。2年随访结果显示,与对照组相比,治疗组的1年累计无病生存率和2年累计无病生存率均显著提高,且治疗组的无疾病进展生存期也明显延长。研究表明,加味香砂六君子汤能够降低结肠直肠癌术后患者的复发转移率,并显著提高其术后生存期。

**2.2 中药提取物能减少结肠直肠癌复发转移** 研究表明,中药及其成分可有效抑制结肠癌细胞增殖,诱导细胞凋亡,阻断细胞周期,能在多个方面发挥抗结肠直肠癌复发转移的作用<sup>[17]</sup>。NF- $\kappa$ B作为一种重要的信号通路,通过控制相关靶基因的表达来介导肿瘤细胞增殖、存活<sup>[18,19]</sup>。黄芩素是从传统中药黄芩中提取的一种黄酮类化合物,具有抗炎和抗癌作用<sup>[20]</sup>。研究发现黄芩素可以通过活化过氧化物酶体增殖物激活受体 $\gamma$ 来抑制NF- $\kappa$ B信号通路,并调节结肠癌细胞的凋亡、迁移、侵袭和炎症反应<sup>[21]</sup>。此外,有研究发现白藜芦醇可以通过抑制TNF- $\beta$ 刺激的NF- $\kappa$ B信号传导来逆转TNF- $\beta$ 诱导的结肠癌细胞增殖和侵袭<sup>[22]</sup>。上皮-间质转化(epithelial-mesenchymal transition, EMT)是肿瘤转移的关键所在。研究表明,EMT与多种癌症的侵袭和迁移能力的增强相关。有研究通过构建TGF- $\beta$ 刺激的结肠癌细胞系HCT-8细胞,结合MTT和Transwell实验,证实白花蛇舌草提取物可以通过抑制TGF- $\beta$ 诱导结肠癌细胞的EMT来减少迁移和侵袭,从而减少结肠直肠癌的复发转移<sup>[23]</sup>。

目前,能抑制结肠直肠癌复发转移、延长患者生存期的相关中药复方及中药提取物如表1<sup>[15,16,21-23]</sup>所示。

## 3 提高机体免疫,减毒增效

**3.1 中药复方能提高患者机体免疫** 随着对中医药作用机制研究的不断深入,逐渐发现中医药不仅具有防止转移复发、延长患者生存期的作用,还能有效提高

**Table 1** Related Chinese herbal compounds and extracts for inhibiting recurrence and metastasis of colorectal cancer and prolonging survival of patients. AOM: Azoxymethane; DSS: Dextran sodium sulfate; EMT: Epithelial-mesenchymal transition

Herbal medicine	Experimental type	Main conclusion	Reference
Jianpi Jiedu Fang	Clinical trial	The combination of Jianpi Jiedu Fang and chemotherapy for the treatment of metastatic colorectal cancer has shown clinical efficacy	[15]
Modified Xiangsha Liujun Decoction	Clinical trial	The modified Xiangsha Liujun Decoction has been observed to prevent recurrence and metastasis in patients post colorectal cancer surgery undergoing chemotherapy	[16]
Baicalein	Basic research	Baicalein induces apoptosis in human colon cancer cells and prevents AOM/DSS-induced colon cancer in mice	[21]
Resveratrol	Basic research	Resveratrol can down-modulate the proliferation in colorectal cancer cells induced by TNF- $\beta$	[22]
<i>Hedyotis diffusa</i>	Basic research	<i>Hedyotis diffusa</i> reduces migration and invasion in colorectal cancer cells by inhibiting TGF- $\beta$ -induced EMT	[23]

机体免疫,降低化疗时产生的毒副作用<sup>[24]</sup>。临床实践证实,参芪扶正注射液可广泛用于提高癌症患者的免疫水平<sup>[25]</sup>。一项临床 meta 分析深入评估了参芪扶正注射液与化疗联用的综合效果,结果证实参芪扶正注射液不仅能显著提升化疗效率,还同步增强了患者的机体免疫水平<sup>[26]</sup>。在早期的临床试验中,有研究者将 71 例大肠癌术后患者科学分组,对照组遵循常规化疗方案,而治疗组则在此基础上加用参芪扶正胶囊。实验结果显示,参芪扶正胶囊对大肠癌术后患者的免疫力提升作用显著<sup>[27]</sup>。Wu 等<sup>[28]</sup>进一步拓展了相关研究,将 38 例大肠癌术后化疗患者随机分为治疗组和对照组,对照组采用单纯 FOLFOX4 方案化疗,治疗组则在化疗基础上配合中药扶脾益胃方。研究发现,治疗组患者外周血 T 细胞亚群中 CD4<sup>+</sup> T 细胞数量明显增加,这一结果有力地提示扶脾益胃方具有显著的免疫增强功效。Li 等<sup>[29]</sup>通过对 70 例结肠癌或直肠癌患者用药前后的外周血进行细致分析,发现治疗后组 CD4<sup>+</sup> T 细胞和 NK T 细胞比例显著高于治疗前组和对照组。该研究结果进一步证实,葛根芩连汤在提升结肠癌患者机体免疫方面具有显著作用。此外,另有临床研究者通过选取 70 例临床患者,随机分为实验组和对照组。对照组患者仅接受 CAPOX 化疗方案,实验组患者则在 CAPOX 化疗方案的基础上加用益气健脾抗癌方。实验结果显示,实验组治疗前后 T 细胞亚群的血清水平显著高于对照组<sup>[30]</sup>,从而有力地证实了益气健脾抗癌方在调节免疫功能、提高患者术后免疫水平方面的有效性。有研究者则采用结直肠癌患者来源的异种移植瘤 (PDX) 小鼠模型,深入研究了健脾化痰方的调控机制。结果显示,健脾化痰方治疗组 PDX 小鼠的中性粒细胞、肥大细胞和 NK 细胞等免疫细胞数量显著增加,这一发现表明健脾化痰方可能通过激活免疫系统,进而有效提高结直肠癌患者的免疫水平<sup>[31]</sup>。综上所述,多项研究均有力地证实了中药在联合化疗治疗结直肠癌过程中,对患者免疫功能的显著增强作用,

为临床治疗方案的优化提供了有力的理论依据和实践参考。

**3.2 中药提取物能减毒增效,改善化疗耐药** 目前,晚期或转移性结直肠癌患者的主要治疗手段仍以化疗为主,但化疗药物耐药问题仍是临床上面临的巨大挑战,极大限制了疗效。有研究表明,中医药可通过多靶点、多途径作用于肿瘤细胞,有效逆转化疗耐药<sup>[10]</sup>。姜黄素是来源于传统中药姜黄根的一种多酚化合物,具有较强的抗癌活性<sup>[32-34]</sup>。研究发现,姜黄素可以抑制结直肠癌系 HCT 116 细胞增殖和诱导凋亡,同时阻滞细胞周期,充分表明姜黄素可有效拮抗结直肠癌。此外,有研究证实姜黄素可调节 DNA 修复相关基因的表达,从而抑制肿瘤生长,促进细胞凋亡,并增强 DNA 错配修复系统 (mismatch repair, MMR) 缺陷型结直肠癌患者对氟尿嘧啶 (5-fluorouracil, 5-FU) 的化疗敏感性<sup>[35-37]</sup>。Han 等<sup>[38]</sup>使用耐药结直肠癌细胞系 HCT116/L-OHP,证实姜黄素能够干预 miR-409-3p 介导的切除修复交叉互补基因 1 (excision repair cross-complementary enzyme 1, ERCC1) 表达来改善奥沙利铂耐药性,从而提高临床疗效。白藜芦醇是一种非黄酮类多酚有机化合物,具有抗氧化、抗炎、抗癌及心血管保护等作用。有研究者发现白藜芦醇可能会抑制 TNF- $\beta$  激活的多种途径,调节 NF- $\kappa$ B 调控的基因表达并增加结直肠癌细胞凋亡,并在 TNF- $\beta$  诱导的炎症性肿瘤微环境中使结直肠癌细胞化学增敏 5-FU<sup>[39]</sup>。白花蛇舌草是茜草科的一种传统中草药,具有清热、解毒、祛瘀的功效<sup>[40,41]</sup>。据研究发现,它可以作为几种中药配方中的主要成分来治疗癌症,并能改善化疗的不良反<sup>[42]</sup>。Lai 等<sup>[43]</sup>发现白花蛇舌草能够抑制 HCT-8/5-FU 细胞的活力、黏附、迁移和侵袭潜力,进而逆转结直肠癌细胞中的多重耐药性。通过网络药理学分析发现槲皮素为白花蛇舌草的主要活性成分<sup>[44]</sup>。早期研究发现槲皮素可以诱导保护性自噬和发动蛋白相关蛋白 1 (dynamin-related protein 1, Drp1) 介导的线粒体断裂,并增强结直肠癌

细胞对常规化疗药物 5-FU 的敏感性<sup>[45]</sup>。半枝莲在中医治疗中具有悠久的历史,具有清热解毒、活血化痰、利水消肿的功效。最近的药理学研究发现半枝莲具有抗炎、抗癌、增强机体免疫的作用<sup>[46]</sup>。有研究者使用 5-FU 耐药的结直肠癌细胞系 HCT-8/5-FU,并用半枝莲乙醇提取物对 5-FU 耐药的治疗效果进行评估,探讨了其分子机制<sup>[47]</sup>。研究表明,半枝莲提取物能够通过抑制 PI3K/AKT 通路来抑制结直肠癌的化疗耐药。

目前,能提高机体免疫、减毒增效的相关中药复方及中药提取物如表 2<sup>[26-31,35-39,43,45,47]</sup>所示。

#### 4 优化菌群结构,发挥抗肿瘤作用

**4.1 中药复方能调节菌群失衡,提高免疫水平** 肠道菌群在人体中发挥着重要作用,有相关研究表明肠道菌群与结直肠癌密切相关<sup>[48]</sup>。肠道是中药在体内最为重要的代谢场所,中药的有效成分可以在肠道中通过某些特定的肠道菌群进行代谢转化,进一步促进机体的代谢,提高整体的免疫水平,从而起到防治结直肠癌的积极作用<sup>[49]</sup>。在临床实践中,有研究者采用健脾补肾方对结直肠癌术后患者进行干预,研究结果显示,该方剂可通过优化菌群结构,显著改善结直肠癌术后患者的肠道微生态环境<sup>[50]</sup>。Miao 等<sup>[51]</sup>通过对 II 期结直肠癌术后患者使用济生散进行干预,研究发现济生散可

显著提高患者肠道中双歧杆菌、乳酸杆菌、粪肠球菌的水平,有效减轻化疗引起的毒副作用,并促进胃肠功能及肠道菌群平衡的恢复。此外,多项研究表明,中药复方可通过调节菌群失调来改善抗肿瘤免疫功能,进而提高机体的免疫水平<sup>[52]</sup>。有研究者以 AOM/DSS 小鼠为模型,用四君子汤进行干预,发现四君子汤能通过维持肠道菌群平衡,使外周血中的 CD3<sup>+</sup>、CD4<sup>+</sup>、CD8<sup>+</sup> T 细胞含量上调,从而显著增强机体免疫功能<sup>[53]</sup>。Chen 等<sup>[54]</sup>通过对 CT-26 脾虚模型小鼠使用健脾解毒方进行干预,研究发现该方剂可通过平衡肠道菌群的结构,使小鼠外周血中的 CD4<sup>+</sup>/CD8<sup>+</sup> T 细胞比例增加,进而有效增强小鼠的免疫力。综上所述,肠道菌群在结直肠癌的发生发展中具有不可忽视的作用,而中药通过调节肠道菌群,可为结直肠癌的防治提供新的思路和方法,具有广阔的应用前景。

**4.2 中药提取物能优化菌群结构,发挥抗肿瘤的作用** 研究表明,广泛存在于中药中的天然多糖具有调节免疫、抗病毒、抗氧化等保健作用,具有显著的抗肿瘤活性<sup>[55-62]</sup>。累计数据显示,天然多糖通过调节肠道微生物组成、微生物组代谢、重塑免疫功能、抑制炎症性肿瘤微环境 (tumor microenvironment, TME) 来抑制肿瘤生长和增殖,抑制转移,诱导细胞凋亡和自

**Table 2** Related Chinese herbal compounds and extracts for improving immunity, attenuating toxicity and enhancing effect. MMR: Mismatch repair; ERCC1: Excision repair cross-complementary enzyme 1; 5-FU: 5-Fluorouracil; Drp1: Dynamin-related protein 1

Herbal medicine	Experimental type	Main conclusion	Reference
Shenqi Fuzheng Injection	Meta-analysis	ShenQi FuZheng Injection combined with chemotherapy in the treatment of colorectal cancer: a meta-analysis	[26]
Zhenqi Fuzheng Capsules	Clinical trial	ZhenQi FuZheng Capsules in the application of postoperative chemotherapy in colorectal cancer	[27]
Fupi Yiwei Prescription	Clinical trial	The recent efficacy of FuPi YiWei Prescription on colorectal cancer patients postoperative chemotherapy and its impact on immune function	[28]
Gegen Qinlian Decoction	Clinical trial	Gegen Qinlian Decoction enhances immunity and protects intestinal barrier function in colorectal cancer patients <i>via</i> gut microbiota	[29]
Yiqi JianPi Anti-Cancer Prescription	Clinical trial	Efficacy of YiQi JianPi Anti-Cancer Prescription combined with chemotherapy in patients with colorectal cancer after operation	[30]
Jianpi Huatan Formula	Clinical trial	Traditional Chinese Medicine JianPiHuaTan Formula improves quality of life and survival in patients with colorectal cancer through RAS/RAF downstream signaling pathways	[31]
Curcumin	Basic research	Curcumin chemosensitizes 5-fluorouracil resistant MMR-deficient human colon cancer cells in high density cultures	[35]
Curcumin	Basic research	Traditional Chinese medicine curcumin sensitizes human colon cancer to radiation by altering the expression of DNA repair-related genes	[36]
<i>Zingiber officinale</i>	Basic research	Diarylheptanoid analogues from the rhizomes of <i>Zingiber officinale</i> and their anti-tumour activity	[37]
Curcumin	Basic research	Curcumin regulates ERCC1 expression and enhances oxaliplatin sensitivity in resistant colorectal cancer cells through its effects on miR-409-3p	[38]
Resveratrol	Basic research	Resveratrol chemosensitizes TNF- $\beta$ -induced survival of 5-FU-treated colorectal cancer cells	[39]
<i>Hedyotis diffusa</i> Willd	Basic research	<i>Hedyotis diffusa</i> Willd suppresses metastasis in 5-fluorouracil-resistant colorectal cancer cells by regulating the TGF- $\beta$ signaling pathway	[43]
Quercetin	Basic research	Quercetin enhances 5-fluorouracil sensitivity by regulating the autophagic flux and inducing Drp-1 mediated mitochondrial fragmentation in colorectal cancer cells	[45]
<i>Scutellaria barbata</i> D. Don	Basic research	<i>Scutellaria barbata</i> D. Don inhibits 5-fluorouracil resistance in colorectal cancer by regulating PI3K/AKT pathway	[47]

噬<sup>[63,64]</sup>,进而发挥抗癌作用。化疗在晚期结直肠癌的控制和治疗中发挥着至关重要的作用。然而,化疗药物的细胞毒性会导致肠道菌群失衡并会破坏胃肠道的黏膜屏障,极大地影响患者的生活质量,甚至威胁他们的生命<sup>[65]</sup>。天然多糖还通过调节肠道微生物组的组成和修复肠道黏膜屏障来发挥抗肿瘤作用。Guo等<sup>[66]</sup>探讨了灵芝多糖对AOM/DSS诱导的炎症、肿瘤发生和肠道菌群修饰的影响,结果显示灵芝多糖减少了AOM/DSS诱导的结肠炎和肿瘤发生。此外,灵芝多糖通过抑制TLR4/MyD88/NF- $\kappa$ B信号传导改善了微生物群的失调,增加了短链脂肪酸的产生,并改善了肠道屏障功能,从而发挥抗肿瘤的作用。

目前,通过优化菌群结构,发挥抗肿瘤作用的相关中药复方及中药提取物如表3<sup>[50,51,53,54,66]</sup>所示。

**Table 3** Related Chinese medicine compounds and extracts for optimizing the gut microbiota structure and exerting antitumor effects

Herbal medicine	Experimental type	Main conclusion	Reference
Jianpi Bu Shen Prescription	Clinical trial	The effect of Jian Pi Bu Shen Prescription on the gut microbiota of patients after colorectal cancer surgery	[50]
Ji Sheng San	Clinical trial	The efficacy of Ji Sheng San combined with postoperative adjuvant chemotherapy on stage II colorectal cancer and its impact on gut microbiota	[51]
Si Jun Zi Tang	Basic research	The regulatory effect of Si Jun Zi Tang on the gut microbiota and immune function in mice with colon cancer	[53]
Jian Pi Jie Du Prescription	Basic research	The regulatory effect of Jian Pi Jie Du Prescription on the gut microbiota of tumor-bearing mice with spleen deficiency syndrome	[54]
<i>Ganoderma lucidum</i> polysaccharide	Basic research	<i>Ganoderma lucidum</i> polysaccharide modulates gut microbiota and immune cell function to inhibit inflammation and tumorigenesis in the colon	[66]

## 5 总结与展望

本文系统性地梳理了中医药在结直肠癌防治领域的文献,归纳了研究者们在该领域的成果,彰显了中医药在防治结直肠癌上的独特优势,诸如缓解化疗不良

反应、增强免疫机能、延长生存期及优化患者生活质量等。当前,临床上针对结直肠癌复发与转移,放化疗、免疫治疗及靶向治疗等手段依然被视为治疗结直肠癌的有效策略,但这些西医治疗方式往往伴随着不可避免的药物毒性,且其治疗理念局限于疾病识别而非证候辨析。相比之下,中医秉持整体观念与辨证施治的原则,贯穿疾病治疗的全过程,这与肠道微生态理论不谋而合<sup>[67]</sup>,提示肠道菌群或可成为中西医融合的关键桥梁。此外,中药及复方成分复杂多样,具备多靶点治疗、安全、高效的特性,构成了中医药防治结直肠癌的另一大亮点。然而,中医药通过调节肠道菌群以防治结直肠癌的具体机制,在现代药理学框架下尚未得到系统阐述,其确切作用机制尚待深入验证。为此,可以利用现代微生物学、分子生物学及宏基因组学等先进技术,深入探索肠道菌群,对于阐明中药抗结直肠癌的机制至关重要,有望为结直肠癌的防治开辟新的治疗路径与方向。

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