·综述·

中药治疗免疫检查点抑制剂相关性结肠炎的作用机制研究进展

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【摘 要】 肿瘤免疫疗法的出现极大地改变了许多晚期恶性肿瘤的治疗格局。然而,随着免疫检查点抑制剂(ICI)的广泛应用,其所引发的一系列免疫相关不良事件(irAEs)日益凸显,其中ICI相关性结肠炎是最常见的胃肠道irAEs之一,严重时可导致治疗中断甚至患者死亡。目前,西医主要采用糖皮质激素及生物制剂进行治疗,但存在疗效不均、副作用及复发风险等问题。近年来,中药在治疗ICI相关性结肠炎方面显示出多靶点、整体调节的独特优势。本文通过综述国内外相关文献,从调节调节性T细胞/辅助性T细胞17平衡、调控巨噬细胞极化、恢复辅助性T细胞1/辅助性T细胞2平衡及改善肠道菌群等方面,系统阐述了中药及其活性成分治疗ICI相关性结肠炎的潜在作用机制,以期为减轻肿瘤irAEs、提高患者生活质量提供新的思路与参考。

【关键词】 免疫检查点抑制剂;免疫相关不良事件;结肠炎;中药;作用机制;研究进展
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Research progress on underlying mechanism of traditional Chinese medicine in treatment of immune checkpoint inhibitor-induced colitis

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【Abstract】 Tumor immunotherapy has profoundly transformed the therapeutic landscape for many advanced malignancies. However, with the increasing clinical application of immune checkpoint inhibitors (ICI), a spectrum of immune-related adverse events (irAEs) has emerged, among which ICI-induced colitis is one of the most common gastrointestinal irAEs. In severe cases, it can lead to treatment interruption and even patient death. The current mainstay treatments, glucocorticoids and biological agents, are often associated with inconsistent efficacy, significant side effects, and a risk of recurrence. In recent years, traditional Chinese medicine (TCM) has demonstrated unique advantages in treating ICI-induced colitis through its multi-target and holistic regulatory approach. In this article, based on advanced domestic and international literature, we systematically elaborated the potential mechanisms of traditional Chinese medicine and its active components in treatment of ICI-induced colitis, from the aspects of regulating regulatory T cell/T helper 17 cell balance, modulating macrophage polarization, restoring T helper 1 cell/T helper 2 cell balance, and improving gut microbiota, aiming to provide new ideas and references for alleviating irAEs and improving patient's quality of life.

【Key words】 immune checkpoint inhibitors; immune-related adverse events; colitis; traditional Chinese medicine; mechanism; research progress
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近年来,免疫疗法已成为继手术、化疗、放疗和靶向治疗之后的又一重要抗肿瘤治疗手段。免疫检查点抑制剂(immune checkpoint inhibitors, ICI)通过激活T细胞介导的抗肿瘤免疫反应,显著改善了

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多种晚期癌症的治疗效果[1,2]。然而,免疫疗法在增强抗肿瘤免疫的同时,也可能导致免疫系统过度激活,攻击正常组织,从而引发免疫相关不良事件(immune-related adverse events, irAEs),其中以胃肠道 irAEs 尤为常见[1]。研究表明,约 15%接受抗配体程序性死亡配体-1(programmed death-ligand 1, PD-L1)单药治疗的患者会出现严重的 irAEs,而在接受抗程序性死亡受体 1(programmed death receptor 1, PD-1)联合抗细胞毒性 T 淋巴细胞相关蛋白 4(cytotoxic T-lymphocyte-associated protein 4, CTLA-4)治疗的患者中,这一比例高达 40%~60%[3]。值得注意的是,ICI 相关性结肠炎在 irAEs 中发生率较高,发生时往往需要中断治疗、永久停药,甚至导致死亡[4]。在临床实践中,对 ICI 相关性结肠炎的管理不当可能最终导致治疗失败,并对患者造成严重后果[5]。

鉴于免疫疗法的不良反应,探索有效的治疗手段显得尤为重要。中药因其多靶点、多途径的作用特点,在缓解 ICI 相关性结肠炎症状中展现出独特优势[6]。本文旨在对中药干预 ICI 相关性结肠炎作用机制的研究进展进行综述。

1 ICI 相关性结肠炎的发生机制

目前,免疫治疗中 irAEs 的发生机制尚未完全阐明,但普遍认为过度活化的 T 细胞起关键作用[7]。T 细胞活化受 CTLA-4、PD-1 等免疫检查点分子的负调控,CTLA-4 主要在淋巴结中抑制 T 细胞的初始活化,而 PD-1 在外周组织或肿瘤部位调节已激活的 T 细胞[8]。在肿瘤微环境中,T 细胞可能因持续刺激而耗竭,并高表达 PD-1、具有 Ig 和 ITIM 结构域的 T 细胞免疫受体、T 细胞免疫球蛋白和黏蛋白结构域-3 及淋巴细胞激活基因 3。ICI 通过阻断这些抑制信号,激活 T 细胞抗肿瘤能力,但可能打破机体原有的免疫耐受,导致正常组织的免疫攻击[9]。

肠道微生物群的组成可能与免疫检查点阻断的疗效及 irAEs 的发生有关[10]。肠道菌群不仅影响 ICI 治疗的有效性,还会影响腹泻和结肠炎的发生[11]。肠道菌群的多样性和差异通过调节相关的合成代谢影响不良反应[12]

最常见的 irAEs 是 ICI 相关性结肠炎,发病率为 8.6%[1],显著高于早期临床试验报道。其中,抗 CTLA-4 导致的全级别腹泻和结肠炎的发生率分别为 35%和 10%,抗 PD-1 治疗组的发病率分别为 10%和 1%。二者联合使用时,发病率升高至 32%和 15%[8,13]。由此可见,ICI 相关性结肠炎的发生机制可能与 T 细胞活化、免疫检查点受体的表达、肠道微生物群的改变等相关。

2 ICI 相关性结肠炎的治疗方法

根据不良事件通用术语标准[14],ICI 相关性结肠炎的治疗通常根据症状的严重程度进行分级管理。1 级腹泻或结肠炎患者可接受支持性治疗并继续 ICI 治疗;2 级或更高级别的患者,建议开始皮质类固醇治疗并暂停 ICI 治疗[15]。在启动免疫抑制治疗前,需排除感染、胰腺功能不全和乳糜泻等其他病因。

ICI 相关性结肠炎的临床治疗主要依赖于激素。研究表明,与 PD-1/PD-L1 抑制剂相比,CTLA-4 抑制剂治疗相关的胃肠道 irAEs 通常需要更高剂量的激素[16]。然而,激素并非对所有患者有效,且可能伴随感染加重、药物耐药性等挑战,为临床治疗带来困难。

在难治性病例中,生物制剂如英夫利昔单抗和维多珠单抗是常用的二线治疗选择[16],这些药物调节免疫反应,对激素耐药的患者有效。但会增加感染风险及其他免疫相关不良事件[17]。此外,ICI 相关性结肠炎在治疗和缓解后,存在复发的可能性[14]。

3 中药治疗 ICI 相关性结肠炎

ICI 相关性结肠炎在中医中被归类为“腹泻”或“痢疾”,其主要病理机制多为本虚标实,以脾虚为本,湿热、气滞及血瘀为标。中医认为,ICI 作为一种“外邪”或“毒药”,损伤人体正气,导致脾胃运化失司,湿热下注大肠,传导失常而发为腹泻、腹痛、里急后重及黏液便等。其治疗原则为清热解毒、健脾祛湿、调和气血。

研究表明,芍药汤[18]可抑制白细胞介素-1β(interleukin-1 beta, IL-1β)、IL-6 和干扰素-γ(interferon-gamma, IFN-γ),减少肠黏膜损伤并保护肠道屏障,同时改善葡聚糖硫酸钠(dextran sodium sulfate, DSS)后粘蛋白和闭塞蛋白在蛋白质和转录水平上的表达,降低活化 B 细胞核因子 κ 轻链增强子 P65 和 P38 的表达,从而发挥抗坏死作用。另外,其联合洛哌丁胺治疗 ICI 相关性结肠炎 7 d 的总有效率为 93.94%,明显高于对照组($P<0.05$)[19]。黄连汤[20]能缓解结肠炎引发的组织学损伤,下调促炎细胞因子,改善肠道菌群。黄芩汤[21]能够减少

促炎因子,调节肠道菌群,缓解溃疡性结肠炎。参苓白术散[22]增加B细胞淋巴瘤-2蛋白(B-cell lymphoma 2, Bcl-2)的表达,减弱Bcl-2蛋白家族中的促凋亡成员的表达,调节免疫因子,改善肠道菌群,缓解腹泻。

中药在治疗ICI相关性结肠炎方面表现出多途径、多靶点的调控作用,其具体机制主要表现为以下几方面。(1)调节性T细胞活化。在免疫应答中,幼稚$CD4^+$T细胞分化成辅助性T细胞17(T helper 17 cell, Th17)和调节性T细胞(regulatory T cell, Treg)。Th17分泌LI-17介导免疫炎症反应,Treg分泌IL-10维持免疫耐受。在结肠炎状态下,Th17的过度活化和Treg的功能抑制导致Th17/Treg平衡失调,加剧肠道炎症[23]。黄芪甲苷和胡桃醌通过调节Th17/Treg平衡和抗氧化应激,减少炎症细胞浸润和促炎因子表达[24]。苦参提取物(如仓雀酮)可下调JAK2/STAT3信号通路并控制Th17和Treg的分化,重建肠道免疫平衡[25]。(2)抑制巨噬细胞。巨噬细胞是肠道固有免疫的重要组成,其极化状态(M1和M2)在炎症调控中发挥核心作用[26]。M1巨噬细胞产生诱导型一氧化氮合酶、IL-1、IL-6和肿瘤坏死因子-α(tumor necrosis factor-α, TNF-α),表达CD86和其他促炎细胞因子,有助于微生物的清除。M2巨噬细胞分泌精氨酸酶1和IL-10等抗炎因子,缓解炎症和促进组织再生。将巨噬细胞从M1表型向M2表型转化是缓解炎症的重要策略[23]。木犀草素不仅降低巨噬细胞的M1极化和增加巨噬细胞的M2极化,还降低促炎因子IL-6和TNF-α表达,增加抗炎因子IL-10水平,缓解肠道免疫炎症[27]。薯蓣改善小鼠结肠炎,减少M1巨噬细胞的极化,促进M2巨噬细胞的极化[28]。黄连厚朴汤[29]中黄连和厚朴调节M2巨噬细胞的极化,降低炎症水平,改善结肠炎症状。(3)Th1/Th2平衡。促炎Th1和抗炎Th2细胞因子是$CD4^+$T细胞的另外两个重要亚群,分别介导细胞免疫和体液免疫,两者之间存在动态平衡[16]。然而,当组织炎症发生时,过量的Th1和Th2会导致自身免疫性疾病的发展[30]。桔梗苷调节Th1、Th2相关细胞因子的水平,恢复结肠免疫细胞的平衡,减轻结肠炎小鼠的症状[31]。荞麦中木犀草素、白藜芦醇、山奈酚等成分的免疫功能,可恢复Th1/Th2平衡,减轻结肠炎小鼠的临床症状和组织损伤[23]。(4)肠道菌群。肠道菌群失调与irAEs之间存在显著关联。Usyk等[32]发现基线微生物群组成与治疗后的临床结果密切相关。放线菌门和厚壁菌门中的毛螺菌科/瘤胃球菌科与良好的临床反应相关,而革兰氏阴性菌与炎症反应、不良结果相关。另一项针对晚期黑色素瘤患者的研究[33]发现,多氏拟杆菌比例高的患者发生irAEs的风险高,而拟杆菌被鉴定为低风险簇中的优势菌株。Mao等[34]进一步证实,肠道微生物群系统发育多样性与ICI治疗的副作用密切相关。溪黄草增加拟杆菌和乳酸菌等有益菌的丰度[35]。人参多糖和人参皂苷Rk3上调益生菌的丰度,抑制病原菌的增殖,显著改善结肠炎症状[36]。

综上,ICI的应用显著改善肿瘤患者的病程和生存率,同时也可能引发ICI相关性结肠炎。其发病机制主要与过度活化的T细胞导致的肠上皮炎症、黏膜损伤、屏障破坏和炎症因子失衡有关[7]。在中医"异病同治"理论的指导下,中医药在治疗炎症性肠道疾病中展现出广泛的适用性。研究表明,中医药联合抗肿瘤治疗不仅可以抑制肿瘤生长、降低耐药性,还能提高患者的生活质量。中药通过调节免疫细胞和肠道菌群,抑制促炎细胞因子的产生,促进抗炎因子的表达,恢复免疫稳态,缓解ICI相关性结肠炎的症状[37]。然而,目前关于中医药治疗ICI相关性结肠炎的研究仍处于早期阶段,许多问题尚未解决。中医药以其副作用小、价格实惠等优势,有望为ICI相关性结肠炎的预防和治疗提供新的策略,未来需要更多的基础和临床研究来明确中医药治疗irAEs的机制和疗效,从而减轻患者痛苦并提高其生活质量。

【参考文献】

[1] Ding M, Zhang X, Wang J, *et al*. Treatment and outcomes of immune checkpoint inhibitors-associated colitis/diarrhea: a systematic review and meta-analysis[J]. Dig Liver Dis, 2023, 55(12): 1621-1631. DOI: 10.1016/j.dld.2023.02.016.

[2] 程琨翔, 崔琳虹, 崔明新, 等. 非小细胞肺癌免疫检查点抑制剂相关肺炎发生的危险因素[J]. 中华老年多器官疾病杂志, 2025, 24(8): 611-616. DOI: 10.11915/j.issn.1671-5403.2025.08.132.

[3] Hommes JW, Verheijden RJ, Suijkerbuijk KPM, *et al*. Biomarkers of checkpoint inhibitor induced immune-related adverse events — a comprehensive review[J]. Front Oncol, 2021, 10: 585311. DOI: 10.3389/fonc.2020.585311.

[4] Shao J, Wang C, Ren P, *et al*. Treatment- and immune-related adverse events of immune checkpoint inhibitors in advanced lung cancer[J]. Biosci Rep, 2020, 40(5): BSR20192347. DOI: 10.1042/BSR20192347.

[5] Gu T, Jiang A, Zhou C, *et al*. Adverse reactions associated with immune checkpoint inhibitors and bevacizumab: a pharmacovigilance analysis[J]. Int J Cancer, 2023, 152(3): 480-495. DOI: 10.1002/ijc.34332.

[6] Zhou F, Lu Y, Sun T, *et al*. Antitumor effects of polysaccharides from Tetrastigma hemsleyanum Diels et Gilg *via* regulation of intestinal flora and enhancing immunomodulatory effects *in vivo*[J]. Front Immunol, 2022, 13: 1009530. DOI: 10.3389/fimmu.

2022.1009530.
[7] Wang J, Guo Z, Shen M, *et al*. Potential application mechanism of traditional Chinese medicine in treating immune checkpoint inhibitor-induced colitis[J]. Front Immunol, 2024, 15: 1366489. DOI: 10.3389/fimmu.2024.1366489.
[8] Haanen J, Obeid M, Spain L, *et al*. Management of toxicities from immunotherapy: ESMO clinical practice guideline for diagnosis, treatment and follow-up[J]. Ann Oncol, 2022, 33(12): 1217-1238. DOI: 10.1016/j.annonc.2022.10.001.
[9] Poto R, Troiani T, Criscuolo G, *et al*. Holistic approach to immune checkpoint inhibitor-related adverse events[J]. Front Immunol, 2022, 13: 804597. DOI: 10.3389/fimmu.2022.804597.
[10] Gopalakrishnan V, Spencer CN, Nezi L, *et al*. Gut microbiome modulates response to anti-PD-1 immunotherapy in melanoma patients[J]. Science, 2018, 359(6371): 97-103. DOI: 10.1126/science.aan4236.
[11] Chang AE, Golob JL, Schmidt TM, *et al*. Targeting the gut microbiome to mitigate immunotherapy-induced colitis in cancer[J]. Trends Cancer, 2021, 7(7): 583-593. DOI: 10.1016/j.trecan.2021.02.005.
[12] Wu Z, Zhang S, Li L, *et al*. The gut microbiota modulates responses to anti-PD-1 and chemotherapy combination therapy and related adverse events in patients with advanced solid tumors[J]. Front Oncol, 2022, 12: 887383. DOI: 10.3389/fonc.2022.887383.
[13] Yao J, Li M, Zhang H, *et al*. Differential risks of immune-related colitis among various immune checkpoint inhibitor regimens[J]. Int Immunopharmacol, 2020, 87: 106770. DOI: 10.1016/j.intimp.2020.106770.
[14] Nicolaides S, Boussioutas A. Immune-related adverse events of the gastrointestinal system[J]. Cancers (Basel), 2023, 15(3): 691. DOI: 10.3390/cancers15030691.
[15] Yamada K, Sawada T, Nakamura M, *et al*. Clinical characteristics of gastrointestinal immune-related adverse events of immune checkpoint inhibitors and their association with survival[J]. World J Gastroenterol, 2021, 27(41): 7190-7206. DOI: 10.3748/wjg.v27.i41.7190.
[16] Westdorp H, Sweep M, Gorris M, *et al*. Mechanisms of immune checkpoint inhibitor-mediated colitis[J]. Front Immunol, 2021, 12: 768957. DOI: 10.3389/fimmu.2021.768957.
[17] Velikova T, Krastev B, Gulinac M, *et al*. New strategies in the diagnosis and treatment of immune-checkpoint inhibitor-mediated colitis[J]. World J Clin Cases, 2024, 12(6): 1050-1062. DOI: 10.12998/wjcc.v12.i6.1050.
[18] Wei Y, Fan Y, Ga Y, *et al*. Shaoyao decoction attenuates DSS-induced ulcerative colitis, macrophage and NLRP3 inflammasome activation through the MKP1/NF-kappa B pathway[J]. Phytomedicine, 2021, 92: 153743. DOI: 10.1016/j.phymed.2021.153743.
[19] 朱伟. 芍药汤加味联合洛哌丁胺治疗免疫相关性结肠炎 33 例疗效观察[J]. 中国肛肠病杂志, 2024, 44(6): 54-56. DOI: 10.3969/j.issn.1000-1174.2024.06.020.
[20] Hao W, Chen Z, Wang L, *et al*. Classical prescription Huanglian decoction relieves ulcerative colitis *via* maintaining intestinal barrier integrity and modulating gut microbiota[J]. Phytomedicine, 2022, 107:154468. DOI: 10.1016/j.phymed.2022.154468.
[21] Zheng Y, Liang C, Li Z, *et al*. Study on the mechanism of Huangqin decoction on rats with ulcerative colitis of damp-heat type base on mtDNA, TLR4, p-PI3K, p-Akt protein expression and microbiota[J]. J Ethnopharmacol, 2022, 295: 115356. DOI: 10.1016/j.jep.2022.115356.
[22] Rao K, Qin S, Yang Y, *et al*. Shenling Baizhu powder alleviates TNBS-induced colitis in rats by improving intestinal epithelial permeability and inhibiting inflammation through the TLR5/MyD88/NF-kappa B pathway[J]. Front Pharmacol, 2022, 13: 883918. DOI: 10.3389/fphar.2022.883918.
[23] Chen S, Xu Y, Cheng N, *et al*. Mitigation of DSS-induced colitis potentially *via* Th1/Th2 cytokine and immunological function balance induced by phenolic-enriched buckwheat (Fagopyrum esculentum Moench) bee pollen extract[J]. Foods, 2022, 11(9): 1293. DOI: 10.3390/foods11091293.
[24] Zhong Y, Liu W, Xiong Y, *et al*. Astragaloside Ⅳ alleviates ulcerative colitis by regulating the balance of Th17/Treg cells[J]. Phytomedicine, 2022, 104: 154287. DOI: 10.1016/j.phymed.2022.154287.
[25] Li Z, Lin M, Li Y, *et al*. Total flavonoids of Sophora flavescens and kurarinone ameliorated ulcerative colitis by regulating Th17/Treg cell homeostasis[J]. J Ethnopharmacol, 2022, 297: 115500. DOI: 10.1016/j.jep.2022.115500.
[26] Lu J, Yang Y, Peng J, *et al*. Trichosanthes kirilowii lectin ameliorates streptozocin-induced kidney injury *via* modulation of the balance between M1/M2 phenotype macrophage[J]. Biomed Pharmacother, 2019, 109: 93-102. DOI: 10.1016/j.biopha.2018.10.060.
[27] Wang S, Cao M, Xu S, *et al*. Luteolin alters macrophage polarization to inhibit inflammation[J]. Inflammation, 2020, 43(1): 95-108. DOI: 10.1007/s10753-019-01099-7.
[28] Wu M, Wang Q, Huang B, *et al*. Dioscin ameliorates murine ulcerative colitis by regulating macrophage polarization[J]. Pharmacol Res, 2021, 172: 105796. DOI: 10.1016/j.phrs.2021.105796.
[29] Cheng W, Wang X, Wu Y, *et al*. Huanglian-Houpo extract attenuates DSS-induced UC mice by protecting intestinal mucosal barrier and regulating macrophage polarization[J]. J Ethnopharmacol, 2023, 307: 116181. DOI: 10.1016/j.jep.2023.116181.
[30] Xue B, Liu X, Dong W, *et al*. EGCG maintains Th1/Th2 balance and mitigates ulcerative colitis induced by Dextran sulfate sodium through TLR4/MyD88/NF-kappa B signaling pathway in rats[J]. Can J Gastroenterol Hepatol, 2017, 2017: 3057268. DOI: 10.1155/2017/3057268.
[31] Liu Y, Dong Y, Shen W, *et al*. Platycodon grandiflorus polysaccharide regulates colonic immunity through mesenteric lymphatic circulation to attenuate ulcerative colitis[J]. Chin J Nat Med, 2023, 21(4): 263-278. DOI: 10.1016/S1875-5364(23)60435-2.
[32] Usyk M, Pandey A, Hayes RB, *et al*. Bacteroides vulgatus and Bacteroides dorei predict immune-related adverse events in immune checkpoint blockade treatment of metastatic melanoma[J]. Genome Med, 2021, 13(1): 160. DOI: 10.1186/s13073-021-00974-z.
[33] McCulloch JA, Davar D, Rodrigues RR, *et al*. Intestinal microbiota signatures of clinical response and immune-related adverse events in melanoma patients treated with anti-PD-1[J]. Nat Med, 2022, 28(3): 545-556. DOI: 10.1038/s41591-022-01698-2.
[34] Mao J, Wang D, Long J, *et al*. Gut microbiome is associated with the clinical response to anti-PD-1 based immunotherapy in hepatobiliary cancers[J]. J Immunother Cancer, 2021, 9(12): e003334. DOI: 10.1136/jitc-2021-003334.
[35] Li H, Wang Y, Shao S, *et al*. Rabdosia serra alleviates dextran sulfate sodium salt-induced colitis in mice through anti-inflammation, regulating Th17/Treg balance, maintaining intestinal barrier integrity, and modulating gut microbiota[J]. J Pharm Anal, 2022, 12(6): 824-838. DOI: 10.1016/j.jpha.2022.08.001.
[36] Wang D, Shao S, Zhang Y, *et al*. Insight into polysaccharides from Panax ginseng C. A. Meyer in improving intestinal inflammation: modulating intestinal microbiota and autophagy[J]. Front Immunol, 2021, 12: 683911. DOI: 10.3389/fimmu.2021.683911.
[37] 孟肖娜, 孙旭, 刘怀民. 免疫检查点抑制剂相关结肠炎的研究进展[J]. 实用医学杂志, 2024, 40(9): 1314-1319. DOI: 10.3969/j.issn.1006-5725.2024.09.023.

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