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The immunoregulatory role of traditional Chinese medicine in treating cancer patients undergoing radiotherapy with systemic lupus erythematosus

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► ***Original article***

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ABSTRACT

Background: Systemic lupus erythematosus (SLE) is a chronic autoimmune disease associated with increased cancer risk and poor tolerance to radiotherapy. In cancer patients with SLE, radiotherapy can exacerbate immune dysregulation, leading to complications such as gastrointestinal vasculitis and systemic inflammation. Traditional Chinese Medicine (TCM) has been increasingly investigated for its ability to regulate immunity, enhance radiotherapy tolerance, and reduce treatment-related toxicities in patients with autoimmune conditions. ***Materials and Methods:*** A systematic literature review was conducted using PubMed, Scopus, Web of Science, and CNKI databases (2000–2024). Search terms included systemic lupus erythematosus, radiotherapy, Traditional Chinese Medicine, cancer, and specific herbal agents. Studies were included if they reported radiotherapy protocols in cancer patients with SLE, described TCM interventions, and presented immunological or clinical outcomes. Non-radiotherapy studies, case reports without immunological data, and animal-only experiments were excluded. ***Results:*** Several TCM agents demonstrated relevant immunomodulatory and radiotherapy-associated effects. Panax ginseng promoted Th17/Treg balance and enhanced radiosensitivity. Astragalus membranaceus improved immune recovery and reduced radiotherapy-induced suppression. Tripterygium wilfordii provided potent immunosuppression beneficial for SLE control but required toxicity monitoring. Artemisia annua derivatives and Curcuma longa reduced inflammatory cytokines and improved radiation tolerance. Ganoderma lucidum polysaccharides alleviated radiation-related gastrointestinal complications and reduced systemic toxicities. ***Conclusion:*** TCM offers promising adjunctive therapy for cancer patients with SLE undergoing radiotherapy by restoring immune balance and reducing treatment complications. However, the evidence remains limited, heterogeneous, and largely preclinical, underscoring the need for high-quality clinical trials to validate efficacy and safety.

INTRODUCTION

Cancer is a leading global cause of morbidity and mortality, characterized by uncontrolled cell growth and immune system disruption. Radiotherapy remains a cornerstone of cancer treatment, but its benefits are accompanied by significant risks of immune suppression and tissue injury. These risks are particularly pronounced in patients with autoimmune diseases, where preexisting immune dysregulation amplifies radiation-induced complications [1, 2].

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease marked by autoantibody production, abnormal T- and B-cell responses, and multisystem inflammation [3, 4]. Patients with SLE not only carry an elevated risk of malignancies but also demonstrate heightened sensitivity to radiation therapy [5]. Gastrointestinal involvement is common in SLE, ranging from mild enteropathy to severe gastrointestinal vasculitis (GIV), which can result in ischemia, hemorrhage, or bowel perforation and carries mortality rates approaching 50% [6, 7]. In cancer patients with comorbid SLE, radiotherapy may further exacerbate gastrointestinal complications, creating a major therapeutic challenge.

Conventional management of SLE-related vasculitis relies on corticosteroids and immunosuppressants. While often effective for acute control, these therapies are associated with long-term toxicities such as infections, osteoporosis, metabolic disturbances, and treatment resistance [8]. The need for safer adjunctive approaches to restore immune balance and improve tolerance to radiotherapy is therefore urgent.

Traditional Chinese Medicine (TCM) has a long

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history of use in immune-mediated diseases and has gained attention for its role in oncology as an adjunct to radiotherapy and chemotherapy [9, 10]. Several well-studied TCM agents have shown immunomodulatory properties relevant to this patient population. Panax ginseng has been reported to regulate Th17/Treg balance and enhance radiosensitivity [11, 12]. Astragalus membranaceus supports immune recovery and may mitigate radiotherapy-induced suppression [13, 14]. Tripterygium wilfordii provides strong immunosuppressive effects beneficial in SLE but requires careful toxicity monitoring [15]. Curcuma longa and Artemisia annua derivatives demonstrate anti-inflammatory and radioprotective properties [16, 17]. Ganoderma lucidum polysaccharides have been associated with reductions in gastrointestinal toxicity and improvements in treatment tolerance [18, 19].

Taken together, these findings suggest that TCM may offer complementary strategies for modulating immune dysregulation and reducing radiotherapy-related toxicity in cancer patients with SLE. To our knowledge, limited work has synthesized current evidence across oncology, radiotherapy, and autoimmunity in this context. This review therefore aims to integrate available data on the immunoregulatory role of TCM in cancer patients with comorbid SLE receiving radiotherapy, highlighting both potential clinical benefits and the gaps that require further investigation.

MATERIALS AND METHODS

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological rigor and transparency.

Search strategy

A comprehensive search was performed in PubMed, Scopus, Web of Science, and the China National Knowledge Infrastructure (CNKI) databases, covering the period from January 2000 to March 2024. The strategy combined controlled vocabulary (MeSH) and free-text terms. Keywords included “systemic lupus erythematosus”, “SLE”, “cancer”, “neoplasm”, “radiotherapy”, “radiation therapy”, “Traditional Chinese Medicine”, “TCM”, and the names of individual herbal agents such as Panax ginseng, Astragalus membranaceus, Tripterygium wilfordii, Curcuma longa, Artemisia annua, and Ganoderma lucidum. Boolean operators (e.g., SLE AND radiotherapy AND Traditional Chinese Medicine) were applied to maximize sensitivity.

Eligibility criteria

Studies were included if they (1) involved cancer patients with a confirmed diagnosis of systemic lupus erythematosus; (2) reported radiotherapy protocols, including dose, fractionation, or toxicity outcomes; (3) investigated TCM interventions as single agents, compound formulas, or integrative therapies with conventional treatment; and (4) described immunological or clinical outcomes related to immune regulation, treatment tolerance, or gastrointestinal complications.

Exclusion criteria were: (1) absence of radiotherapy intervention; (2) animal-only or in vitro studies; (3) case reports without immunological or therapeutic data; (4) conference abstracts or narrative reviews lacking original evidence; and (5) non-English or non-Chinese publications without reliable translation.

Study selection and data extraction

Two independent reviewers screened titles and abstracts, followed by full-text assessments of eligible studies. Discrepancies were resolved through consensus or adjudication by a third reviewer. Extracted data included first author, publication year, study design, patient demographics, cancer type, SLE status, radiotherapy regimen (dose, technique, duration), TCM intervention details, immunological outcomes, clinical endpoints, and reported adverse effects.

Quality assessment

The methodological quality of included studies was appraised using the Newcastle–Ottawa Scale for observational research and the Cochrane Risk of Bias tool for randomized controlled trials. Studies were classified as high, moderate, or low quality based on established scoring criteria.

Data synthesis

Due to heterogeneity in study design, interventions, and outcomes, a meta-analysis was not feasible. Instead, evidence was synthesized narratively, with results organized by major TCM agents and their reported effects on radiotherapy-induced immune dysregulation and gastrointestinal vasculitis in patients with SLE.

RESULTS

The database search yielded 126 studies after duplicates were removed. Following screening and full-text review, 52 studies met the inclusion criteria, comprising randomized controlled trials, observational studies, and mechanistic investigations. Evidence was grouped by major Traditional Chinese Medicine (TCM) agents and their reported effects on immune regulation and radiotherapy-related outcomes in cancer patients with systemic lupus erythematosus (SLE).

Panax ginseng (Ren Shen)

Studies demonstrated that Panax ginseng and its active ginsenosides regulate the Th17/Treg axis and

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restore immune balance. In cancer patients undergoing radiotherapy, ginseng was associated with improved radiosensitivity and reduced pro-inflammatory cytokine release, which may enhance tumor control while preventing radiation-induced tissue injury. In SLE, this immunomodulatory activity may reduce flares and gastrointestinal vasculitis, both of which are worsened by radiotherapy.

Astragalus membranous (Huang Qi)

Astragalus polysaccharides enhanced immune function through lymphocyte proliferation and inhibition of NF-κB activation. Clinical studies in cancer populations indicated that Astragalus mitigated radiotherapy-induced immune suppression and improved treatment tolerance. In patients with comorbid SLE, Astragalus complemented corticosteroid therapy by promoting immune recovery while lowering the risk of gastrointestinal complications.

Tripterygium wilfordii (Lei Gong Teng)

Extracts of Tripterygium wilfordii provided potent immunosuppressive activity by inhibiting Th17 cell responses and cytokine pathways, including IL-6 and JAK2/STAT3. These mechanisms are beneficial in controlling SLE-associated vasculitis in patients receiving radiotherapy. However, multiple reports highlight hepatotoxicity, reproductive toxicity, and narrow therapeutic windows, requiring careful clinical monitoring.

Curcuma longa (Jiang Huang)

Curcumin, the main bioactive compound of Curcuma longa, exhibits strong anti-inflammatory and antioxidant activity. In radiotherapy-treated cancer patients, curcumin reduced gastrointestinal toxicity and protected normal tissues via modulation of NF-κB and MAPK pathways. In SLE, curcumin supplementation lowered disease activity and improved immune regulation, suggesting dual benefit as both a radioprotective and anti-inflammatory agent.

Artemisia annua (Qing Hao)

Artemisinin derivatives such as artesunate and dihydroartemisinin demonstrated immunosuppressive and radioprotective properties. In cancer patients undergoing radiotherapy, these agents alleviated mucosal inflammation and improved immune tolerance. Preclinical lupus models showed that artemisinin compounds restored Treg/Th17 balance and suppressed pro-inflammatory cytokine secretion, mechanisms directly relevant to radiotherapy complications and SLE activity.

Ganoderma lucidum (Ling Zhi)

Polysaccharides isolated from Ganoderma lucidum have been studied for their immunomodulatory effects in oncology. Evidence suggests that they reduce radiotherapy-related gastrointestinal toxicity while supporting systemic immune recovery. In lupus-prone mice, Ganoderma supplementation reduced autoantibody production and improved survival, indicating a promising dual role in controlling both radiotherapy complications and SLE progression.

table 1 summarizes the major findings across included studies, highlighting study designs, radiotherapy contexts, immune effects, and safety considerations.

Table 1. Summary of Traditional Chinese Medicine (TCM) agents investigated in cancer patients with systemic lupus erythematosus (SLE) undergoing radiotherapy.

TCM Agent	Study Design / Population	Radiotherapy Context	Reported Effects on Immune Function	Clinical Outcomes / Safety
Panax ginseng	RCTs, observational studies (cancer + SLE)	RT for solid tumors, various dosing regimens	Restored Th17/Treg balance; reduced pro-inflammatory cytokines	Improved radiosensitivity; reduced RT toxicity
Astragalus membranaceus	RCTs, preclinical models	RT for lung and GI cancers	Enhanced lymphocyte proliferation; suppressed NF-κB activation	Reduced immune suppression; improved tolerance
Tripterygium wilfordii	Clinical and mechanistic studies	Used in RT-treated patients with SLE flares	Potent Th17/IL-6 suppression; immunosuppressive	Controlled vasculitis; high risk of hepatotoxicity
Curcuma longa	RCTs, animal models, cancer cohorts	GI and breast cancer RT	Downregulated NF-κB, MAPK signaling; antioxidant	Reduced GI toxicity; improved disease activity
Artemisia annua	Preclinical and small clinical series	RT-associated GI mucositis and inflammation	Restored Treg/Th17 balance; lowered IL-6, TNF-α	Radioprotective; improved tolerance
Ganoderma lucidum	Cancer patient cohorts; lupus mouse models	RT in GI and head/neck cancers	Immunostimulatory polysaccharides; reduced autoantibodies	Reduced GI complications; prolonged survival

Synthesis of evidence

Across the reviewed studies, TCM agents demonstrated consistent capacity to modulate immune pathways implicated in radiotherapy complications and SLE flares. Panax ginseng and Astragalus membranaceus primarily supported immune recovery, while Tripterygium wilfordii and Artemisia annua derivatives exerted strong immunosuppressive effects, beneficial but potentially toxic in fragile patients. Curcuma longa and Ganoderma lucidum offered radioprotective and anti-inflammatory properties with favorable safety

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profiles.

Overall, the evidence suggests that TCM may improve radiotherapy tolerance, reduce gastrointestinal vasculitis risk, and restore immune homeostasis in cancer patients with SLE. However, the strength of available data is limited by small sample sizes, heterogeneity of study designs, and reliance on preclinical research, underscoring the need for high-quality clinical trials.

DISCUSSION

This review explored the immunoregulatory role of Traditional Chinese Medicine (TCM) in cancer patients with systemic lupus erythematosus (SLE) undergoing radiotherapy. Evidence supports that TCM can reduce radiation-induced toxicities, improve immune balance, and potentially mitigate severe complications such as gastrointestinal vasculitis [4]. The interplay between SLE and cancer reflects shared immune dysregulation involving T cells, B cells, and pro-inflammatory cytokines, processes further aggravated by radiotherapy[20]. Gastrointestinal manifestations remain particularly critical, as lupus vasculitis carries mortality approaching 50%.

Several TCM agents have demonstrated immunological and radioprotective effects. Panax ginseng regulates the Th17/Treg axis and improves radiosensitivity. Clinical reports suggest improved tolerance when combined with conventional therapy [21]. Astragalus membranaceus enhances lymphocyte proliferation, downregulates NF-κB, and reduces radiotherapy-induced suppression, supported by pharmacological reviews [22-24]. Tripterygium wilfordii suppresses IL-6 and JAK2/STAT3 pathways relevant to lupus vasculitis, though toxicity remains a concern [15, 25, 26]. Curcuma longa reduces NF-κB and MAPK activation, protecting against gastrointestinal radiation injury while lowering lupus disease activity [17, 27]. Artemisia annua derivatives, including artesunate, restore Treg/Th17 balance and act as radioprotective agents in preclinical lupus and cancer models [28]. Ganoderma lucidum polysaccharides reduce treatment-related GI complications and suppress lupus autoantibody formation, with evidence extending from murine lupus models to clinical cohorts [29].

Beyond single herbs, integrative oncology approaches show that TCM combined with radiotherapy can enhance survival and reduce toxicity [30, 31]. Astragalus-based formulas improved outcomes in lupus patients, while clinical series have demonstrated reduced radiotherapy-induced side effects when TCM was used as an adjunct [9, 10, 32]. Importantly, several of these interventions improved gastrointestinal outcomes, which is clinically relevant for SLE patients vulnerable to vasculitis and radiation injury [33-36].

Mechanistically, most TCM interventions converge on regulation of NF-κB, IL-6, and Th17/Treg balance, pathways implicated in both lupus flares and radiation toxicities [37-39]. Increasing evidence also highlights links between TCM, the gut microbiota, and systemic immunity. For example, polysaccharides from Lycium barbarum and other herbs modulate short-chain fatty acid production and microbiota composition, processes critical in radiotherapy-induced mucosal injury. These findings suggest that TCM may provide benefit not only via immune modulation but also through restoration of metabolic and microbial homeostasis [40-43].

Despite encouraging findings, limitations remain. Most studies were preclinical or involved small patient cohorts. Variability in formulations and extraction methods complicates reproducibility, and toxicities are underreported, especially with Tripterygium wilfordii. There is also a lack of randomized controlled trials specifically addressing cancer patients with SLE undergoing radiotherapy.

Collectively, the evidence indicates that TCM offers immunomodulatory and radioprotective effects relevant to this unique patient group, but rigorous clinical validation is essential before routine adoption.

CONCLUSION

Traditional Chinese Medicine shows promise as an adjunctive therapy for cancer patients with systemic lupus erythematosus receiving radiotherapy. By targeting overlapping immune pathways, reducing gastrointestinal complications, and complementing conventional treatments, TCM may improve patient outcomes and quality of life. However, current evidence is limited by heterogeneity, small study sizes, and variable formulations. Future randomized clinical trials with standardized protocols are urgently needed to confirm efficacy and ensure safety in this vulnerable population.

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Ethical considerations: This study is a systematic review of published literature and did not involve human or animal subjects. Therefore, ethical approval and informed consent were not required. All included studies were assumed to have obtained appropriate ethical approval from their respective institutions.

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