Volume 24, No 3 | International Journal of Radiation Research, July 2026

Integrated medicine in oncology: Enhancing radiotherapy outcomes in gastric cancer through traditional and conventional approaches

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► ***Review article***

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Received: June 2025
Final revised: October 2025
Accepted: October 2025

Int. J. Radiat. Res., July 2026; 24(3): 895-900

DOI: 10.61186/ijrr.24.3.40

Keywords: *Stomach neoplasms, radiotherapy, chemotherapy, integrative medicine, medicine, Chinese traditional.*

ABSTRACT

Background: Radiotherapy is a cornerstone in the treatment of gastric cancer, particularly in locally advanced cases, but its clinical benefit is often limited by gastrointestinal and systemic toxicities. Conventional approaches provide mainly symptomatic relief, while Traditional Chinese Medicine (TCM) has been explored for its potential to reduce adverse effects, improve tolerance, and support recovery. ***Materials and Methods:*** This narrative review synthesized evidence from PubMed, Web of Science, and CNKI (2000–2024). Eligible studies included clinical trials, observational studies, and reviews evaluating radiotherapy, chemotherapy, and TCM-based interventions in gastric cancer. The focus was on toxicity reduction, treatment adherence, quality-of-life outcomes, and underlying biological mechanisms. ***Results:*** Evidence indicates that integrating radiotherapy and chemotherapy with TCM modalities-such as herbal medicine, acupuncture, and dietary therapy-may alleviate mucosal injury, nausea, fatigue, and systemic inflammation. Reported benefits include higher treatment completion rates, improved quality-of-life scores, and modulation of inflammatory biomarkers. However, heterogeneity in trial design and the absence of large randomized controlled studies limit definitive conclusions. ***Conclusion:*** Integrating TCM with conventional oncological care may enhance radiotherapy outcomes in gastric cancer by reducing treatment-related toxicities and supporting patient resilience. Future well-designed clinical trials are required to confirm efficacy and establish standardized integrative protocols.

INTRODUCTION

Gastric cancer is one of the leading causes of cancer-related mortality worldwide and remains highly prevalent in East Asian countries such as China, Japan, and South Korea, where dietary, genetic, and environmental factors contribute to its incidence and progression [1]. Despite advances in early detection, surgical techniques, and systemic chemotherapy, the prognosis for advanced-stage gastric cancer remains poor. For patients with locally advanced or inoperable disease, radiotherapy continues to play a pivotal role in tumor control, symptom palliation, and improved survival, particularly when integrated with chemotherapy in neoadjuvant or adjuvant settings [2, 3].

Modern radiotherapy techniques, including intensity-modulated and proton-based modalities, have improved dose conformity and precision, yet treatment-related toxicities remain a major clinical challenge. Recent work published has highlighted the complexity of gastric cancer dosimetry, for example through modeling pencil beam scanning proton therapy, underscoring the need for strategies that not only maximize tumor control but also mitigate collateral damage to surrounding tissues [4]. Despite these technological advances, patients frequently experience radiation-induced gastritis, nausea, anorexia, mucosal injury, and fatigue, which compromise nutritional status, immune function, and psychological well-being, often leading to dose reductions or treatment interruptions that negatively affect outcomes [5-7].

In this context, integrative medicine-which combines conventional biomedical treatments with complementary approaches such as Traditional Chinese Medicine (TCM)-has emerged as a promising adjunct in oncology [8, 9]. TCM interventions, including herbal medicine, acupuncture, moxibustion, and dietary therapy, have long been used to regulate gastrointestinal function, restore energy balance (qi), and strengthen resilience. Increasing clinical evidence suggests that these therapies can reduce treatment-related toxicities, enhance quality of life, and modulate immune and inflammatory responses [10]. For instance, acupuncture has demonstrated efficacy in alleviating nausea and fatigue, while herbal formulations such as Banxia Xiexin Tang and Shenling Baizhu *San* have been reported to improve digestion and protect mucosal integrity. Broader analyses have also shown that complementary and integrative therapies can play an important supportive role

during radiotherapy, improving adherence and symptom control [11]. Furthermore, integrative oncology is increasingly recognized as a framework for redefining comprehensive cancer care, positioning patient-centered approaches alongside conventional treatments [12].

Despite these encouraging findings, challenges remain. Variability in herbal preparations, the absence of standardized acupuncture protocols, and concerns about herb–drug interactions highlight the need for rigorous evaluation. Successful integration will also depend on enhancing provider education, improving patient awareness, and conducting large-scale randomized controlled trials to establish safety, efficacy, and cost-effectiveness.

The present review provides a focused synthesis of current evidence on the role of integrative medicine in gastric cancer radiotherapy. Unlike prior broad discussions, it emphasizes radiotherapy-specific challenges, reviews both conventional and TCM-based supportive strategies, and explores potential mechanisms of synergy. This approach highlights the novelty of integrative care as a means of enhancing treatment tolerance, quality of life, and long-term outcomes in patients with gastric cancer.

MATERIALS AND METHODS

This review was conducted as a narrative synthesis of current evidence on integrative medicine in gastric cancer radiotherapy. A structured search of PubMed, Web of Science, and CNKI was performed for articles published between January 2000 and April 2024. The search strategy combined keywords and MeSH terms related to gastric cancer and its management, including Stomach Neoplasms, Radiotherapy, Chemotherapy, Integrative Medicine, Medicine, Chinese Traditional, Acupuncture Therapy, Phytotherapy, and Quality of Life.

Studies were considered eligible if they reported on clinical trials, observational studies, systematic reviews, or meta-analyses involving gastric cancer patients and addressed radiotherapy or chemotherapy as part of the treatment protocol. Articles were included if they evaluated the role of Traditional Chinese Medicine (TCM) or other integrative interventions-such as herbal therapy, acupuncture, or dietary approaches-either alone or in combination with conventional care. Both English- and Chinese-language publications were considered. Studies were excluded if they focused solely on preclinical or animal models, if they consisted of single case reports without sufficient clinical detail, or if they did not involve gastric cancer or treatment-related outcomes. Non-peer-reviewed reports and conference abstracts without full datasets were also excluded.

Two authors independently screened titles and abstracts, followed by full-text assessment of potentially relevant studies. Disagreements were resolved by consensus. From each included study, information was extracted on design, sample size, intervention type, treatment context (adjuvant, neoadjuvant, or palliative radiotherapy), outcomes reported (including toxicity, adherence, quality of life, survival, or biomarker changes), and principal findings. Although no formal risk-of-bias scoring was applied, greater weight was given to randomized controlled trials and systematic reviews where available.

Because the aim of this review was to highlight the integration of TCM into gastric cancer radiotherapy, discussion of conventional radiotherapy and chemotherapy standards was also included to provide clinical context.

Conventional radiotherapy and chemotherapy in gastric cancer

Radiotherapy is an established component of multimodal therapy for gastric cancer, particularly in patients with locally advanced or unresectable disease, where it contributes to improved tumor control, symptom relief, and survival when combined with systemic therapy [2, 3]. Advances in radiotherapy technology, including three-dimensional conformal radiotherapy (3D-CRT), intensity-modulated radiotherapy (IMRT), and volumetric-modulated arc therapy (VMAT), have allowed more precise dose distributions while sparing critical structures such as the liver, kidneys, and intestines [13]. In a meta-analysis comparing IMRT with 3D-CRT, IMRT achieved superior three-year local control without increasing toxicity, underscoring its therapeutic advantage in gastric cancer management [14]. More recently, dosimetric studies have highlighted the potential of pencil beam scanning proton therapy to further improve tumor targeting and reduce dose exposure to normal tissues [4]. Despite these technical advances, radiation-induced gastritis, mucosal injury, anorexia, nausea, and systemic fatigue remain frequent complications that often necessitate treatment breaks or dose reductions, ultimately compromising outcomes [5-7].

Chemotherapy is likewise a cornerstone of gastric cancer management and is frequently integrated with radiotherapy in adjuvant or neoadjuvant regimens. Standard protocols commonly involve fluoropyrimidines such as 5-fluorouracil (5-FU) or capecitabine in combination with platinum agents including oxaliplatin or cisplatin. More recently, intensified regimens such as FLOT (5-FU, leucovorin, oxaliplatin, and docetaxel) have demonstrated improved perioperative outcomes and are increasingly recommended in advanced disease settings [2]. Clinical experiences, including a recent retrospective analysis from Peking Union Medical College Hospital, have reported that neoadjuvant

chemoradiation using image-guided IMRT (45 Gy in 25 fractions) with capecitabine or XELOX was feasible, with acceptable toxicity profiles and favorable clinical outcomes [15]. Nevertheless, chemotherapy is associated with mucositis, myelosuppression, neuropathy, and gastrointestinal toxicities, which can be exacerbated by concurrent radiotherapy.

Taken together, radiotherapy and chemotherapy represent globally accepted, evidence-based modalities in gastric cancer care. Their integration has significantly improved patient outcomes, yet persistent treatment-related toxicities continue to limit tolerability. These challenges highlight the need for complementary strategies that can enhance adherence, reduce adverse effects, and support resilience—providing the rationale for exploring Traditional Chinese Medicine (TCM) within an integrative oncology framework.

Traditional Chinese medicine approaches

Herbal medicine

Herbal medicine is a central element of Traditional Chinese Medicine (TCM) in the supportive care of gastric cancer, particularly during radiotherapy. Prescriptions are tailored to syndrome differentiation, with formulas such as Banxia Xiexin Tang and Shenling Baizhu San traditionally used to alleviate nausea, regulate digestion, and protect the gastric mucosa [16]. Pharmacological studies show that active herbal compounds, including Coptis chinensis (Huang Lian) and Aucklandia lappa (Mu Xiang), exert anti-inflammatory, antioxidative, and mucoprotective effects that help maintain tissue integrity under radiotherapy-induced stress [17]. Modern investigations have further clarified these mechanisms: network pharmacology studies on decoctions such as Tiao-Yuan-Tong-Wei demonstrated regulation of pathways including PI3K/AKT and MAPK, along with inhibition of pro-inflammatory cytokines such as IL-6 and TNF-α, both of which are implicated in radiotherapy-related injury [18]. Broader reviews confirm that TCM herbal interventions can modulate metabolism, suppress angiogenesis, and reprogram the tumor immune microenvironment [19]. Clinical evaluations also suggest that combining herbal therapies with standard cancer treatments may reduce treatment-related toxicity, enhance immune parameters, and improve tolerance [20]. Despite these promising findings, variability in herbal preparations and limited large-scale randomized trials remain obstacles to standardization.

Acupuncture

Acupuncture has been widely investigated for its potential to alleviate radiotherapy- and chemotherapy-related toxicities in gastric cancer. Commonly employed acupoints include Zusanli (ST36), Neiguan (PC6), and Zhongwan (CV12), which are traditionally used to regulate gastrointestinal function and strengthen systemic resilience. Clinical data support its utility: in a randomized trial, electroacupuncture improved quality-of-life scores and reduced treatment-related toxicities among gastric cancer patients receiving adjuvant chemotherapy [21]. In another study examining acupuncture in conjunction with neoadjuvant chemoradiotherapy, patients reported lower rates of gastrointestinal adverse events and better treatment adherence, suggesting synergistic benefits in integrative protocols [22]. Mechanistic insights indicate that acupuncture stimulates afferent nerve fibers, modulates the hypothalamic–pituitary–adrenal axis, and influences immune and stress-related cytokines, consistent with its observed effects on nausea, fatigue, and systemic inflammation [23]. While results are encouraging, heterogeneity in study design and acupoint selection underscores the need for standardized, oncology-specific acupuncture protocols.

Dietary therapy

Dietary therapy is another important component of TCM that supports patients undergoing radiotherapy by addressing nutrition, digestion, and overall resilience. TCM dietary principles emphasize warm, easily digestible foods such as rice porridge, steamed vegetables, and herbal teas, while advising against cold, greasy, or highly spiced dishes that may aggravate gastric irritation [24]. Clinical studies have shown that TCM-based dietary interventions, such as herbal porridges enriched with qi-tonifying herbs, can significantly improve symptoms of functional dyspepsia and support nutritional recovery during cancer treatment [24]. Emerging evidence also indicates that many food-based botanicals used in TCM -such as ginseng, curcumin, and berberine- exert anticancer effects through regulation of apoptosis, autophagy, and immune signaling, and may help counteract resistance to chemotherapy and radiotherapy [25]. These findings highlight the potential of dietary therapy to complement biomedical nutritional support, maintaining strength and improving adherence to demanding treatment regimens.

Integrative models and clinical evidence

Integrating Traditional Chinese Medicine (TCM) with conventional oncological care has gained increasing attention in the management of gastric cancer, particularly for patients undergoing radiotherapy and chemotherapy. In this model, standard regimens such as intensity-modulated radiotherapy (IMRT) or volumetric-modulated arc therapy (VMAT) combined with fluoropyrimidine-platinum chemotherapy are supplemented with supportive interventions including herbal decoctions,

acupuncture, and dietary therapy. The goal is not to replace conventional care but to enhance tolerability, reduce treatment-related toxicity, and improve overall quality of life.

Clinical evidence supports the potential benefits of this approach. Retrospective analyses have reported that gastric cancer patients receiving integrative care exhibited fewer severe gastrointestinal side effects, better nutritional stability, and higher completion rates of prescribed radiotherapy schedules compared with those receiving conventional treatment alone [26]. In randomized clinical settings, acupuncture has been particularly well studied. A trial published in Journal of Pain and Symptom Management demonstrated that electroacupuncture significantly improved quality-of-life scores and reduced chemotherapy-related toxicities in gastric cancer patients receiving adjuvant chemotherapy [27]. Similarly, the multicenter EAGER trial, reported in Annals of Oncology, confirmed that electroacupuncture preserved health-related quality of life and reduced symptom burden during adjuvant therapy for gastric cancer [28]. These findings align with earlier observational studies suggesting that acupuncture and herbal medicine, when used alongside chemoradiotherapy, can decrease nausea, appetite loss, and systemic fatigue while improving patient adherence [29].

Evidence from systematic reviews and meta-analyses further strengthens the case for integrative oncology. A network meta-analysis of acupuncture for radiotherapy-induced adverse effects concluded that acupuncture combined with standard antiemetic medication ranked as the most effective strategy for preventing radiation enteritis and related gastrointestinal complications. Another meta-analysis focusing on gastric cancer patients undergoing chemotherapy reported that acupuncture and moxibustion significantly reduced gastrointestinal adverse events and improved treatment tolerability [30]. Herbal therapies have also been shown to modulate inflammatory pathways, lowering levels of cytokines such as IL-6 and TNF-α, which are associated with radiation-induced tissue injury.

Mechanistic studies provide plausible biological explanations for these effects. TCM interventions have been linked to modulation of gut microbiota, enhancement of intestinal barrier function, and reduction of systemic inflammation during radiotherapy and chemotherapy [30]. Such findings suggest that integrative care not only addresses symptom burden but also influences host–tumor interactions and systemic resilience.

Individual case reports illustrate the real-world impact of integrative oncology. For example, a gastric cancer patient who developed severe fatigue and mucositis during adjuvant radiotherapy achieved symptom relief and uninterrupted treatment completion after receiving herbal decoctions targeting spleen qi deficiency, acupuncture at ST36 and PC6, and TCM-based dietary modifications. This case highlights how carefully designed integrative strategies can mitigate treatment toxicity and support adherence [16, 24].

Looking forward, large-scale prospective studies are underway to evaluate integrative models more rigorously. The Traditional Chinese Medicine Collaborative Model (TCMCM) trial is currently testing whether the addition of TCM modalities to standard adjuvant chemotherapy in stage III gastric cancer improves disease-free survival, quality of life, and toxicity profiles [31]. Such high-quality randomized studies will be crucial for establishing standardized, evidence-based guidelines for integrative oncology in gastric cancer radiotherapy.

Despite encouraging data, challenges remain, including heterogeneity in herbal formulations, variability in acupuncture protocols, and limited sample sizes across trials. Nevertheless, the growing body of clinical and mechanistic evidence indicates that integrative models can enhance patient tolerance, reduce treatment-related adverse effects, and improve overall quality of life, thereby offering a valuable complement to conventional radiotherapy and chemotherapy in gastric cancer management.

DISCUSSION

The integration of Traditional Chinese Medicine (TCM) with conventional radiotherapy and chemotherapy in gastric cancer represents a rapidly evolving field with promising implications for patient care. Evidence synthesized in this review indicates that integrative approaches can mitigate the adverse effects of radiotherapy, improve quality of life, and support treatment adherence. Herbal medicine, acupuncture, and dietary therapy have each demonstrated potential benefits in reducing gastrointestinal toxicity, alleviating fatigue, and modulating inflammatory and immunological pathways. These findings align with the broader shift toward patient-centered oncology and the increasing recognition of complementary modalities in supportive cancer care.

A central theme across the available literature is the potential of integrative care to address the dual challenge of maintaining therapeutic efficacy while reducing toxicity. Conventional radiotherapy and chemotherapy regimens, while effective, are frequently associated with gastrointestinal mucositis, nausea, anorexia, and systemic fatigue, all of which can compromise treatment delivery [5-7]. Integrative interventions, particularly acupuncture and selected herbal decoctions, have been associated with reduced symptom burden and higher completion rates of

prescribed therapies [27, 28]. Mechanistic studies further support these observations, showing that TCM may modulate cytokine expression (e.g., IL-6, TNF-α), regulate the neuroendocrine axis, and improve gut microbiota composition, thereby reducing inflammation and enhancing mucosal resilience [17, 32].

Despite encouraging data, significant limitations temper the strength of current evidence. Many studies are retrospective, involve small cohorts, or use heterogeneous interventions that limit reproducibility. Herbal preparations often vary in composition and dosage, and acupuncture protocols lack standardization in acupoint selection, frequency, and duration. Furthermore, few large-scale randomized controlled trials have been conducted in gastric cancer populations, and most meta-analyses combine data from multiple cancer types, making it difficult to draw cancer-specific conclusions [33]. These methodological limitations underscore the need for rigorously designed prospective trials to validate the safety, efficacy, and cost-effectiveness of integrative oncology models.

Another challenge is the potential for herb–drug interactions, particularly in patients receiving multi-agent chemotherapy. While many TCM herbs have demonstrated anti-inflammatory and mucoprotective effects, their impact on cytochrome P450 metabolism and drug pharmacokinetics remains incompletely understood. Clinicians must therefore exercise caution and adopt interdisciplinary collaboration to ensure safe implementation of integrative therapies.

Looking forward, several research priorities emerge. First, large-scale randomized trials specifically focused on gastric cancer are needed to confirm the preliminary benefits of integrative care. Second, efforts should be directed toward the development of standardized TCM protocols that are reproducible and compatible with conventional oncology practice. Third, mechanistic studies exploring immune regulation, oxidative stress pathways, and gut microbiota modulation will be crucial in elucidating the biological underpinnings of integrative therapies. Finally, health-economic evaluations are needed to determine whether integrative approaches can reduce overall healthcare costs by minimizing treatment interruptions, hospitalizations, and supportive care needs.

In summary, the current body of evidence suggests that integrative medicine has the potential to complement conventional radiotherapy and chemotherapy in gastric cancer. By reducing toxicity and supporting patient resilience, TCM-based interventions may enhance treatment adherence and outcomes. However, to translate these promising findings into routine clinical practice, more rigorous evidence, standardized protocols, and interdisciplinary collaboration are required.

CONCLUSION

Integrative medicine offers a valuable complement to conventional radiotherapy and chemotherapy in gastric cancer, particularly in reducing treatment-related toxicities and improving patient quality of life. Evidence suggests that herbal medicine, acupuncture, and dietary therapy can support treatment adherence and resilience, though current studies remain heterogeneous and often limited in scale. To translate these benefits into clinical practice, well-designed randomized trials and standardized protocols are urgently needed. Integrative oncology should be viewed not as an alternative, but as a supportive framework that strengthens the effectiveness and tolerability of modern gastric cancer treatment.

***Acknowlegments*:** The authors thank the staff of the Gastrointestinal Specialty Hospital, Shanghai General Hospital Jiuquan Hospital (People's Hospital of Jiuquan), for their support in providing access to literature and clinical insights that informed this review.

***Funding*:** This research received no external funding.

***Conflict of interest*:** The authors declare no conflicts of interest related to this work.

***Ethical considerations*:** This article is a narrative review and does not involve human participants or animal experiments; therefore, ethical approval was not required.

***Author contributions*:** R.X.: Literature search, drafting of manuscript. Y.M.: Conceptualization, critical revision, corresponding author responsibilities. T.Y.: Data interpretation, manuscript editing, and final approval of the version to be submitted.

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