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Original Article

Effect of Xiangpi Shengji ointment combined with nano-silver medical antibacterial dressing on wound healing of deep partial thickness burn

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Abstract: Background: Deep second-degree burn wounds lead to infection, significant inflammation, and delayed healing, with sole dressing therapies exhibiting limited efficacy. This study was to investigate the therapeutic effect of Xiangpi Shengji ointment combined with nano-silver medical antibacterial dressing to provide a clinical reference. Methods: A retrospective analysis was implemented on 115 patients with deep second-degree burns at the First Hospital of Hebei Medical University from February 2023 to August 2025. Patients were rolled into a treatment group (n=59, combination therapy) and a control group (n=56, nano-silver dressing alone). Inflammatory factors, growth factors, infection markers, healing indicators, pain and scar scores, and clinical efficacy were compared between the two groups employing *SPSS 20.0* for statistical analysis. Results: On days 7 and 14, IL-16 was lower in the treatment group than that in the control group, while growth factor EGF was higher from day 14 onward (both $P<0.05$). The treatment group had a lower bacterial positivity rate, lower incidence of fever, shorter eschar separation time, wound healing time, and hospital stay (all $P<0.05$). Visual Analogue Scale and VSS scores were greatly lower at all post-treatment time points in the treatment group (both $P<0.05$). The total effective rate was 91.53% in the treatment group, markedly surpassed 71.43% in the control group (all $P<0.05$). Conclusion: The combined regimen can alleviate inflammation, inhibit infection, promote repair, shorten healing time and hospital stay, improve pain and scar outcomes, and enhance therapeutic efficacy, demonstrating value for clinical application.

Keywords: Deep partial thickness burn, Xiangpi Shengji ointment, nano-silver medical antibacterial dressing, wound healing, antibacterial effect

Introduction

Among the types of acute trauma, burn is one of the important diseases that threaten human health because of its sudden onset and high injury intensity. Whether accidents in daily life, in industrial production, or a sudden fire and other disaster events, it may cause burns to varying degrees [1]. These injuries not only bring heavy resource consumption to the social and medical systems, but also have an irreversible impact on the physiological function and long-term quality of life of patients. According to statistics, 11 million people worldwide suffer from burns every year, and nearly 180,000 of them eventually die from burn-related complications [2]. In addition to burn depth and wound area, the occurrence and severity of complications also play a decisive role in the severity of burn. Burn patients may develop local and systemic complications. Locally, they are mainly manifested by wound deepening and hypertrophic scar formation, with high clinical incidence rates; systemically, they may be accompanied by serious problems such as hemodynamic abnormalities, sepsis and acute injury of multiple organs [3, 4]. As an important physical barrier of human body, skin integrity is destroyed after burns, greatly reducing the body's ability to resist external pathogens, which is prone to infection. Infection will not only prolong the healing process of wounds, but also aggravate the pain of patients and increase the complexity of clinical treatment [5, 6].

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At present, studies on burn treatment mainly focus on the optimization of fluid resuscitation scheme in shock stage, the improvement of infection prevention and control strategy, the improvement of nutritional support scheme and the innovation of surgical treatment technology. However, the exploration of the application of traditional Chinese medicine (TCM) in burn treatment is relatively limited. For patients with deep burns, the conventional clinical treatment is to remove necrotic tissue through surgery and carry out skin grafting in time to achieve wound closure [7]. However, some patients can't meet the indications for surgical treatment because of their own underlying diseases, poor physical tolerance, etc. Currently, local dressing change has become a key means to promote deep wound healing. As a serious burn type, deep second-degree burns involve deep skin tissues, often accompanied by obvious blisters, local erythema, and severe pain [8], with long treatment cycle and slow wound repair speed, which brings great trouble to patients. Therefore, it is of great practical significance to develop and verify the treatment scheme that can effectively accelerate the healing of such wounds and improve the clinical treatment level of burns.

Xiangpi Shengji ointment for promoting granulation, a commonly used external preparation of TCM, has multiple effects, such as moistening skin, promoting tissue regeneration, removing toxins, relieving pain, improving local blood circulation, dispelling blood stasis, and dredging meridians. It is widely used in various wound repair treatments, which can effectively speed up wound healing, relieve patients' pain, and reduce the infection risk. Previous studies showed that the intervention of deep burn wounds with TCM compound preparation won't cause obvious adverse reactions and can effectively relieve the pain symptoms of patients [9]. It is worth noting that ellagic acid (EA) extracted from tortoise shell component contained in this preparation has dual functions of hemostasis and anti-inflammation, and can also regulate the immune function of rats with deep second-degree burn. The research results of Deng et al. confirmed that EA can significantly promote the healing of burn wounds and improve the burn-induced immunosuppression by regulating the levels of inflammatory factors, immunoglobulin content, and T cell activity in burned rats [10]. The core component of nano-silver medical antibacterial dressing is nano-silver particles. Relying on its unique surface effect, small size effect, and macroscopic tunnel effect, the dressing has broad-spectrum antibacterial activity and can effectively inhibit the growth and reproduction of various pathogenic microorganisms [11]. A previous review on the treatment of deep second-degree burns with nano-silver dressing combined with recombinant human epidermal growth factor (EGF) pointed out that the combined therapy can obviously shorten the wound healing time, reduce the positive rate of bacteria detection and the incidence of adverse reactions, and improve the success rate of wound healing [12].

Based on the above research, the combined application of Xiangpi Shengji ointment and nano-silver medical antibacterial dressing provides a new idea for treating deep second-degree burn wounds. Xiangpi Shengji ointment can promote tissue regeneration and accelerate wound repair, while nano-silver medical antibacterial dressing can effectively block wound infection path and maintain clean wound environment. Their synergistic effects are expected to further accelerate the wound healing process, relieve the pain of patients and reduce the risk of infection. In view of this, the purpose of this study was to explore the effects and mechanism of Xiangpi Shengji ointment combined with nano-silver medical antibacterial dressing in deep second-degree burn wound healing, thereby providing better and safer treatment options for clinical burn treatment.

Materials and methods

Study subjects

Clinical data of 115 hospitalized patients with deep partial thickness burn who were admitted to the First Hospital of Hebei Medical University, between February 2023 and August 2025 were retrospectively analyzed. Patients were allocated according to the treatment received. 59 patients who were treated with Xiangpi Shengji ointment combined with nano-silver medical antibacterial dressing were assigned to the treatment group, and 56 patients who were treated with nano-silver medical antibacterial dressing only were assigned to the control group.

Inclusion criteria: a burn area less than 30% of the total body surface area (TBSA); partial wounds confirmed as deep partial thickness burn [13]; patients refusing surgical treatment and requesting dressing therapy.

Exclusion criteria: a burn area exceeding 30% of the TBSA; concomitant complications such as severe burn wound sepsis or heart failure; pre-existing diabetes mellitus or thrombotic disorders; failure to complete the full intervention.

The study was reviewed and approved by the Medical Ethics Committee of the First Hospital of Hebei Medical University.

Treatment methods

The research team consisted of 6 medical staff including 4 doctors and 2 nurses. The whole intervention process for each patient was carried out by a doctor and at least one nurse.

Upon admission, vital signs were monitored, fluid resuscitation was initiated, and tetanus antitoxin was routinely administered to all patients. Electrocardiography, complete blood count, urinalysis, chest CT, serum hepatic and renal function tests, and coagulation profiles were performed on every in-patient. Before each dressing change, the wound was cleansed with normal saline and disinfected with an antiseptic. Necrotic tissues and foreign bodies were gently excised using sterile forceps and surgical scissors. In cases with blisters, the blisters were incised with scissors, the blister roofs were preserved intact and repositioned over the wound bed, and the area was re-irrigated with normal saline. After residual antiseptic was rinsed off, the wound was gently dried with sterile gauze, and the prescribed medication was evenly applied with a sterile cotton swab. During dressing removal, the gauze was first moistened with normal saline to minimize trauma, and all manipulations were performed gently. At each visit, erythema, inflammation, and wound-healing progression were observed and documented.

Patients in the treatment group were managed with Xiangpi Shengji ointment combined with nano-silver medical antibacterial dressing. According to burn area, Xiangpi Shengji ointment (Z12020345, Tianjin Darentang pharmaceutical Jingwanhong Co., Ltd.) was applied to the wound surface at a thickness <2 cm. For wounds complicated by soft tissue defects, the amount of the applied agent was moderately adjusted upward as appropriate. A nano-silver medical antibacterial dressing (Specifications: 10 cm × 15 cm; National Medical Device Approval Number: 20163640190; Shenzhen Aijiete Medical Technology Co., Ltd.), trimmed to extend 1 cm beyond the wound margins, was then placed over the burn, and the area was covered with 3-4 layers of sterile gauze. Dressings were changed once daily and adjusted to once every two days upon observation of new tissue growth in the wound. Each treatment course lasted 14 days, with two consecutive courses administered. The control group was treated with a single nano-silver medical antibacterial dressing (same as that in the treatment group). The dressing was trimmed to extend approximately 1 cm beyond the wound edges according to the burn area, directly applied to cover the wound, and then secured with 3-4 layers of sterile gauze. The frequency of dressing changes and the treatment course were consistent with the treatment group: initially once daily, then adjusted to once every two days upon observation of new tissue growth in the wound. A 14-day period constituted one treatment course, with a total of two courses completed. All patients were instructed to follow a bland diet with avoidance of spicy and greasy foods, while those with severe conditions received adjunct antibiotic therapy.

Observation indicators

(1) Blood index detection: Fasting venous blood (5 mL) was collected from patients in the early morning before treatment and on days 7, 14 after treatment. The blood was immediately centrifuged, and the supernatant was stored at -80°C. The levels of interleukin-16 (IL-16) (Cat No. ZC-32411, Shanghai Zhuocai Biotechnology Co., Ltd.), interleukin-18 (IL-18) (Cat No. LX-102768, Shanghai Lianxiao Biotechnology Co., Ltd.), and C-reactive protein (CRP) (Cat No. MO-P31115R, Shanghai Meiao Biotechnology Co., Ltd.) were measured using the enzyme-linked immunosorbent assay (ELISA).

(2) Wound growth factor detection: On days 7, 14, 28 after treatment and 2 and 3 months of follow-up, the levels of epidermal growth factor (EGF) (Model GOY-0081E, Shanghai Guyan Industrial Co., Ltd.) and vascular endothelial

growth factor (VEGF) (Cat No. NL-2338, Shanghai Nalian Biotechnology Co., Ltd.) in the wound tissues were detected using the ELISA.

(3) Infection-related index monitoring: On days 7, 14, 28 after treatment and 2 and 3 months of follow-up, the wound exudate was collected to detect the bacterial positivity rate. The number of patients with a body temperature higher than 38.5°C on days 7, 14, 28 after treatment was recorded.

(4) Healing process indicators: The time of eschar shedding, wound healing time, and length of hospital stay were compared between the two groups.

(5) Scar and pain assessment: The scar condition was assessed using the Vancouver Scar Scale (VSS) [14], with scores given on four dimensions: melanin (M), vascularity (V), height (H), and pliability (P). The total score ranges from 0 to 15, with higher scores indicating more severe scarring. Pain intensity was assessed using the Visual Analogue Scale (VAS) [15], with a total score ranging from 0 to 10, where higher scores indicate more severe pain. Both were measured on days 7, 14, 28 after treatment and 2 and 3 months of follow-up.

(6) Efficacy evaluation: Cured: The wound is completely closed, with good skin appearance, no purulent discharge, and appearance close to normal skin. Markedly effective: The wound is closed by ≥3/4, with no purulent discharge and newly formed skin appearing bright red. Effective: The wound is closed by ≥1/4, with visible granulation tissue and the presence of scar tissue. Ineffective: The wound is closed by <1/4, with purulent discharge present or increased compared to that before treatment. The total effective rate = number of (cured + markedly effective + effective) cases/total number of enrolled cases × 100%.

Statistical methods

Statistical analysis was performed using *SPSS 20.0*. Measurement data conforming to a normal distribution were denoted as mean ± standard deviation ($\bar{x}$ ± sd), and intergroup comparisons were conducted using the independent samples t-test. Count data were recorded as number (percentage), and intergroup comparisons were performed using the chi-square test.

For data involving repeated measurements at multiple time points, such as inflammatory factors (IL-16, IL-18, CRP), wound growth factors (EGF, VEGF), pain score (VAS), and scar score (VSS), overall effects were analyzed using repeated measures analysis of variance (ANOVA). If the sphericity assumption was met (P>0.05), the repeated measures ANOVA were used; if the sphericity assumption was violated (P<0.05), the degrees of freedom were adjusted using the Greenhouse-Geisser correction. Pairwise comparisons within groups across different time points were performed using the LSD-t test, while comparisons between groups at the same time point were conducted using the independent samples t-test. P<0.05 was considered statistically significant.

Given the retrospective design of this study, propensity score matching was employed in subsequent data reanalysis to mitigate potential selection bias. With receipt of combination therapy as the dependent variable, covariates such as gender, age, burn type, and burn area, factors that may influence both treatment selection and outcomes, were included to construct a 1:1 matched comparison cohort with balanced baseline characteristics, thereby further validating the authenticity of intergroup efficacy differences.

Results

Comparison of general data

No significant differences in gender (χ^2=0.023, P=0.879), age (t=0.146, P=0.884), or burn type distribution (χ^2=0.785, P=0.855) were found between the two groups (P>0.05), indicating comparability (**Table 1**).

Comparison of levels of inflammatory factors

Negligible differences in IL-16, IL-18, or CRP levels were observed between the two groups before treatment (t=0.213, 0.175, 0.301; P=0.832, 0.862, 0.765, respectively). At 7 days post-treatment, the treatment group exhibited substantially lower levels of IL-16, IL-18, and CRP compared to the control group (t=10.892, 11.205, 13.564; all P<0.001). These significant reductions persisted in the treatment group at 14 days post-treatment (t=8.763, 7.982, 10.117; all P<0.001). Furthermore, the inflammatory factor levels in the treatment group at 7 days were comparable to those in

Table 1. Comparison of baseline characteristics

Characteristic	Treatment group (n=59)	Control group (n=56)	Statistic	*P*
Sex (n)	Male 30, Female 29	Male 28, Female 28	χ^2=0.023	0.879
Age (years)	36.63±11.72	36.93±11.49	t=0.146	0.884
Burn type (n)	Scald 15, Flame 12, Arc 18, Chemical 14	Scald 17, Flame 14, Arc 13, Chemical 12	χ^2=0.785	0.855

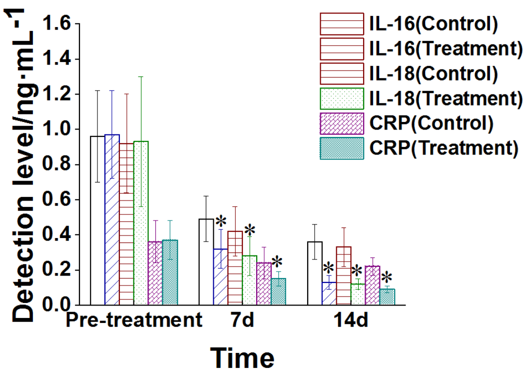

Figure 1. Comparison of the levels of inflammatory factors before and after remedy. Note: Compared to controls, **P*<0.05.

the control group at 14 days (all *P*>0.05) (**Figure 1**).

Comparison of wound growth factor levels

At 7 days post-treatment, negligible differences in EGF or VEGF levels were observed between the two groups (*t*=0.421, 0.385; *P*=0.676, 0.702, respectively). At 14 days post-treatment, the treatment group exhibited notably higher levels of EGF and VEGF compared to the control group (*t*=12.031, 13.145; both *P*<0.001). These significant elevations persisted in the treatment group at 28 days post-treatment (*t*=14.256, 15.012; both *P*<0.001). Furthermore, the treatment group maintained notably higher levels of EGF and VEGF than the control group at 2 and 3 months of follow-up (both *P*<0.001). Both groups demonstrated a progressive increase in growth factor levels over the intervention period, with all pairwise comparisons between different time points within each group being statistically significant (all *P*<0.05) (**Figure 2**).

Comparison of positive rates of wound bacterial culture

No significant difference in the positive rate of wound bacterial culture was observed between the two groups before treatment (χ^2=0.136, *P*=0.713). At 7 days post-treatment, the positive rate in the treatment group was substantially lower than that in the control group (χ^2=4.800, *P*=0.028). This significant reduction persisted in the treatment group at 14 days post-treatment (χ^2=4.320, *P*=0.038). Furthermore, the treatment group maintained a substantially lower positive rate compared to the control group at 28 days, 2 months, and 3 months post-treatment (χ^2=3.927, 3.529, and 3.267, respectively; all *P*<0.05) (**Figure 3**).

Comparison of fever rate

On day 7 of the intervention, the fever incidence in the treatment group was substantially lower than that in the control group (χ^2=3.927, *P*=0.048). On day 14, the fever incidence in the treatment group remained substantially lower than that in the control group (χ^2=3.267, *P*=0.071). On day 28, the treatment group continued to demonstrate a substantially lower fever incidence compared to the control group (χ^2=4.000, *P*=0.046) (**Figure 4**).

Comparison of wound healing

The wound eschar separation time and wound healing time in the treatment group was drastically shorter than that in the control group (*t*=4.215, *t*=5.362, both *P*<0.001) (**Figure 5**).

Comparison of length of hospital stay

The hospital stay of patients in the treatment group was drastically shorter than that in the control group (*t*=6.128, *P*<0.001) (**Figure 6**).

Comparison of scar score and pain score

No significant difference in wound VAS scores was observed between the two groups before treatment (*t*=0.258, *P*=0.797). The treatment group exhibited substantially lower VAS scores compared to the control group at 7 days, 14 days, 28 days, 2 months, and 3 months post-treatment (t=3.892, 4.561, 5.123, 5.789, and 6.345, respectively; all *P*<0.001) (**Figure 7A**). In

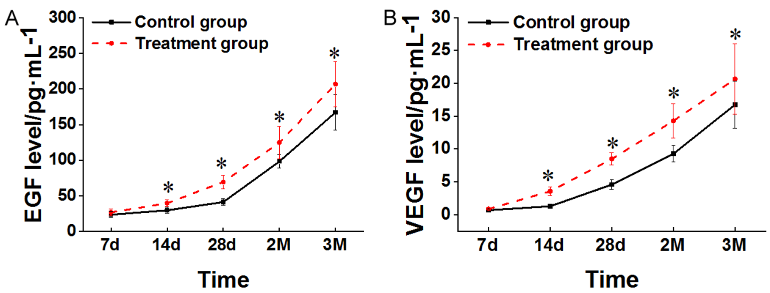

Figure 2. Comparison of growth factor levels in the wound tissues after remedy. A. EGF (Epidermal Growth Factor); B. VEGF (Vascular Endothelial Growth Factor). Note: *P<0.05 as compared to controls.

addition, negligible difference in wound VSS scores was observed between the two groups before treatment (t=0.312, P=0.756). The treatment group exhibited substantially lower VSS scores compared to the control group at 7 days, 14 days, 28 days, 2 months, and 3 months post-treatment (t=3.654, 4.218, 4.897, 5.432, 5.987, respectively; all P<0.001) (**Figure 7B**).

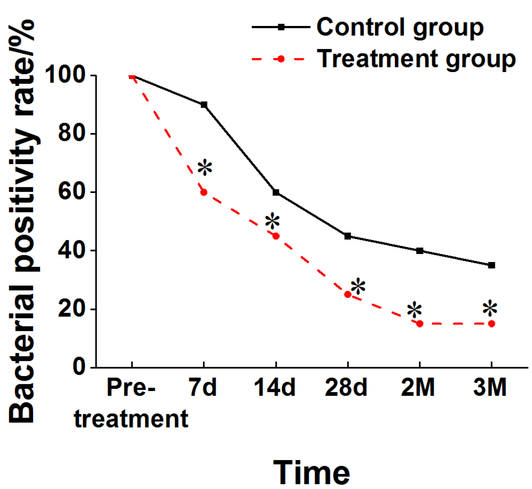

Figure 3. Comparison of positive rates of wound bacterial culture at various times. Note: Compared to controls, *P<0.05.

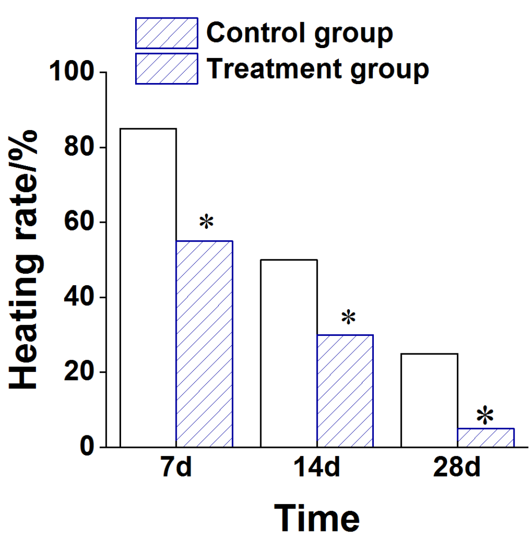

Figure 4. Comparison of fever rate at different time points. Note: Compared to controls, *P<0.05.

Comparison of treatment efficacy

In the treatment group (n=59), therapeutic outcomes were distributed as follows: 18 cured, 25 markedly effective, 11 effective, and 5 ineffective. In the control group (n=56), the outcomes were: 8 cured, 17 markedly effective, 15 effective, and 16 ineffective.

The total effective rate (cured + markedly effective + effective) was 91.53% (54/59) in the treatment group and 71.43% (40/56) in the control group. Statistical analysis showed that the total effective rate was notably higher in the treatment group than that in the control group (χ^2=6.735, P=0.009) (**Figure 8**).

Discussion

Deep second-degree burns cause serious damage to the epidermal and dermal of the skin, with partial tissue necrosis, which impairs the self-repair ability of wound. If the necrotic tissue is not removed in time, it will easily become a breeding medium of bacteria, which leads to systemic infection and even sepsis. The infected burn wound will form obvious scars, and even hinder local blood circulation, resulting in insufficient nutrition supply, which aggravate the difficulty of wound healing [16]. In clinic, deep second-degree burns are often accompanied by complications such as infection, hypertrophic scar, limited joint movement, tissue fibrosis and muscle atrophy. Therefore, exploring a treatment scheme that can reduce such complications and improve wound healing efficiency has become one of the core focuses.

For patients who are unable to tolerate surgical treatment, conservative treatment is the pri-

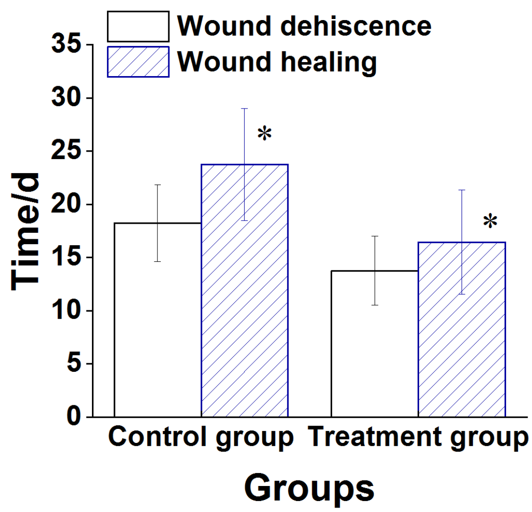

Figure 5. Comparison of wound healing. Note: Compared to controls, **P*<0.05.

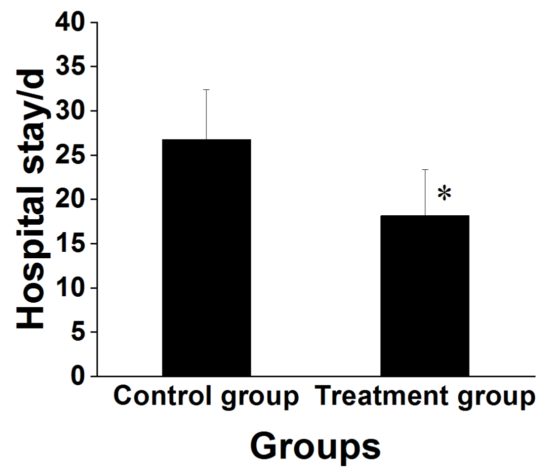

Figure 6. Comparison of length of hospital stay. Note: **P*<0.05 as compared to controls.

mary method, including wound debridement, local use of antibacterial dressing, application of warm and wet dressing to maintain a humid wound environment and avoid secondary injury [17]. In traditional antibacterial therapy, silver sulfadiazine can reduce the wound infection risk, reduce inflammatory reaction, and promote the proliferation and repair of wound epithelial cells by inhibiting the growth and reproduction of bacteria [18]. Its core effective component, silver ion, can inhibit a variety of bacteria, reduce the probability of infection, improve the wound microenvironment, and accelerate the repair process [19]. Studies confirmed that standardized fig frankincense herbal preparation and 1% silver sulfadiazine cream have positive effects on burn healing [20]. Additionally, TCM preparations for promoting granulation also show significant advantages in wound repair, such as promoting tissue regeneration and accelerating epithelial cell proliferation and differentiation. A study pointed out that Shengji Huayu recipe can stimulate granulation tissue synthesis and collagen regeneration, increase the number of vascular endothelial cells, and improve diabetic ulcers [21].

This study found that the combined application of Xiangpi Shengji ointment and nano-silver medical antibacterial dressing can exert antibacterial effect, reduce patients' inflammatory reaction, optimize wound microenvironment, and inhibit scar formation. Specifically, VSS and VAS scores in the treatment group were substantially lower than those in the control group, suggesting that the combined scheme has outstanding effects in relieving pain and inhibiting scar hyperplasia. In the process of wound healing, the scabbing time and overall healing time of the treatment group were drastically shorter than those of the control group, which reflected its role in promoting wound repair. The shorter hospitalization time further shows that the combined scheme can accelerate the rehabilitation process of patients and improve the clinical treatment efficiency. In terms of inflammatory factor regulation, the levels of IL-16, IL-18, and CRP in the treatment group decreased significantly, and these inflammatory factors after 7 days of treatment were similar to those in the control group after 14 days of treatment, which fully proved the effectiveness and timeliness of the combined treatment. However, the levels of EGF and VEGF in the treatment group increased significantly, which revealed that the combined scheme could accelerate wound healing by promoting the release of growth factors, which echoed the result of shortening wound healing time. In addition, the positive rate of wound bacterial culture in the treatment group was lower, further verifying the powerful antibacterial effect of the combined scheme.

Comparing the results of this study with other related studies, it was found that its core mechanism was highly consistent with the overall logic of external treatment of TCM. A meta-analysis of treating diabetic foot by external

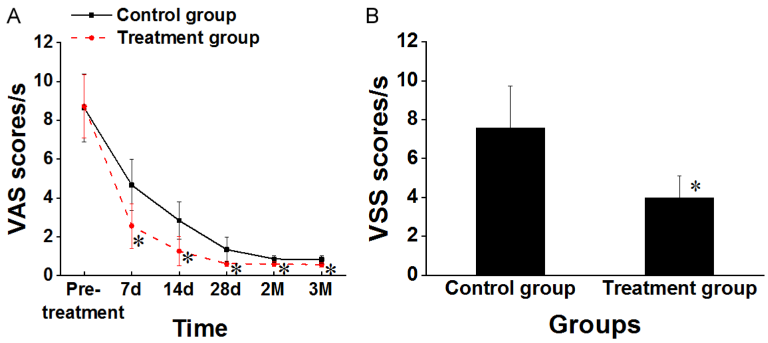

Figure 7. Comparison of scar score and pain score. A. VAS (Visual Analogue Scale) score; B. VSS (Vancouver Scar Scale) score). Note: Compared to controls, *$P<0.05$.

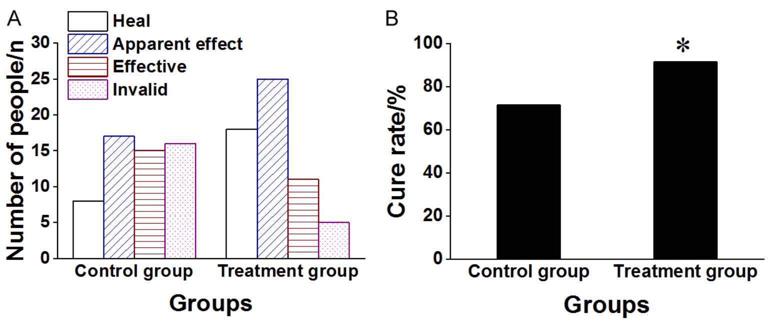

Figure 8. Comparison of intervention efficacy. A. The number of sick persons treated; B. The cure efficiency of sick persons. Note: Compared to controls, *$P<0.05$.

use of TCM showed that, the combination of basic treatment with star pomegranate, meta burn ointment, compound cortex phellodendri, and Shengji Yuhong ointment can significantly improve the total effective rate and the healing rate and shortened the healing time compared with simple basic treatment [22]. This study confirmed that topical TCM can improve the wound healing effect through local regulation and overall improvement, which is consistent with the mechanism of Xiangpi Shengji ointment promoting tissue regeneration through multi-component synergy in this study, and reflects the overall advantages of TCM in wound repair. The former is aimed at refractory wounds such as diabetic foot, while the latter focuses on deep second-degree burn wounds. Although the types of lesions are different, they all realize the regulation of wound microenvironment and the improvement of repair efficiency through the multi-target effect of Chinese medicine components.

Another study on Sanhuang powder provides evidence from the perspective of component activity [23]. This study found that certain herbal extracts in Sanhuang powder can reduce the level of inflammatory cytokines in HMEC-1 cells induced by LPS. In the porcine burn model utilized in this study, the experimental group containing the key component demonstrated significantly superior healing outcomes compared to the group without this component. This result revealed the key significance of the anti-inflammatory effect of the core components in the TCM compound on wound healing, which echoes with the dual prevention and control mechanism of Xiangpi Shengji ointment combined with nano-silver strengthening antibacterial activity and promoting repair. Both of them emphasize the creation of a good repair wound environment by regulating the inflammatory reaction and inhibiting the proliferation of harmful microorganisms.

From the mechanism of drug action, various components in Xiangpi Shengji Ointment play a synergistic role. Gypsum can clear away heat and reduce swelling, elephant skin can reduce ulcer toxicity, improve qi and blood circulation and coagulation function, calamine can help promote granulation to reduce swelling, detoxify and absorb moisture and remove necrotic tissue, and residual carbon can reduce wound exudation and promote wound healing. These four components work together to reduce pus secretion and remove toxins, creating favorable conditions for wound healing [24]. Angelica sinensis can promote blood circulation and remove blood stasis, and Radix Rehmanniae can stop bleeding and heal sores, and the whole prescription forms a synergistic effect of "promoting granulation, clearing away toxin and promoting blood circulation" [25]. The nano-silver dressing further strengthens the prevention and control of infection by virtue of its broad-spectrum antibacterial properties. It is worth noting that during the treatment, some patients' wound pus temporarily increased, which may be related to the accelerated dissolution of necrotic tissue. Although this process is characterized by increased local exudation, it can actually promote the release and absorption of effective components of drugs, accelerate scabbing and healing, and finally drastically shorten the healing time of the treatment group.

Current studies confirmed that silver nanoparticles mediated by extracts of TCM such as *Swertia chirata* and *Houttuynia cordata* (Sc-AgNPs, HCE-AgNPs) exhibit excellent regulatory effects against pathogens including *Escherichia coli* and methicillin-resistant *Staphylococcus aureus* (MRSA), as well as oxidative stress damage [26]. However, the specific pathways of the synergistic action between the active components of TCM and silver nanoparticles remain unclear, hindering their advancement in translational medicine. Research by Shereen et al. indicated [27] that Ag^+ released from silver nanoparticles can induce oxidative stress by disrupting bacterial membrane structures. Combined with the membrane-interfering properties of phenolic and flavonoid components in *Swertia chirata*, it is hypothesized that Sc-AgNPs may exert antibacterial effects through the pathway involving TCM components - Ag^+ - NF-κB. The active TCM components first bind to lipopolysaccharides on the bacterial membrane surface, increasing membrane permeability and promoting the entry of Ag^+ into the cell. Ag^+ further inhibits the phosphorylation of key proteins in the NF-κB pathway, reduces the release of inflammatory factors such as IL-6 and TNF-α, and simultaneously blocks the expression of bacterial stress repair-related genes. Subsequent verification of this pathway's mediating role can be achieved by detecting NF-κB/p65 phosphorylation levels via Western blot and analyzing inflammatory factor gene expression using qPCR.

Moorthy et al. [28] discovered that HCE-AgNPs derived from *Houttuynia cordata* can inhibit bacterial energy metabolism. Considering the regulatory effects of herbal components on enzymatic activity, it is hypothesized that HCE-AgNPs may enhance antibacterial efficacy through the herbal polyphenols-Ag^+-PI3K/Akt/mTOR pathway. Polyphenolic constituents such as chlorogenic acid in *Houttuynia cordata* synergize with Ag^+ to suppress the activation of the bacterial PI3K/Akt/mTOR pathway, reduce the expression of key glycolytic enzymes, and decrease ATP production. Concurrently, inhibition of this pathway can diminish the transcription of bacterial drug resistance genes, thereby enhancing susceptibility to MRSA. Subsequent investigations may involve detecting the expression of key pathway proteins (Akt, mTOR) and measuring ATP concentrations to elucidate the regulatory mechanism of this pathway.

It should be specifically noted that, although this study adjusted for key variables through univariate control, there are some limitations. First, it is difficult to fully control for potential confounding factors beyond gender, age, and burn type, such as patients' baseline nutritional status, concomitant medications, and differences in wound care details. Second, due to the nature of retrospective data collection, it is impossible to establish a definitive causal relationship between the interventions and outcome measures, which deviates somewhat from the core requirement of rigor in translational medicine. Therefore, caution is warranted when interpreting the findings. The association between the combined regimen and better efficacy should not be directly equated with causality, and the generalizability of the conclusions should be reasonably defined based on clinical context. To address these limitations, future research will be optimized in the following aspects. First, conducting multicenter, large-sample prospective randomized controlled trials with randomization and blinding to further control bias and rigorously validate the clinical efficacy of the combined use of Xiangpi Shengji Ointment and nano-silver medical antibacterial dressings. Second, incorporating propensity score matching in subsequent statistical analyses to reduce the impact of selection bias in retrospective data and enhance the reliability of the research conclusions by constructing a virtual control cohort.

Conclusion

To sum up, Xiangpi Shengji ointment combined with nano-silver medical antibacterial dressing has obvious advantages in the treatment of deep second-degree burn wounds. It improves the treatment effect by reducing inflammatory factors levels, promotes the release of growth factors, inhibits bacterial infection, relieves pain, shortens healing and hospitalization time, etc. Its mechanism of action not only conforms to the overall regulation characteristics of external use of TCM, but also integrates the infection prevention and control advantages of modern antibacterial dressing, which provides a reliable scheme choice for clinical conservative treatment of deep second-degree burn wounds. Besides, it also provides a new perspective for the treatment of refractory wounds with integrated traditional Chinese and western medicine.

Disclosure of conflict of interest

None.

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