Review Article

Surgery and Medicinal Plants: A review of important indigenous medicinal plants of Iran for burn wound healing

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Abstract

Surgical Science is one of the branches of medical science that deals with surgical and medicinal interventions, which can cure surgical wounds, cuts, burns and so on. The accelerated recovery process has always been a concern for surgeons and physicians. Standard local antibiotic drugs such as silver nitrate, mafenide acetate, sulfadiazine silver and AgNO3 are also used to treat wounds which are associated with some complications. Considering the fact that no effective herbal remedy has been introduced for wound healing, the purpose of this review is to investigate and identify indigenous Iranian herbs used for wound healing after surgery, especially burn wounds. In this systematic review paper, published articles in the period 1952 to 2017 with keywords of surgery, wound healing, burns, herbs, etc. from databases such as SID, MEDLIB, ProQuest, Magiran, Europe PubMed Central and Google Scholar. Abstract and title of all articles were studied and non-relevant articles were deleted and remaining articles were used for review. Based on the results of the study, Malva sylvestris, Camellia sinensis, Aloe vera, Cydonia oblonga, Scrophularia striata, Centella asiatica, Arnebia euchroma, Calendula officinalis and Hypericum perforatum are the most important herbal remedies for burn restoration. The following is an explanation of the most important herbal remedies for native burn wounds in Iran.

Keywords: Surgery; Wound; Burn; Medicinal plants; Iran

Introduction

Surgery is one of the branches of medicine that along with surgical and pharmacotherapeutic interventions can treat surgical wounds, cuts and burns, etc. The continuous development of new information in surgery has led progression of surgical treatments (1). Wound is an inevitable event in life. It can occur due to microbial infection, physical or chemical damages. Wound healing is commonly impaired by disturbance in the normal process of wound repair and treatment, and excess
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**Results**

Based on the results of this review the medicinal plants *i.e.* *Malva sylvestris*, *Camellia sinensis*, *Aloe vera*, *Cydonia oblonga*, *Scrophularia striata*, *Centella asiatica*, *Arnebia euchroma*, *Calendula officinalis* and *Hypericum perforatum* are effective in restoring burns. The following is an explanation of these medicinal plants for restoring burn wounds.

### *Malva sylvestris*

In a study conducted by Pirbalouti et al. (19), the extract of the *Malva sylvestris* caused an increase in connective tissues such as collagen, high levels of fibroblast cells, and a decrease in inflammatory cells in the wound area, and was as effective in healing wound as that of the control group. In a study by Barros et al. (20), the efficacy of treatment was evaluated based on reduction in burn wound area and histopathologic characteristics of *M. sylvestris* and the results showed increased collagen regeneration, increased fibroblast cells and reduced inflammatory cells in improving the wound healing process (20). Another study also showed considerable antioxidant properties of *M. sylvestris* which is due to the presence of polyphenols, vitamins C and A (21). In the study of Nasiri et al., the *M. sylvestris* was observed to effectively prevent leukemia, secretion, erythema and other complications due to burns (22).

### *Camellia sinensis*

The results of the study by Asadi et al. (23) on the *C. sinensis* (green tea) extract showed a significant reduction in the area of burn wound because of its antibacterial, antioxidant and anti-inflammatory properties. Increased collagen synthesis is also observed and it is due to the polyphenolic compounds called catechin in the leaf extract of green tea. The results of Fatemi et al. (24) showed that green tea extract has antioxidant and anti-inflammatory properties due to the presence of polyphenols and has a positive effect on accelerating the repair and contraction of the wound.

### *Aloe vera*

It was found that *A. vera* gel containing herbal anti-inflammatory agents and thromboxane inhibitors prevent vasoconstriction and improves wound repair process by exerting anti-inflammatory properties, boosting the immune system, producing positive effects on gram-negative and gram-positive bacteria and exerting antiviral effect. Due to these effects, the gel is a suitable dressing for burn wounds (25).
studies, A. vera has been used to inhibit thromboxane (a healing wound inhibitor), leading to progression of healing and reduction of wound inflammation. A. vera has been reported to be effective against a wide spectrum of bacteria such as Pseudomonas aeruginosa, Escherichia coli, Salmonella typhi, Streptococcus pyogenes and Staphylococcus aureus (26). The gel of this plant contains an anti-inflammatory agent called salicylate and inhibitors of formation of thromboxane (as a vasoconstrictive agent) as well as carboxypeptidase, which inhibits bradykinin as a pain-causing agent in the wound site. Antibacterial and antifungal effects have also been reported for the A. vera gel (27).

**Cydonia oblonga**

In the study of Alizadeh et al. (28) on skin burn infections due to S. aureus, the antimicrobial effect of Cydonia oblonga in the process of burn wound healing was demonstrated. Regarding the effect of C. oblonga ointment in improving the skin wounds in humans; it seems that the effect of this herb in reducing skin inflammation and improving burn wounds is mainly due to active ingredients in its mucilage (29). The results of microscopic and macroscopic evaluation of Tajedini et al. (30) showed that the extract of C. oblonga had a significant effect on the healing process of wound burns by increasing tissue proliferation, proliferating fibroblast cells and reducing edema and inflammation in the burn wound area. After C. oblonga treatment, the process of regenerating the epithelial cells is greater and the extent of the fibrotic reaction is greater, and edema and inflammation in the burn area are lower. The extract has antioxidant and anti-inflammatory properties and repairs and disinfects the wound (30).

**Scrophularia striata**

Studies have shown that S. striata and its compounds have effects on necrosis factors, tumorigen and interferon, which reduces edema and cell infiltration and reduces the proliferation of T lymphocytes (31). Another study found that the presence of phenylpropanoid glycosides inhibited the activity of macrophages thereby inhibiting the production of inflammatory chemical intermediates and ultimately reducing inflammation (32). The results of a study showed that the active ingredients of S. striata had a significant effect on the process of wound healing by increasing the angiogenesis and synthesis of collagen and reducing muscle involvement in comparison with other groups. Stimulation of fibroblast cell growth, the antioxidant and anti-inflammatory properties of S. striata confirm the effect of this plant on burn wound healing by stimulating collagen production and faster contraction of the wound, angiogenesis and vasodilation (33). In addition, antibacterial properties of phenolic acids are another reason for the effectiveness of the plant in healing skin wounds (34).

**Centella asiatica**

Centella asiatica at a low dose caused an increase in the levels of monocyte chemotactic protein 1 (MCP-1), vascular endothelial growth factor, and interleukin beta-1 in burn wounds. Increase in angiogenesis induced by vascular endothelial growth factor following increased expression of MCP-1 in keratinocytes and increased expression of interleukin beta-1 resulted in an increase in the process of burn wound healing in the group treated with the plant extract (35). In the study of Wu et al. (36), the effect of triterpenoid compounds including glycosides (madecassoside and asiaticosides) and madecassic acid and asiatic acid aglicans in C. asiatica extract increased the synthesis of collagens 1-3 of the fibroblast cells by increasing the synthesis of fibroblast growth factor, thereby causing an increase in the process of burn wound healing in the groups treated with the extract of the plant compared with the control group.

**Arnebia euchroma**

It has been established that A. euchroma is useful for improving skin burns and injuries (37). The study of Ogurtan et al. (38) on the healing of burn wounds in rabbits, showed that except for extremely severe burns, other cases completely healed by A. euchroma. The study of Nasiri et al. (39) showed that the effect of the A. euchroma ointment on burn wound healing effectively prevented the secondary complications of burn, including inflammation and wound secretion or infection, probably due to antibacterial properties of the plant. The results of Aliasl et al. (40) showed that A. euchroma has significant effects on the progression of epithelization, proliferation of fibroblast cells, the synthesis of collagen strands and angiogenesis in damaged tissue due to antibacterial and antimicrobial properties.

**Calendula officinalis**

Oral use of the C. officinalis extract improves the process of skin burn wound healing by strengthening the antioxidant defense mechanisms (41). The antioxidant mechanism, acute phase proteins and granulation in skin burns indicated an increase in hexosamine and hydroxyproline of collagen in the burn area. In addition acute-phase proteins including heptoglobin and orosomucoid which increase in burn injury were significantly reduced after treatment with this extract (42).

**Hypericum perforatum**

H. perforatum extract accelerated burn wound healing due to the antioxidant properties of tannin and its effect on increasing the proliferation of burn wound healing has been accelerated by TNF fibroblast cells and high secretion compared to
other groups and reduced the length of wound healing (43). This plant accelerated progression of the burn wound healing process by re-epithelization and increasing expression of vascular endothelial growth factor and transforming growth factor-β (44).

Discussion
Burns are a kind of damage to skin and the underlying tissues caused by heat, electricity, chemicals, friction, or radiation. Although large burns can lead to death, new treatments that have been invented since the 1960s have significantly reduced death from burn, especially in children and adolescents (45).

Variety of chemical compounds present in medicinal plants accelerate wound healing. The most important compounds of Arnebia euchroma are the combination of shikonin and alkannin (46). The Camellia sinensis contains caffeine, catechins, and flavonoids (47). The most important compounds of Scrophularia striata plants are iridoid glycosides, aucubin and catalpol (48). The Cynodia obunga contain mucilages, lipids, alcohols, resins and tannins (49). Among the compounds of Calendula officinalis flowers of the spring contains flavonoids, coumarins, saponins, volatile oils, carotenoids and amino acids (50). The chemical elements that make up the Centella asiatica include triterpenoids, glycosides and phenolic compounds (51).

Conclusion
The review has brought out several indigenous plants of Iran which are effective on the restoration process of the burn wounds. All these plants accelerate wound healing process due to substantial anti-inflammatory activity, increased epithelization, increased fibroblast cell proliferation, increased antioxidant activity, collagen synthesis and angiogenesis.

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Authors' contribution
MS and SA have done the collection of literature. All authors (MS, GB, AH and SA) prepared the content of the manuscript, provided inputs, and approved the final version.

Competing Interest
The authors declare that they have no competing interest.

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