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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.

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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

or deficient healing (2). One of the goals of surgery and medicine is wound healing in shorter time and with less complications (3). Wounds have different types and are caused for various reasons for example burn wounds, surgical wounds, cuts, wounds due to infectious agents, etc. Burn wound is one of the most important wounds. One of the major causes of death and disability in the world is due to burn and its complications. Burn is defined as tissue damage caused by factors such as heat, chemicals, electricity, sunlight and nuclear radiation. Most burns are caused by building fires, contact with boiling water, water vapor, flammable liquids and gases. Acceleration of burn healing has always been a concern for surgeons and doctors (4). Approximately 1,200,000 people per year in the United States experience burn requiring treatment (5). If burn is infected, the entire skin in the affected area may be lost, where a skin graft is needed; in these wounds, after the healing, permanent color changes appear in the skin (6). Repair of skin lesions is largely dependent on the restorative role of fibroblast cells and the regeneration of an extracellular environment that contains a high amount of collagen (7). Standard topical antibiotic drugs such as silver nitrate, mafenide acetate and silver sulfadiazine are also used to treat wounds yet they may cause certain complications (8,9). Currently one of the most common antibiotic drug used for burns is sulfadiazine cream which causes many side effects including lack of penetration into the wound, resistance to gram-negative microorganisms, delayed repair of small burn wounds due to decreased pigmentation and epithelization (10). Increased rate of wound healing has many desirable health and economic effects. The rate of wound infection decreases with increasing the rate of wound restoration, and in this way the overall wound healing process will be accelerated (11). From ancient time the preparation of the ointment has been considered for the relief of pain and accelerating recovery of burn wounds by the medical community.

In spite of the therapeutic effects of synthetic drugs, the tendency of people to use these drugs has been decreasing day by day due to their unwanted side effects, and on the other hand tendency to use drugs of natural origin has increased. Medicinal plants are a rich source of various compounds that can be effective in the treatment of infectious and noninfectious diseases, as well as acute and chronic diseases (12-18). Considering the fact that no effective herbal drug has been introduced for healing wounds, the purpose of this review is to investigate and report indigenous medicinal plants of Iran used for healing wounds after surgery especially burn wounds.

Methodology

In this systematic review paper, published articles were selected for 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.

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). In the

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 chemoattractant 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 *Cydonia oblonga* 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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