A review on role of medicinal plants on Effective wound healing

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Abstract
Wound healing is a natural body reaction leading to the restoration of structural and functional integrity of injured tissues but the rate of healing is slow and microbial infection is high. The increase in resistance towards antibiotics and other synthetic drugs currently used in wound healing activity made a new path to introduce alternative wound healing agents from natural origin. India has a rich tradition of plant-based knowledge on healthcare system. Several herbs and medicinal plants proved to be a wound healers were identified and formulated for treatment and management of wounds. Some of them are Aloe, Tulsi, Neem, Turmeric, Achiote… are mostly used in all kinds of wounds. The pharmacological validation on Indian medicinal plants is very limited and a large number of plants used in tribal and folklore with enormous potential has not been validated for their wound healing activity. The review therefore attempts to bridge the lacunae in the existing literature and offers immense scope for researchers engaged in validation of the traditional claims and development of safe and effective and globally accepted herbal drugs for cuts and wounds.

Key words: Wounds, wound healing, Antibiotics, Medicinal plants, Traditional claims.

INTRODUCTION
Wound may be defined as a disruption of the cellular and anatomic continuity of a tissue, with or without microbial infection and is produced due to any accident or cut with sharp edged things. It may be produced due to physical, chemical, thermal, microbial or immunological exploitation to the tissues.

Classification of wound
Wounds may be classified by several methods; their aetiology, location, type of injury or presenting symptoms, wound depth and tissue loss or clinical appearance of the wound. Wounds are classified as open and closed wound on the underlying cause of wound creation and acute and chronic wounds on the basis of physiology of wound healing.

Open wounds
In this case blood escapes the body and bleeding is clearly visible. It is further classified as incised wound, Laceration or tear wound, Abrasions or superficial wounds, Puncture wounds, Penetration wounds and gunshot wounds (Fig 1).

Closed wounds
In closed wounds blood escapes the circulatory system but remains in the body. It includes contusion or bruises, haematomas or blood tumour, crush injury etc.

Fig 1. Open wound model

Types of closed wounds
Contusions
These are a common type of sports injury, where a direct blunt trauma can damage the small blood vessels and capillaries, muscles and underlying tissue, as well the internal organs and, in some cases, bone. Contusions present as a painful bruise with reddish to bluish discoloration that spreads over the injured area of skin (Fig 2).

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Hematomas
These include any injury that damages the small blood vessels and capillaries resulting in blood collecting and pooling in a limited space. Hematomas typically present as a painful, spongy rubbery lump-like lesion. Hematomas can be small or large, deep inside the body or just under the skin; depending on the severity and site of the trauma.

Crush injuries
These are usually caused by an external high pressure force that squeezes part of the body between two surfaces. The degree of injury and pain can range from a minor bruise to a complete destruction of the crushed area of the body, depending on the site, size, duration and power of the trauma.

Acute wounds
Acute wound is a tissue injury that normally precedes through an orderly and timely reparative process those results insustained restoration of anatomic and functional integrity. Acute wounds are usually caused by cuts or surgical incisions and complete the wound healing process within the expected time frames.

Types of acute wounds
Surgical wounds
These are incisions made purposefully by a health care professional and are cut precisely, creating clean edges around the wound. Surgical wounds may be closed (with stitches, staples or adhesive) or left open to heal. The healing process for surgical wounds is classified by their potential for infection (Fig 3).

Clean
A clean surgical wound considered uncontaminated, likely made in an operating room or in a sterile procedure environment.

Contaminated
A surgical wound that was possibly contaminated with bacteria but is not yet infected.

Dirty
A surgical wound with a bacterial infection.

Traumatic wounds
These are injuries to the skin and underlying tissue caused by a force of some nature. They are classified by the object that caused the force.

Abrasion
A rough surface scrubs or rubs the skin, causing trauma and tearing the tissue, such as the knee scraping against asphalt.

Puncture
A pointed object pokes into the tissue, sometimes causing deep multi-layered trauma, such as the foot stepping on a nail.

Laceration
A sharp object delivers a hard blow to the tissue, resulting in a tear that can be jagged and irregular, such as bumping a leg on a table, causing a break in the skin.

Incision
A straight edged cut to the skin caused by a sharp blade such as cutting a finger with a knife.

Chronic wounds
Chronic wounds are wounds that have failed to progress through the normal stages of healing and therefore enter state of pathologic inflammation chronic wounds either require a prolonged time to heal or recur frequently (Fig 4).
Fig 4. chronic wound model

Types of chronic wounds

- **Infectious wounds**: Whether it is bacterial, fungal or viral, if the cause of the infection is not treated with the proper medication, the wound will not heal properly in the expected time.

- **Ischemic wounds**: Ischemia means that the wound area is not getting sufficient blood supply. Limiting the blood supply, and the oxygen and nutrients it carries, can delay the healing process or even prevent it.

- **Radiation poisoning wounds**: Regardless of whether the source of radiation was therapeutic (gamma rays or x-rays) or accidental (exposure to radioactive materials from nuclear plant accidents or radioactive devices that detonate), excessive exposure to ionizing radiating materials can weaken the immune system, cause damage to exposed tissue and delay the healing time of all wounds.

- **Surgical wounds**: Wounds caused by incisions made during surgery can progress to chronic wounds if the blood supply to the surgery area was accidentally damaged or if wound care was inadequate. Both can delay the healing time of a wound.

Wound healing can be defined as a complex dynamic process that results in the restoration of anatomic continuity and function. It is a finely orchestrated and overlapping sequence of events involving –control of infection, resolution of functional connective matrix, contraction, resurfacing, differentiation and remodelling. It is one of the natural phenomenon by which body itself overcome the damaged to the tissue but the rate of healing is very slow and chance of microbial infection is high. This creates demand of a substance that speeds up the rate of healing.

The concept of developing drugs from plants used in indigenous medical system is much older, while in some cases direct links between a local and biomedical use exists, in other cases the relationship is much more complex. Wounds and particularly chronic wounds are major concerns for the patient and clinician alike; chronic wounds affect a large number of patients and seriously reduce their quality of life. Current estimates indicate that nearly 6 million people suffer from chronic wounds worldwide. There are very few Indian studies on the epidemiology of chronic wounds. The prevalence of chronic wounds in the community was reported as 4.5 per 1000 population whereas that of acute wounds was nearly doubled at 10.5 per 1000 population. India has a rich tradition of plant-based knowledge on healthcare. A large number of plants/plant extracts/decotions or pastes are equally used by tribal and folklore traditions in India for treatment of cuts, wounds, and burns.

Many Ayurvedic herbal plants have a very important role in the process of wound healing. Plants are more potent healers because they promote the repair mechanisms in the natural way. The healing process can be physically monitored by assessing the rate of contraction of the wound.

**Pathology of wound**

Wound healing occupies an important field of research in modern biomedical sciences. The detailed pathophysiology of wounds is better understood following the establishment of the theory of a cell signal cascade system involved in the formation of new tissues repairing the wound. Modern biomedical scientists are now trying to develop suitable wound healing drug(s), corroborating the activity with cell signal triggering properties. According to the Ayurveda, Vrana (wounds or ulcers) is the discontinuation of lining membrane that after healing leaves a scar for life, closely resembling the modern definition. Similarly, inflammation is considered to be an early phase in the pathogenesis of wounds termed Vranashotha.

Different types of wounds as mentioned in Ayurveda may be endogenous in origin due to a defect in human functional units, such as Vata (nerve impulses), Pitta (enzymes and hormones), and Kapha (body fluids), or exogenous due to trauma, such as Chinna (cut wound), Bhinna (perforated wound), Kshata (punctured wound), Picchita (contusion), and Ghrista (abrasion wound).

In modern medicine, it is understood that there are certain essential polypeptides of the low
concentration (10−9 to 10−11 M) present in animal serum that control cell proliferation. These are called growth factors. Growth factors act by autocrine-, paracrine-, and endocrine-signalling systems. There are several growth factors, which help in the healing of wounds in different ways. Platelet-derived growth factor is responsible for stimulation of connective tissue proliferation, epidermal growth factor mainly stimulates cutaneous tissue proliferation, and fibroblast growth factor stimulates many cell types with special references to fibroblast cells. Transforming growth factor β, on the other hand, inhibits excess growth of some cell types. However, a recent study reveals that some of these growth factors may have serious untoward effects such as carcinogenesis.Classical management of wounds according to Sushruta Samhita follows 60 therapeutic steps, starting with an aseptic dressing of the affected part and ending with the rehabilitation of the normal structure and function. These therapeutic measures were aimed not only to accelerate the healing process but also to maintain the quality and aesthetics of the healing.

Phases of wound healing

Haemostasis
Haemostasis is the human body’s response to blood vessel injury and bleeding. It involves a coordinated effort between platelets and numerous blood clotting proteins (or factors), resulting in the formation of a blood clot and subsequent stopping of the bleed. It takes place by three steps mainly. They are:

Inflammation
During this phase, damaged and dead cells are cleared out, along with bacteria and other pathogens or debris. This happens through the process of phagocytosis, where white blood cells “eat” debris by engulfing it. Platelet-derived growth factors are released into the wound that cause the migration and division of cells during the proliferative phase and the presence of necrotic tissue, foreign material and bacteria result in the abnormal production of metallo proteases which alter the balance of inflammation and impair the function of cytokines.

Epithelialisation
It is also called migration refers to the basal cell proliferation and epithelial migration in the fibrin bridge work inside in the clot. It continues until individual cells are surrounded by cells of similar type. In a clean surgical wound, the epithelial cells migrate downward to meet deep into the dermis. Migration ceases when the layer is rejuvenated, this is normally within 48 hours of surgery. The superficial layer creates a barrier to bacteria and other foreign bodies. However, it is very thin, easily traumatized, and gives little tensile strength.

Fibroplasia
Fibroplasia consists of fibroblast proliferation, accumulation of ground substance and collagen production. These are transformed from local mesenchymal cells, are usually present in the wound within 24 hrs, and predominate by the 10th prospective day. They attach to the fibrin matrix of the clot, multiply, and produce glycoprotein and mucopolysaccharides, which make up to the ground tissue.

Maturation
The main elements of maturation include collagen cross linking, collagen remodelling, and wound contraction. Five types of collagen has been identified, types I to III predominate in the skin and
aponeurotic layers. The tensile strength of the wound is directly proportional to the amount of collagen, as disorganised collagen is degraded and reformed, crosslinks are formed that enhance tensile strength.

Maximum strength depends on the interconnection of the collagen subunits. Approximately 80% of the original strength of the tissue is obtained by 6 weeks after surgery or wound taken place, but the diameter and morphology of collagen fibres don’t have the appearance of normal skin until 180 days. Rest and immobility are important during the immediate postoperative period for the successful healing to occur. However, some physical activity is essential during the maturation phase because the light tension increases tensile strength by remodelling, which may continue for many years.

**Tensile strength**
The tensile strength of a wound is the measurement of its load capacity per unit area. The bursting strength of a wound is the force required to break a wound regardless of its dimension. It varies with the skin thickness. The peak tensile strength of a wound occurs approximately 80% of the injury. A healed wound reaches approximately 80% of the tensile strength of unwounded skin.

**Impaired wound healing**
There is usually not a single primary factor that contributes to impaired wound healing. There are multiple smaller contributing issues that can disrupt the process.

**Commonly used natural products as wound healers**
India has a rich tradition of plant-based knowledge on healthcare. A large number of plants/plant extract/decoctions or pastes are equally used by tribal and folklore traditions in India for treatment of cuts, wounds, and burns. Many Ayurvedic herbal plants have a very important role in the process of wound healing. Plants are more potent healers because they promote the repair mechanisms in the natural way. The healing process can be physically monitored by assessing the rate of contraction of the wound.

Some of the natural products are:

**Aloe Vera**
*Aloe Vera* commonly known as Kumari is a perennial herb belonging to liliaceae family. Today Aloe Vera gel is an active ingredient in hundreds of skin lotions, sun blocks and Cosmetics (Grindlay *et al.*, 1986). *Aloe Vera* is an excellent remedy for minor burns, cuts and sunburns. Both juice and aqueous extract from the leaves shows significant healing properties. It is also reported that it not only speeds up healing but also prevents injured surface from getting infected (Chitra *et al.*, 1998). Beside wound healing effect, it is reported to have ulcer healing property (when taken internally) and protective action on skin (Fig 6).

**Fig 6. Aloe Vera**

**Centella asiatica**
*Centella asiatica* is a small trailing herb bearing white to reddish flowers which normally grows widely in the wet places. Commonly it is known as Brahmi. Clinical studies of the formulation (ointment, cream & gels) of aqueous extracts of *Centella asiatica* reports that, when it is applied topically thrice daily for 24 days on open wound site. The treated wound epithelized faster and the rate of wound contraction was higher as compared to control wound (Fig 7).

**Fig 7. Centella asiatica**

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**Nelumban ucifera**
*Nelumban ucifera* belonging to family Nymphacaceae is called as Kamal in Hindi and Lotus in English. *Nelumban ucifera* is very common among natural and traditional healers. The rhizomes and leaves are dried and burnt to produce ash which acts as a wound healer. But now it is reported that the methonolic extract of rhizomes of
**Nelumban ucifera** in the formulation of ointment is effective in different types of wound models (Fig 8).

**Fig 8. Nelumban ucifera**

![Image of Nelumban ucifera](image1.png)

**Tulsi**

**Fig 9. Tulsi**

![Image of Tulsi](image2.png)

This extract is derived from the plant of *Ocimum sanctum* belonging to family Labiatae. *Ocimum sanctum* is used for malarial fevers, gastric disorders and other cutaneous diseases. The main chemical constituent of Tulsi shows wound healing properties (Fig 9).

**Neem**

**Fig. No. 10 Neem**

![Image of Neem](image3.png)

Alcoholic extract of neem is useful in eczema, ringworm and scabies. Neem leaf extracts and oil from seeds has proven anti-microbial effect. This keeps any wound or lesion free from secondary infections by microorganisms. Clinical studies have also revealed that neem inhibits inflammation as effectively as cortisone acetate; this effect further accelerates wound healing. Neem oil contains margosic acid, glycerides of fatty acids, butyric acid and trace valeric acid (Fig 10).

**Achiote (Bixa Orellana)**

**Fig 11. Achiote**

![Image of Achiote](image4.png)

Annatto is the non-edible fruit of the achiote plant. The plant is cultivated for the seeds of the annatto, which contain an anti-inflammatory, antioxidant compound called bixin. This is extracted to treat ulcers and other wounds because it inhibits inflammation and speeds up collagen maturation and wound contraction (Fig 11).

**Comfrey (Symphytum officinale)**

**Fig 12. Momfery**

![Image of Comfrey](image5.png)

Comfrey leaves contain active compounds thought to be rosmaric acid, choline, and allantoin that multiply collagen deposition and decrease cellular inflammation by a significant amount. While the herb should not be applied to open wounds - like cuts - or taken orally, a salve made of comfrey leaves is effective in speeding the healing of scar tissue, abrasions, and bruises (Fig 12).

**CONCLUSION**

Wound healing is a complicated mechanism. It involves many steps of skin and tissue reconstruction. The commercial wound healers are acting very effectively in wound healing process, but at the same time they evolve many side effects. To overcome the problems of regular wound healers, natural products are best choice. These are
collecting from plants sources, having fewer side effects, more effective and economical. It has proven that some of the natural products collecting from Neem, Turmeric etc. are well recognised as wound healers and antiseptics. These are using traditional methods of wound healing treatment. Thus these products are well in wound healing than the synthetic wound healers. So, selecting natural products as wound healers is better choice. Perhaps lots of researchers focusing in this way, but still much more work to be carried out to develop better natural wound healers.

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**CONFLICT OF INTERESET**

No conflict of interest.

**REFERENCE**