IJBPAS, July, 2025, 14(7): 3792-3802

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EXPLORING THE EFFICACY OF MEDICATIONS IN WOUND HEALING: A COMPREHENSIVE ANALYSIS

RAZA MOHD IMTIYAZ AA[1*], UROLAGIN D[2], PANDA S[3], KASHYAP A[4] AND DEEPIKA H L[5]

[1]Research scholar, Department of Pharmacology, R R College of Pharmacy, Bangalore- India

[2]HOD & Professor, Department of Pharmacology, R R College of Pharmacy, Bangalore- India

[3,4,5] Research scholar, Department of Pharmacology, R R College of Pharmacy, Bangalore- India

***Corresponding Author: Mr. Ansari Aashif Raza Mohd Imtiyaz: E Mail: ansariaashif251@gmail.com**

Received 20th March 2024; Revised 24th April 2024; Accepted 16th Aug. 2024; Available online 1st July 2025

https://doi.org/10.31032/IJBPAS/2025/14.7.9193

ABSTRACT

Wound repair is a multicellular tissue that is organized by development and muscle that characterizes local formation in the skin. This stem contains the simple functions of several types of cells, including keratinocytes, fibroblasts, endothelial cells, macrophages, and platelets. The repair, penetration, expansion, and division of these cells complete the circle through violent reactions, organization of new tissue, and finally closure. The exudative, proliferative, and extracellular stages of bone remodeling are events that result from a combination of cellular forms that include soluble mediators, blood cells, and parenchymal cells. Exudative shock occurs after injury and contributes to the improvement of tissue edema. Proliferative tissue tries to reduce the area of tissue damage by contracting myofibroblasts and fibroplasia. Forms of angiogenesis and re-epithelialization can still be seen in this tissue. To explain the mechanisms of dynamic wound healing, a comprehensive understanding of healing stem cells, polymers, and potential biologic compounds, extending to healing devices for wound management, is considered a key technique that physicians and technicians must understand. Biological agents are used to heal wounds. An advanced overview of the potential of biomaterials and their applications in wound healing and treatment, with the aim of providing a systematic system for the identification and application of bioactive polymers and Biomedical devices.

Keywords: Repair, Proliferative, epithelization, Wound-healing, penetration

INTRODUCTION

The injury occurs when the epidermal layer of the skin is broken and the dermis underneath is exposed. Depending on the depth of skin damage and the area of skin affected, the exposed tissue will extend from blood vessels to bone. When the epidermal skin surface is damaged, it is considered a shallow wound. (E.g., blood vessels, sweat organs, and hair follicles), it is called a partial-thickness lesion. In the case of full-thickness wounds, this occurs when the underlying layer of fat under the skin or deeper tissues eventually ruptures. Burns are common skin injuries that also pose serious challenges in treating rehabilitation and scar prediction. In fourth-degree burns, nerve endings are severed and there is loss of sensation in the wound area, and damage includes core tissues, muscles, ligaments, tendons, and even bones. In summary, after injury, as part of the normal repair process, hemostasis occurs. To pave the way for progressive wound healing, a comprehensive understanding of aspects of the recovery process, polymers, and potential Bioactive compounds, in addition to existing medical devices for wound management, are considered an essential prerequisite that physicians and technologists Surgeons need to know how to benefit from biomaterials that support wound healing. This study aims to provide an improved overview of the potential of biomaterials and their applications in wound delivery and treatment, and to provide an organized system to characterize and modify polymers, as well as bioactive compounds, which will be valuable in the production of biomedical devices. Sutures, in particular, are considered the most notorious surgical instruments, and their potential to promote wound healing is diminished. In our view, we must know the broader areas so that we can create underutilized techniques to address the challenges posed by persistent injuries **[1]**.

WOUND HEALING

Wound recuperating may be a particular natural handle related to the common phenomenon of development and tissue recovery. It isn't the reason of this paper to audit in detail the physiology of wound recuperating, but to depict as it were that which is significant to wound administration and the choice of wound dressings. The peruser is alluded to the natural and physiological writings and writing for nitty gritty logical expositions **[2-5]**. Wound recuperating advances through a arrangement of forbid and covering stages in which a assortment of cellular and network components act together to reestablish the judgment of harmed tissue and substitution of misplaced tissue **[6, 7]**. The wound mending handle has been checked on and depicted by Schultz14 as comprising five

covering stages that include complex biochemical and cellular forms. These are depicted as haemostasis, irritation, relocation, expansion and development stages. In reality, Cooper **[8]** has contended for extend ing the understanding of wounds past the cellular level to a atomic setting as well. He underlined the got to approach wound mending at different levels (cellular and atomic) to assist move forward wound treatment and administration. Wound recuperating details (dressings) and novel innovations created to date center on one or more of these viewpoints of the normal mending process **[9]** that are abridged briefly underneath.

Haemostasis and Inflammation

Haemostasis and Irritation Dying ordinarily happens when the skin is injured and serves to flush out microscopic organisms and/or antigens from the wound. In expansion, dying actuates haemostasis which is started by exudate components such as clotting components. Fibrinogen within the exudate inspires the clotting instrument coming about in coagulation of the exudates (blood without cells and platelets) and, along side the arrangement of a fibrin network, produces a clot within the wound causing dying to halt. The clot dries to create a scab and gives quality and back to the harmed tissue. Haemostasis subsequently, plays a defensive part as well as contributing to fruitful wound healing **[10]**. The incendiary stage happens nearly at the same time with haemostasis, now and then from inside some minutes of damage to 24 h and lasts for approximately 3 days. It includes both cellular and vascular responses. The discharge of protein-rich exudate into the wound causes vasodilation through discharge of histamine and serotonin, permits phagocytes to enter the wound and immerse dead cells (necrotic tissue). Necrotic tissue which is difficult is condensed by enzymatic activity to deliver a yellowish coloured mass portrayed as sloughy. Platelets freed from harmed blood vessels become activated as they come into contact with develop collagen and frame totals as portion of the clotting mechanism.

Relocation

The movement stage includes the development of epithelial cells and fibroblasts to the harmed region to supplant harmed and misplaced tissue. These cells regenerate from the edges, quickly developing over the wound beneath the dried scab (clot) went with by epithelial thickening.

Proliferation

The proliferative stage happens nearly at the same time or fair after the migration stage (Day 3 onwards) and basal cell expansion, which lasts for between 2 and 3 days. Granulation tissue is shaped by the in-growth of capillaries and lymphatic vessels into the wound and collagen is incorporated

by fibroblasts giving the skin quality and shape. By the fifth day, maximum arrangement of blood vessels and granulation tissue has happened. Advance epithelial thickening takes put until collagen bridges the wound. The fibroblast multiplication and collagen amalgamation proceed for up to 2 weeks by which time blood vessels decrease and oedema retreats.

Development or Maturation

This stage (too called the 'remodelling phase') includes the arrangement of cellular connective tissue and fortifying of the modern epithelium which decides the nature of the final scar. Cellular granular tissue is changed to an acellular mass from a few months up to around 2 years. the appearance of wounds in connection to the stages of wound mending. These portrayals relate not as it were to diverse sorts of wounds but also to the different stages through which a single wound may pass because it heals **[11, 12]**.

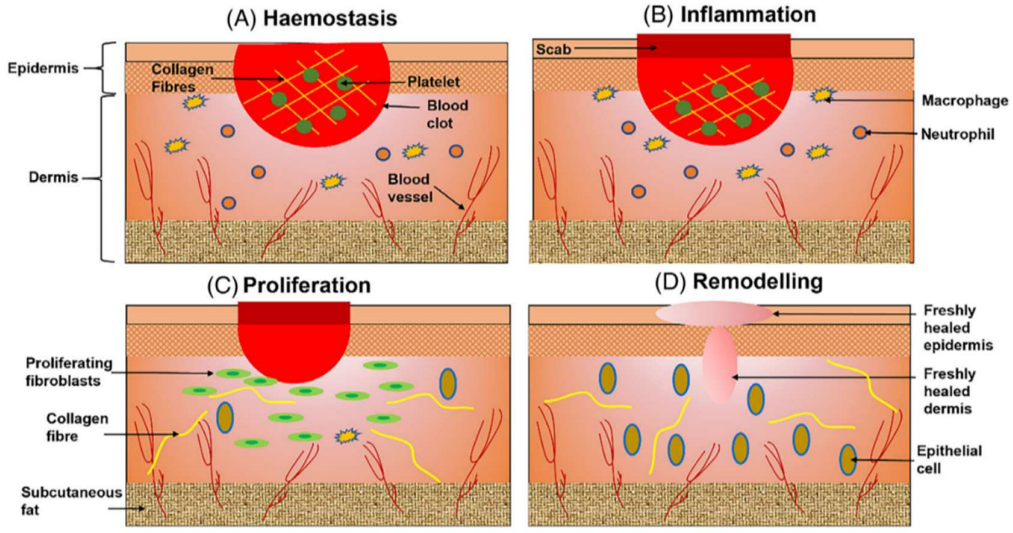

Figure 1: Schematic representation of the cutaneous wound healing. (A) Haemostasis. A wound causes blood clot formation. (B) Inflammation. Recruitment of macrophages and neutrophils. (C) Proliferation. Fibroblast proliferation induces epithelial cell generation. (D) Remodeling. Wound closure

Wound Healing Activity Of Different Plants & Their Chemical Constituents

S. No.	Botanical Name/ Common Name/ family	Chemical constituent	Use
1.	*AllumCepa Linn. (Liliaceae)*	kampferol, β-sitosterol, ferulic acid, myritic acid, Prostaglandins.	Wound Healing, Antioxidant, anti-hypertensive, anti-thrombotic, hypoglycaemic & hyperlipidemic Activities (S.A. Dahanukar 2000 *et al*).
2.	*Argemone mexicana L. (Papaveraceae), Kakbhilai*	Berberine, protopine, allocryptopine	Wound Healing, Antifungal, skin diseases, leprosy, and inflammations, (Das and Murthy, 2011).
3.	*Ocimum gratissimum 'Ran-tulas'. (Lamiaceae)*	Eugenol, methyl Eugenol, Ellagic corrosive, Geranyl acetic acid derivation,	Skin illnesses, Wound Mending, anti-fungal, joint joint torment. Anti-bacterial, neurological, and rheumatic illnesses. (Khare, 2007; 2009; Jain, 2012).

		Linalyl acetic acid derivation, and Verbenone.	
4.	***Curcuma longa Haladi rhizomes (Zingiberaceae)***	**Curcuminoids, (bisdemethoxycurcumin in Curcumin and desmethoxycurcumin)**	**Wound Healing, Anti Inflammatory, Anti-Ulcer Activity, (Wang, X.; Shen, K.; *et al* 2020).**
5.	***Catharanthus roseus (Vinca rosea) Apocynaceae***	**Vincristine, vinblastine.**	**wound Healing, Anti-Cancer, Anti Diabetics, Anti Inflammatory, Antimicrobial activities, etc (Rasinenis *et al* 2010)**
6.	***Radix Rehmanniae Orobanchaceae***	**Libosch. Herein, ursolic acid and oleanolic,**	**wound healing effects, (Lau *et al*. 2008).**
7.	***Aloe Vera Asphodelaceae (Liliaceae)***	**Aloin, Anthraquinone, Aloe-emodin, Myricetin, Isoorientin, Sinapinic acid**	**wound healing activity, Antidiabetic, anti-inflammatory, (Attah, M.O., Jacks,2016).**
8.	***Mimusops elengi Linn (Sapotaceae) commonly known as Bakul***	**Taraxerol, taraxerone, ursolic acid, betulinic acid, V-spinosterol, W-sitosterol, lup**	**Cardiotonic, anthelmintic astringen, Wound Healing, Anti-Microbial activity, Anti Inflammatory. Devipriya, C.S. Shyamladevi (1999).**
9.	***Tecomaria capensis (Bignoniaceae)***	**Benzoic Acid, cinnamic esters. 7-O- (p-methoxy) benzoyl tecomoside.**	**Wound Healing Activity, antioxidant, anti-microbial & free radical scavenging activities, NK Saini, M Singhal, B Srivastava (2012).**
10.	***Mussaenda frondosa. Linn (Rubiaceae)***	**Caryophyllene, hexadecenoic acid, quinic acid, 4-((1E)-3- Hydroxy-1-propenyl)- 2-methoxyphenol, Naphthalene, decahydro2-methoxy, 1, 2, 3-Benzenetriol.**	**Wound Recuperating, Antimicrobial, Diuretic action, Hepatoprotective movement, asthma & hack, ulcer, sickness, BD. Basu, K. Kirtikar (1998).**
11.	***Ageratum conyzoides (Asteraceae)***	**Ageratochromene (precedence II), 6-demethoxyageratochr omene (precedence I) and β-caryophyllene**	**Wound Healing Activity, allergic conditions KF.Chah, C.A. Eze, C..Emuelosi, (2006).**
12.	***Cinnamomum verum, Lauraceae***	**Cinnamaldehyde, Eugenol, and linalool, Eugenol, Cinnamyl acetate**	**Antioxidant, antiulcer, Antimicrobial, Antidiabetic, hypoglycaemic, hyperlipidemic and anti-inflammatory activity**

Curcumin: Curcumin could be a characteristic polyphenolic atom extricated from the Curcuma longa rhizome. This compound has anti-inflammatory, antibacterial, and antioxidant properties and particularly moves forward wound recuperation **[13]**. Curcumin influences different stages of the recuperating handle: granulation tissue arrangement, collagen statement, remodeling of tissues, and compression of wounds **[14]**. In any case, curcumin has amazingly moo water dissolvability, restricting its bioavailability and speaking to a major obstruction to restorative utilize. Hence, curcumin requires the improvement of appropriate carriers to convey the particle in a supported way at helpful levels to upgrade its bioavailability. A few of the carriers utilized are hydrogel, nanoparticles, micelles, hyaluronic/oleic corrosive **[15, 16]**, and may be a well-known biofilm inhibitor **[17]**.

N-Acetyl Cysteine:N-acetyl cysteine (NAC) could be a sulfhydryl compound and a forerunner within the arrangement of glutathione, which has noteworthy

antioxidant action. NAC plays a part in regulating the redox status in tissues, lessening oxidative stretch by changing the ROS delivered by macrophages, endothelial cells, and fibroblasts **[18, 19]**.

Chitosan: Chitosan could be a straight polysaccharide composed of D-glucosamine and N-acetyl-Dglucosamine determined from chitin (displayed on the exoskeleton of shellfish). This compound shows a few critical properties, such as biocompatibility and biodegradability **[20, 21]**. Chitosan acts as a hemostatic agent (through the official platelet surface), is antibacterial, and acts as a bioadhesive fabric (as nanofibers), which may be an exceptionally promising elective for wound dressings **[22-24]**.

Gallic acid: Gallic acid has a place to a gather of normal polyphenol compounds found in nearly all plants, counting natural products, takes off and wildflowers. It has picked up noteworthy consideration for its natural impacts, such as its antioxidant, anti-inflammatory and pain relieving properties **[25, 26]**.

Edaravone: Edaravone (3-methyl-1-phenyl-2-pyrazolin-5-one) could be a solid free radical forager that smothers the impact of oxidative stress. As an antioxidant, it has been utilized to treat intense cerebral dead tissue because this molecule encompasses a positive impact on the cerebral blood stream, smothers deferred neuronal passing, makes strides to center neurologic shortages, and appears altogether free radical rummaging properties. Be that as it may, its moo solidness and dissolvability have constrained its topical applications **[27, 28]**.

Crocin and Safranal: Crocin and Safranal (and its trailblazer picrocrocin) are carotenoid compounds appear in *Crocus sativus* L. (saffron crocus). Both crocin and safranal have a basic antioxidant and free radical scrounging activity. Considers have prescribed that these compounds might have anti-inflammatory and antitumoral properties **[29, 30]**.

Quercetin: Quercetin could be a flavonoid compound commonly found in vegetables and natural products. It has solid antioxidant and anti-inflammatory properties, which advocates its conceivable application in wound recuperation. In expansion, quercetin can repress both intense and unremitting stages of aggravation **[31, 32]**. In this way, quercetin may control two variables that delay the mending handle: oxidative stretch and irritation **[33-35]**.

Novel Formulations And Their Mechanisms Of Action For Wound Care [36]

Sr.No	Novel Formulations	Mechanisms of Action
	Silver Nanoparticles	1) Anti-microbial activity - Disruption of bacteria cell membrane integrity - Interaction with cellular components (e.g. DNA) - Release of silver ions 2) Anti-inflammatory activity - Inhibition of TNF-α pathway. - Promotion of IL-10, VEGF and IFN-γ expression 3) Initial TGF-β1 stimulation 4) Keratinocytes proliferation, migration and maturation (re-epithelialization) 5) Decrease in type I collagen 6) Fibroblasts differentiation into myofibroblasts (increase in α-SMA)
	Gold Nanoparticles	1) Anti-microbial activity - Formation of holes in the bacterial cell wall - Bacterial DNA binding 2) Anti-inflammatory activity - Decrease in the secretion of IL-6, IL-12 and TNF-α levels 3) Angiogenesis stimulation
	Zinc Oxide Nanoparticles	1) Anti-microbial activity - Disruption of bacteria cell membrane integrity - Generation of ROS - Reduction of cell surface hydrophobicity - Downregulation of oxidative stress-resistance genes transcription in bacteria 2) Keratinocyte proliferation (re-epithelialization)
	Topical Insulin	1) Proliferation, migration, and secretion by keratinocytes, endothelial cells and fibroblasts 2) Promotion of the epidermis attachment to the dermis 3) Increment in mobilization of SPCs due to an eNOS increment 4) Stimulation of angiogenesis by increasing VEGF 5) SDF-1α Increase
	IGF-1 Based Cream	1) Stimulation of ECM production 2) Keratinocytes and fibroblasts proliferation 3) Inhibition of apoptosis pathways 4) Attenuation of anti-inflammatory cytokine production 5) Increase in myofibroblast expression
	Insulin-coated Silver Nanoparticles	1) Anti-inflammatory activity - Decrease of IL-6 and TNF-α and increase in IL-10 levels 2) Higher human epidermal keratinocyte (HEKa) migration 3) Decrease in leukocyte infiltration 4) Faster deposition of collagens

CONCLUSION

The studies underscores the basic part of effective wound recuperating in keeping up tissue homeostasis and anticipating disease. It emphasizes the importance of understanding the fundamental instruments included in wound recuperating forms. Propels in wound mending inquire about in later progressions in wound mending investigate, counting the recognizable proof of key cellular and atomic players included in different stages of wound recuperating. It talks about promising helpful targets and imaginative approaches that have developed to upgrade wound mending results. It emphasizes the complex interaction between aggravation and the safe reaction in wound mending. It investigates the double part of aggravation, both as a essential component for starting the recuperating handle and as a potential impediment when dysregulated. The significance of tweaking the safe reaction to advance ideal wound mending is discussed.It addresses the interpretation of investigate discoveries into clinical hone and the challenges confronted in actualizing novel wound-healing procedures. It emphasizes the require for

intrigue collaboration and thorough clinical trials to approve the adequacy and security of developing treatments. The survey moreover talks about the significance of quiet instruction and adherence to wound care conventions for ideal recuperating results. The conclusion diagrams potential future headings for wound mending inquire about, counting the investigation of personalized pharmaceutical approaches, the integration of regenerative medication procedures, and the utilize of progressed imaging and detecting innovations for real-time wound observing. The survey energizes advance examination into the basic cellular and atomic components to reveal modern helpful targets and techniques.

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