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Role of Nano - Technology in Wound Healing and Dermatitis: A Review

Divya Kumari[1], Archana[2]

[1]Research Scholar at Saroj Institute of Technology and Management

[2]Assistant Professor at Saroj Institute of Technology and Management (Corresponding author)

Abstract: ***Skin infections and diseases are the most common type of lessons through which of large population suffers. Some wounds are considered as acute wounds, which are treated with general medication, but some wounds which comes under chronic conditions required some special kind of medication for their treatment. The existing therapies for the treatment of wound and infections proves as inadequate as well as less satisfactory. So, in this review we discuss about the various nanotechnology, including the use of liposome, noisome, polymeric nanoparticles etc. that can be useful for the prevention and treatment of various skin diseases and infections. The nanotechnology drug delivery act as targeted drug delivery so that the amount of drug required can be reduced as well as drug loss may be prevented, which leads to reduction in the side effects as well as adverse effect of the drug.***

Keywords: Skin, Barrier to skin, Anti - microbial agents, Various nanotechnologies for drug delivery

1. Introduction

Skin is the largest integumentary organ of the body (1) , functions as various types of barrier protection of internal organs like physical, chemical, immunological barrier etc (2) , as well as protection from various types of radiations (3) . Approximately 1 - 2 % of United States and European population is affected due to chronic wound (4) . Traditionally used therapies generally involve long lasting treatment and cost consuming along with greater degree of side effect (5) . With the impressive and innovative nano - technology development, various (nano - DDS) nanotechnology was developed and implemented at relevant areas for regeneration of skin along with treatment of wound (6) . In case of incorporation with bioactive molecule nano drug delivery system (nano - DDS prevent degradation of drug by enzymes involved, as well as enhances therapeutic effect of the drug (7) . The controlled and sustained drug release also prolongs to maintain the effective drug concentration, lowers the frequential. dose administration, which leads to cost decline and improve patient compliance. The motto of this review is to mainly introduce the current scenario of wound healing and its limitation, the promising potential of Nano - DDS for future application with focus on liposome nervosum polymeric nanoparticles.

1.1 Current Wound Treatment

The goal of management of wound is to protect ourselves from equity as well as chronic infection in house healing process of wound with reduced pain for patients. Currently, a various kind of strategies are available for the management of wound which mainly includes therapeutic agent application, autografts, and debridement.

1) **Therapeutic Agent Application –** Topical drug application mainly targets on promoting process of healing and prevention of infection. Topical therapeutic agent includes anti - microbial agents and growth factors which are important for the treatment of wound, as well as regeneration of skin (8) .
2) **Autografts** - the implementation of autografts is considered as gold standard for regeneration of skin. Autografts has excellent wound adhesion property, good cosmetic results and remarkable pain – relieving property (9)
3) **Debridement** - Its works by removing the nercrotic cells or tissue that are infected, which prolong the inflammatory phase and resist contraction of wound as well as re - epithelialization, promote a better wound bed for proper process of healing. Debridement including enzymatic method, mechanical, autolytic, surgical and involves further wound dressing application (10, 11) .

1.2 Wound Healing Process

Wound healing is a dynamic and complex physiological process, which involves growth factors, mediators, and extra cellular matrix compartments. It is categorised into three overlapping categories which includes inflammatory phase, proliferative and re - epithelialization phase (12) .

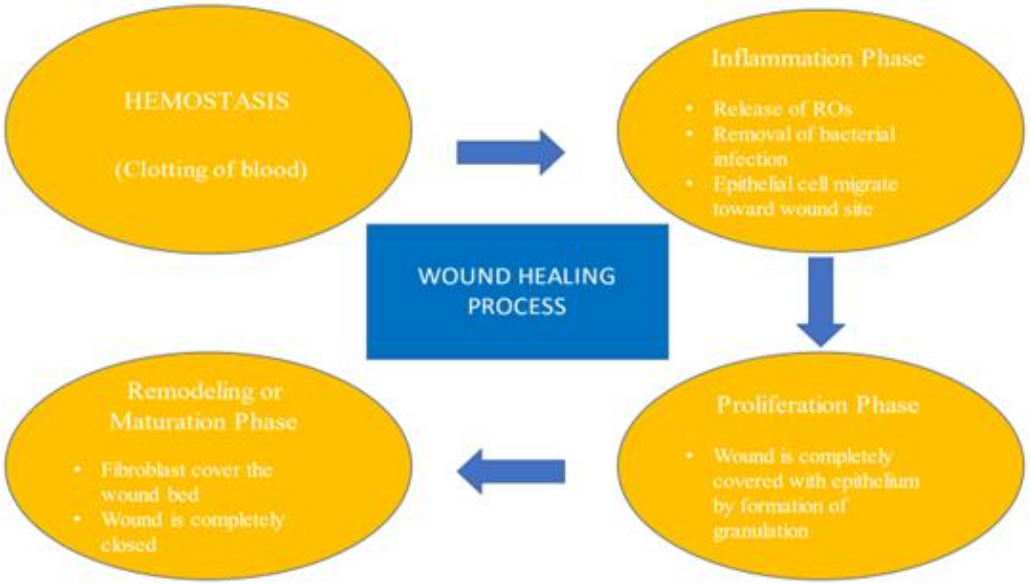

Figure 1: Showing process of wound healing

1.3 Most commonly used antimicrobial agents in wound treatment

Antimicrobial agents	Administration Route	Spectrum	Reference
Gentamicin	Topical/Systemic	Gram Positive bacteria	(13)
Vancomycin	Systemic	Gram - positive bacteria mainly MRSA	(14)
Amphotericin B	Topical/Systemic	Fungi	(15)
Neomycin	Topical/Systemic	Gram - positive aerobes and Aerobic Gram - negative bacilli	(16)
Ciprofloxacin	Systemic/Oral	(Gram - negative bacteria and Gram - positive bacteria) mainly Gram - negative bacilli	(17)
Silver sulfadiazine	Topical	Some fungal forms, most Gram - negative bacteria, and Gram - positive bacteria.	(18)
Polymyxin B	Systemic	Gram - negative bacteria.	(19)
Mupirocin	Topical	Some Gram - negative fora and Gram - positive bacteria especially MRSA.	(20)
Penicillin G	Systemic	Anaerobes, Non - β - lactamase - producing Gram - positive bacteria.	(21)

1.4 Recent research of nano - drug delivery system in wound treatment and skin regeneration

Nano drug delivery system plays an important role for the delivery of the drug to the desired organ of the body. The various nano - DDs techniques involved in the delivery of the drug may include - Liposomes, Solid Lipid Nanoparticles, Nano Structured Lipid Carriers, Nano - fibres, Nano - caffolds, Polymeric Nanoparticles, Inorganic nanoparticles, etc.

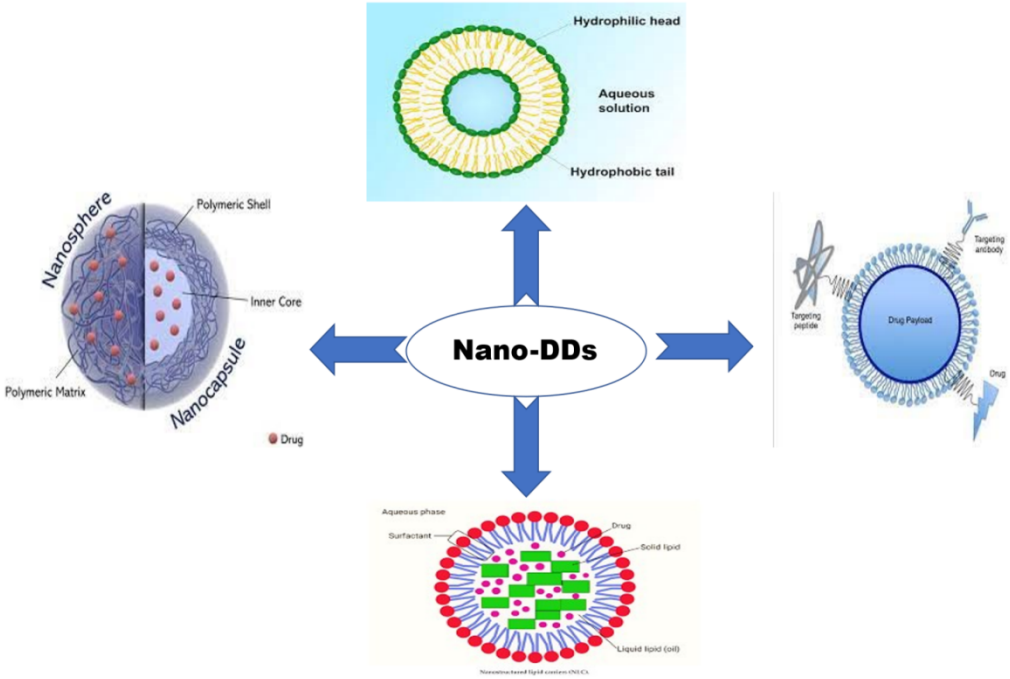

Figure 2: Nano - drug delivery systems in wound treatment and skin regeneration

Table 1: Recent research of nano - drug delivery system in wound treatment and skin regeneration

Formulation	Drug	Administration	Outcome	References
Liposomes	Madecassoside	Smearing wound once a day for 12 days	Improved permeation and distribution in skin, so as to express better wound healing effect.	(22)
Deformable liposomes	EGF, PDGF - A and IGF - 1	Once a day topical treatment for 18 days.	Enhanced chronic wound healing due to complex synergistic effect.	(23)
Deformable liposomes	Curcumin	Once a day topical treatment for 18 days	Reduces inflammatory process, promotes fibrosis and angiogenesis.	(24)
Nanoparticles	Silver	Topically with everyday dressing.	Enhanced cosmetic appearance and rapid healing via wound inflammation reduction.	(25)
Nanoparticles	Cerium oxide	Once a day topical treatment for 13 days	Oxidative stress reduces at site of wound and protects regenerative tissue.	(26)
Hydrogel loading nanoparticles	Silver Oxide	As locally injectables	Shows excellent antimicrobial activity and healing of burn wound	(27)
Microspheres/ scafold	Mupirocin	Topically applied, tied and covered	Sustained release of drug to 24 h, holds antimicrobial efficacy and exhibits good stability.	(28)
SLNs	EGF	Administered twice a week.	Enhanced closure of wounds, inflammatory phase restoration and re - epithelialization.	(29)

2. Conclusion

The chronic wound or ulcer treatment always remains a challenge because the currently available therapies mostly in - sufficient and less effective to provide favourable outcomes for healing of wound. The expansion of various recently developed nano drug delivery system bought a new insight for wound healing as well as regeneration of skin. The development of new carrier prolongs release of drugs, protects degradation of drug and improves retention of skin. Various combinations of nano - DDs provide synergistic route for the delivery of drug. These technologies prevent loss of drug and reduces the amount of dug required for the action hence reduces drug side effect to the functional body organs.

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