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The Insight of Body's Immune System, Inflammation and Damages in Wound Healing- The review

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Abstract: ***The injuries and its infections are the most painful form of trauma. Wound infections are the growth of microorganisms within the wound area. This infection causes the body's immune system, inflammation and damages the tissue within the wound site. Hence, there is an immense need to formulate new dressing materials for wound dressing application. To know more about new dressing material working it is need of time to study the mechanism of wound healing. Today's review focus on mechanism of wound healing, wound dressing, new dressing material and necessity of wound dressings.***
Keywords: Wound healing, dressing material

I. INTRODUCTION

Scientist all over the world is trying to find out the comfort zone to many kind. It may be food habits like probiotics for healthy life or protection to body skin as nutraceutical products [1, 3, 18-27]. Human skin is one of the important and protective organs of the body. Every year, several million people have affected skin injury of both acute and chronic nature [1, 2]. Worldwide 3, 00,000 people die every year in lower middle-income countries due to the chronic and burn injury [2]. The injuries and its infections are the most painful form of trauma. Wound infections are the growth of microorganisms within the wound area. This infection causes the body's immune system, inflammation and damages the tissue within the wound site. Therefore, it causes delay in wound healing and may come to life-threatening infections [3]. Thus, these bacterial wound infections are serious complications of wound management. Initially, microorganisms of an initial stage of the infected process involved gram-positive *Staphylococcus aureus* (*S. aureus*) and *Streptococcus pyogenes* (*S. pyogenes*) bacteria. Gram- negative bacteria such as *Escherichia coli* (*E. coli*) and *Pseudomonas aeruginosa* (*P. aeruginosa*) etc are involved in later stage of the infectious process that is when a chronic wound is formulated [4]. The main signs of wound infections include pus formation, spreading redness, increased pain or swelling, and fever for patients [5]. This problem can be overcome by protecting the wound from proper antibacterial wound dressing materials. Based on these, different types of dressings are available in the market. Most of these dressing materials are lacking one or the other reasons such as low level of mechanical properties, insufficient blood clotting ability, lower swelling ability, and inadequate antibacterial activity [6, 7]. Hence, there is an immense need to formulate new dressing materials for wound dressing application. The potential dressings offer the development of antibacterial dressings basedon biomaterials has become an important area of research because of the materials are of biological origin [8, 9]. According to the literature study, biomaterials based composite materials have been used as the best wound dressing materials [10]. The main aim of this chapter is to introduce the background of wound and healing process, wound healing model, the necessity of wound dressings, types of dressings and requirements of wound dressing materials. Further, it also focuses on the different types of biomaterials and the advantages of Silk fibroin (SF) and itscomposite films for wound dressing applications.

A. Wound and wound Healing Process

1) *Wound:* The wound is a type of injury to the body. It damages the underlying tissue with disruption in anatomical structure and function due to accidents, burns, surgery etc. [11]. The wounds are classified into several types according to the wound depth, tissue loss, and type of injury, location or clinical appearance of the wound. Wounds are classified into two types based on wounds with and without tissue damage. Wounds by tissue damage comprise second and third-degree burns wounds, diabetic foot ulcer etc. and wounds without tissue damage comprise first- degree burn wound and laceration etc [12]. According to the time of healing process, wounds are divided into two different types, first acute wound and second chronic wound. The acute wound heals normally 8-12 weeks, and the chronic wound heals very slowly beyond 12 weeks [13]. Wounds involving epidermis only is called a superficial wound whereas wound includes epidermis, deeper dermal layer, blood vessels etc. considered as partial thickness wounds. When wound consisted of epidermis, dermis and subcutaneous tissue may be referred to as full thickness wounds [14].

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2) *Wound Healing Process:* Wound healing progress is the multistep method for formation of cell growth and tissue regeneration. It is a typical biological process in human anatomy shows in figure 1.1. Regeneration of tissue is achieved by four phases including coagulation or haemostasis, inflammation, proliferation, and remodeling or maturation phase.

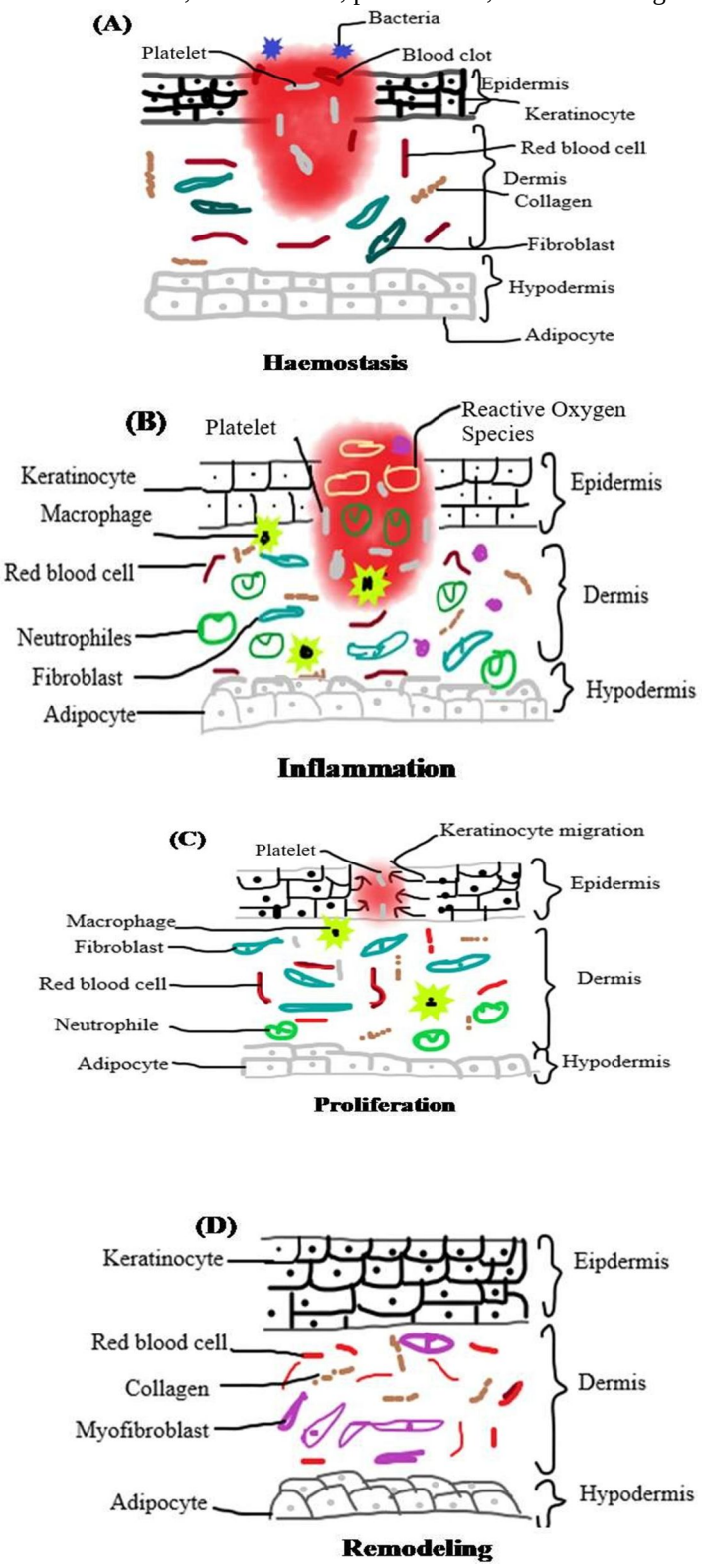


Figure 1.1 Schematic diagram of the wound healing process of **(A)** Haemostasis, **(B)** Inflammation, **(C)** Proliferation and **(D)** Remodeling.

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The first phase of hemostasis is within the first few minutes of injury, with the production of a fibrin clot in the blood to the injured site and vascular constriction [15, 16]. Surrounding wound tissue and blood clot release cytokines and growth factors such as interleukin-1 (IL-1) β, tumor necrosis factor (TNF)-α, transforming growth factor (TGF) β, platelet-derived growth factor (PDGF), basic fibroblast growth factor (bFGF), epidermal growth factor (EGF), which causesmigration of neutrophils (after 6 hrs), formation of initial matrix for early wound healing by fibrins, lymphocytes and histiocytes (after 12 hrs) .

During the inflammation phase, dead and damaged cells are cleared out, along with microorganisms and debris. In this stage, neutrophils appear in thewound area, followed by lymphocytes and monocytes which differentiate into macrophages. This takes place with the process of phagocytosis. In this process, the bacteria, foreign particles and injured tissues are removed. Neutrophils also create substances like proteases and reactive oxygen species (ROS) that cause some supplemental bystanders damage. In the wound healing process, macrophages show various roles. Macrophages release cytokines and cytokinesstimulate the inflammatory response by activating additional leukocytes. Macrophages are responsible for inducing apoptotic cells (including neutrophils) thus paving the way for the resolution of inflammation [16].

The proliferative phase is beginning from the 3rd day after the formation of wound and lasts for about 2 weeks thereafter. During the proliferative healingphase, fibroblast migration, deposition, collagen synthesis, angiogenesis and granulation tissue formation takes place in the wounded area. Fibroblasts generate collagen also glycosaminoglycans and proteoglycans that are major constituents of the extracellular matrix (ECM).

In the final remodeling phase, reversion of several newly created tissues occurs. Scar maturation is another major avenue in this phase of healing. Collagen remodeling and maturation continues for two years [14-16].

II. CONCLUSION

Wound healing is the natural process, but if it not start in time may result into many dreadful health condition. Minor accident to major surgery are closely related to the wound healing. Thus by knowing the mechanism of wound healing and new strategy to develop the new dressing material can save lives of many people with good and timely healing of the patient.

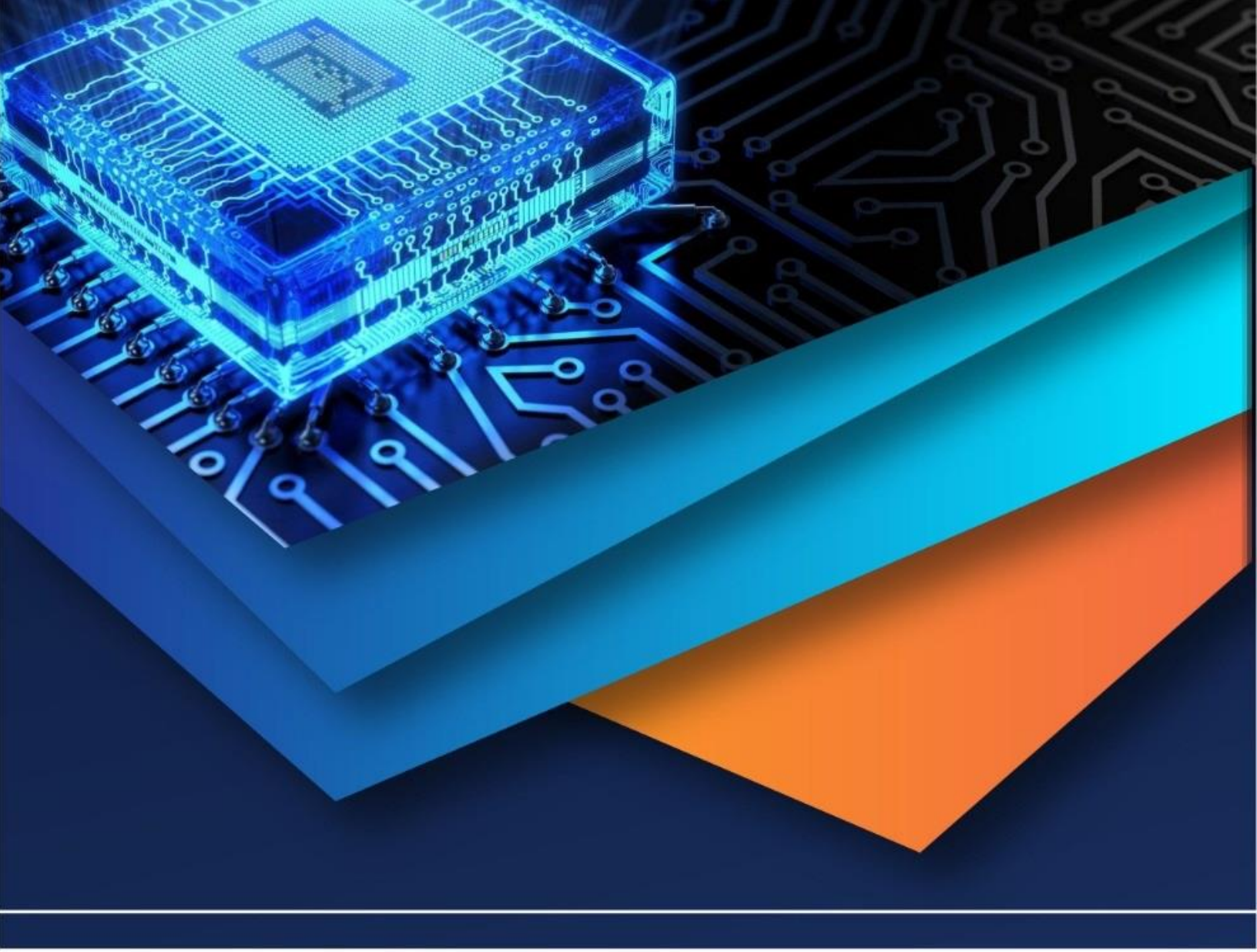
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