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Recombinant Human EGF in Wound Healing: 3D Computational Insights

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Abstract

A Growth Factor represents a naturally-occurring compound with the remarkable ability to incite cellular growth, proliferation, and differentiation. Typically manifesting as either a protein or a steroid hormone, these factors wield significant influence over an array of cellular activities. Their pivotal role lies in the regulation of diverse cellular processes, often serving as catalysts for cell specialization and maturation, a characteristic that distinguishes them from one another. For instance, bone morphogenic proteins are renowned for their capacity to ignite the differentiation of bone cells, whereas fibroblast growth factors and vascular endothelial growth factors are instrumental in orchestrating the differentiation of blood vessels, a phenomenon known as angiogenesis. These Growth Factors represent critical signaling molecules that orchestrate the intricate dance of cellular behavior, ensuring the proper functioning and development of biological systems. Their effects span a spectrum, from promoting cell division to guiding cells towards specific fates. In essence, they act as molecular messengers, relaying instructions that shape the landscape of cellular growth and development. The significance of Growth Factors extends beyond individual cells to encompass broader physiological processes, such as tissue repair, embryonic development, and immune response modulation. Their intricate interplay with other molecular players within the cellular milieu underscores their indispensability in maintaining the delicate balance of biological function. Thus, understanding the mechanisms underlying Growth Factor activity holds profound implications for fields ranging from regenerative medicine to cancer therapeutics, offering tantalizing avenues for intervention and manipulation in the pursuit of improved health outcomes.

Keywords: Wound healing, recombinant human epidermal growth factor, angiogenesis, cytokines

INTRODUCTION

The process of wound healing, also known as cicatrisation, intricately involves the self-repair mechanism of the skin or other organ tissues following injury. Upon skin injury, a series of complex biochemical events occur in a meticulously coordinated cascade to initiate the repair process. Remarkable progress has been achieved in comprehending the intricacies of wound healing. The sequence of cell types appearing in the wound and their roles has been delineated, alongside the elucidation of numerous growth factors and their functions [1]. These growth factors serve as vital intercellular signals that coordinate the intricate sequence of cellular activities including migration, division, differentiation, and protein synthesis during wound healing.

Beyond the essential roles of cell-cell and cell-matrix interactions, a diverse array of growth factors exerts control over all stages of the repair

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process. Numerous studies have underscored the advantageous effects of many such growth factors on the healing process, observed both in animal models and individuals afflicted with various wound healing disorders [2]. In this review, we aim to succinctly encapsulate the documented expression and functions of growth factors in the context of wound healing Advancements in our understanding of wound healing mechanisms have shed light on the pivotal role played by growth factors in orchestrating this intricate process. These signaling molecules regulate the sequential events crucial for efficient tissue repair, including inflammation resolution, re-epithelialization, granulation tissue formation, and tissue remodeling [3]. Notably, growth factors exert their effects through binding to specific cell surface receptors, triggering intracellular signaling pathways that modulate gene expression and cellular behavior. Furthermore, the dysregulation of growth factor signaling has been implicated in various pathological conditions characterized by impaired wound healing, such as chronic wounds and diabetic ulcers. Thus, elucidating the precise mechanisms underlying the actions of growth factors in wound healing holds immense therapeutic potential, offering avenues for the development of targeted interventions to enhance tissue repair and mitigate the burden of chronic wound-related morbidity [4].

MATERIALS AND METHODS

This is a case report of the use of innovative Recombinant Human Epidermal Growth Factor in a electrical burn wound. This study was conducted in a JIPMER, tertiary care hospital in 2024, a case of 8 years old male child with electrical burns (35%) (Figure 1). Informed written consent was taken from the patient. The patient had a raw area over the scalp following the electrical burn. After comprehensive investigation, including wound tissue culture and administration of suitable antibiotic therapy, the wound was diligently cleansed and dressed for a duration of two weeks [5]. However, despite these efforts, the wound did not exhibit any signs of healthy granulation tissue formation [6]. In an effort to facilitate healing, it was decided to initiate a trial treatment involving innovative Recombinant Human Epidermal Growth Factor. under all aseptic precautions, cleaning and draping was done and Recombinant Human Epidermal Growth Factor was applied over the raw area in scalp and a sterile dressing was applied. The Recombinant Human Epidermal Growth Factor was applied every time the dressing was changed (twice a week) (Figures 2 and 3). Weekly clinical examinations were conducted to assess the wound's progress.

RESULTS

The beneficial effect of exogenous growth factors in the treatment of wound repair as well as the identification of the in vitro activities of many growth factors and cytokines have implicated these proteins as key regulators of the wound healing process [7]. This hypothesis is strongly supported by the expression of multiple growth factors and their receptors in different cell types of healing skin wounds.

Figure 1. Showing condition of raw area electrical burn at the time of presentation.

Figure 2. Showing the application of recombinant human epidermal growth factor.

Figure 3. Showing the result of the application of recombinant human epidermal growth factor

Moreover, increased expression of growth factors post-injury is commonly noted, implying a necessity for elevated growth factor levels throughout the healing process. Additionally, numerous instances exist where aberrant expression of growth factors is linked to hindered wound healing or excessive scarring, underscoring the critical importance of precise temporal and spatial expression of these genes for proper repair.

DISCUSSION

The Epidermal Growth Factor (EGF) family encompasses various mitogens, including EGF itself, Transforming Growth Factor-alpha (TGF-α), Heparin-Binding EGF (HB-EGF), Amphiregulin, Epiregulin, Betacellulin, Neuregulin, the recently identified Epigen, as well as proteins encoded by Vaccinia virus and other poxviruses. Additionally, there are more distantly related proteins known as Neuregulin (also referred to as heregulins, neu differentiation factors, or NDF 14) that can also bind to certain members of the EGF receptor famil These growth factors initiate their actions by engaging with four unique high-affinity receptors: EGFR/ErbB1, HER2/ErbB2, HER3/ErbB3, and HER4/ErbB4.Upon binding with their ligands, these receptors form either homo- or heterodimers [8].

Notably, the overexpression of these receptors, particularly HER2, is frequently observed in various human cancers and is believed to play a contributory role in tumor formation. Moreover, both experimental and clinical investigations have revealed a beneficial impact of EGF, TGF-α, and HB-EGF on wound healing processes [9]. These results imply a notable involvement of these intrinsic growth factors in the mechanism of wound repair. Understanding the intricate interplay between members of the EGF family and their receptors sheds light on their multifaceted roles in both normal physiological processes and pathological conditions, such as cancer and wound healing [10].

The pathways of signaling triggered by these growth factors are crucial in overseeing cellular proliferation, differentiation, and survival. Moreover, dysregulation of these pathways can have profound implications for disease progression and treatment outcomes, highlighting the importance of continued research into the mechanisms underlying EGF family signaling in health and disease [11].

CONCLUSION

This investigation revealed that the administration of Recombinant Human Epidermal Growth Factor contributes to the process of wound healing, evidenced by the accelerated formation of granulation tissue observed in the wounds (see Figure 3). However, it's important to note that this study is limited by its reliance on a single case, which precludes definitive conclusions regarding the efficacy of Recombinant Human Epidermal Growth Factor in wound healing.

Large-scale randomized controlled trials are crucial to substantiate the robustness of evidence regarding its efficacy. While our findings offer promising insights into the potential role of Recombinant Human Epidermal Growth Factor in facilitating wound repair, they underscore the necessity for further rigorous investigation. Randomized controlled trials involving a diverse cohort of participants are essential to corroborate these preliminary observations and ascertain the consistency and magnitude of any therapeutic effects. Additionally, such trials would allow for the exploration of potential variations in treatment response across different wound types, severity levels, and patient demographics. Moreover, comprehensive trials can provide valuable insights into the optimal dosing regimens, administration routes, and potential adverse effects associated with Recombinant Human Epidermal Growth Factor therapy. By rigorously evaluating its safety and efficacy profile in diverse clinical settings, we can elucidate its potential as a therapeutic intervention for enhancing wound healing outcomes. In conclusion, while this study hints at the promising role of Recombinant Human Epidermal Growth Factor in wound healing, it serves as a springboard for further research rather than a definitive confirmation of its effectiveness. Robust clinical trials are warranted to validate these preliminary findings and inform evidence-based clinical practice in the management of wounds.

REFERENCES

1. Nguyen DT, Orgill DP, Murphy GF. The Pathophysiologic Basis for Wound Healing and Cutaneous Regeneration. In: Biomaterials For Treating Skin Loss. Woodhead Publishing (UK/Europe) & CRC Press (US), Cambridge/Boca Raton 2009; 25-57.
2. Stadelmann WK, Digenis AG, Tobin GR. Physiology and healing dynamics of chronic cutaneous wounds. American journal of surgery 1998;176: 83-4.
3. Ueno C, Hunt TK, Hopf HW. Using physiology to improve surgical wound outcomes. Plast Reconstr Surg. Jun 2006;117(7 Suppl):59-71.
4. Abraham JA, Klagsbrun M. Modulation of wound repair by members of the fibroblast growth factor family. In: The Molecular and Cellular Biology ofWound Repair (2nd ed.), edited by Clark RAF. New York: Plenum, 1996; 195 248.
5. Dorland. Growth factor. In: Dorland's Medical Dictionary 2012. R K Chittoria 5 REVIEW ARTICLE Journal SWCR 2012

6. Yorio T, Clark AF, Wax MB. Ocular Therapeutics. In: Eye on New Discoveries, Academic Press, 2007; 88-92.
7. Mitchell RS, Kumar V, Abbas AK, Fausto N. Table 3-1 In:Robbins Basic Pathology, 8th edition, Philadelphia Saunders, 2007; p2973-77.
8. Embil JM and Nagai MK. Becaplermin: recombinant platelet-derived growth factor, a new treatment for healing diabetic foot ulcers. Exp Opin Biol Ther 2002; 2: 211 218.
9. Steed DL. Modifying the wound healing response with exogenous growth factors. Clin Plast Surg 1998; 25: 397 405.
10. Johnson DE and Williams LT. Structural and functional diversity in the FGF receptor R K Chittoria multigene family. Adv Cancer Res 1993; 60: 141.
11. Massagué J. The transforming growth factor-beta family. Annu Rev Cell Biol 1990; 6: 597641. 12. Romano Di Peppe S, Mangoni A, Zambruno G, Spinetti G, Melillo G, Napolitano M, and Capogrossi MC. Adenovirus-mediated VEGF(165) gene transfer enhances wound healing by promoting angiogenesis in CD1 diabetic mice. Gene Ther 2002; 9: 1271 1277.

