

Beyond Breastfeeding: Prolactin's Powers in Burn Wounds

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ABSTRACT

Burn injuries represent a significant health care challenge worldwide that requires effective interventions to optimize patient outcomes. Prolactin, a versatile hormone traditionally associated with lactation, has emerged as a promising factor with potential implications beyond its classical role. In this review article, we aim to synthesize and analyze the existing literature on the role of prolactin in burn injuries, focusing on its impact on inflammation, immune response, tissue repair, and potential neuroprotective effects. By exploring the mechanisms underlying prolactin's actions, this article provides insights into the therapeutic potential of prolactin in burn injury management.

KEY WORDS: *Anterior pituitary, Burn tissue repair, Inflammatory response, Lactation hormone, Thermal injuries*

INTRODUCTION

Burn injuries are a major cause of morbidity and mortality worldwide, affecting millions of individuals annually. The complex pathophysiology of burns involves a cascade of events, including tissue damage, inflammation, oxidative stress, and impaired tissue repair. Prolactin, a hormone primarily known for its role in lactation, has shown promise in various physiological processes beyond its traditional function.¹ Several studies²⁻⁶ have explored the potential impact of prolactin in burn injuries, and this review aims to consolidate the current knowledge on this topic.

PROLACTIN: MOLECULAR FORMS

In humans, prolactin is produced from a solitary gene located on chromosome 6, comprising 6 exons and 4 introns.⁷ After removal of the 28-amino acid signal peptide, the resulting mature protein weighs 23 kDa and contains 199 amino acids.⁸ This protein belongs to the cytokine family of proteins and possesses a 3-dimensional structure comprising 4 antiparallel α -helices. In addition, this protein exhibits important structural similarities with growth hormone and placental lactogen.⁹

Numerous variations of the prolactin protein have been discovered, many of which arise from posttranslational modifications of the mature protein, including phosphorylation, glycosylation, sulfation, and deamidation.^{9,10} Alongside the monomeric 23-kDa prolactin, 2 other primary forms exist in the bloodstream: "big prolactin," which is a dimer of the monomeric form, and "big-big prolactin" (macroprolactin), composed of high molecular mass (>150 kDa) complexes of 23-kDa prolactin and immunoglobulin G autoantibodies. However, both forms exhibit minimal biological activity.¹¹ Table 1 shows the main characteristics of prolactin and some factors that can regulate its secretion.

PROLACTIN: BEYOND LACTATION

Prolactin is synthesized and secreted by the anterior pituitary gland and plays a crucial role in lactation and reproductive physiology. Prolactin acts via various signaling pathways, including JAK-STAT and PI3K-Akt, leading to diverse effects in different tissues and organs.¹²⁻¹⁴ Aside from its classical role in lactation, prolactin is involved in immune modulation, anti-inflammatory effects, tissue repair, and neuroprotection, which have sparked interest in its potential therapeutic applications.^{4-6,14}

Inflammatory response in burn wound healing

Burn injuries trigger a complex inflammatory response, which is essential for tissue repair but can also lead to harmful consequences if uncontrolled.¹ Prolactin's

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TABLE 1. Main Characteristics of Human Prolactin and Factors Control its Secretion

Synthesis	Structure	Target Tissue	Stimulating Factors	Inhibitory Factors
Lactotroph cells, mammosomatotroph cells	23 kDa, 199 amino acids	Breast tissue	Suckling or nipple stimulation, TRH	Dopamine

anti-inflammatory properties have been investigated in preclinical studies, which have suggested that it may play a modulatory role in the inflammatory response following burn injuries. This modulation could potentially contribute to a more controlled and efficient healing process.¹⁵⁻¹⁷

Prolactin and immune response in burn injuries

The immune system plays a crucial role in modulating the response to burn injuries. Prolactin has been shown to influence immune cell function and cytokine production, potentially affecting immune responses to burn wounds.^{6,14} Studies investigating the interplay between prolactin and the immune system in burn injuries are still limited but hold promise for understanding the complex immunological processes in wound healing.

Prolactin promoting tissue repair and regeneration

Effective tissue repair is essential for optimal recovery from burn injuries. Prolactin has been implicated in promoting tissue repair and regeneration in other contexts, and preliminary evidence suggests it may have a similar role in burn wounds. Studies in animal models have demonstrated enhanced wound healing and reduced scar formation with prolactin administration, by promoting reepithelialization and reducing scar formation, leading to improved functional and cosmetic outcomes.^{17,18} However, translating these findings into clinical applications requires further investigation.

Neuroprotective effects of prolactin in burn patients

Burn injuries can lead to neurological complications, affecting the patient’s long-term outcomes. Prolactin has been shown to have neuroprotective properties in various neurological conditions, which raises the possibility of its involvement in minimizing neurological damage resulting from burn injuries.^{14,19} However, specific investigations into this area are scarce, warranting more focused research.

CLINICAL IMPLICATIONS AND FUTURE DIRECTIONS

Although the therapeutic effects of prolactin in burn injuries show promise, many questions remain unanswered. Future research should focus on elucidating the underlying mechanisms of prolactin’s actions in burn wound healing and determining the optimal dosage, timing, and mode of administration, as well as ensuring the safety and efficacy of prolactin-based interventions. Investigating potential interactions between prolactin and existing burn treatment

modalities may lead to improved patient outcomes. It is important to consider species-specific variations when conducting research and interpreting findings related to prolactin in different mammalian models. Although the basic functions of prolactin are conserved across species, there are notable differences in gene regulation, physiological roles, secretion patterns, and receptor signaling. Understanding these differences can provide valuable insights into the mechanisms underlying lactation, reproduction, and other physiological processes influenced by prolactin in both rodents and humans.²⁰

CONCLUSIONS

The multifunctional hormone, prolactin, presents a fascinating avenue for potential therapeutic interventions in burn injuries. The anti-inflammatory, immunomodulatory, tissue repair, and neuroprotective properties of prolactin make it an attractive candidate for enhancing wound healing and patient outcomes. Although the evidence is encouraging, further research is essential to fully understand the underlying mechanisms and to determine whether prolactin-based therapies can be integrated effectively into burn patient care. Such advancements may eventually lead to novel therapeutic approaches, offering hope for improved recovery and quality of life for burn patients.

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