VOLUME - 12, ISSUE - 06, JUNE - 2023 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Medical Science

THE ROLE OF PLATELET-RICH PLASMA IN ANDROGENETIC ALOPECIA: A COMPREHENSIVE NARRATIVE REVIEW

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ABSTRACT Platelet-rich plasma (PRP) is a promising treatment in regenerative medicine for androgenetic alopecia (AGA). PRP, derived from the patient's blood, contains a concentrated platelet fraction rich in growth factors and bioactive molecules that aid in tissue repair and wound healing. When PRP is administered, these factors are released, stimulating hair growth and regeneration. PRP's mechanism of action involves the release of growth factors like PDGF, TGF-β, VEGF, and IGF, which promote cell proliferation, activate dormant hair follicles, and induce hair cycle growth. PRP also reduces inflammation, promotes angiogenesis, and may inhibit 5-alpha reductase activity, which contributes to AGA. By understanding these mechanisms, PRP can be optimized for effective hair restoration therapies in AGA.

KEYWORDS : Platelet-rich plasma, Androgenetic alopecia, Hair growth, Regenerative medicine

INTRODUCTION

Androgenetic alopecia (AGA) is the most common form of hair loss, affecting a significant portion of the population, particularly men and women as they age. The current treatment options for AGA are limited and often associated with variable efficacy and potential side effects. As a result, there has been growing interest in exploring alternative therapeutic approaches that can provide satisfactory outcomes with minimal adverse effects. Platelet-rich plasma (PRP) therapy has emerged as a promising treatment modality for AGA. PRP contains a concentrated solution of growth factors, cytokines, and other bioactive molecules derived from the patient's own blood, which have the potential to stimulate hair growth and improve hair follicle function. The application of PRP in AGA has gained considerable attention due to its regenerative and tissue-healing properties (1,2).

METHODS

A comprehensive literature search was conducted to identify relevant studies on the role of platelet-rich plasma (PRP) in androgenetic alopecia (AGA). The search strategy involved electronic databases including PubMed/MEDLINE, Embase, and Cochrane Library. The search was performed using a combination of Medical Subject Headings (MeSH) terms and keywords related to PRP, AGA, hair loss, hair growth, and regenerative medicine. The search strategy aimed to capture articles published from the earliest available date up to the present. No restrictions were placed on language or publication type to ensure inclusivity. In addition to the electronic database search, the reference lists of retrieved articles were manually screened to identify any relevant studies missed during the initial search. However, efforts were made to provide a comprehensive summary of the available evidence and discuss the implications for clinical practice.

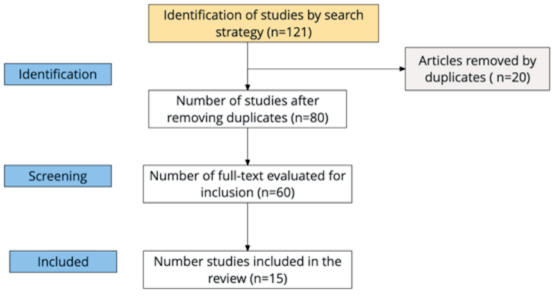

Figure 1. PRISMA.

Platelet-rich Plasma Mechanism Of Action

Platelet-rich plasma (PRP) has gained significant attention in regenerative medicine due to its potential therapeutic effects in various conditions, including androgenetic alopecia (AGA). Understanding the mechanism of action underlying PRP's efficacy is crucial for optimizing its clinical use. PRP is derived from the patient's own blood and contains a concentrated platelet fraction. Platelets are rich in growth factors, cytokines, and other bioactive molecules that play essential roles in tissue repair, angiogenesis, and wound healing. When PRP is administered to the target area, these bioactive factors are released, initiating a cascade of events that promote hair growth and regeneration (3,4).

One of the key mechanisms of PRP is its ability to stimulate hair follicle proliferation and activation. Growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-), vascular endothelial growth factor (VEGF), and insulin-like growth factor (IGF) present in PRP promote cell proliferation, leading to the activation of dormant hair follicles and the induction of the anagen (growth) phase of the hair cycle. These growth factors also enhance the survival and differentiation of hair follicle stem cells, contributing to the generation of new hair strands (4,5).

PRP also exerts its effects by modulating the inflammatory response. In AGA, chronic inflammation in the hair follicles plays a role in hair loss. PRP contains anti-inflammatory cytokines, such as interleukin-1 receptor antagonist (IL-1RA) and interleukin-4 (IL-4), which can counteract the pro-inflammatory environment in the scalp. By reducing inflammation, PRP helps create a favorable milieu for hair follicle growth and regeneration. Furthermore, PRP promotes angiogenesis, the formation of new blood vessels. VEGF and other angiogenic factors present in PRP stimulate the development of blood vessels in the vicinity of hair follicles. Improved blood supply to the hair follicles enhances nutrient and oxygen delivery, facilitating hair follicle function and promoting hair growth. Another mechanism by which PRP may benefit AGA is through its potential effect on the 5-alpha reductase enzyme. This enzyme converts testosterone into dihydrotestosterone (DHT), which is implicated in AGA pathogenesis. Some studies suggest that PRP may inhibit 5-alpha reductase activity, thereby reducing DHT levels and mitigating its negative impact on hair follicles (5,6).

Platelet-rich Plasma Classification Systems

Platelet-rich plasma (PRP) has gained recognition as a valuable therapeutic modality in various medical fields, including regenerative medicine, sports medicine, and dermatology. As the popularity of PRP continues to grow, the need for standardized classification systems to categorize and describe PRP formulations has emerged. This chapter aims to discuss the existing classification systems for PRP and their implications in clinical practice. Several classification

systems have been proposed to characterize PRP formulations based on their platelet concentration, leukocyte content, and activation status. One commonly used classification system is the Anitua classification, which categorizes PRP into four types: pure PRP, leukocyte-rich PRP, pure platelet-rich fibrin (PRF), and leukocyte-rich PRF. This classification takes into account both the platelet and leukocyte content, which can influence the therapeutic effects of PRP (5-7).

Another widely recognized classification system is the classification proposed by Dohan Ehrenfest et al. This classification system categorizes PRP into four groups: pure PRP, leukocyte- and platelet-rich fibrin (L-PRF), leukocyte- and platelet-rich plasma (L-PRP), and pure platelet-rich plasma (P-PRP). This classification focuses on the fibrin architecture and the presence or absence of leukocytes, which may influence the regenerative potential of PRP. The classification systems serve as valuable tools for standardizing PRP formulations and facilitating communication among healthcare professionals. They enable clinicians to select the most appropriate PRP formulation for specific indications and patient characteristics. For instance, certain conditions may benefit from the anti-inflammatory properties of leukocyte-rich PRP, while others may require pure PRP without leukocytes to minimize potential side effects (8,9).

Preparation Of Platelet-rich Plasma

The preparation of platelet-rich plasma (PRP) involves a series of steps to concentrate and isolate platelets from a patient's own blood. This process aims to enhance the concentration of growth factors and bioactive molecules present in platelets, which are thought to promote tissue healing and regeneration. Various techniques and protocols have been developed for PRP preparation, each with its own advantages and considerations (10).

The most common method for PRP preparation involves a two-step process of blood collection and centrifugation. Blood is typically drawn from the patient's vein using a sterile collection system. The collected blood is then processed to separate the platelet-rich fraction from the red blood cells and other blood components. Centrifugation is employed to separate the different components based on their density. The centrifugation process involves spinning the collected blood at a predetermined speed and time. The centrifugal force causes the heavier red blood cells and other cellular components to sediment at the bottom, while the platelet-rich plasma rises to the top. The resulting PRP layer, which is located between the plasma and red blood cell layers, is carefully extracted and collected (11).

The exact centrifugation parameters, such as speed, time, and the use of anticoagulants, can vary depending on the specific PRP protocol and the desired platelet concentration. These parameters are crucial to achieve the optimal platelet concentration and composition for the intended therapeutic application. In recent years, automated systems for PRP preparation have gained popularity. These systems provide standardized and reproducible PRP formulations by automating the blood processing and centrifugation steps. They often incorporate features such as specialized collection tubes, programmable centrifuge settings, and controlled separation processes (12).

Adverse Effects of Platelet Rich Plasma

Adverse effects of platelet-rich plasma (PRP) are relatively rare, but it is important to be aware of potential complications associated with its use. While PRP is derived from a patient's own blood, there are still risks and side effects that can occur. One of the common adverse effects of PRP treatment is pain or discomfort at the injection site. This is usually temporary and subsides within a few days. In some cases, swelling, redness, or bruising may also occur at the injection site. These local reactions are typically mild and self-limiting (13).

Infection is another potential adverse effect, although it is extremely rare when proper sterile techniques are followed during PRP preparation and administration. Strict adherence to aseptic protocols minimizes the risk of introducing bacteria into the injection site. There have been occasional reports of allergic reactions to PRP. These reactions can manifest as itching, rash, or hives. In rare cases, more severe allergic reactions such as difficulty breathing or anaphylaxis may occur. It is important to discuss any known allergies with the healthcare provider before undergoing PRP treatment (14,15).

CONCLUSION

Adverse effects of platelet-rich plasma (PRP) are generally rare. Local reactions (pain, swelling, bruising) at the injection site are temporary and mild. Infections are rare with proper sterile techniques. Allergic reactions, though infrequent, should be monitored. Tissue damage may occur if injections are incorrect. PRP has a favorable safety profile, but providers should discuss risks and benefits with patients for proper education and safety.

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