

Blood-Derived Products in the Treatment of Corneal Ulcers: Therapeutic Potential of PRP and PRF

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Abstract

Corneal ulcers are among the most critical ophthalmic disorders requiring urgent intervention, as they pose a significant risk of vision loss and ocular integrity disruption. Conventional treatment strategies primarily aim to reduce pain, prevent secondary infections, control collagen degradation, and support epithelial regeneration. Medical therapy, including topical antibiotics, anticollagenase agents, cycloplegics, and analgesics, forms the cornerstone of initial management. However, in cases resistant to standard approaches or associated with delayed healing, biological products have recently emerged as promising adjunctive options.

Blood-derived preparations such as autologous serum, platelet-rich plasma (PRP), and platelet-rich fibrin (PRF) have gained increasing attention in both human and veterinary ophthalmology due to their natural biological composition and regenerative potential. Autologous serum contains essential growth factors, vitamins, and antimicrobial components that nourish epithelial cells and support their migration and proliferation. PRP, characterized by its high platelet concentration, delivers a rapid release of growth factors including PDGF, VEGF, IGF, and EGF, thereby stimulating angiogenesis, fibroblast activation, and epithelial repair. In contrast, PRF represents a second-generation product that incorporates platelets and leukocytes within a fibrin matrix, allowing for a slower and more sustained

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release of bioactive molecules. This unique feature enhances its effectiveness in chronic and deep corneal ulcers.

Overall, blood-derived therapies offer safe, accessible, and biologically compatible alternatives or complements to conventional medical and surgical interventions. Although their clinical potential has been demonstrated in various studies, further standardized and controlled trials are required to establish their long-term efficacy and optimize their use in both veterinary and human ophthalmology.

1. INTRODUCTION

The corneal epithelium is one of the most important barriers protecting the eye from environmental factors. When the integrity of this layer is disrupted, microorganisms can easily reach the stroma, and this condition often results in corneal ulceration. In clinical practice, corneal injuries may occur due to mechanical factors such as entropion, ectropion, trichiasis, eyelid tumors, foreign bodies, chemical and thermal burns, as well as bacterial, viral, or fungal infections (Liu & Kao, 2015; Ljubimov & Saghizadeh, 2015; Wilson, 2020; Bulut et al., 2023).

Corneal injuries may be limited to the loss of the superficial epithelial layer, but they can also extend into the stroma and deeper layers. In advanced lesions, permanent opacities, vascularization, and vision loss may develop due to the degradation of collagen fibers and the loss of keratocytes. Clinically, they may present with signs such as pain, photophobia, epiphora, blepharospasm, and corneal edema (Dua, 1998; Lu et al., 2001).

The main goal of treatment is to reduce pain, prevent secondary infections, control collagen degradation, decrease the risk of perforation, and support epithelialization. To achieve these goals, medical, biological, and surgical methods are used. Antibiotics, anticollagenase agents (such as EDTA, N-acetylcysteine), cycloplegics, and topical analgesics form the basis of medical treatment. However, in recent years, biological products, especially blood-derived preparations, have attracted attention as effective adjuvant treatment options that support corneal healing (Saika, 2004; Carrington et al., 2006; Tsai et al., 2015).

Among biological products, those most emphasized are blood-derived preparations such as autologous serum drops, platelet-rich plasma (PRP), and platelet-rich fibrin (PRF). Owing to their content of growth factors and cytokines, these products accelerate tissue healing, support epithelial cell migration and proliferation, and exert anti-inflammatory effects (Schultz et al., 1992; Esquenazi et al., 2005; Akyol-Salman, 2006; Yu et al., 2010; Shahi & Mishra, 2022; Airlangga et al., 2023; Bahar et al., 2025).

2. TREATMENT METHODS FOR CORNEAL ULCERS

Corneal ulcers are among the significant ophthalmic conditions that require urgent intervention. The treatment approach is planned according to the depth, width, etiology, and complication status of the ulcer. The main objectives here are to achieve rapid healing, prevent vision loss, and preserve ocular integrity (Foster & Pavan-Langston, 1977; Dang et al., 2022; Netto et al., 2005; Khosravimelal et al., 2021).

Medical therapy is prioritized as the first-line management of ulcers. Topical antibiotics, particularly broad-spectrum agents, are widely used to suppress bacterial pathogens. The use of combinations effective against both gram-positive and gram-negative bacteria increases the success of treatment. Antiviral drugs are employed in ulcers of viral origin, while antifungal preparations are administered in fungal cases. In addition, anticollagenase agents, particularly compounds such as EDTA and N-acetylcysteine, slow down stromal collagen degradation and prevent the progression of the ulcer. The use of cycloplegic drugs is important for reducing pain and preventing iridocorneal adhesions. Topical analgesics may also improve patient comfort; however, it should be remembered that their long-term use may cause toxic effects on the corneal epithelium (Dua et al., 1994; Lu et al., 2001; Thiel et al., 2017; Eghtedari et al., 2022; Wei et al., 2023).

In addition to medical therapy, biological and surgical methods are also among the treatment options. In recent years, biological products have attracted increasing interest. Among these, blood-derived products such as autologous serum, PRP, and PRF are prominent. Through their content of growth factors, cytokines, and other biologically active molecules, these preparations accelerate corneal epithelial repair, support stromal healing, and suppress inflammation. Furthermore, by enhancing epithelial cell migration and proliferation, they facilitate faster closure of defects (Akyol-Salman, 2006; Yu et al., 2010; Khaksar et al., 2013; Freire et al., 2014; Dang et al., 2022; Airlangga et al., 2023; Kumar et al., 2024).

Surgical methods are considered mainly in ulcers that are resistant to treatment, advanced, or at risk of perforation. Surgical options such as conjunctival flap, lamellar keratoplasty, or penetrating keratoplasty may be applied as a last resort to preserve ocular integrity. However, it is known that surgery is generally preferred for cases with a serious risk of vision loss, whereas medical and biological therapies are prioritized in the early stages (Netto et al., 2005; Wang et al., 2018; Zemba et al., 2020).

3. BLOOD PRODUCTS AND THE CHARACTERISTICS OF PRP/PRF

In recent years, blood products have been increasingly used in ophthalmology and veterinary ophthalmic diseases. The main reason for this is that these products are obtained from the patient's own blood and contain natural biological components. Due to these properties, they are considered both safe and effective treatment options that accelerate tissue healing. They provide significant advantages particularly in the repair of epithelial defects, in chronic and refractory corneal ulcers, in dry eye disease, and in trauma-related healing processes (Freire et al., 2014; Giannaccare et al., 2017; Rushton et al., 2018; Kumar et al., 2024).

Blood products can generally be classified as autologous serum, platelet-rich plasma (PRP), and platelet-rich fibrin (PRF). These products support healing through different mechanisms thanks to their content of growth factors, cytokines, vitamins, and other biological molecules. For example, autologous serum contains components such as EGF (epidermal growth factor), TGF- β (transforming growth factor-beta), and vitamin A, which promote epithelial cell migration and proliferation. In addition, through lactoferrin and immunoglobulins, it exerts antimicrobial effects and contributes to the prevention of secondary infections. Owing to these properties, it is widely used particularly in the treatment of dry eye syndrome and superficial epithelial defects (Geerling et al., 2004; Akyol-Salman, 2006; Tanidir et al., 2010; Yu et al., 2010; Khaksar et al., 2013; Giannaccare et al., 2017; Demir et al., 2022; Demir et al., 2022).

PRP is a product obtained from whole blood and contains a much higher concentration of platelets compared to normal plasma. During its preparation, platelets are concentrated from blood by centrifugation at a specific speed and duration. The most important feature of PRP is its strong stimulation of tissue regeneration due to its high content of growth factors. Platelets store numerous growth factors in their alpha granules, including PDGF (platelet-derived growth factor), VEGF (vascular endothelial growth factor), IGF (insulin-like growth factor), and EGF. These factors promote neovascularization, enhance fibroblast activity, and help epithelial cells proliferate rapidly. Therefore, PRP is applied in many fields such as orthopedics, dentistry, dermatology, and ophthalmology. In corneal diseases, it is particularly preferred in the treatment of persistent epithelial defects because of its healing-accelerating effect (Miron et al., 2017; Pitzurra et al., 2020; Demir et al., 2022; Demir et al., 2022).

PRF, unlike PRP, is a second-generation blood product. It is also obtained by centrifuging blood collected from the patient; however, its preparation technique is simpler than PRP and generally does not involve the use of any anticoagulants or additional chemical substances. For this reason, it has a more natural structure. During centrifugation, not only platelets but also leukocytes are retained within the fibrin matrix. The resulting three-dimensional fibrin network enables the slower and more prolonged release of growth factors. This is one of the most important advantages enhancing the biological effectiveness of PRF. While PRP provides a rapid and short-term release of growth factors, PRF can continue this release for days or even weeks. This feature supports tissue healing in a more sustained manner, particularly in chronic and deep corneal ulcers (Masuki et al., 2016; Alpan & Cin, 2020; Choi et al., 2022; Demir et al., 2022; Hosny et al., 2023).

The preparation of PRF is also quite practical. Whole blood collected from the patient is subjected to low-speed centrifugation. In the obtained tube, three layers are separated: plasma at the top, a gel-like PRF layer in the middle, and erythrocytes at the bottom. The PRF layer can be separated and converted into a topical drop form or applied directly onto the tissue in gel/plaque form. Thanks to this versatile use, PRF is widely preferred not only in ophthalmology but also in orthopedics, oral and maxillofacial surgery, wound healing, and the treatment of skin lesions (Can et al., 2016; Miron et al., 2017; Shahi & Mishra, 2022).

There are some distinct differences among autologous serum, PRP, and PRF. Autologous serum mainly exerts a nourishing and supportive effect on epithelial cells, while PRP and PRF strongly stimulate the regenerative process. PRP provides a faster but shorter-term effect, whereas PRF offers a longer lasting and more sustainable healing process. In addition, since anticoagulants are not used in the preparation of PRF, additional chemical risks during application are eliminated (Can et al., 2016; Miron et al., 2017; Kumar et al., 2024).

In conclusion, blood products, particularly PRP and PRF, are promising biological agents in the treatment of challenging ocular diseases such as corneal ulcers. With their natural content, ease of application, and low side effect profile, they stand out as a strong alternative or adjunct to classical medical and surgical treatments. Although studies using these products are currently available, future clinical trials will further clarify their efficacy and potential applications, paving the way for their much broader use in both veterinary medicine and human medicine (Tanidir et al., 2010; Shahi & Mishra, 2022).

4. CONCLUSION

Blood-derived products, particularly PRP and PRF, represent an important advancement in the management of corneal ulcers and other ocular surface disorders. Their natural origin, ease of preparation, and regenerative potential make them attractive alternatives or adjuncts to conventional medical and surgical therapies. While autologous serum provides nutritional and supportive effects for epithelial cells, PRP and PRF offer stronger regenerative stimulation, with PRF ensuring a more sustained release of growth factors. Despite the growing number of experimental and clinical studies demonstrating their efficacy, further controlled trials are needed to establish standardized protocols, determine long-term outcomes, and expand their clinical applications. Ultimately, these products hold significant promise for both human and veterinary ophthalmology as safe, effective, and biologically compatible therapeutic options.

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