

Platelet-Rich Plasma as a Biocompatible and Safe Antimicrobial Product

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ABSTRACT

Microbial resistance, due to the inappropriate or inadequate use of antibiotics, is a serious and complicated dilemma. Therefore, the use of new effective and safe antimicrobial compounds is of great importance. This mini-review points to the mechanisms involved in antimicrobial properties of platelets and briefly introduces Platelet-rich plasma as an important biocompatible and safe antimicrobial product.

Keywords: Platelet-rich plasma, Microbial infection, Antimicrobial compound, Mechanism

INTRODUCTION

Despite the familiarity of health care systems with microbial infections, awareness of the need to combat them and a wide spectrum of available potent antimicrobial compounds, microbial infection still remains as a serious and complicated dilemma. The main reason for this is the emergence of microbial resistance due to the inappropriate or inadequate use of antibiotics [1].

Therefore, the use of new effective and safe antimicrobial compounds is of great importance.

PLATELET-DERIVED PREPARATIONS

Platelets are small, anucleate and multifunctional blood cells which are necessary for human hemostasis [2]. Furthermore, they have other useful features such as antimicrobial effects, healing properties and tissue regeneration due to the existence of high quantities of critical growth factors (GFs), as well as platelet microbicidal proteins (PMPs), cytokines, chemokines and many other bioactive molecules in their alpha granules [3-10].

This has led to the widespread use of platelet-derived preparations in various clinical areas such as dentistry, orthopedics, dermatology, ophthalmology, plastic surgery, urology, wound healing, sport medicine, rheumatology, maxillofacial surgery, cellular therapy and tissue engineering. At the same time, they have been studied in the research fields of biomaterial and pharmaceutical sciences [11-17].

MECHANISMS INVOLVED IN ANTIMICROBIAL PROPERTIES OF PLATELETS

The antimicrobial effect of platelet-derived preparations is one of the important properties that have been reported in several conducted studies [3,11,18-36].

In fact, Platelets which play important and multifunctional roles in antimicrobial host defense mechanisms, can be considered as key effector cells which bridge innate and adaptive immunity against infection [21,22,37,38].

Some of the most important mechanisms involved in the antimicrobial properties of platelets are:

1. Rapid accumulation of platelets at the sites of microbial infection [2,21]
2. Recognition of microbial signals via pattern recognition receptors (PRRs) [2,39,40]
3. Direct or indirect interactions of platelets with microbial pathogens [2,4,5,41]
4. Increasing blood clearance of pathogens via binding, aggregation, and internalization of pathogens [2,41]
5. Restricting pathogen dissemination [2]
6. Destroying bacterial, fungal, and protozoal pathogens [2]
7. Modulation of complement activation [2,4,5,21,41]
8. Release of platelet microbicidal proteins (PMPs) [4,5,22,27,41-45]
9. Generation of cytotoxic oxygen metabolites and free

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radicals [2,21,39,46]

10. Augmentation of leukocyte antimicrobial activities [2,5,24,47]
11. Facilitation the ability of lymphocytes to recognize and respond to microbial pathogens [2,40]

Accordingly, platelet-derived preparations can be considered as important antimicrobial products due to biocompatibility and biosafety, high clinical efficacy, few adverse effects, ease of preparation and simple legal requirements [6,10,14,48].

PLATELET-RICH PLASMA

Platelet-rich plasma (PRP), one of platelet-derived preparations, was first introduced in 1984 by Assoian [49]. It contains a minimum platelet concentration of more than 1×10^6 /lit or a 2- to 6-fold increase in platelet concentration from baseline [48,50,51]. PRP also contains multiple platelet-derived bioactive molecules and leucocytes which are involved in inflammatory response and antimicrobial properties [20,52].

Platelet-rich plasma can be prepared from the whole blood using double centrifugation protocol in which soft spin and high-speed centrifugation is used respectively [53-56].

However, donor's blood characteristics [57] well as preparation methods and devices [40] cause variations in PRP bioformulations and impact their quality, biological efficacy and clinical outcomes [11,40,58].

Therefore, using PRP preparations as a new achievement to combat microbial infections, requires facing many challenges, including standardization and validation of PRP preparation protocols.

CONCLUSION

Platelet-rich plasma can be considered as an important biocompatible and safe antimicrobial product. However, standardization and validation of PRP preparation protocols are necessary in order to achieve consistent and acceptable outcomes.

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