
A PERSPECTIVE ON PLATELET-DERIVED PRODUCTS FOR REGENERATIVE MEDICINE

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In modern health sciences, cell-based therapies have emerged as one of the most transformative approaches for treating a variety of diseases. In this regard, autologous platelets and their products have garnered significant attention in regenerative medicine. With a pivotal contribution in hemostasis, platelets are rich in cytokines, growth factors and numerous bioactive molecules with tremendous potential in tissue repair and regeneration.¹ The generation of extracellular vesicles including microvesicles and exosomes from activated platelets have also been demonstrated to participate in intercellular transport of different types of biomolecules including protein, nucleic acids and small molecules, that has strong therapeutic potential.² The clinical use of platelet-rich plasma and its derivatives including platelet-rich fibrin, platelet releasate/secretome and extracellular vesicles have evolved into promising avenues for treating a wide range of medical conditions.^{1,3} Platelet-rich plasma (PRP) is one of the most widely used platelet-derived products in regenerative medicine with its applications in, but not limited to, sports medicine, dermatology, cosmetology, ophthalmology and orthopedics. Its low cost and ease of preparation from a relatively small volume of blood makes it a promising therapeutic strategy for treating several acute and chronic injuries. The concentrated platelets in PRP release growth factors such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), transforming growth factor-beta (TGF- β), and epidermal growth factor (EGF), all of which contribute to several cellular processes including tissue repair, angiogenesis, collagen synthesis, and inflammation modulation. PRP has shown potential in the treatment of musculoskeletal injuries, bone fractures, wound repair, and hair regeneration by promoting healing and reducing recovery time, though outcomes can vary depending on preparation protocols, injury type, and patient factors.^{3,4} Platelet-rich fibrin (PRF) is a second-generation platelet-rich product that also contains leukocytes, circulating stem cells and cytokines in a fibrin matrix. As compared to PRP, which has short term effects, PRF therapy at the injury site is associated with a prolonged bioavailability due to slow release of cells and biomolecules from the fibrin network. By providing sustained release of growth factors, PRF accelerates tissue repair, enhances healing, reduces inflammation, and promotes regeneration. It has broad spectrum clinical applications with a more common use in oral and maxillofacial surgery, orthopedics, wound healing and hair restoration.^{1,5} Beyond PRP and PRF, platelet-derived growth factors (PDGFs) and extracellular vesicles (EVs) are emerging as novel therapeutic modalities. PDGFs, which are present in high concentrations in platelets, regulate cellular processes such as migration, proliferation, and angiogenesis. These growth factors are essential for wound healing and tissue regeneration. EVs, including exosomes, are released by platelets that carry bioactive molecules, including proteins, lipids, and RNA, which impacts cellular behavior. EVs have been shown to promote tissue repair, enhance angiogenesis, and modulate immune responses, making them an attractive tool for regenerative applications. The application of platelet-derived EVs is in the research phase, but their potential to deliver targeted therapeutic effects makes them a promising approach for future regenerative therapies.^{2,3}

The use of platelet-derived products particularly PRP has significantly increased in regenerative medicine worldwide including Pakistan.⁶ However, the regulatory framework for the use of these products in Pakistan is still developing. Although, the PRP is an autologous biological product that often falls outside the scope of traditional pharmaceutical regulation, there is still a need to develop specific guidelines and regulations by ensuring standardized protocols and devices for safe and effective patient care.

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