



# Platelet-Rich Plasma: Applications in Cosmetic Dermatology

Boy Ardi Rohanda\*<sup></sup>, Nelva Karmila Jusuf<sup></sup>

Department of Dermatology and Venerology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia

## Abstract

Platelet-rich plasma (PRP) or autologous platelet gel, plasma-rich growth factors, and platelet-concentrated plasma are blood component that is rich in thrombocytes on a small volume of plasma. There were seven primary growth factors that actively secreted by thrombocytes including platelet-derived growth factor, transforming growth factor- $\beta$ , vascular endothelial growth factor, epidermal growth factor, fibroblast growth factor, connective tissue growth factor, and insulin-like growth factor-1. PRP application in cosmetic dermatology includes tissue regeneration, wound healing, repairing scar tissue, skin rejuvenation, and being used in alopecia patients. PRP could accelerate soft-tissue formation in the subdermal, activate fibroblast formation and new collagen deposition, and formation of blood vessels and fat cells. PRP is also considered a potential therapy for accelerating hair growth for alopecia.

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\***Correspondence:** Boy Ardi Rohanda, Department of Dermatology and Venerology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia.

E-mail: boyardirohanda@yahoo.com

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## Introduction

Platelet-rich plasma (PRP) or autologous platelet gel, plasma-rich growth factors, and platelet-concentrated plasma are blood component that is rich in thrombocytes on small volume of plasma. Thrombocyte is cytoplasm fragment derived from megakaryocyte that formed in bone marrow. Thrombocyte consisted of more than 30 bioactive proteins that have a role in homeostasis regulation or tissue healing. PRP consisted of various growth factors based on concentration of platelet (thrombocyte), stored as  $\alpha$ -granule in thrombocyte. PRP consisted of 3–5 folds of growth factor concentration. Growth factor on PRP has a fundamental role on modulating repairing and regeneration of tissue, while plasma protein has a role in bone formation, connective tissue, and epithelium migration [1].

PRP application in cosmetic dermatology includes tissue regeneration, wound healing, repairing scar tissue, skin rejuvenation, and used in alopecia patient. *In vitro* study showed that PRP could stimulate skin's fibroblast cell proliferation and increased Type I collagen. PRP is injected to dermal layer which could accelerate soft-tissue formation in subdermal, activate fibroblast formation and new collagen deposition, and also formation of blood

vessels and fat cells. PRP also considered as potential therapy to accelerate hair growth in alopecia [2], [3]. This review aimed to explain about PRP application in cosmetic dermatology.

## PRP

### Contents of PRP

PRP is a plasma autologous component that consisted of thrombocyte concentration and various bioactive components [2]. There were seven primary growth factors that actively secreted by thrombocyte for wound healing process. PRP could increase wound healing with delivering various growth factors and cytokines from  $\alpha$ -granule which is contained in thrombocyte. Cytokines are identified in thrombocyte which include platelet-derived growth factor (PDGF), transforming growth factor- $\beta$  (TGF- $\beta$ ), vascular endothelial growth factor (VEGF), epidermal growth factor (EGF), fibroblast growth factor (FGF), connective tissue growth factor, and insulin-like growth factor-1 (IGF-1). Those cytokines have role in cell proliferation, chemotaxis, cell differentiation, and angiogenesis [1], [4].

### **Classification and technique to obtaining PRP**

Based on classification reported by Ehrenfest *et al.* (2014), there were four preparations which are identified, based on contents of the concentrate include pure platelet-rich plasma which is a preparation without leukocyte and little amount of fibrin tissue, leukocyte, and PRP which is a preparation with leukocyte and little amount of fibrin tissue and often used commercially and for experiment, pure platelet-rich fibrin which is a preparation without leukocyte and consisted of high-density fibrin tissue, and leukocyte and platelet-rich fibrin which is a preparation that consisted of leukocyte and high-density fibrin tissue [5].

Technique used on PRP to obtain thrombocyte was to obtain blood taken from a vein of a patient and collected in sterile tubes with anticoagulant. The blood in tubes is then centrifuged to form an arrangement of blood components based on their molecular weight. The duration, speeds, and number of centrifuge steps depend on the method used to avoid fragmentation of the platelets; low centrifugation speeds are recommended [1], [6], [7].

## **Applications of PRP in Cosmetic Dermatology**

### **Skin rejuvenation**

Skin aging is caused by combination of gradual decline in function over time (intrinsic aging) and cumulative damage by environmental factors (extrinsic aging) include smoking, exposure from chemical, and ultraviolet B (UVB) radiation. UVB could stimulate production of collagenase by human dermal fibroblasts. Skin is continuously exposed to UVB, will have collagen degeneration and change in elastic tissue deposition, and resulted in structural damage of dermal extracellular matrix that causes wrinkled skin. PRP could induce collagen synthesis and other matrix components that stimulate fibroblast activation, thereby rejuvenating the skin [8], [9]. Methods that can be used for applying PRP for skin rejuvenation include topical application, intradermal injection, and often used as adjuvant therapy in laser and microneedling [1]. Conde *et al.* (2015) explained that PRP used could stimulate fibroblast proliferation, with increased anti-inflammatory factor, angiogenic factor, and protein that related with remodeling of extracellular matrix such as pro-collagen I, hyaluronic acid, and tissue inhibitor of metalloproteinase 1 [7].

### **Acne scar**

PRP has become one of modalities that support skin repair. PRP showed significant improvement

of scar, both on acne and traumatic scars. Acne and traumatic scars often complained by patient with major problems in esthetic and functional view. PRP also could decrease erythema in acne scar. Growth factors in PRP modulate cell proliferation, differentiation, angiogenesis, and chemotaxis, thereby helpful in acne scar healing process [10]. A study by Zhu *et al.* (2013) evaluates PRP use in acne scar healing with erbium fractional laser administered on facial acne scar patient and coadministered with topical PRP after laser therapy and showed that result of 91% of patients had 50% improvement [11].

### **Striae distensae**

Striae distensae are dermal scar with epidermal atrophy that found in skin that has continuous stretch over time. At first, striae looked like red to purple-colored line (striae rubra), and over time, lesion become atrophy with smooth skin appearance, white colored, and wrinkled (striae alba). The most common predilection is on stomach, breast, gluteal, and thigh areas. Wound healing mechanism through PRP therapy also applied in overcoming the striae [10], [12].

### **Alopecia**

In 2006, PRP be considered as a new therapy for alopecia, both on androgenetic alopecia and areata alopecia. Growth factor and bioactive molecule contained in PRP have role in four main actions in proliferation, migration and cell differentiation, and angiogenesis. Various cytokines and growth factor involved in hair morphogenesis regulation and hair growth cycle. Dermal papilla cell produced growth factors such as IGF-1, FGF-7, hepatocyte growth factor, and VEGF that responsible for maintaining hair follicles in anagen phase from hair cycle [3]. Uebel *et al.* (tahun) showed that administration of PRP could increase the continuity of growth of hair grafts, increased density of hair, and stimulate hair follicle growth [13].

Activated PRP stimulates proliferation and differentiation of stem cells in hair follicle area through various molecular mechanisms such as increased activity of  $\beta$ -catenin transcriptional on differentiating stem cell to become hair follicle cell, increased bcl-2 protein level as anti-apoptosis that has role to prolong survival of dermal papilla cell, activating Akt signaling pathway as anti-apoptosis and ERK as cell growth regulation that can prolong survival of hair follicle growth, expressed FGF-7 in dermal papilla cell that able to give effect on activating hair cycle on anagen phase, and increased VEGF and PDGF that has pro-angiogenic feature from PRP that could increase perifollicle vascular plexus. Methods that are used in androgenic alopecia therapy with PRP are through injection of interfollicular PRP with dose of 0.05–0.1 ml/cm<sup>2</sup> retrogradely from inner layer to superficial layer, mesotherapy PRP that started

with microneedle puncture with roller accompanied by interfollicular PRP injection and PRP also can be used as adjuvant therapy in hair transplantation [14].

### **Vitiligo**

PRP appeared to be effective alternative therapy in vitiligo, role as factors that limit formation of vitiligo. The mechanism of PRP in vitiligo remains unclear. It is reported that not only has an effect on melanocytes in pathogenesis of vitiligo but also in keratinocytes and fibroblasts. Deficiency of FGF and keratinocyte growth factor may attenuate melanocyte attachment, transepidermal elimination, and can occur on chronic condition. Beneficial effect of PRP in vitiligo obtained from growth factor contents (PDGF and TGF- $\beta$ ) and angiogenic factor (VEGF and FGF) that can stimulate keratinocyte and fibroblast proliferation with increasing interaction with melanocyte that led to melanocyte stabilization [15].

### **Melasma**

Melasma is hyperpigmentation disorder caused by various factors related to genetic tendency, ultraviolet exposure, and hormonal factors. Some study revealed that PRP became one of the choices in melasma therapy with significant decrease statistically on Melasma Area and Severity Index obtained from epidermal melasma and mixed-type melasma after PRP therapy. Repigmentation effect from PRP promotes healing in basal membrane area of laminin formation, collagen, and tenascin that stimulate by TGF- $\beta$  on PRP. Inhibition effect from melanin synthesis caused by EGF and TGF- $\beta$  content on PRP and the effect of increasing skin volume through performance of PDGF from PRP that could stimulate synthesis of collagen and extracellular component [16].

## **Combination of PRP and Other Therapy Modalities**

### **PRP with hyaluronic acid-based filler**

Combination of PRP with hyaluronic acid-based filler has gain popularity and used widely in cosmetic dermatology for years. Vampire facelift is the method that combines PRP and filler to dermal inner layer. This technique became famous after spreading widely in social media. Growth factor in PRP has a role in rejuvenating skin, improved skin texture and smoothness, and decreased wrinkled skin. Adding hyaluronic- acid-based filler into dermal layer serves as frame in PRP bonding, increased skin rejuvenation, augmentation of soft tissue, and overall increasing esthetic appearance [17]. This combination therapy

commonly used to improved cosmetic appearance in nasolabial fold, horizontal fold on neck, skin homogeneity and tonicity, and face wrinkle [18]. Study by Ulusal (2017) in 94 patients using PRP and hyaluronic acid-based filler showed that there was a significant increase in overall skin appearance and texture improvement [19].

### **PRP with microneedling**

PRP with microneedling is adding PRP with needle injection 0.25–2.5 mm depth. Microneedling creates small hole on skin that would increase absorption of PRP, helps to increased new collagen formation, or neocollagenesis [17]. Study by Chang *et al.* (2020) found that patients who undergo combination therapy of PRP and microneedling would have clinical improvement significantly better than microneedling therapy alone [20].

### **PRP with laser**

PRP used with laser therapy had gained more popularity in cosmetic dermatology. This method combined fractional laser resurfacing with PRP application. Adding PRP after application of fractional laser resurfacing could increase skin elasticity, stimulate fibroblast formation process, and increase collagen density. Combining PRP with laser therapy could increase wound healing and accelerate wound healing, and reducing erythema and melanin index on wound area. Transepidermal water loss and hyperpigmentation inflammation also found significantly lower when combining PRP with both methods. The patient treated with PRP after CO<sub>2</sub> fractional laser resurfacing or erbium has more elastic skin, more fibroblast, and mainly thicker collagen compared with wound that treated with laser without adding PRP [21]. Study by Gawda *et al.* (2014) that compared efficacy and safety of administration of two different methods of autologous PRP (intra dermal injection and topical administration) after fractional carbon dioxide laser (FCL) compared with administration of FCL therapy alone on treating acne scar showed that combination therapy of PRP and FCL has statistically and significantly better response with less adverse effects and shorter time compared with group of FCL therapy alone, but there is no significant difference statistically on pain score in both groups [22].

### **Contraindications and adverse effects of PRP**

Contraindications of PRP include sepsis, cancer, chemotherapy, thrombocyte dysfunction syndrome, thrombocytopenia, hypofibrinogenemia, hemodynamics instability, anticoagulant therapy users, acute and chronic infection, chronic liver pathology, metabolic disorder, severe metabolic and systemic disorder,

and skin disorder (systemic lupus erythematosus), porphyria, allergic, and patient that consumed nicotine, alcohol, and drug abuse. Adverse effects of PRP can occur, and some of that appeared significantly. The most common adverse effects were infection, skin discoloration and bruising, pain in injection area, allergic reaction (rarely occur), and blood clot (caused by PRP that using needle, the vein can be damaged). Certain factors (smoking and alcohol consumption) resulted in reducing stem cell release. Avoiding those factors can increase the successful of PRP procedure [23].

## Conclusion

PRP has potential to increase tissue healing through delivering signals to various growth factors, cytokines, and adhesion molecules that have repairing effect on skin rejuvenation process, acne scar, striae distensae, alopecia, vitiligo, and melasma. PRP could be combined with hyaluronic acid-based filler, microneedling, and laser that have more optimal results compared with single therapy.

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