Review for good platelet–rich plasma procedure in cosmetic dermatology and surgery

Moon Hee Kim, MD, MS1, Hyeon Seob Byeon, MD2

1Department of Cosmetic Medicine, GC iMED, Seoul, Rep. of Korea, 2Zen Clinic, Zen medical Corporation, Tokyo, Japan

Autologous platelet–rich plasma (PRP) is a type of platelet concentrate that has been used as an adjuvant therapeutic in the field of dental and orthopedics as well as a regenerative cosmetic medicine and surgery worldwide. Recently, the paradigm for platelet–mediated therapy has shifted from conventional transfusion to regenerative and immune modulating therapeutics. Technological advancements have enabled cutting–edge research to understand the mechanism of platelet activation, platelet–derived extracellular vesicles, microRNAs, protein synthesis as well as target regulation function. Although there is increasing focus on the clinical use of platelets in tissue engineering as a source of growth factors and scaffolds as well as its use in combination with various type of stem cells and other scaffold materials or for pure non–cellular therapeutic materials, in reality, there is lack of standardization of the preparation process including the devices, nomenclature of products, and parameters for product adequacy, even for autologous use. The main reason behind this is the fact that platelets are not typical cell–based materials and they have a wide range of functional variation according to the patient’s condition. Moreover, there are legal issues regarding the medical act in each country depending on their policy. Therefore, the present study aimed to review the latest paradigm shift and the stance regarding PRP therapy and to offer suggestions check lists for quality management of PRP procedures to ensure effective clinical results.

Keywords: extracellular vesicles; platelet–derived growth factors; platelet–rich plasma; PRP preparation; quality assured procedure; regeneration

Platelets as bio–engineering materials

Characteristics of platelets and platelet–rich plasma

Clinicians, who are willing to conduct platelet–rich plasma (PRP) or PRP related product therapy, should know the important aspects of platelets as regenerative bio–sources for their adequate use. The three main functions of platelets are coagulation, immune modulation, and tissue repair. In addition, the platelets in PRP provide two main elements; “growth factors (GFs) and scaffold” for tissue repair except "cell" among the tissue regeneration triad [1]. In this review, we attempt to focus on “tissue repair function” of platelets in the field of cosmetic dermatology and surgery.

Platelets are small fragments of the cytoplasm of megakaryocytes formed in the bone marrow and their size ranges from approximately 5 to 12 μm³. The average platelet count ranges from 150 to 400×10³/μl of circulating blood, and their in vivo life span is approximately 8 to 10 days before they are cleared by the reticuloendothelial system. Although platelets contain some intracellular organelles such as mitochondria and endoplasmic reticulum fragments, they lack a nucleus and hence, cannot divide into two daughter cells (Fig. 1) [2]. In brief, this means that they cannot proliferate and differentiate or dedifferentiate when used in cell engineering. However, even though they lack...
Platelets play a critical role in tissue repair and regeneration as they are highly responsive and secretory [4]. They can regulate fundamental mechanisms involved in the tissue healing process including cellular migration, proliferation, and angiogenesis. Activated platelets release a whole range of chemokines and promote recruitment, adhesion, and proliferation of adult stem cells. In addition, there is increasing evidence indicating that the regulation of the balance between apoptosis and cell survival, which determines the fate of the injured tissues, is controlled by platelets (Fig. 2) [5].

The most conspicuous organelles in platelet are the secretory granules. The three major granule types in platelets are dense granules, α-granules, and lysosomes and those carry distinct cargos and vary in biogenesis, trafficking, and exocytosis. Among them, the α-granules are the most abundant organelle in platelets (40 to 80 per platelet) and contain a plethora of proteins that comprise the bulk of the platelet secretion. The α-granules, which are formed in megakaryocytes in the bone marrow, release GFs and have direct effects on the stem cells (Table 1) [6]. These granules are formed in the megakaryocytes, specifically in the trans-Golgi network and early endosomes, before being transported into the platelets. These granules mature in multivesicular bodies (MVB), and this maturation process continues in the circulating platelets through synthetic and endocytic pathways (Fig. 3) [7]. When the platelets are activated by various types of stimuli or even in case of basal vesicle secretion, the cargoes stored in the platelet granules are released, and the rates and extent of the release depend on the type of activator and the activation strength.

Platelets or platelet-derived GFs can be obtained from whole blood or platelet apheresis. In addition, they can be acquired from autologous or allogeneic pools. Currently, the apheresis platelets or pooled allogeneic platelet concentrate (PC) are used for Good Manufacturing Practice (GMP)-grade manufacture of human platelet lysate (PL) for preclinical cell propagation, which has been most commonly used for propagation of mesenchymal stem cells (MSC) and endothelial progenitors for more than a decade [8]. For clinical practice, autologous PRP or PRP derived products from whole blood are preferred for various reasons [9,10].

Depending on the device and the technique used for preparing PRP, they can contain variable amounts of platelets, red blood cells (RBCs), white blood cells (WBCs), and plasma. The term PRP can be defined as the volume fraction of the blood plasma, which has a higher concentration of platelets than the baseline serum level. However, it has been suggested that approximately 1,000 to 1,500×10⁶ platelet in 50 ml whole blood derived PC (source of human PL) [14]. When platelets are present at concentrations of over 5,000×10⁶/μl, they can inhibit stem cells proliferation and differentiation [15].

In the PRP, there should be as few RBCs as possible. AABB permits only <0.5 ml of RBCs in 50 ml of PC [13]. RBCs can adversely affect the platelet function by altering the local pH, suppressing proliferation and stimulating apoptosis of fibroblasts and other stromal cells [16]. In addition to platelets, the PRP contains a number of different cells such as neutrophils, monocytes, endothelial cells, keratinocytes and MSCs [1]. These cells
interact with the platelets through cellular expression and excreted components. Further, PRP might also contain other elements such as soluble proteins, hormones, and cell adhesion molecules [5].

The abundant GFs and cytokines stored in the platelet granules can be either naturally released by thrombin activation and
clotting or artificially by freeze/thaw-mediated platelet lysis, sonication or chemical treatment. For the clinical use in regenerative medicine, autologous PRP collected from peripheral blood has been commonly used with or without ex vivo activation using 3 main activators, collagen, thrombin, and calcium. Thrombin acts significantly faster than calcium (which is usually injected), and calcium is a faster than collagen [17]. Platelets are the first bodies to reach the injured tissue and continuously release GFs throughout their viable period even in the absence of any activator during the clinical procedure. However, once activated, they begin to act within 10 minutes after activation, with more than 95% of the pre-synthesized GFs secreted within

| Growth Factor | Source | Function |
|---------------|--------|----------|
| Transforming growth factor-beta | Platelets, extracellular matrix of bone, cartilage matrix, activated TH1 cells and natural killer cells, macrophages/monocytes and neutrophils | Stimulates MSCs proliferation; regulates endothelial, fibroblastic and osteoblastic mitogenesis; regulates collagen synthesis and collagenase secretion; regulates mitogenic effects of other growth factors; stimulates endothelial chemotaxis and angiogenesis; inhibits macrophage and lymphocyte proliferation |
| Basic fibroblast growth factor | Platelets, macrophages, MSCs, chondrocytes, osteoblasts | Promotes growth and differentiation of chondrocytes and osteoblasts; mitogenic for MSCs, chondrocytes and osteoblasts |
| Platelet derived growth factor | Platelets, osteoblasts, endothelial cells, macrophages, monocytes, smooth muscle cells | Mitogenic for MSCs and osteoblasts; stimulates chemotaxis and mitogenesis in fibroblast/glial/smooth muscle cells; regulates collagenase secretion and collagen synthesis; stimulates macrophage and neutrophil chemotaxis |
| Epidermal growth factor | Platelets, macrophages, monocytes | Stimulates endothelial chemotaxis/angiogenesis; regulates collagenase secretion; stimulates epithelial/mesenchymal mitogenesis |
| Vascular endothelial growth factor | Platelets, endothelial cells | Increases angiogenesis and vessel permeability, stimulates mitogenesis for endothelial cells |
| Connective tissue growth factor | Platelets through endocytosis from extracellular environment in bone marrow | Promotes angiogenesis, cartilage regeneration, fibrosis and platelet adhesion |

Reused from the article of Everts PA, et al. (J Extra Corpor Technol 2006;38:174-87) [6]. MSC, mesenchymal cells.

**Fig. 3.** Working models of platelet α-granule formation in megakaryocytes. α-granules derive from two major pathways: synthetic and endocytic. The synthetic pathway originates at the trans-Golgi network (TGN). Soluble clathrin molecules recruited to the TGN self-assemble into a lattice structure and interact with coat proteins, presumed to be adaptor protein 1 (AP-1), to form clathrin-coated pits. These pits invaginate to bud off early membrane-bound vesicles that are ultimately directed to early endosomes. Endocytic vesicles originate similarly at the plasma membrane employing adaptor protein 2 (AP-2) and ultimately merge into early endosomes. α-granules mature in multivesicular bodies (MVBs), a process that requires proteins Vacuolar Protein Sorting (VPS) 33B, VPS16B, and Neurobeachin Like 2 (NBEAL2). Reused from the article of Sharda A, et al. (F1000Res 2018;7:236) [7].
1 hour, depending on the PRP preparation technique [18]. Activation by collagen occurs spontaneously when PRP is injected into a soft tissue site [19]. Once the PRP is activated, irrespective of whether the activation is strong or weak or whether the action is occurring in vivo or ex vivo, a fibrin network begins to form. During this process, fibrin supports the tissue scaffold and platelets release their contents over a sustained period. The fibrin fibers, in turn, form networks featuring different architectures, which facilitate release of GFs as well as the adherence, proliferation and differentiation of living cells during tissue regeneration events [9,10,20]. If PRP is over-activated, the fibrin will form into a bivalent network that is unstable. In comparison, if the PRP is activated in a more physiological manner, a stable tetra-molecular network forms that enhances the adherence of cells and release of GFs [21]. By understanding the above points, clinicians can select and prepare the adequate form of PRP and select an activator whose strength is appropriate for the clinical purpose (Fig. 4) [9,10,22].

There has been a lot of debate about the role of neutrophil in PRP therapy. It is possible that they may confer an advantage to the patient by reducing the chances of infection or by modulating the inflammatory response [23]. However, when PRP is used for the purpose of regeneration, neutrophils appear to have a deleterious effect on the tissue, resulting in increased inflammation, pain and further scarring as they contain over 40 hydrolytic enzymes and release oxygen-free radicals, catabolic cytokines, matrix metalloproteinases, P-selectin, CD40L, and other pro-inflammatory mediators which can degrade tissue [24]. Nonetheless, WBCs, to some extent, are inevitably present in the usual PRP product.

Autologous PRP or PRP related products are safe and easy to prepare for the point of care, and provide a GF-rich scaffold. Injectable PRP is also easily applicable for combinational use with other scaffolds such as hyaluronic acid and fat grafts [25,26].

**Platelet-derived extracellular vesicles, microRNA and cell-free therapy**

Platelets was regarded simply as cellular fragments that can release GFs cargo and have no synthetic capabilities. And, there is lack of understanding about PRP induced tissue repair. Degradation of GFs in vivo can occur via several distinct pathways including denaturation, oxidation and proteolysis. Most of the GFs in platelets, found in the unbound form, have a short life span (minutes to hours). The biological half-life of insulin-like GF-1 in serum is 10 minutes, vascular endothelial growth factor is less than 30 minutes, and for platelet-derived growth factor A

![Fig. 4. After centrifuged with anticoagulant (A–D), platelet-rich plasma (PRP) and PRP gel can be acquired. And after centrifugate without anticoagulant, platelet-rich fibrin (PRF) is acquired. PRP can be injected directly into the lesion and, PRP gel and PRF are implanted as mass or modified form. HA/β-TCP, hydroxylapatite/β-tricalcium phosphate; PPP, plate-poor plasma. Cited from the articles of Moshiri A, et al. (Hard Tissue 2013;2:6) [9]; Masoudi E, et al. (Curr Stem Cell Rep 2016;2:33-42) [10]; Fernandes G, et al. (Bone Res 2016;4:16036) [22].](image-url)
Subsequent studies revealed that new proteins can be synthesized by platelets [28]. In addition, these studies also suggested that the platelets can actively transfer RNAs to other cells. Among the RNAs, the messenger RNAs incorporated into the target cells can be translated into proteins and microRNAs have been found to regulate gene expression, resulting in functional changes in the target cells [3,29].

As seen in the Fig. 5, platelet-derived extracellular vesicles (p-EVs) carry various cargoes including lipids, anchored membrane receptors, cytosolic proteins such as GFs, proteins transcription factors as well as RNA molecules, including microRNAs. Exosomes originate from the inward budding of the endosomal membrane and are more rigid compared to the others that are formed by the outward budding of the plasma membrane or sequestration [30]. A recent publication suggested a possible coordinated biogenesis between exosomes and microvesicles, and demonstrated that these functions appear either complementary or non-complementary as exosomes respond positively during immune responses and can act as tools for immunotherapy against cancer, whereas microvesicles act as antagonists [31]. Platelet α-granules, which are considered to be late endosomes or MVB, release exosomes to the extracellular space [7]. A study showed that there are slight time-dependent (from 30 minutes to >3 hours) increase in total p-EVs in the “absence” of an added activator, and the p-EVs of inactivated platelets were more protein-rich compared to those from activated platelets [32]. Exosomes that were isolated from human PL elicited a significant, dose-dependent increase in the cell proliferation and migration of bone marrow MSCs (BM-MSCs) and ability of these MSCs to deposit mineralized matrix. Moreover, evaluation of the exosome protein content revealed higher amount of GFs compared to PL [33]. Further, small RNAs were found to be enriched in exosomes as compared to donor platelets. These results suggest that exosomes can consistently contribute to PL activity and can be suitable nano-delivery systems for cell-free regeneration therapies, even though limited than MSC exosomes [34]. However, so far, there are many questions that still need to be addressed for the practical clinical use of exosomes.

Paradigm shift and the current status of platelet-rich plasma therapy in the world

With increase in the demand for PRP therapy, it is important for clinicians to understand the regulation and the stance of
their country as well as be up to date with the biological knowledge. With globalization, many countries have included common regulations and audit programs in addition to safety-based common grading systems, irrespective of the differences in the detailed category codes [35]. However, from a medical practice perspective, PRP therapy is still a controversial issue in many ways. Based on scientific breakthroughs, individual countries intend to regulate the medical procedures for using cell-based therapeutics by establishing a new regulatory framework. One of the most notable example is Japan. In November 2014, they enforced a new regulatory framework for regenerative medicine to ensure the complete safety of regenerative medicine and to promote the development of its practical applications. (Fig. 6) [36,37].

PRP therapy is now going through a period of transition as although platelets have been used as transfusion therapeutics for coagulopathies for a long time, they have not been fully utilized for cell-based regenerative therapy for many reasons. The acts for the regulation of PRP devices and medical practice of some countries are compared in Table 2 [38-43]. In the Republic of Korea, devices for PRP preparation have been categorized as Grade III (moderate risk) by Korea Food and Drug Administration and, till June 2019, over 35 PRP kits have been permitted. However, the medical act, which is controlled by the Ministry of Health & Welfare, indicates that the medical practice of PRP is considered to be illegal except for use as a dental implant adjuvant and aesthetic or for plastic surgery. The reason is that its therapeutic effectiveness has not yet been fully elucidated in order to be included in national health insurance system, even though its safety has already been approved. However, in most other countries, medical practice is at the discretion of clinician under the presumption that they act responsibly as medical personnel.

In Japan, the Ministry of Health, Labour and Welfare (MHLW) classified PRP therapy with/or without activation as Class III (low risk) grade “cell-based therapy”, which is defined as low risk therapy involving cells that are subjected to limited manipulation using processes by the Act on the Safety of Regenerative Medicine (ASRM) [43]. However, procedures such as blood transfusion, hematopoietic stem cell transplantation and assisted reproductive technology are excluded from these regulations by government ordinance. Cell-based medical practice such as PRP should be enacted only in licensed facilities in accordance with the licensed standard operating procedures.
(SOP) based on the concepts of GMP. Therefore, those facilities should be qualified to ensure the safety and efficacy of the devices. Therefore, inside a medical institution, clinicians may use specially controlled ready-made PRP processing kits approved by the MHLW (class III and IV grade generic name as for medical device classification) or home-made protocols using lower grade devices after due notification to the MHLW. According to a report by Kawase and Okuda [43], some groups of clinicians use devices which are not for the preparation of implantable blood-derived materials or low quality devices as the verification for autologous PRP therapy is somewhat lax due to the assumption that it is the safest cell-based therapy. They claimed that clinicians should choose products manufactured in accordance with reliable quality systems of manufacturing. Actually, MHWL has increased the regulatory pressure for safety and efficiency for that. So far, only two PRP kits, TriCell (REV-MED Inc., Seongnam, Korea; approval number, 22900BZX00068000) and GPS III (Zimmer Biomet Inc., Warsaw, IN, USA; approval number, 22700BZX00420000), have verified their PRP products through certification of analysis and have been approved as Class III medical devices in Japan [44].

**Consensus about nomenclature and classification system**

It is very difficult to sort and interpret the published clinical or research data about PRP therapy due to the complicated no-

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**Table 2. The act and stance for platelet-rich plasma (PRP) devices and medical practice of some countries (June 2019)**

| Country       | PRP device (risk base grade and classification)                                                                 | PRP medical act                                                                                         |
|---------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Republic of Korea | • Class III (moderate risk) (I-IV)  
• A91020.01 as Blood separating kit—a device used for treatment of the extracted blood to re-inject into the body. It includes a container for centrifugation, blood transfusion set, and syringe  
• Over 35 ready-made PRP kit [39] are approved in Korea | • Illegal except for aesthetic or plastic surgery purpose and adjuvant use for dental implant [38]                 |
| U.S [40]      | • Class II (low-moderate risk) (I-III)  
• 21 CFR 864.9245 as Automated blood cell separator—the devices intended to be used to mix with bone graft materials to enhance bone graft handling properties in orthopedic practices—should be approved with under a 510 (k) pre-market notification submit  
• No ready-made kits made in Rep. of Korea are approved as 510 (k) [41] | • PRP is included in HCT/Ps (human cells, tissues, and cellular and tissue-based products) and it is under control of the FDA’s 21 CFR 1271 of the Code of Regulations  
• Free to use a PRP product by Section 361 of the Public Health Service Act—commonly used in the field of dental, orthopedics, plastic surgery as well as office injection for wound and cosmetic purpose, and etc. |
| E.U [42]      | • Class IIA (low-moderate risk) (I-II).  
• Regulation (EU) 2017/745 on Medical Devices (MDR)  
– For collecting, controlling, processing, preserving, and distributing human blood and its components | • Individual European countries are treating the use of PRP devices differently  
• Mostly, the usage ambulatory under the direct responsibility of the physician is possible  
• But, in Italy, the principle does not allow exceptions, and blood components for topical use (considered as blood products) are always under the responsibility of the Blood Transfusion Service |
| China         | • Class III (moderate high–high) (I–III)  
• MD code 10-02-08:  
  10: Transfusion, Hemodialysis, Extracorporeal circulation  
  02: Blood separation, processing, storage equipment  
  08: Preparation of autologous platelet-rich plasma from human autologous blood samples  
• Only 3 ready-made PRP kits are approved as Class III | • Medical institutions permitted by government may use approved ready-made PRP kit to serve their own clinical needs, and use them within their own institution under the guidance of licensed medical practitioners |
| Japan [43]    | Both PRP processing and medical act are controlled under Regenerative Medicine Promotion Act (from November 2014)  
• Production of PRP: The revised Pharmaceuticals and Medical Devices Act (PMD Act)  
• Conventional medical device must be set generic names classified to class I–IV according to their risk level  
• Only 2 ready-made PRP kits are approved as Class III  
• Ready-made PRP kits usually get permission as class I-III according to the purpose. To get class III permission, especially for regenerative medical procedure purpose, it takes a long time and the process of getting permission is difficult  
• MHLW trying to fix PRP kits should take class III approval (May 2019) | • Medical procedure: The Act on the Safety of Regenerative Medicine (ASRM)  
• Autologous PRP procedure is “Class III Regenerative medicine” |
Check points for quality assured autologous platelet-rich plasma therapy

For the achievement of satisfactory clinical results, factors such as control of human influence, PRP preparation protocol and devices, verification of PRP products, medical procedures used by clinicians, and the follow-up treatment procedures should be standardized and maintained [43,46]. The influencing factors and check lists are listed in (Table 3-5) [40,43,47-52]. All the information has been collected on a quality assurance sheet to document the reason for seeking injection, adverse events, and the immediate outcome.

Selection guideline for platelet-rich plasma devices

The most important considerations during the preparation of PRP are safety and effectiveness for human tissue regeneration. Recently, there have been suggestions that there should be more emphasis on the quality testing of final PRP products rather than the preparation protocol and devices to support strong therapeutic evidence [53]. However, these tests are expensive, time-consuming and cumbersome for clinical procedures. Simple tests have been proposed although their validity needs to be further verified. Although most clinicians prefer ready-made kits for many reasons, there are too many variations in their specifications such as recovery rate, concentration performance, RBC and WBC content, the volume of drawn blood, centrifuge condition and the time required.

Therefore, we have made a suggestion that will enable clinicians to select the appropriate commercial kit. First of all, kits

Table 3. Recommended check lists for pre-procedure of autologous platelet-rich plasma (PRP) therapy [43]

|   | Contraindication                                                                 |   |
|---|----------------------------------------------------------------------------------|---|
| 1 | • Cancer or cancer with metastatic state, especially hematologic malignancy      |   |
|   | • Platelet disorder in function and number - Thrombocytopenia (<10^9/μl), platelet dysfunction syndrome etc. |   |
|   | • Hemodynamic instability or hematologic disorder - anemia (Hb <10 g/dl)         |   |
|   | • Hypofibrinogenemia, Coagulopathies, Septicemia                                |   |
|   | • Active infection with *Pseudomonas*, *Klebsiella*, or *Enterococcus*           |   |
|   | • Pregnancy or active breastfeeding                                              |   |
|   | • Skin lesions in the area of the injection                                      |   |
|   | • Medication affect platelets activation and PRP preparation                     |   |
|   | • Type 2 diabetes mellitus, Life habits (alcohol and smoking), Diet (fasting for 3 hours is recommended to prevent plasma opacity and viscosity), Diet (Garlic), etc. |   |
|   | • Disorders and conditions affect platelets activation and PRP preparation       |   |
|   | - Type 2 diabetes mellitus, Life habits (alcohol and smoking), Diet (fasting for 3 hours is recommended to prevent plasma opacity and viscosity), Diet (Garlic), etc. |   |
|   | **Recommended laboratory test to evaluate general condition and rule out contraindications - efficacy and clinical outcomes largely dependent on a patient’s conditions (CBC, LFT, aPTT, BT), Liver Function Test, Diabetes Test, Lipid profile, Thyroid Function Test, Renal Function Test, Inflammation marker (ESR, CRP), Tumor markers, Uric acid, Folic acid, Vitamin B12, and Routine Urinalysis, Tracking of Infection if have, Bone metabolism marker (Vitamin D, Parathyroid Hormone, Growth Hormone) if PRP is used for bone graft adjuvant** |   |
|   | - Platelet indices in CBC profile shows platelet size variation and production status |   |
|   | - The cholesterol or uric acid crystals in plasma induce aggregation and pre-activation of platelet and affect to tissue healing process at injured site |   |
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|   | - Platelet indices in CBC profile shows platelet size variation and production status |   |
|   | - The cholesterol or uric acid crystals in plasma induce aggregation and pre-activation of platelet and affect to tissue healing process at injured site |   |
|   | 4. Recommended laboratory test to evaluate general condition and rule out contraindications - efficacy and clinical outcomes largely dependent on a patient’s conditions (CBC, LFT, aPTT, BT), Liver Function Test, Diabetes Test, Lipid profile, Thyroid Function Test, Renal Function Test, Inflammation marker (ESR, CRP), Tumor markers, Uric acid, Folic acid, Vitamin B12, and Routine Urinalysis, Tracking of Infection if have, Bone metabolism marker (Vitamin D, Parathyroid Hormone, Growth Hormone) if PRP is used for bone graft adjuvant |   |
|   | - Platelet indices in CBC profile shows platelet size variation and production status |   |
|   | - The cholesterol or uric acid crystals in plasma induce aggregation and pre-activation of platelet and affect to tissue healing process at injured site |   |
|   | 4. Informed consent and patients instruction                                      |   |
|   | - Risks to patient from the procedure should be noticed: infection, bleeding, nerve damage, pain, unsatisfactory result and complications associated with accompanying operations, regulatory issues, process, efficacy and clinical outcomes, etc. |   |
|   | - Allow the patient to make an informed decision                                  |   |

CBC, complete blood count; LFT, liver function tests; aPTT, activated partial thromboplastin time; BT, bleeding time; ESR, erythrocyte sedimentation rate; CRP, C-reactive protein.
with the verified features for the final product, such as platelet concentration and GFs contents, should be selected. The next important factor is the RBC contamination [13]. Following that, the subsequent factor that should be considered is the WBC concentration in the final PRP. When the platelets are highly concentrated, there are greater chances of an increase in the number of WBCs, which results in higher chances of destruction or pre-activation of the platelets. If clinicians prefer the combinational approach for immune modulation, kits with flexible WBC content are advantageous. The type of anticoagulant, the draw blood volume and the final volume of PRP should be adjustable to suit the clinical purpose. The handling time and
centrifugation specifications are also other influencing factors. The kits and centrifuges should be easy to operate, ergonomically comfortable, and economically appropriate.

Finally, irrespective of the choice of device or method, care should be taken to keep the platelet count in the prepared PRP within the recommended limits as a minimum check point is required to assure efficacy.

Conclusion

In the field of cosmetic and reconstructive medicine, PRP has been used as a source of abundant GFs and scaffolding. Recently, the role of PRP in stimulating tissue regeneration has been demonstrated, which has made it a suitable candidate as a bioengineering material. To use PRP as an effective regenerative material, clinicians need to be well informed about its essential physiological role as well as the quality assurance procedure.

Conflicts of interest

The authors have nothing to disclose.

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