INTRODUCTION

Surgeons are continually searching for ways to improve the success of bone grafting with either autogenous bone or other bone substitutes. Platelet-rich plasma (PRP) was first introduced to the oral surgery community by Whitman et al. in their 1997 article entitled “Platelet Gel: An autologous alternative to fibrin glue with applications in oral and maxillofacial surgery”. The authors thought that “through activation of the platelets within the gel and the resultant release of these growth factors, enhanced wound healing should be expected”. PRP enjoyed a great increase in popularity in the oral and maxillofacial surgery community after the publication of a landmark article by Marx et al. in 1998. Marx study showed that combining PRP with autogenous bone in mandibular continuity defects resulted in significantly faster radiographic maturation and histomorphometrically denser bone regenerate.

Platelet-rich plasma (PRP) is autologous concentration of human platelets in a small volume of plasma. Therefore, the term PRP is preferred to autologous platelet gel, plasma-rich growth factors (PRGFs), or a mere autologous platelet concentrate. Because it is a concentration of platelets, it is also a concentration of the 7 fundamental protein growth factors proved to be actively secreted by platelets to initiate all wound healing. These growth factors included the 3 isomers of platelet-derived growth factor (PDGFαα, PDGFββ, and PDGFβα), 2 of the numerous transforming growth factors-b (TGFβ1 and TGFβ2), vascular endothelial growth factor, and epithelial growth factor. All of these growth factors have been documented to exist in platelets (Marx et al.; Kevy & Jacobson, 2001). Because these concentrated platelets are suspended in a small volume of plasma, PRP is more that just a platelet concentrate; it also contains the 3 proteins in blood known to act as cell adhesion molecules for osteoconduction and as a matrix for bone, connective tissue, and epithelial migration. These cell adhesion molecules are fibrin itself, fibronectin, and vitronectin.

The purpose of this article is to review the available literature about PRP and the impact of the growth factors it contains. The aim is to realize an update and to inform about the use, application, mechanism of action and clinical benefits of PRP.

PRP CHARACTERISTICS

The mechanism of PRP works. PRP works via the degradation of the α granules in platelets, which contain the synthesized and prepackaged growth factors. The active secretion of these growth factors is initiated by the clotting
process of blood and begins within 10 minutes after clotting. More than 95% of the presynthesized growth factors are secreted within 1 hour (Kevy & Jacobson). Therefore, PRP must be developed in an anticoagulated state and should be used on the graft, flap, or wound, within 10 minutes of clot initiation. Studies that have not used anticoagulated whole blood, which is then clotted to activate the PRP, are not really studies of PRP and therefore are misleading. Related to this, PRP has been shown to remain sterile and the concentrated platelets viable for up to 8 hours once developed in the anticoagulated state and placed on a sterile surgical table (Fig. 1A).

How many platelets are enough? This question has been answered by the work of Haynesworth et al. (2002), who showed that the proliferation of adult mesenchymal stem cells and their differentiation were directly related to the platelet concentration. They showed a dose-response curve, which indicated that, a sufficient cellular response to platelet concentrations first began when a 4- to 5-fold increase over baseline platelet numbers was achieved. A similar study by Lui et al. (2002) showed that fibroblast proliferation and type I collagen production were also enhanced by increasing platelet concentrations and that much of the response was pH dependent with the best responses occurring at more acidic pH levels (Fig. 1B).

Effects of PRP Growth Factors on Cells Involved in Oral Wound Healing. The oral and maxillofacial wound healing involves gingival fibroblasts, gingival epithelial cells, periodontal ligament fibroblasts and osteoblasts, all of which are important for tissue repair and hard-tissue regeneration. A series of well-orchestrated cell-cell interactions is initiated after injury. Disruption of the vasculature as a result of injury leads to fibrin formation and platelet aggregation. Several growth factors are then released into the tissue from the platelets and from the adjacent cells after injury, including platelet-derived growth factor (PDGF), transforming growth factor-alpha, transforming growth factor-beta (TGF-b) andinsulin-like growth factor 1 (IGF-I) (Antoniades et al.,

Fig. 1A. Concentrated platelets on a sterile surgical surface. Fig.1B: Blood samples with platelet in different concentrations. Fig. 1C: PRP insertion in oral cavity with the objective to recover peri-implant defect. Fig. 1D: PRP and PPP after centrifuged process.
Clinical situations benefit from PRP. Because PRP enhances osteoprogenitor cells in the host bone and in bone grafts (Marx et al.; Weibrich et al., 2002), it has found clinical applications in fully autogenous bone grafts and composites of autogenous bone grafts with a variety of bone substitutes with as little as 20% autogenous bone (Garg, 2000). Therefore, PRP has shown improved results in continuity defects 2,15,16,17, sinus lift augmentation grafting (Kassolis et al., 2000; Lozada et al., 2001; Mendonça-Caridad et al., 2006), horizontal and vertical ridge augmentations (Garg), ridge preservation grafting (Carlson et al., 2002) and periodontal peri-implant defects (Kim et al., 2002). We have also observed PRP to allow earlier implant loading and improved osseointegration when used in compromised bone such as osteorotic bone and bone after radiotherapy. Because PRP also enhances soft tissue mucosal and skin healing, it is used in connective tissue grafts, palatal grafts, gingival grafts, mucosal flaps together with Alloderm (BioHorizons, Birmingham, AL) for root coverage, skin graft donor and recipient sites, dermal fat grafts, face lifts, blepharoplasty, and laser resurfacing surgery (Fig. 1C).

Does PRP promote infections? Some have empirically suggested that PRP may promote infections due to the flawed logic that it is a blood clot and that blood agar is used in microbiology laboratories to culture bacteria. However, PRP is no different in substrate than the blood clot that forms in every wound and therefore could not support bacterial growth any more than any other blood clot (Marx, 2004).

PRP-Recent studies. Human studies have also shown that PRP can be advantageously and easily applied in surgery. Man et al. (2001) used PRP in 20 patients undergoing cosmetic surgery, including face lifts, breast augmentations, breast reductions and neck lifts. The application of PRP yielded adequate hemostasis if platelet-poor plasma (PPP) was also applied to create a seal to halt bleeding. The authors reported that bleeding capillaries were effectively sealed within 3 minutes after application of the platelet gel (PRP) and fibrin glue (PPP). They also noted the advantage of minimizing use of electrocautery as to minimize the chance of damage to the adjacent nerves. They concluded that PRP offered significant benefits in terms of accelerated postoperative wound healing, tissue repair and regeneration if PPP was used as a hemostatic agent (Man et al.). Hiramatsu et al. (2002) examined effects of reinfusion of autologous platelet concentrate after open heart surgery in patients with noncyanotic congenital heart disease. Reinfusion of freshly prepared autologous PRP was followed by good aggregation responses and low blood loss. The authors suggested that this procedure might be useful in pediatric open heart surgery to avoid blood transfusion and minimize the need for homologous blood products (Hiramatsu et al., 2002) (Fig. 1D).

CONCLUSION

PRP is new application of tissue engineering and can be used in the most varied areas of the dentistry, being applied in periodontal and maxillofacial surgeries. It is a storage vehicle for growth factors, especially PDGF and TGF-ß. Although growth factors and the mechanism involved are still poorly understood, the ease of applying PRP in the dental clinic and its beneficial outcomes hold promise for further procedures. However, that is new area of the science and many clinical results still will be published, especially in that refers to the efficiency of the procedures, application form, growth factors carriers, genetic modifications of the proteins and growth factors. Certainly, the use of PRP is a step in the history evolution of the regenerative methods and the tissue engineering that will be used next years.
REFERENCES


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