

Comparison of the platelet concentrations obtained in platelet-rich plasma (PRP) between the GPSTM II and GPSTM III systems

Comparaison des concentrations plaquettaires obtenues au sein du plasma concentré en plaquettes (PRP) entre les systèmes GPSTM II et GPSTM III

J.-F. Kaux^a, C. Le Goff^b, J. Renouf^a, P. Peters^b, L. Lutteri^b, A. Gothot^b, J.-M. Crielaard^a

^a Physical Medicine and Sport Traumatology Service, Motility Department, University of Liège, University Hospital Sart-Tilman, avenue de l'Hôpital, B35, 4000 Liège, Belgium

^b Clinical Biology Department, University of Liège, University Hospital Sart-Tilman, avenue de l'Hôpital, B35, 4000 Liège, Belgium

ABSTRACT

Introduction. - Platelet growth factors are known for their ability to speed up tissue healing (bone, skin, tendons, muscle). Various techniques make it possible to collect this platelet-rich plasma or PRP.

Methods. - This study compares the platelet concentrations obtained from five patients using GPSTM III, which has recently come onto the market, with those obtained using GPSTM II.

Results and conclusion. - We obtain a platelet concentration that is six to nine times greater with GPSTM II and GPSTM III, but there is no significant difference between the concentrations of PRP obtained with the two systems.

RESUME

Introduction. - Les facteurs de croissance plaquettaires sont connus pour leur capacité à accélérer la cicatrisation (os, peau, tendons, muscle). De nombreuses techniques permettent cette collecte de plasma riche en plaquettes (PRP).

Méthode. - Cette étude compare les concentrations plaquettaires obtenues à partir du sang de cinq patients à l'aide du système GPSTM III, récemment mis sur le marché, en comparaison de celles obtenues avec le système GPSTM II.

Résultats et conclusion. - Nous obtenons une concentration plaquettaire six à neuf fois plus importante avec les systèmes GPSTM II et GPSTM III. Cependant, il n'existe pas de différence significative entre les concentrations de PRP obtenues avec ces deux systèmes.

Keywords : Platelets ; Comparison ; GPS system

Mots clés : Plaquettes ; Comparaison ; Système GPS

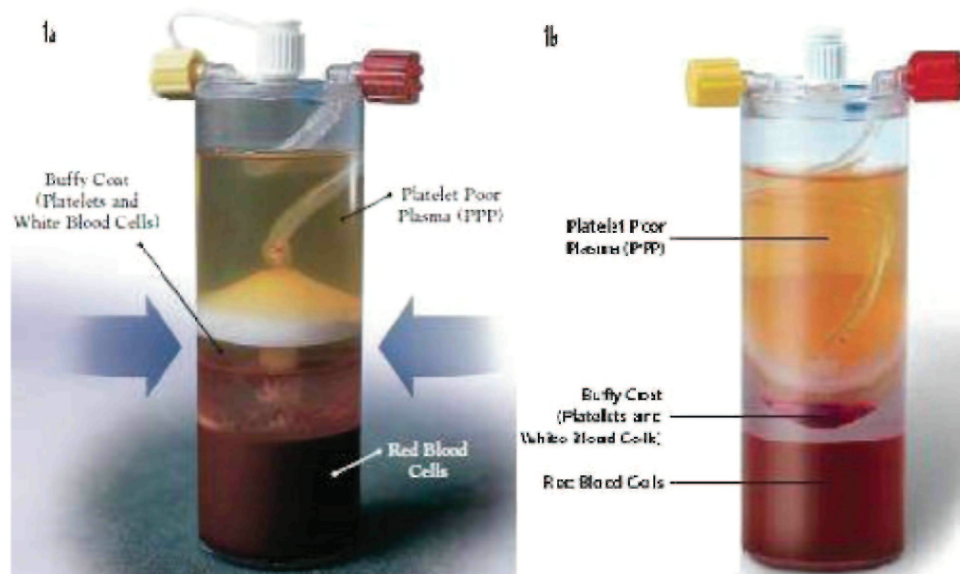
1. Introduction

Blood platelets contain numerous growth factors such as PDGF (platelet-derived growth factor), TGF- β (transforming growth factor- β), IGF-1 (insulin-like growth factor-1), VEGF (vascular endothelial growth factor) and FGF (fibroblast growth factor) [1-3]. They are stored in the α -granules and released when the platelets are activated [1-3]. These growth factors "accelerate" and enhance the healing of different tissues such as bones, skin and tendons. These properties have already been demonstrated in several fundamental or clinical studies on the regeneration of tissue following local injections of platelet concentrates (platelet-rich plasma or PRP) [1-3]. In fact, this technique is already used on a regular basis in maxillofacial and orthopaedic surgery in order to improve bone graft incorporation, in dermatology to treat varicose ulcers in diabetics and, more recently, in sports medicine when treating various chronic tendinopathies [1,3-7].

PRP is obtained after centrifugation of venous blood taken from the patient; as it is prepared from autologous blood, there is no risk of incompatibility or transmission of disease by blood contact (e.g. HIV) [3]. However, there is a theoretical risk of infection when the blood is handled in the preparation of the PRP. Blood must not be taken at the level of any perfusion due to the risk of dilution which is likely to lead to a lower platelet concentration and, as a result, a reduction in its effectiveness [3].

Different techniques for preparing the PRP enable variable concentrations and volumes of PRP to be obtained [1,3,8-10]. GPSTM (Biomet® Biologics, LLC, www.biometbiologics.com) is one of the easiest systems to use as it allows the PRP to be collected in a sterile manner and simplifies the handling procedure. In fact, there is no need to transfer the platelet concentration in a sealed container to another test tube, which is a possible source of microbial contamination. Our study compares the platelet concentrations obtained using GPSTM III (Fig. 1b), which has recently come onto the market, with those obtained using GPSTM II (Fig. 1a).

Fig. 1. : a GPSTM II system; b: GPSTM III system (Biomet® Biologics, LLC).



2. Materials and methods

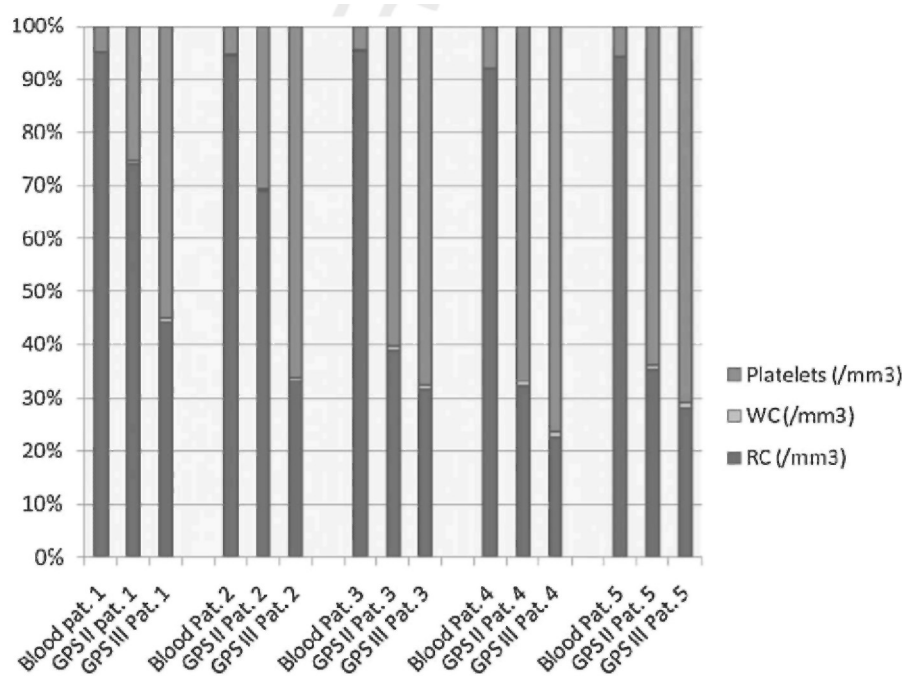
Blood samples were taken by venipuncture on the same day from five volunteers (three males and two females), aged between 29 and 36 (average age 32.5 years) who had given informed consent beforehand. For each patient, 52 mL of blood was collected in a 60 mL syringe containing 8 mL of anticoagulant ACD-A (adenosin-citrate-dextrose-acid). A 12 mL syringe containing 1.6 mL of ACD-A was used to collect 10.4 mL of blood in order to provide a base measurement.

The PRP, prepared from anticoagulated blood and contained in the 60 mL syringes, was transferred to the GPSTM II or GPSTM III system (Fig. 1a and Fig. 1b) and centrifuged for 15 minutes at 3200 rpm (755VES-230 V, Biomet® Biologics, LLC). The plasma was then withdrawn using the yellow cap (Fig. 1a and Fig. 1b). The system was then agitated for 30 seconds to resuspend the buffy coat containing the majority of the platelets. The PRP was then collected using the red cap in a 12 mL syringe (Fig. 1a and Fig. 1b).

The PRP and 6 mL of the collected whole blood were transferred to dry 8 mL tubes and then placed on a tray to settle for 15 minutes before performing the cell and platelet counts (cytoanalyzer ABX Micros 60 [Horiba ABX]).

The comparison between the two techniques is made using Student's t-test. The results will be regarded as significant at a level of uncertainty of 5% ($p < 0.05$).

Fig. 2. Representation (%) of the platelet concentrations, red blood cells and white blood cells obtained in the PRP.



3. Results and Discussion

The GPSTM II and GPSTM III represent two simple techniques that enable PRP to be collected without the risk of samples being contaminated by excessive handling. These closed systems make it possible, after centrifugation, to concentrate the autologous platelets that will be reinjected locally into the patient (Fig. 1a and Fig. 1b). We compared the results for the GPSTM II and GPSTM III to each other and in relation to whole blood. The average volume obtained is 6.2 mL and 6.6 mL, respectively.

We obtained a platelet concentration that is 6.2 to 9.4 times greater with GPSTM II and 7.3 to 8.3 times greater with GPSTM III compared to whole blood. These increases in platelet concentration are significant in comparison with whole blood ($p = 0.004$ and $p = 0.0008$, respectively) (Fig. 2) but there is no significant difference between the concentrations of PRP obtained with the two systems ($p = 0.6$). The platelet concentration found in this comparison between the GPSTM II and GPSTM III systems is different than what was found for the GPSTM II system in a study we performed before [10]. This difference is due to the use of a conventional centrifuge in the original study which was used to standardize the outcome between the different PRP preparations, compared to the use of the Biomet® Biologics Drucker centrifuge used in the current study.

The collection efficiency is 92.2% for platelets present in the initial samples for GPSTM II and 96.4% for GPSTM III; there is no significant difference between the two systems ($p = 0.4$).

Neither system is able to avoid collecting red blood cells (RBC) or white blood cells (WBC). The average concentration of RBC and WBC for each system is $241.6 \cdot 10^3/\text{mm}^3$ and $312.8 \cdot 10^3/\text{mm}^3$, respectively for GPSTM II, and $96.4 \cdot 10^3/\text{mm}^3$ and $275.4 \cdot 10^3/\text{mm}^3$ for GPSTM III; these differences are not significant ($p = 0.07$ and $p = 0.4$ respectively) (Fig. 2). Activated WBCs release MMPs that degrade matrix and reactive oxygen species [11], and lysed RBCs release free radicals, similar to WBCs [12], thus both lead to local inflammation and destroy anything close by.

4. Conclusion

GPS™ II and GSP™ III are systems that make it easy to collect PRP with 90 to 95% efficiency. The platelet concentrations obtained are higher than in whole blood but there is no significant difference between the two systems.

Conflict of interest statement

The 10 GPS™ II and GPS™ III systems were supplied free of charge by Biomet® Biologics LLC.

References

- [1] Eppley BL, Pietrzak WS, Blanton M. Platelet-rich plasma : a review of biology and applications in plastic surgery. *Plast Reconstr Surg* 2006; 118(6): 147e-59e.
- [2] Anitua E, Andia I, Ardanza B, Nurden P, Nurden AT. Autologous platelets as a source of proteins for healing and tissue regeneration. *Thromb Haemost* 2004;91(1):4-15.
- [3] Kaux JF, Degrave N, Crielaard JM. Platelet rich plasma : traitement des tendi- nopathies chroniques ? Revue de la littérature. *J Traumatol Sport* 2007;24(2): 99-102.
- [4] Frey M. Une nouvelle approche thérapeutique dans les pathologies tendinomusculaires : l'utilisation des facteurs de croissance plaquettaires. *J Traumatol Sport* 2009;26(2):76-80.
- [5] Adams JJ, Pal G, Yam K, Spencer HL, Jia Z, Smith SP. Purification and crystallization of a trimodular complex comprising the type II cohesin-dockerin interaction from the cellulosome of *Clostridium thermocellum*. *Acta Crystallogr Sect F Struct Biol Cryst Commun* 2005;61(Pt 1):46-8.
- [6] Mishra A, Woodall Jr J, Vieira A. Treatment of tendon and muscle using platelet-rich plasma. *Clin Sports Med* 2009;28(1):113-25.
- [7] Sanchez M, Anitua E, Orive G, Mujika I, Andia I. Platelet-rich therapies in the treatment of orthopaedic sport injuries. *Sports Med* 2009;39(5):345-54.
- [8] Kaux JF, Le Goff C, Seidel L, Peters P, Gothot A, Albert A, et al. [Comparative study of five techniques of preparation of platelet-rich plasma.]. *Pathol Biol (Paris)* 2009.
- [9] Weibrich G, Kleis WK. Curasan PRP kit vs PCCS PRP system. Collection efficiency and platelet counts of two different methods for the preparation of platelet-rich plasma. *Clin Oral Implants Res* 2002;13(4):437-43.
- [10] Weibrich G, Kleis WK Hitzler WE, Hafner G. Comparison of the platelet concentrate collection system with the plasma-rich-in-growth-factors kit to produce platelet-rich plasma: a technical report. *Int J Oral Maxillofac Implants* 2005;20(1):118-23.
- [11] Scott A, Khan KM, Roberts CR, Cook JL, Duronio V. What do we mean by the term “inflammation”? A contemporary basic science update for sports medicine. *Br J Sports Med* 2004;38(3):372–80.
- [12] Jiang N, Tan NS, Ho b, Ding JL. Respiratory protein-generated reactive oxygen species as an antimicrobial strategy. *Nat Immunol* 2007;8(10):1114–22.