Platelets from platelet-rich-plasma versus buffy-coat-derived platelets: What is the difference?

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Platelets can be prepared from whole blood either using the platelet-rich-plasma (PRP) method or the buffy-coat method (BC-PC). Yet a third type of platelet component is collected using the apheresis technique. Only a few countries still produce PRP platelets with the USA remaining among those countries. For this reason, studies on PRP platelets often were published quite a long time ago. Using the PRP method, whole blood units are centrifuged using a soft spin to concentrate the platelets in the supernatant, i.e. the plasma. The PRP is transferred into a satellite bag. After pelleting the platelets by "hard-spin" centrifugation of the PRP with removal of most of the supernatant, platelet poor plasma, platelets are resuspended and stored as a platelet concentrate (PC) in a reduced volume of the remaining plasma. The second centrifugation in the preparation of PC is associated with reversible platelet aggregation, which probably is induced by activation due to the close contact between platelets in the platelet pellet. Several methods for the preparation of buffy-coat derived platelet concentrates (BC-PCs) are used with differences in the time of storing whole blood preceding the preparation of BC, the time before the preparation of platelet units and the platelet storage medium. BC-PCs are generally prepared from a pool of BCs using sterile connections. Pre-storage leukocyte removal by filtration is often preferred. In contrast to the PRP method, BC methods do not involve significant close cell contact between platelets in a pellet.

The collection of blood is associated with primary activation of coagulation and the generation of significant levels of thrombin and in the next step, activation of platelets.[1] The activation of platelets may result in the release of cytokines and other factors during preparation and storage of platelets that may cause febrile non-hemolytic transfusion reactions (FNHTR) at transfusion. The activation may also affect platelet metabolism, platelet function and morphology of platelets.

In the 1980s, Snyder et al. studied the degree of damage that occurred during the preparation and storage of PC prepared by the PRP method by determining the extracellular percentage of beta-thromboglobulin, a marker for alpha-granule release during the activation of platelets.[2] The results suggested that the degree of *in vitro* activation, as evidenced by the release of alpha-granule content, was dependent on the different preparative steps. In particular, the concentration of platelets into a pellet by centrifugation was found to result in a large degree of release. However, the subsequent storage of platelet was associated with even higher levels of platelet activation. In a later comparative study, Metcalfe et al. studied platelet activation associated with the different preparation methods.[3] They found that the extent of activation was significantly higher in PRP platelets than in BC-PC. In contrast to the studies by Snyder (measuring beta-thromboglobulin), the greatest incremental change occurred during preparation (measuring P-selectin); this was highest in PRP-PC and lowest in BC-PC preparations. These findings further support the negative effects on platelet activation associated with close cell contact between platelets during preparation.[4] Whether these *in vitro* differences translate into a meaningful clinical difference has not been definitely answered. In an even later study by Shanwell et al., the release of RANTES, beta-thromboglobulin, platelet factor 4 (PF4) and IL-7 was measured in BC-PCs stored in different platelet storage media.[5] A continuous increase in cytokine levels during storage was observed. They also observed that the presence of magnesium in the latest generation of platelet additive solutions (PAS) significantly reduced the release of cytokines and other factors from alpha-granules. It was suggested that since FNHTR still occur even after pre-storage leukocyte removal from platelets, such cytokines could be released from platelets during storage and potentially cause transfusion reactions.

In this issue of the journal, Costa et al. present data on CD42b, CD62p (P-selectin), and cytokines IL-1b, IL-6, IL-8, and TNF-alpha.[6] In some respect, this study is similar to the earlier study by Metcalfe et al. since P-selectin was measured in both studies.

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In contrast to the results of the study by Metcalfe et al., Costa et al. did not observe higher levels of P-selectin in PRP PCs than in BC-PC. However, the BC-PC may have been prepared in a different way. The cytokines measured are generally derived from white blood cells. The platelet units used in the present study were not leukocyte-reduced, suggesting that higher levels of leukocyte-derived cytokines could be expected than in leukocyte-reduced platelet units. Increasing, but similar, levels during storage were observed in PCs from PRP and in BC-PCs indicating continuous release of cytokines over time. A number of other *in vitro* parameters were also included, viz. pH, pO_2, pCO_2, bicarbonate, Na^+, K^+, Cl^-, glucose, and lactate. No significant differences were observed that would indicate difference in quality between the two types of platelet preparations. Previous studies suggest that the pH tends to be lower in PRP PCs than in BC-PCs.

The presence of cytokines in platelet preparations poses a potential risk for transfusion-related reactions. The concentrations can be reduced by using leukocyte-reduced platelet units to avoid release of cytokines from leukocytes during storage. In addition, release of platelet-derived cytokines such as RANTES, alpha-TG, PF4, and IL-7 can be reduced by using storage media that will reduce activation of platelets associated with release of alpha-granule content. The clinical consequences of the effects of passive transfusion of low concentrations of leukocyte- or platelet-derived cytokines need to be addressed in further studies.

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