The Arthrex Autologous Conditioned Plasma Double Syringe System® for Canine Use

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Arthrex Research and Development

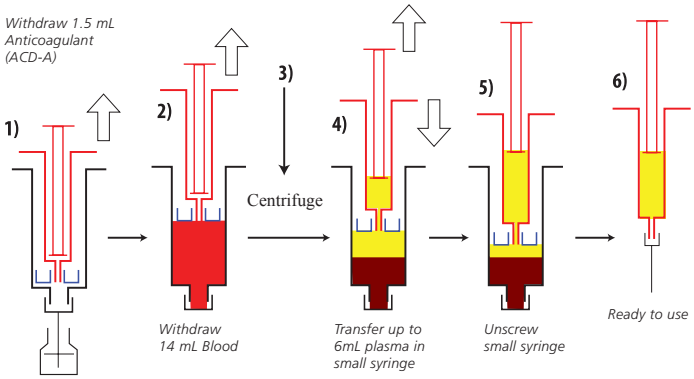
Introduction

The Arthrex ACP® (Autologous Conditioned Plasma) System is designed to concentrate autologous blood to produce a platelet concentrate. ACP has been used for a multitude of clinical and surgical procedures, from intra-articular therapy to augmentation of total joint replacements. The use of ACP in dogs has been shown to alleviate osteoarthritis symptoms, improve postoperative recovery, and reduce infection rates after invasive surgery (Fahie, Franklin, Silva).

Production of ACP

(Figure 1) illustrates the ACP process. In Step 1, 1.5 mL of anticoagulant citrate dextrose solution A (ACD-A) is drawn into the larger 15.5 mL syringe. ACD-A is a mixture of citric acid, sodium citrate, and dextrose which acts as an anticoagulant by binding free calcium in the blood. In Step 2, 14 mL of the patient's blood is drawn into the larger syringe. In Step 3, the entire syringe containing the whole blood is centrifuged at 5x1500 with the brake disengaged. This separates red blood cells (RBCs) from the platelet-containing plasma solution, but does not separate what is within the plasma further. In Step 4, up to 6 mL of the platelet concentrate solution is carefully drawn into the smaller syringe, with care taken to not draw up any RBCs into the smaller syringe. There are two distinct methods of platelet extraction. In the normal technique, the user transfers the platelet concentrate into the smaller syringe until the tip of the smaller syringe reaches the transition layer. In the "sunrise technique", the user continues to pull the plunger of the smaller syringe past the transition layer until a flash of red blood cell incursion can be seen. The smaller syringe is then unscrewed from within the larger syringe and the sample is agitated to distribute platelets uniformly in solution. Finally in Step 5 the ACP is ready for use.

Figure 1: Steps in production of ACP using double syringe system.



Methods

Dogs (n=21) weighing over 25kg were enrolled in a clinical study and 60 mL of blood was drawn. 1.5mL of ACD-A and 14 mL of blood were transferred into the double syringe. Syringes were gently mixed, and 0.5 mL of blood transferred into a sterile tube for hematologic analysis (baseline / reference values). Double syringes were then placed into the centrifuge with appropriate counterbalances at 1500 rpm for 5 minutes without the brake engaged. After the one step centrifugation process, double syringes were removed, being careful to keep them in the upright position so as to not disturb the plasma layer. As described in the previous section, platelet concentrate was then transferred into the inner syringe via normal or sunrise techniques. The concentrate was then analyzed and results recorded.

Results

See (Table 1 and 2) for numerical results. The normal and sunrise techniques produced a platelet increase of greater than 1.5 while also drastically reducing white blood cells and hematocrit. The normal technique had a statistically significant, and perhaps clinically important, reduction in RBC and WBC compared to the sunrise technique.

Table 1: Cellular concentrations of ACP (n = 21 donors) compared to baseline, whole blood values.

Cellular Concentrations	PLT (K/uL)	WBC (K/uL)	HCT (%)
Control, Whole Blood	253.4 ± 57.0	6.94 ± 2.16	39.8 ± 4.8
Normal Technique	393.6 ± 159.1	1.06 ± 1.27	0.0
Sunrise Technique	397.8 ± 121.6	2.69 ± 2.06	4.4 ± 61.6

Table 2: Comparison of ACP techniques. Platelet and white blood cells in platelet concentrate were compared to whole blood values. Column [PLT]:[WBC] refers to the ratio of platelet concentration to white blood cell concentration.

Cellular Ratios	PLT Increase	WBC Increase	[PLT]:[WBC]
Arthrex Normal Technique	1.55x	0.15x	371
Arthrex Sunrise Technique	1.57x	0.39x	148
Protec*	0.85x	0.14x	173
C-PET*	1.84x	2.49x	23
SmartPReP2*	5.15x	3.27x	55

*Franklin study, "Characterization of canine plasma using commercially available 'platelet rich plasma' concentrating systems" (submitted for publication).

Notes:
[1]In-house data
[2]Published data, where N/A = not reported
*Normal human circulating levels of HCT% = 35.50%

Discussion

Both techniques concentrate platelets over baseline, which previous studies have shown aids in the healing process while simultaneously reducing inflammation in human, equine, and canine subjects (Fahie, Anitua, Bosch).

Both techniques also effectively reduce white and red blood cell count in the final product. Research has shown that an excess of white blood cells induce inflammation and may over-phagocytize the wound site (Diegelmann). The presence of red blood cells releases degradative proteins that trigger a pro-inflammatory response and oxidative stress as well as the recruitment of more white blood cells (Lundvig). Therefore, the normal ACP technique may be preferred.

In comparison to equivalent competitor products, Arthrex ACP® produced the highest platelet concentrate to lowest white blood cell concentrate (Table 2).

Additional investigation is ongoing, but preliminary data suggests that platelets may be concentrated in the lower part of the separated plasma. Where platelet concentration is important, e.g. when injected sample volume must be limited, it may be advisable to remove the top level of plasma and discard, and then to aspirate the remaining plasma for clinical use.

References

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