The effects of autologus platelet rich plasma and various growth factors on non-transplanted miniaturized hair

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Abstract

After utilizing platelet rich plasma (PRP) in all phases of a hair transplant procedure and infusing PRP into the scalp of patients prior to hair transplantation, the authors noticed a more mature hair growth sooner when compared to patients who had not had PRP therapy. While this observation was anecdotal, the authors proposed a study to determine if autologus platelet rich plasma had any effect on non-transplanted miniaturized hair.

What would be the effect of traumatizing and then infusing concentrated amounts of growth factors directly into the scalp? Is it possible to reverse miniaturization in androgenetic alopecia and stimulate hair growth in other conditions such as alopecia areata?

The results from this small study indicate that traumatizing and infusing PRP into the scalp did reverse miniaturization over an 8-month period when compared to control. Additionally, infusion of PRP into a patient with alopecia areata did result in new hair growth 1 month after treatment and lasted over 8 months.

Introduction

In 2004, one of the authors treated a severe equine wound with platelet rich plasma (PRP) and within 1 month the wound healed and hair was growing. After utilizing PRP in all phases of a hair transplant procedure, the authors infused PRP into scalps of patients prior to hair transplantation and these patients seemed to have "thicker" looking hair when compared to patients who had not had PRP therapy.[1] This led the authors to believe that revascularization and the effects of high concentrations of growth factors could possibly be stimulating the follicular cells of the non-transplanted hair in the affected region. When whole blood is processed, platelets and other plasma protein cells are centrifuged and concentrated. For PRP to be effective or at a therapeutic level, a normal platelet count of 150,000-450,000 platelets per microliter must be increased to over 1 million platelets per microliter.[2]

There are seven growth factors (GFs) located in the alpha-granules plus antimicrobial peptides, catecholamines, serotonin, osteonectin, von Willebrand factor, proaccelenn, and other substances. The dense granules contain over 100 GFs, which are released upon activation at the site of an injury. In addition to the GFs, the serum or platelet poor plasma (PPP) contains three proteins known to act as cell adhesion molecules: Fibrin, fibronectin, and vitronectin, which, when concentrated, can create a matrix or scaffolding for the cells to attach and build upon.

Takakura, et al. demonstrated that PDGF (platelet derived growth factor) signals are involved in both epidermis-follicle interaction and the dermal mesenchyme interaction required for hair canal formation and the growth of dermal mesenchyme, respectively.[3] In 2001, Yano, et al. identified VEGF (vascular endothelial growth factor) as a major mediator of hair follicle growth and cycling providing the first direct evidence that the improved follicle revascularization promotes hair growth and increases follicle and hair size.[4]

If we believe that "when a follicle has become miniaturized beyond recognition by the naked eye, it still has the potential of retransformation and of generating large shafts"[5] and if "vellus hair follicles have pretty much the same complement of epithelial hair follicle stem cells in the bulge region as large terminal ones,"[6] then it should be possible for miniaturized hair to reverse.

Material and Methods

Ten hair samples were taken from each patient; there were 5 patients in the control group (CG) and 5 patients in the treatment group (TG). Ten hair samples were taken because of the ratio of 90% anagen and 10% telogen hairs. Hair diameter was measured with a Starrett micrometer 1cm above the base.

Next, in all patients local anaesthesia was administered in the treatment area.

In the TG patients, 60cc of blood was drawn and 10cc of PRP was processed. The CG patients also had 60cc of blood drawn, but this was not processed. Local anaesthesia was used in both groups.

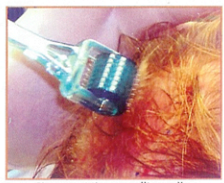

Figure 1. Micro needling roller

The scalp was then traumatized in both the TG and CG with a 1mm micro needling roller (Figures 1 and 2) to initiate the Stat3-dependent keratinocyte migration toward the anagen progression and wound healing (Figure 3).

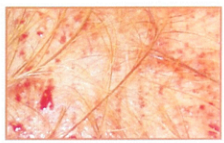

Figure 2. Traumatized scalp

The TG was then injected with PRP in a retrograde fashion "deep to superficial" every centimeter throughout the treated area and then PRP was sprayed on the scalp and left on overnight.

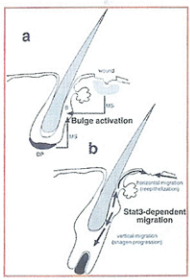

Figure 3. Stat3-dependent keratinocyte migration

Normal saline was injected into the scalp of the CG in a similar fashion.

Patients were evaluated and hair diameter measurements were taken at 4 and 8 months post treatment in a similar fashion and an average of 10 hairs were measured and compared.

Results

The results revealed an increase of 9.7% in average hair shaft diameter at 4 months, and

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6.1% at 8 months in the TG. The CG demonstrated a 2.8% average decrease in hair shaft diameter at 4 months, and 3.5% decrease at 8 months (Figures 4, 5, and 6).

In Figure 5, the blue line demonstrates the increase of average hair shaft diameter in the treatment group at 4 months and then a gradual decrease at 8 months due to the effects of DHT; whereas the CG (purple line) average hair shaft diameter decrease continued from 4 months to 8 months.

Discussion

This small study demonstrated that the combination of traumatizing scalp and infusing various growth factors reversed miniaturization in non-transplanted hair for up to 8 months in androgenetic alopecia patients.

The authors also observed that hair growth was stimulated in a patient with alopecia areata after traumatizing and infusing PRP. The patient was growing hair at 1 month and hair growth continued over 10 months (Figure 7). An expanded study is underway to evaluate this therapy.

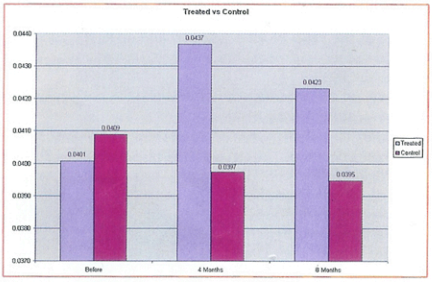

Figure 4. Control vs. treated study results

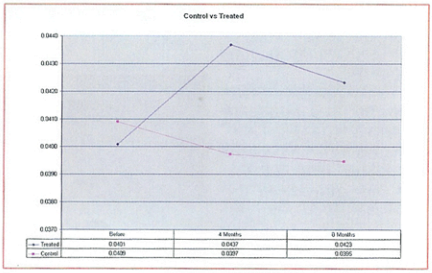

Figure 5. Control vs. treated hair diameter

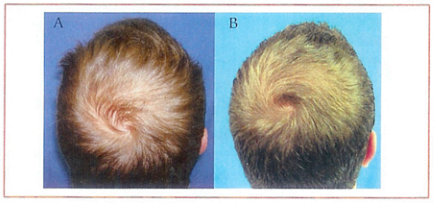

Figure 6. A: Androgenic alopecia, before; B: 8 months after PRP treatment

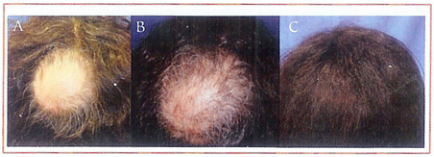

Figure 7. A: Alopecia areata, before; B: 1 month after PRP; C: 1 year after PRP

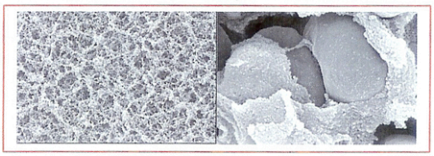

Figure 8. A: SEM low-resolution matrix view; B: SEM high-resolution matrix view

The next generation of autologous PRP is the addition of an extracellular "matrix" (ECM) and independent studies conclude that "GF-ECM complexes may well be the most effective and efficient method to stimulate cell proliferation, as well as tissue healing or regeneration."[7] In 2001, one of the authors developed a patented process that creates a natural protein matrix (ECM) (Figure 8), which entraps growth factors and allows cells to attach and proliferate. This GF-ECM complex has demonstrated a synergistic effect in both human and equine wounds, as well as soft tissue and bone regeneration treatments and will be utilized in subsequent hair research studies.

Knowing the composition of hair and the future of hair multiplication, is there a more logical way to proliferate the growth of newly cultured dermal papilla and keratinocytes, then entrapping those cells in the body's own natural protein/growth factor matrix that promotes angiogenesis and mitogenesis?

References

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