Platelet Derived Growth Factor and the Clinical Outcome of Platelet Rich Plasma in Female Pattern Hair Loss

Thesis

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Mohamed Aly Aidaros

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Abb.	Full term
ACTH	*Adrenocorticotropic Hormone*
AGA	*Androgenetic Alopecia*
AKT	*Ak Strain Transforming*
AR	*Androgen Receptor*
ATP	*Adenosine Triphosphate*
Bcl-*2*	*B-cell lymphoma 2*
bFGF	*Basic Fibroblast Growth Factor*
CaCl2	*Calcium Chloride*
CAG	*Cytosine-Adenine-Guanine*
cc	*Cubic Centimeters*
CUB	*Complement C1r/C1s, Uegf, Bmp1*
CYP	*Cytochrome*
CYP17A1	*Cytochrome P450c17*
DHEA	*Dehydroepiandrosterone*
DHEA-S	*Dehydroepiandrosterone Sulfate*
DHT	*Dihydrotestosterone*
DNA	*Deoxyribonucleic Acid*
DP	*Dermal Papilla*
DPCs	*Dermal Papillae Cells*
EGF	*Epithelial Growth Factor*
ERK	*Extracellular Signal-Regulated Kinases*
FGF	*Fibroblast Growth Factor*
FGF2	*Fibroblast Growth Factor 2*
FGF5	*Fibroblast Growth Factor 5*

List of Abbreviations (Cont...)

Abb.	Full term
FGF7	*Fibroblast Growth Factor 7*
FPHL	*Female Pattern Hair Loss*
HDPCs	*Human Dermal Papilla Cells*
HF	*Hair Follicle*
HGF	*Hepatocyte Growth Factor*
IGF-1	*Insulin-Like Growth Factor 1*
IL-1 α	*Interleukin-1 Alpha*
LH	*Luteinizing Hormone*
L-PRP	*Leukocyte and Platelet-Rich Plasma*
MMP	*Matrix Metalloproteinase*
MPA	*Male Pattern Alopecia*
PCF	*Platelet Concentration Factor*
PCOS	*Polycystic Ovary Syndrome*
PDGF	*Platelet- Derived Growth Factor*
PGD2	*Prostaglandin D2*
PGE2	*Prostaglandin E2*
PI3K	*Phosphatidylinositol 3`-Kinase*
PPP	*Platelet Poor Plasma*
PRFM	*Platelet- Rich Fibrin Matrix*
PRP	*Platelet-Rich Plasma*
RBCs	*Red Blood Cells*
RTKs	*Receptor Tyrosine Kinases*
SAHA	*Seborrhea, Acne, Hirsutism, Androgenetic Alopecia*

List of Abbreviations (Cont...)

Abb.	Full term
SHGB	*Sex Hormone Binding Globulin*
STUL	*Streptomyces Tubercidicus Sequence-Specific Endonuclease*
T	*Testosterone*
TGF	*Transforming Growth Factor*
TGF-b	*Transforming Growth Factor-b*
TNF-α	*Tumor Necrosis Factor α*
VEGF	*Vascular Endothelial Growth Factor*
VEGFRs	*Vascular Endothelial Growth Factor Receptors*
WB	*Whole Blood*
WBCs	*White Blood Cells*
Wnts	*Wingless-related integration site*

INTRODUCTION

Female pattern hair loss (FPHL) is a common condition which is generally regarded as the female counterpart of male balding. FPHL typically presents as a diffuse reduction in scalp hair density, which predominantly affects the crown and frontal scalp, although the parietal and occipital regions are also involved in some women. The prevalence and severity of FPHL increase with age ***(Messenger et al., 2006).***

In FPHL there is a reduction in the duration of the anagen phase and a miniaturization of the dermal papilla (thinning of the hair). Thick pigmented hairs are gradually replaced by miniaturized hairs. Moreover, there is a delay between the end of the telogen phase and the beginning of the new anagen phase. This resting phase, during which the hair follicle remains empty, is known as the kenogen phase. There is a gradual decrease in capillary density in the affected areas ***(Rebora et al., 2002).***

In general, FPHL has its onset during the reproductive years. More severe cases of the disease are already noticeable at puberty. However, there is a greater demand for treatment among patients aged 25-40 years. There is a second peak incidence at menopause, between 50 and 60 years of age ***(Tosti et al., 2006).***

There is evidence that FPHL has a phenotype independently associated with insulin resistance and atherosclerosis. The causal model for this finding has not yet been established, but it may be related to a hyperandrogenic state induced by insulin resistance, which also favors atherosclerosis ***(Madnani et al., 2013).***

Platelet-rich plasma (PRP) is defined as a volume of the plasma fraction of autologous blood with an above baseline platelet concentration (usually more than 1,000,000 platelets/μL) ***(Angeliki et al., 2015).***

Platelet rich plasma is used as an innovative therapy in diverse fields including dermatology, dentistry, surgery, orthopedics, and aesthetics. Its use for hair restoration is becoming increasingly common ***(Lin et al., 2016).***It has shown remarkable beneficial effects without any major adverse reactions in the treatment of androgenic alopecia ***(Singhal et al., 2015).***

Platelet rich plasma is a rich source of growth factors such as insulin-like growth factor 1 (IGF-1), platelet- derived growth factor (PDGF), transforming growth factor-b (TGF-b), vascular endothelial growth factor (VEGF), epidermal growth factor (EGF) and fibroblast growth factor (FGF) which together can stimulate cell survival, proliferation, differentiation, and angiogenesis. Application of these growth factors to dermal papilla (DP) cells can lead to the initiation and prolongation of

anagen phase in the hair follicle. Alpha granules within the platelets contain the growth factors and facilitate release at high concentrations, when the PRP preparation is activated ***(Li et al., 2012).***

Biologic functions of PDGF in hair folliculogenesis include acting as mitogenic factor for mesenchymal cell differentiation, stimulation of fibroblast and smooth muscle cell chemotaxis and mitogenesis, regulation of collagenase secretion and collagen synthesis, and stimulation of macrophage and neutrophil chemotaxis ***(Dhurat et al., 2014).***

AIM OF THE WORK

This study aims to evaluate the relationship between the concentration of platelet derived growth factor (PDGF) in the platelet rich plasma (PRP) preparation and the treatment results obtained using PRP.

Chapter 1

FEMALE PATTERN HAIR LOSS

Definition:

The female pattern hair loss (FPHL) is a non-scarring progressive thinning of hair. It results from a progressive decrease in the ratio of terminal hair to shorter, thinner vellus hair, a process known as follicular miniaturization ***(Messenger et al., 2006).*** It follows a pattern of distribution where in women there is diffuse thinning over the frontal and vertex areas ***(Price 2003).***

Epidemiology:

The FPHL is very common and increases with age in the Caucasian women populations **(Table 1).** A study in 2001 established a prevalence of 19 percent in a series of 1000 Caucasian women. It can occur at any age but most commonly occurs following menopause. The rise with age was also established in the same study where FPHL occurred in 4 of 121 women between the ages of 20 and 29 (3%), but in 41 of 140 women between the ages of 70 and 89 (29%) ***(Norwood, 2001).*** In a British study of 377 women, 38 percent of women over the age of 70 years had FPHL ***(Birch et al., 2001).*** No data regarding FPHL in African women has been published ***(Vujovic et al., 2014).***