Evaluation of Using Stromal Vascular Fraction and Platelet Rich Plasma In The Treatment of Androgenetic Alopecia

Thesis

Submitted for Partial Fulfillment of Master's Degree in General Surgery

By:

Basem Osama Mohammed Ahmed Ashry

Degree: M.B.B.Ch.

Under the Supervision of:

Prof. Khaled Abdallah Alfeky

Professor of General Surgery - General Surgery Department
Faculty of Medicine - Ain Shams University

Dr. Khaled Mohammed Ali Elgazzar

Assistant Professor of Plastic, Burn and Maxillofacial Surgery
Plastic, Burn and Maxillofacial Surgery Department
Faculty of Medicine - Ain Shams University

Dr. Ahmed Mamdouh Nafeh

Lecturer of Plastic and Reconstructive Surgery
Plastic and Reconstructive Surgery Department
Faculty of Medicine - Helwan University

Faculty of Medicine
Ain Shams University
2018

ACKNOWLEDGEMENT

*First of all, all gratitude is due to **Allah** almighty for blessing this work, until it has reached its end, as a part of his generous help, throughout my life.*

*I would like to express my deep gratitude, appreciation, thanks and respect to **Prof. Dr. Khaled Elfeky & Ass. Prof. Dr. Khaled Elgazzar,** for their continuous encouragement, advise, understanding and meticulous supervision.*

*Also I'd like to use this opportunity to express my gratitude to **Dr.Ahmed Mamdouh Nafeh** who supported me throughout the course of this thesis. I am thankful for his aspiring guidance, invaluably constructive criticism and friendly advice not only during this work, but also throughout my whole career.*

*Finally, I must express my very profound gratitude to the Discussion and judging committee **Prof. Dr. Khaled Elfeky, Prof. Dr. Ahmed Aly & Ass. Prof. Dr. Hatem ElGohary** for accepting nothing less than excellence from me. Without their passionate & meticulous participation and input, this work could not have been successfully completed. many thanks & appreciations for your time & consideration.*

Basem Osama

Dedication

To:

My beloved mother

My great father

For their endless love, support,
and continuous care

LIST OF CONTENTS

LIST OF ABBREVIATIONS

Acronym	Definition
Aa-Prp	Autologous Activated Platelet Rich Plasma
ACD	Anticoagulant Citrate Dextrose
ADP	Adenosine Diphosphate
ADS	Adult Stem
ADSC	Adipose Derived Stem Cells
AFT	Autologous Fat Transfer
AGA/TE	Androgenetic Alopecia / Telogen Effluvium
ANA	Antinuclear Antibodies
AS	Adult Stem
ASC /ASCs	Adult Stem Cells
AT-ASC / AT-ASCS/ AT-ASCs	Adipose Tissue Adult Stem Cells
ATP	Adenosine Triphosphate
BM	Bone Marrow
BM-MSCs	Bone Marrow Mesenchymal Stem Cells
CaCl 2	Calcium Chloride
CBC	Complete Blood Count
CB-SCs	Cord Blood Stem Cells
CE	European Conformity
CESC /CESCs	Corneal Epithelial Stem Cells
CO2	Carbon Diaoxide
CSC /CSCs	Cardiac Stem Cells
CTE	Chronic Telogen Effluvium
CTGF	Connective Tissue Growth Factor
DHT	Dihydrotestosterone
DKK	Dickkoft
DMEM	Dulbecco's Modified Eagle Medium
DNA	Deoxyribonucleic Acid
DP	Dermal Papilla
ECGF	Epithelial Cell Growth Factor
ECM	Extracelluar Matrix

EDTA	Ethylene Diamine Tetraacetic Acid
EGF	Epidermal Growth Factor
ERK	Extracellular Regulated Kinase
ESC	Embryonic Stem Cells
ESCs	Embryonic Stem Cells
FDA	Food & Drug Administration
FBS	Fetal Bovine Serum
FGF	Fibroblast Growth Factor
FPHL	Female Pattern Hair Loss
FSC	Fetal Stem Cells
FSH	Follicle Stimulating Hormone
FUT	Follicular Unit Transplantation
GF	Growth factors
GFP	Growth factors by the platelets
GFs	Growth Factors Source
GSK-3b	Glycogen Synthase Kinase-3b
He-Ne	Helium Neon
HF	Hair Follicle
HGB	Hemoglobin
HGF	Hepatocyte Growth Factor
HOC	Hepatic Oval Cells
HSC	Hematopoietic Stem Cells
HUCM	Human Umbilical Cord Matrix
IBMX	3-Isobutyl-1- Methylxanthine
ID	Intra Dermal
IDDM	Insulin Dependent Diabetes Mellitus
IGF	Insulin Like Growth Factor
IL-1	Interlukin
IV	Intravenous
LED	Light Emitting Diode
LH/FSH	Luteinizing Hormone/ Follicular Stimulating Hormone
LLLT	Low Level Laser Therapy
L-PRF	Leucocyte and Platelet Rich Fibrin
L-PRP	Leucocyte and Platelet Rich Plasma

MHC	Major Histocompatibility Complex
MHPL	Male Pattern Hair Loss
MMP	Matrix Metalloproteinases
MPHL	Male Pattern Hair Loss
MSC	Mesenchymal Stem Cells
NSAID	Nonsteroidal Anti-Inflammatory Drug
PBS	Phosphate Buffered Saline
PCO	Poly Cystic Ovary
PDAF	Platelet Derived Angiogenesis Factor
PDEGF	Platelet Derived Endothelial Growth Factor
PDGF	Platelet Derived Growth Factor
PPP	Platelet Poor Plasma
P-PRF	Pure Platelet Rich Fibrin
P-PRP	Pure Platelet Rich Plasma
PRF	Platelet Rich Fibrin
PRFM	Platelet Rich Fibrin Matrix
PRGF	Plasma Rich In Growth Factors
PRP	Platelet Rich Plasma
PSC	Pancreatic Stem Cells
PT	Prothrombin Time
PTT	Partial Thromboplastin Time
RANTES	Regulated Activation Normal T-Cells Expressed And Secreted
RBC	Red Blood Cells
ROS	Reactive Oxygen Species
RPM	Rotations Per Minute
SD	Standard Deviation
SVF	Stromal Vascular Fraction
TCF/LEF	T-Cell Factor/ Lymphoid Enhancer-Binding Factor
TE	Telogen Effluvium
TGF-β	Transforming Growth Factor- β
TSH	Thyroid Stimulating Hormone
VEGF	Vascular Endothelial Growth Factor
WB	Whole Blood
WBC	White Blood Cell

LIST OF FIGURES

LIST OF FIGURES (Cont.)

LIST OF FIGURES (Cont.)

LIST OF FIGURES (Cont.)

LIST OF TABLES

Abstract

Background: Androgenetic alopecia (AGA) is the most common form of alopecia, affecting up to 80% of men and 50% of women during their life time.

Aim of the Work: to compare the efficacy, safety and adverse effects of using lipo-aspirate stromal vascular fraction versus Platelet Rich Plasma injection in the treatment of Androgenetic Alopecia (AGA).

Patients and Methods: This study included 40 patients (18 male & 22 female) suffering from androgenetic alopecia. A written consent was obtained from all the patients. Approval from the research ethics committee of the faculty of medicine, Ain-Shams University was also obtained.

Results: Our study suggests that was significant improvement in AGA after PRP and highly significant after SVF therapy, with significant difference of SVF in terminal hair count and highly significant in vellus hair. Both modalities could effectively and safely be used to treat AGA.

Conclusion: Finally, histopathological study is needed to detect ultrastructure changes following PRP & SVF injections in androgenetic alopecia before and after treatment.

Key Word: Stromal Vascular Fraction, Platelet Rich Plasma, Androgenetic Alopecia

INTRODUCTION

Androgenetic alopecia is a common disorder leading to a progressive thinning of the scalp hair in a distinctive pattern more in men and occasionally in women. AGA develops with hairline recession in most men while women develop a diffuse thinning over the top of the scalp with more thinning towards the front and maintaining the frontal hair line ***(Ferneini et al., 2017)***.

Androgenetic alopecia (AGA) is the most common form of alopecia, affecting up to 80% of men and 50% of women during their life time ***(Piraccini and Alessandrini, 2014)***.

Androgenetic alopecia (AGA) is one of the commonest reasons for plastic surgery consultation. Over the last few years our understanding of the pathophysiology of AGA has improved and this has paved the way for better diagnostic and therapeutic options ***(Rompolas and Greco, 2014)***.

AGA usually begins between 18 and 40 years in both men and women and affects approximately 50% of the population before the age of 50 ***(Rodrigues et al., 2017)***. Individuals impacted by Androgenetic alopecia are subject to general psychological trauma, as many reports a decreased quality of life, lack of self-confidence and limited social contacts. Conventional treatments of AGA may fail to treat the patients completely; they include medical treatments or surgical hair transplantation ***(Goren et al., 2015).***

Researches were concentrated on the role of stem cells in the pathophysiology of AGA ***(Kaliyadan et al., 2013)***. The discovery of pre-adipocytes by Zuk, its mesenchymal origin and its role as pluripotent stem cells has been used in regenerative medicine to maintain graft tissue ***(Zuk, 2001)***.

Stem cell is a cell that can self-replicate and can give rise to more than one type of mature daughter cell ***(Forbes et al., 2002)***. Stem cells are classified into four broad types based on their origin: Stem cells from embryos, Stem cells from the fetus, Stem cells from the umbilical cord and Stem cells from the adult ***(Jones et al., 2001)***. Although the therapeutic potential of embryonic

stem cells is enormous due to their auto reproducibility and pluripotentiality, there are still some limitations to their practical use, including cell regulations, ethical considerations and genetic manipulations ***(Lenoir, 2000 and Takahashi, 2006)***. In contrast, postnatal adult stem cell, are by nature, immune-compatible and there are no ethical issues related to their use ***(Mizuno, 2009)***.

Adult Stem Cells (ASCs) are unspecialized or undifferentiated cells; that not only retain their ability to divide mitotically while still maintaining their undifferentiated state; but also, when given the right conditions, ASCs have the ability to differentiate into different types of cells including cells of different germ origin, an ability referred to as trans-differentiation or plasticity ***(Filip et al., 2003)***. Adipose tissue ASCs are extremely similar to stem cells isolated from bone marrow in morphology, growth, transcriptional and cell surface phenotypes ***(Pittenger and Martin, 2004; Young et al., 2005)***.

Clinically, stromal vascular fraction-derived AT-ASCs have the advantage of been easy and less painful over their bone marrow derived counterparts ***(Pittenger and Martin, 2004).*** Compared to any other source, the vast amounts of adipose tissue especially in the abdominal region, ensure an abundance in numbers of ASCs ranging in the millions per unit volume ***(Tholpady et al., 2006).***

Adipose tissue derived adult stem cells (AT-ASCs) are isolated as part of the aqueous fraction derived from enzymatic digestion of lipoaspirate. This aqueous fraction, a combination of ADSCs, endothelial precursor cells (EPCs), endothelial cells (ECs), macrophages, smooth muscle cells, lymphocytes, pericytes, and pre-adipocytes among others, is what is known as the stromal vascular fraction (SVF) ***(Bora and Majumdar, 2017)***

Adipose tissue derived adult stem cells (AT-ASCs), as well as Bone marrow derived adult stem cells (BM-ASCs), are called Mesenchymal ASCs because they are both of mesodermal origin. This means that AT-ASCs are able to differentiate into specialized cells of mesodermal origin such as adipocytes, fibroblasts, myocytes, osteocytes and chondrocytes ***(Zuk et al., 2002)***.