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Exosome Therapy for Androgenetic Alopecia: Case Report

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Abstract

Alopecia (hair loss) is considered a common condition worldwide. However, Androgenetic alopecia is the most common form of hair loss and does affect both men and women. Androgenetic alopecia is reported to affect 50% of the population by the age of 50 years in males and a decade later in females in Singapore. Alopecia has significant implications for patients' physical appearance, psychological well-being and overall quality of life. Exosomes are nanosized, membrane-bound extracellular vesicles (EVs) that contain bioactive molecules such as proteins, lipids, mRNA, and microRNA to mediate intercellular communication and participate in numerous dermatological processes and therapeutic mechanisms. The ability of exosomes to control vital biological mechanisms, such as dermal papilla cell growth, neovascularization, and the regulation of inflammatory pathways, has been demonstrated. These mechanisms are essential for the hair regrowth cycle and Exosomes play a role in the treatment of androgenetic alopecia.

Keywords

Exosome Therapy; Androgenetic Alopecia; MicroRNA; Vascular endothelial growth factor.

Introduction

Hair covers most regions of the human body and serves essential physiological and psychological functions, such as protection, thermoregulation and sensory input. Each hair strand is formed in a **hair follicle** that goes through three phases divided didactically into anagen (growth phase), catagen (involution phase), and telogen (latent or resting phase). At the end of the telogen phase, the hair follicle restarts the anagen phase and a new shaft begins to be produced, even before the previous one is detached. The exogenous phase or teloptosis are other names for shaft detachment.

Hair experiences cyclical growth and shedding as part of its dynamic biological process. In general, people shed between 50 and 100 scalp hairs a day, which is considered normal physiologically. However, when hair shedding exceeds the normal range or lasts longer than anticipated, it may be clinically identified as alopecia. Alopecia (hair loss) is considered a common condition worldwide. However, Androgenetic alopecia is the most common form of hair loss and it affecting both men (male-pattern baldness) and women (female-pattern baldness). It is hair thinning or balding due to the influence of androgens in males and females. Androgenetic alopecia is reported to affect 50% of the population by the age of 50 years in males and a decade later in females in Singapore. Hamilton reported that 96% of men and 79% of women will develop a natural progression of androgenetic alopecia after puberty.

In male androgenetic alopecia, there is a reduction in the anagen phase with premature entry into the catagen phase and a reduction in the anagen-telogen ratio. With a greater predominance of telogen hairs, the patient may notice an increase in hair loss. Reduced expression of factors that sustain the anagen phase, such as vascular endothelial growth factor (VEGF), basic fibroblast growth factor, and insulin-like growth factor (IGF-1), may lead to entry into the catagen phase, according to some research. and increased expression of cytokines that promote cell apoptosis such as transforming growth factor beta 1 (TGF- β 1), interleukin-1 alpha (IL-1 α) and tumour necrosis factor alpha (TNF- α).

In addition to the change in the follicular cycle, there is also a morphological change in the follicles and, consequently, in the hair shafts: miniaturization. The miniaturized hair is very similar to a vellus hair, with a thickness of less than 0.03 mm.

Alopecia has significant implications for patients' physical appearance, psychological well-being and overall quality of life. The limitations of traditional therapies such as topical agents, oral medications and hair transplantation have led to increasing interest in regenerative approaches. Biological interventions based on exosomes have shown great promise.

Exosomes are nanosized, membrane-bound extracellular vesicles (EVs) that mediate intercellular communication and participate in numerous dermatological processes and therapeutic mechanisms. They also play vital roles in both physiological and pathological processes relevant to dermatology.

They contain bioactive molecules such as proteins, lipids, mRNA, and microRNA that reflect the regenerative and immunomodulatory properties of the origin of the cells from which they are derived.

These molecules can influence the behaviour of recipient cells by modulating signalling pathways and gene expression. They represent a novel cell-free regenerative therapeutic approach.

MSC-derived exosomes have been shown to promote wound healing by enhancing cell migration, collagen synthesis and re-epithelialisation, primarily through the modulation of matrix metalloproteinases and activation of signalling pathways like PI3K/AKT. In addition, exosomes play a role in counteracting skin ageing by mitigating photo-ageing effects. Mechanistically, MSC-derived exosomes enhance skin repair and rejuvenation by regulating inflammation, promoting extracellular matrix remodelling and activating antioxidant pathways.

Androgenetic alopecia is primarily caused by the miniaturization of hair follicles due to dihydrotestosterone, altered dermal papilla cell signalling, inflammation around the hair follicle, and a shorter anagen phase. The ability of exosomes to control vital biological mechanisms, such as dermal papilla cell growth, neovascularization, and the regulation of inflammatory pathways, has been demonstrated. These mechanisms are essential for the hair regrowth cycle.

Case Presentation

Patient history

A 60-year-old Chinese male presented with progressive hair loss localized at vertex of scalp. The onset of alopecia began 5 years ago and no treatment was sought prior to this. In January 2025, patient sought consultation and treatment at Dr Plus aesthetic clinic. A thorough clinic assessment including a detailed history and physical examination were performed.

Clinical findings

On examination, there is thinning at the crown and vertex of scalp and recession at temples. There is no erythema of scalp and pull test was negative.

Timeline

Month 0 – Baseline

- Presented with Norwood stage 3 vertex hair loss
- Scalp visibility through crown under bright light
- Fitzpatrick skin type III

Month 3 – after 3rd session

- Noticeable thickening at the crown and vertex of scalp

Month 5 – after 5th sessions

- Overall hair density improved 20-25% compared to baseline
- Scalp less visible under standard lighting compared to baseline
- Patient reports he has more hair, happy with the improvements



Figure 1: Before Photo-Baseline and After photo -5th month.

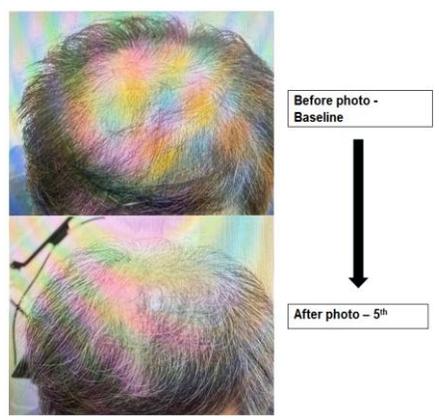
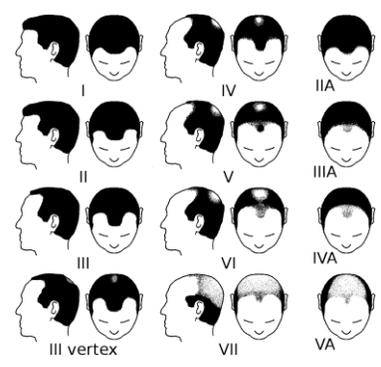


Figure 2: Before Photo-Baseline and After Photo-5th.

Diagnostic Assessment

The diagnosis of male androgenetic alopecia is essentially clinical, with no need for laboratory tests or histopathology, which should be performed only in doubtful cases. Examination of the hair and scalp reveals the characteristic pattern of hair loss with no evidence of a scarring pattern.

Severity of male pattern baldness was assessed and graded by using Hamilton-Norwood Scale, which categorizes hair loss into 7 stages ranging from minimal recession (Type I) to severe, horseshoe-shaped hair loss (Type VII).



Hamilton-Norwood Scale.

Stage I, No apparent hair loss or minimal loss in the temporal regions; Stage II, Slight bitemporal recession, showing a symmetrical triangular shape; Stage III, Significant loss with little or absence of hair in the temporal areas; Stage III Vertex; The recession in the temporal region is not greater than that described, and hair loss is more noticeable in the vertex in stage III; Stage IV, Significant thinning in the temporal regions and in the vertex, leaving a dense band of hair separating the two areas; Stage V, Recession of the implantation line and more evident thinning at the vertex. The transition area is less noticeable because the band of hair between the two areas exhibits even lower density; Stage VI; The vertex and frontotemporal regions come together via the complete loss of the band of hair that separated them; Stage VII: More extensive form of involvement, leaving only a narrow band of hair in the lateral and occipital regions.

Therapeutic Intervention

3cc of Exosomes manually injection over crown and vertex of scalp during each treatment session. Each treatment session is 1 month apart. Patient received total of 5 treatment sessions. Baseline photo and after treatment photo were taken for comparison.

Follow up / Outcome

Patient has significant improvement in hair density after a course of exosomes therapy. Reported adverse events were predominantly mild and transient including mild pain during treatment, local scalp irritation, redness and swelling. There was no need to stop treatment because these side effects went away on their own. Crucially, no allergic reactions, severe systemic complications, or long term negative effects were noted.

Patient continues subsequent Exosome treatment for maintenance. Follow up scheduled for 6-9 months. Long term plan includes annual refresh session.

Discussion

Hair loss disorders such as androgenetic alopecia (AGA) and other non-scarring alopecia are a significant cosmetic and psychologic issue in men and women. Although current treatments like finasteride, minoxidil, and hair transplantation have certain advantages, their drawbacks have sparked interest in regenerative therapies. In the last few years, MSC-derived exosomes have emerged as cell-free therapeutics due to their ability to deliver bioactive molecules that modulate inflammation, promote angiogenesis, and activate hair follicle regeneration.

The application of exosomes in Androgenetic Alopecia therapy is a rapidly emerging field, offering a novel mechanism to modulate immune responses and promote tissue regeneration. Growth factors, cytokines, and miRNAs are examples of regenerative and anti-inflammatory bioactive molecules that are abundant in exosomes and are essential for reestablishing follicular health. Recently, Norooznejhad et al. reported the successful treatment of persistent chemotherapy-induced alopecia (PCIA) in a 36-year-old woman using human mesenchymal stromal cell (MSC)-derived exosome-enriched extracellular vesicles (EVs); the patient achieved complete scalp hair regrowth after three monthly subcutaneous injections of EVs, administered 18 months post-chemotherapy. Thirty patients with androgenetic alopecia (AGA) participated in a clinical study where the treatment improved global photographic assessments and

resulted in a statistically significant increase in hair density over a 24-week period, without severe adverse reactions. On the other hand, studies on plant-derived exosomes, such as RSCEs, have demonstrated their ability to suppress inflammatory pathways, stimulate follicular stem cells, and improve the hair regrowth process. This aligns with the case's outcome, where a significant hair regrowth and follicular repigmentation were observed after six months.

This case report provides compelling evidence for the use of exosomes as an innovative treatment for Androgenetic Alopecia, particularly in cases with advanced age. The observed outcome - significant hair regrowth highlights the potential of exosome therapy to address the limitations of conventional treatments. By integrating regenerative and immune-modulatory mechanisms, exosome-based protocols represent a promising frontier in the management of Androgenetic Alopecia. Further research is warranted to confirm these findings and optimize treatment protocols for broader clinical applications.

Conclusion

In summary, the patient with androgenetic alopecia was successfully treated with exosomes therapy, resulting in significant hair regrowth after 5 monthly treatments. In addition, Exosome therapy exhibited a favorable safety profile. The majority of adverse events were minor and temporary, and included itching, redness, swelling, and irritation of the scalp, as well as sporadic headaches. No serious systemic side effects, infections, or immunogenic reactions were reported. This case underscores the potential of plant-derived exosome therapy as a viable treatment option for androgenetic alopecia.

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