

INNOVATIONS IN THE TREATMENT OF ANDROGENETIC ALOPECIA: A CRITICAL REVIEW OF CURRENT LITERATURE

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Abstract: Goal: This narrative literature review article investigates innovations in the treatment of androgenetic alopecia (AGA), a common condition that results in progressive hair loss in men and women. Methodology: The review was conducted using the electronic database PubMed, with the search terms “androgenetic alopecia”, “treatment innovations”, “effective”, and combinations of these terms. Of the 42 articles initially selected, 14 were chosen for more detailed analysis. Results: Studies indicate that many available treatments for AGA have limited efficacy and are often associated with significant side effects. Recent research shows that the use of topical medications, whether alone or in combination with oral therapies, as well as innovative treatments such as lasers and microneedling, have demonstrated statistically significant reductions in AGA indicators. Final considerations: The review highlights the need for innovation in treatments for AGA, seeking more effective, safe options with fewer side effects. However, the complexity of AGA treatment requires further research to fully elucidate the beneficial effects of new therapies and establish specific guidelines for the affected population.

Keywords: Androgenetic alopecia, Therapeutics, Innovation.

INTRODUCTION

Since the 1970s, clinical research has identified specific inflammatory markers and subclinical signs related to the physiology of hair follicles, bringing new perspectives to the understanding of AGA (Mahe et al., 2021). AGA is characterized by the progressive reduction of hair follicles due to factors such as genetics, stress, and sex hormones (Kim et al., 2021). Traditionally, treatments for AGA include oral and topical medications, but the limitations of these therapies, such as the need for continuous use and possible side effects,

drive the search for new solutions (Prabahar et al., 2023).

In this context, advances in surgical procedures and hair restoration technologies present new therapeutic alternatives. Among these advances, the use of laser therapies stands out, which, according to Avci et al. (2014), have shown promise by stimulating the stem cells of hair follicles and inducing the anagen phase, the growth phase of hair. These therapies are valued for their low side effects and non-invasive nature (Wickenheisser et al., 2019).

Additionally, the use of stem cells, particularly those derived from adipose tissue, represents a less invasive and potentially effective method of treatment. Research indicates that these cells have a high capacity for expansion and can be applied in hair regeneration, enhancing the production of important growth factors such as hepatocyte growth factor (HGF) and epidermal growth factor (EGF) (Kind; Garcovich, 2019).

On the other hand, an innovative approach called Stem Cell Educator therapy, described by Li et al. (2015), involves the circulation of the patient's blood through a system that isolates and allows the interaction of mononuclear cells with umbilical cord stem cells before they are reintroduced into the patient. This approach promises to improve the treatment of hair conditions by facilitating tissue repair and immune regulation.

In light of the above, the aim of this study is to explore and synthesize the most recent evidence on innovations in the treatment of androgenetic alopecia, with the aim of providing a comprehensive overview of the new therapies available and their impact on the clinical management of this dermatological condition.

METHODOLOGY

The methodology used in this literature review was outlined according to the PVO strategy, adapted to include: Population or research problem, Intervention, Comparison (optional) and Outcome (outcome). This framework was used to refine the study's guiding question: "What are the most recent innovations in the treatment of androgenetic alopecia, and how are these approaches impacting therapeutic efficacy and patients' quality of life?"

Searches for relevant literature were carried out in the PubMed - MEDLINE (Medical Literature Analysis and Retrieval System Online) database. To this end, specific terms associated with the Boolean operator "AND" were used: "Androgenetic Alopecia AND Treatment Innovations AND Efficacy". This initial search resulted in the identification of 42 potential articles.

The inclusion criteria specified for this review were: articles written in Portuguese and English, published between 2019 and 2024, that directly discussed the topics of interest and that were review-type studies available in full. Articles that were only available in summary form and those that did not directly address the research question or that did not meet the other inclusion criteria were excluded from the selection.

After rigorous application of the inclusion and exclusion criteria, the final corpus of the study was composed of 14 articles selected from the PubMed database. These articles were then used to compose the analysis and discussion of the most recent approaches in the treatment of androgenetic alopecia, focusing on their effectiveness and impact on patients' quality of life.

This systematic and insightful method ensured a comprehensive and up-to-date review of therapeutic innovations for androgenetic alopecia, allowing a detailed assessment of

recent advances and their real impact on clinical practice and patient well-being.

DISCUSSION

EMERGING PHARMACOLOGICAL THERAPIES FOR ANDROGENETIC ALOPECIA

Ruksiriwanich et al. (2022), analyzed the activity of bioactive compounds from shallot extract and their action on hair growth, evaluating the anti-inflammatory response and its modulation in gene expression. In this clinical trial, the authors confirmed that a possible cause of AGA would be inflammation of the hair follicle due to high levels of nitric oxide. The study proved that phenolic compounds, such as quercetin, rosmarinic and p-coumaric acids, present in the extract, are capable of neutralizing free radicals and inhibiting inducible nitric oxide synthase, in addition to demonstrating an increase in the anagen phase and promoting hair growth.

According to Ruthvik et al. (2024), a therapy that showed a significant increase in hair follicle density and hair shaft diameter was platelet-rich plasma (PRP) therapy associated with the use of minoxidil. This treatment consists of injections with a platelet concentrate into areas of hair loss. Additionally, Prabahaar et al. (2023) reported on the use of beta-sitosterol (β -ST) associated with Cubosomes with soluble microneedles (CUBs-MN D), which in addition to a good therapeutic response, this combination showed an increase in the effectiveness of the drug, facilitating its passage through the skin barrier.

The use of dermal sheath cells as a form of treatment for hair loss, acting as a source of myofibroblasts, important for wound healing and responsible for tissue repair, was discussed by Yoshida et al. (2022). However, the results of the study are still imprecise, as these cells can lose their intrinsic properties during cell

culture, suggesting a possible limitation in bioactivity.

Zhao et al. (2023), reported on the use of oral finasteride for the treatment of baldness, which acts by inhibiting the type II 5-alpha-reductase enzyme. The drug has demonstrated efficacy in treatments lasting up to five years, with studies indicating continued improvements over time. However, some of the side effects include orthostatic hypotension, erectile dysfunction, ejaculatory dysfunction and decreased libido, with these effects persisting for up to four years after discontinuation of treatment.

Mir-Palomo et al. (2020), presented topical finasteride associated with phospholipid vesicles and baicalin as a promising alternative, increasing bioavailability and depth of penetration, in addition to prolonging the time of pharmacological action.

Shome et al. (2021), observed that many patients opt for hair transplantation, especially when other therapies prove to be ineffective or when there is a large loss of scalp. The procedure, performed under topical anesthesia, can vary between Ellipse harvesting and Robotic Follicular Unit Extraction (FUE), with each method presenting its own advantages and challenges, such as the formation of scars.

ADVANCES IN SURGICAL PROCEDURES AND HAIR RESTORATION TECHNOLOGIES

The treatment of AGA presents several therapeutic options, especially for patients who do not respond adequately or have significant side effects to oral therapies. Among the emerging alternatives, significant advances in surgical procedures and hair restoration technologies stand out, such as autologous transplantation, the use of lasers and stem cells (Lueangarun et al., 2021).

Laser therapy, specifically, has been investigated for its effectiveness in treating AGA. According to Avci et al. (2014), this therapeutic approach promotes the stimulation of epidermal stem cells in the bulge of the hair follicle and induces the transition to the anagen phase. Wickenheisser et al. (2019) highlight that laser therapy offers advantages such as minimizing side effects, non-invasive nature and relatively low costs. However, the effectiveness of this treatment can vary significantly due to factors such as the type of laser and application methods, directly influencing conclusions about its effectiveness.

Furthermore, recent research has explored the potential of adipose tissue as a rich and less invasive source of stem cells compared to bone marrow. Studies have shown that small amounts of adipose tissue have a high capacity for expansion, facilitating the separation of stem cells suitable for therapeutic use. New approaches include obtaining stem cells from scalp tissue and using platelet-derived growth factors such as hepatocyte growth factor (HGF), epidermal growth factor (EGF) and platelet-derived growth factor (PDGF). Hypoxia, characterized by a low-oxygen environment, stimulates adipose stem cells to produce growth factors that are essential for hair regeneration (Kind; Garcovich, 2019).

Another promising development is Stem Cell Educator therapy, as described by Li et

al. (2015). This innovative procedure involves circulating the patient's blood through a system that separates mononuclear cells, allowing them to interact with umbilical cord stem cells before being reintroduced into the patient's circulation. This method was applied to patients who did not respond to standard therapies and, after a period of discontinuation, underwent a single therapy session with the Stem Cell Educator. The human umbilical cord stem cells used were isolated from healthy donors and cultured under specific conditions to ensure the efficacy and safety of the treatment.

FINAL CONSIDERATIONS

Innovations in the treatment of AGA range from pharmacological options, such as minoxidil and finasteride, which are consolidated in the literature and whose side effects are known, to surgical procedures and advanced technologies, such as the use of laser, which still requires standardization due to variations in techniques of application. Stem cell research emerges as a promising frontier in AGA therapy, requiring more randomized clinical studies to establish effective and standardized treatments. These advances represent a promising future for the management of AGA, enhancing the effectiveness of treatment in specialized clinical practice.

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