Review article

Use of finasteride and minoxidil for the treatment of androgenetic alopecia: a review

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SUMMARY

Objective: This study aimed to conduct a literature review to investigate the efficacy of Minoxidil and finasteride in the treatment of AGA. **Methods**: It is a narrative review, where articles published between 2013 and 2023 were searched in the LILACS, SciELO, and MEDLINE databases, prioritizing research published in English. **Results**: Pharmacological treatment for AGA mainly involves the use of two approved drugs: Minoxidil and finasteride, available in topical and oral forms. Topically applied Minoxidil, used in concentrations of 2% to 5%, has demonstrated efficacy in promoting hair growth by prolonging the follicle growth phase, with higher concentrations being more effective, however, its use may cause cutaneous adverse effects such as irritation and hypertrichosis. Oral Minoxidil, in concentrations of 0.25-5.0 mg, has been considered as a treatment option, allowing for dose adjustments and better patient adherence compared to the topical formulation, but its cardiovascular effects are concerning. Topical finasteride, 0.25-1.0%, is effective but may be associated with hypertrichosis and cardiovascular effects. Its oral form, 1mg/day, is also effective, but its use is restricted to men due to potential sexual and reproductive problems. Studies suggest an association between Minoxidil and finasteride, whether topical or oral, showing superior efficacy to monotherapy. Final considerations: In summary, pharmacological treatment for AGA presents effective options but also potential adverse effects. Combined therapy may be a promising strategy to improve clinical outcomes and patient adherence while reducing side effects, indicating a multifaceted therapeutic approach to androgenetic alopecia.

Keywords: Alopecia; hair treatment; pharmacological treatment.

RESUMO

Uso de finasterida e minoxidil para o tratamento da alopecia androgenética: uma revisão

Objetivo: Este estudo teve como objetivo realizar uma revisão da literatura para investigar a eficácia do minoxidil e da finasterida no tratamento da alopecia androgenética (AGA). **Métodos:** Trata-se de uma revisão narrativa, na qual foram pesquisados artigos publicados entre 2013 e 2023 nas bases de dados LILACS, SciELO e MEDLINE, priorizando-se pesquisas publicadas em inglês. **Resultados:** O trata-

mento farmacológico da AGA envolve principalmente o uso de dois medicamentos aprovados: minoxidil e finasterida, disponíveis em formas tópica e oral. O minoxidil tópico, utilizado em concentrações de 2% a 5%, demonstrou eficácia na promoção do crescimento capilar, prolongando a fase de crescimento do folículo, sendo as concentrações mais elevadas mais eficazes. No entanto, seu uso pode causar efeitos adversos cutâneos, como irritação e hipertricose. O minoxidil oral, em concentrações de 0,25 a 5,0 mg, tem sido considerado uma opção de tratamento, permitindo ajustes de dose e melhor adesão do paciente em comparação com a formulação tópica, mas seus efeitos cardiovasculares são preocupantes. A finasterida tópica, a 0,25-1,0%, é eficaz, mas pode estar associada à hipertricose e efeitos cardiovasculares. Sua forma oral, 1 mg/dia, também é eficaz, mas seu uso é restrito a homens devido a potenciais problemas sexuais e reprodutivos. Estudos sugerem uma associação entre minoxidil e finasterida, tanto tópica quanto oral, demonstrando eficácia superior à monoterapia. Considerações finais: Em resumo, o tratamento farmacológico para a alopecia androgenética apresenta opções eficazes, mas também potenciais efeitos adversos. A terapia combinada pode ser uma estratégia promissora para melhorar os resultados clínicos e a adesão do paciente, reduzindo os efeitos colaterais, o que indica uma abordagem terapêutica multifacetada para a alopecia androgenética.

Palavras-chave: Alopecia; tratamento capilar; tratamento farmacológico.

RESUMEN

Uso de finasterida y minoxidil para el tratamiento de la alopecia androgenética: una revisión

Objetivo: El presente estudio tuvo como objetivo realizar una revisión de la literatura para investigar la eficacia del Minoxidil y la finasterida en el tratamiento de la AGA. **Métodos**: Se trata de una revisión narrativa en la que se buscaron artículos publicados entre los años 2013 y 2023 en las bases de datos LILACS, SciELO y MEDLINE, priorizando investigaciones en inglés. **Resultados:** El tratamiento farmacológico para la AGA principalmente implica el uso de dos fármacos aprobados: Minoxidil y finasterida, disponibles en formas tópica y oral. El Minoxidil aplicado tópicamente en concentraciones de 2,0% a 5,0% ha demostrado eficacia en la promoción del crecimiento capilar al prolongar la fase de crecimiento de los folículos. Sin embargo, su mayor concentración es la más efectiva, aunque su uso puede causar efectos adversos cutáneos como irritación e hipertricosis. El Minoxidil oral, en concentraciones de 0,25-5,0 mg, se considera una opción de tratamiento que permite ajustes de dosis y mejor adherencia del paciente en comparación con la formulación tópica, aunque sus efectos cardiovasculares son preocupantes. Por otro lado, la finasterida tópica en concentraciones de 0,25-1,0% es efectiva, pero puede asociarse con hipertricosis y efectos cardiovasculares. La finasterida oral, a 1 mg/día, también es efectiva pero su uso está restringido a hombres debido a posibles problemas sexuales y reproductivos. Estudios sugieren que la combinación de Minoxidil y finasterida, ya sea tópica u oral, muestra una eficacia superior a la monoterapia. **Consideraciones finales:** En resumen, el tratamiento farmacológico para la AGA ofrece opciones efectivas, pero también con potenciales efectos adversos. La terapia combinada puede ser una estrategia prometedora para mejorar los resultados clínicos y la adherencia del paciente, al tiempo que se reducen los efectos secundarios, indicando un enfoque terapéutico multifacético para la alopecia androgenética.

Palabras clave: Alopecia; tratamiento capilar; tratamiento farmacológico.

1. INTRODUCTION

Alopecia androgenetica (AGA) is the leading cause of hair loss in individuals with a genetic predisposition. This occurs when genetically sensitive hair follicles are stimulated by dihydrotestosterone (DHT). The presence of DHT leads to a decrease in follicle size, resulting in reduced hair density [1].

This condition is characterized by progressive thinning of terminal hairs after puberty. With a prevalence reaching at least 80% in men and 50% in women by the age of 70, AGA tends to increase in incidence with advancing age. Additionally, it is most commonly observed in individuals of Caucasian descent, followed by Asians and African Americans, with lower incidence among Native Americans and Eskimos [2].

The treatment of AGA is challenging and often requires a multifaceted approach to achieve satisfactory results. Among the available therapeutic options, finasteride and minoxidil emerge as two of the most studied and effective interventions for slowing the progression of hair loss and stimulating hair growth [3].

Finasteride is a selective inhibitor of the enzyme 5-alpha-reductase, responsible for converting testosterone into DHT, thus reducing DHT levels in the body. On the other hand, minoxidil is a vasodilator that works by increasing blood flow to hair follicles and prolonging the hair growth phase [3, 4].

Despite both drugs being widely used against AGA, there is evident scarcity of information among healthcare professionals regarding the efficacy of oral and topical monotherapies, as well as the combination of drugs.

2. METHODOLOGY

2.1. Study Design

The present study is a narrative literature review. According to Andrade Júnior *et al.* [5], this type of research deals with broad questions and typically involves qualitative data. For article searching, the following terms were used: 1) Alopecia; 2) Androgenetic alopecia; 3) Pharmacological treatment; 4) Alopecia; 5) Androgenetic alopecia; 6) Pharmacological treatment. The aforementioned keywords were used in different combinations, utilizing the Boolean operator "AND" [5].

2.2. Inclusion and Exclusion Criteria

Studies addressing drugs used alone or in combination for the pharmacological treatment of androgenetic alopecia were included. Furthermore, articles published in Portuguese and English within the last ten years (2013-2023) were prioritized. Course completion papers, monographs, dissertations, theses, and editorials were excluded from the research.

2.3. Sources of Information

Articles were retrieved from the following databases: LILACS (Latin American and Caribbean Health Sciences) and SciELO (Scientific Electronic Library Online) and MedLine.

2.4. Article Selection and Filtering Process

The initial search in the LILACS, SciELO, and MedLine databases using the established keywords resulted in 48 articles. The filtering process was conducted in three phases. The first phase consisted of an initial screening by title and abstract, in which the articles were reviewed for immediate relevance to Minoxidil or Finasteride in the context of Androgenetic Alopecia (AGA) treatment, excluding those focused solely on hair transplantation, hormonal disorders other than AGA, or animal models. This phase eliminated 18 articles.

In the second phase, a full-text assessment was conducted for the remaining 30 articles, which were read in full. The exclusion criteria applied at this stage included the absence of primary efficacy data, focus on combined therapies without detailing the individual drugs, and non-scientific literature (such as opinion pieces or news articles). This phase excluded 8 articles.

Finally, in the final inclusion phase, a total of 22 articles was included for comprehensive review and data synthesis in the results section, ensuring the inclusion of recent publications (2013–2023) to maintain up-to-date relevance.

This detailed process justifies the selected evidence, allowing the reader to understand the intentional (non-systematic) nature of the inclusion criteria, which is characteristic of a narrative review.

3. RESULTS AND DISCUSSION

In Table 1, it is possible to observe the main information regarding the use of finasteride and minoxidil for the treatment of androgenetic alopecia.

Table 1. Main information on the use of finasteride and minoxidil for the treatment of androgenetic alopecia.

Drug / Type	Key Findings	Mechanism of Action and Concentration/Dose	Common Adverse Effects	Source
Topical Minoxidil	Only topical medication approved by the FDA. Promotes rejuvenation and prolongs the anagen phase (growth). Efficacy proven at 6 months, 1 year, and 5 years vs. placebo.	Mechanism: Potassium channel opener, promoting vasodilation and angiogenesis (improving blood flow). Concentrations: 5% (preferred for men, more effective) and 2% (for women).	Irritation, itching, flaking, contact dermatitis, hypertrichosis (excessive hair growth), reversible hair loss [4, 9-12].	[6-8]
Oral Minoxidil	More convenient, aesthetic, and lower-cost option than topical, resulting in better patient adherence.	Typical Dose: 2.5 mg/day (for men) or 0.25–1.25 mg/day (for women). Can be adjusted up to 5 mg/day [16].	Hypertrichosis (dose-dependent, more common at 5 mg/day). Cardiovascular effects of concern: hypotension, tachycardia, peripheral edema, ECG changes [15, 17].	[13, 15-17]
Oral Finasteride	FDA-approved (1 mg/day) for male AGA. Reduces follicle miniaturization responsible for progressive hair loss.	Mechanism: Selective inhibition of the 5-alpha-reductase Type II enzyme, blocking the conversion of testosterone to DHT (60% to 70% reduction of DHT) [18]. Dose: 1 mg/day (chronic use) [13, 18].	Gynecomastia, muscle atrophy, reduced libido and potency, sexual dysfunction, depression, congenital defects (risk in women). Sexual side effects: affects 1% to 40% [17, 19, 21, 22].	[7, 13, 17-19, 21, 22]
Topical Finasteride	Alternative to avoid systemic effects of the oral route. Efficacy proven in clinical trials, with less pronounced reduction in serum DHT levels.	Concentrations: 0.25% spray or 1% gel (topical application 1-2x/day) [3, 6].	Itching, burning, irritation, contact dermatitis, scalp erythema [3].	[3, 6, 15]
Combined Therapy	Shows significantly greater clinical and instrumental efficacy than monotherapies (individually) [23, 25].	Combination of Topical Minoxidil (5% or 2%) with Topical Finasteride (0.25%) or Systemic Finasteride (1 mg) [1, 23, 25].	Tolerability and safety profile comparable to monotherapies, but with potential for better adherence due to faster efficacy [23].	[1, 23, 25]

Source: own authorship, 2024.

3.1. Topical Therapy

For patients experiencing early hair loss or mild to moderate intensity and prefer to avoid oral medications due to potential systemic side effects, topical therapies may be considered as an effective option, either as initial treatment or as a complement to androgenetic alopecia (AGA) treatment [6].

3.1.1. Minoxidil

Several treatment options exist to control alopecia, though there are significant reports of adverse reactions and lack of efficacy in many cases. Both natural and synthetic medications are utilized, however only two medications (topical minoxidil and oral finasteride) have been FDA-approved to promote hair growth. Due to the diversity of alopecia types, medications are not universally prescribed but rather selected based on the specific type of condition [7].

Minoxidil is the only topical medication FDA-approved for alopecia treatment. Originally developed as an oral treatment for hypertension, Minoxidil was serendipitously discovered as a hair growth promoter during studies to treat high blood pressure [7].

Minoxidil prescriptions are typically available in concentrations of 5% (for male use) and 2% (for female use). This improvement in blood circulation is believed to significantly contribute to hair rejuvenation. Minoxidil is also capable of extending the active growth phase of hair follicles, known as the anagen phase [7]. Additionally, the use of topical minoxidil at a concentration of 5% has been shown to be more effective than the 2% version in promoting changes in terminal hair after 48 weeks of treatment [8].

Topical minoxidil usage presents numerous adverse effects: irritation, itching, flaking, contact dermatitis, reversible hair loss, burning sensation, hypertrichosis, dry scalp, rashes, and redness [4, 9-12]. Adverse cutaneous effects are more common in formulations with higher minoxidil content, possibly due to increased propylene glycol content [6].

Minoxidil should be applied once or twice daily for maximum efficacy. Considering the need for regular treatment application, patient adherence is a critical aspect to consider when recommending minoxidil use. When used appropriately, patients may observe hair growth within a period of 4 to 8 months, reaching stabilization around 12 to 18 months of continuous use. However, if treatment is discontinued, progressive hair loss is expected to occur within 12 to 24 weeks following cessation of medication use [6].

The 5% solution is preferred for male use. Patients should undergo evaluations after six months of treatment. Studies have demonstrated that both the 2% and 5% formulations showed a significant difference in hair growth compared to placebo at six months, one year, and five years after the start of treatment. In men, the 5% solution was significantly more effective than the 2%, while in women, both concentrations, 2% and 5%, showed promising improvements in hair growth area (APF). Although concentrations above 5% may increase efficacy, they also tend to increase the incidence of local irritation [6].

The exact mechanism by which minoxidil stimulates hair growth is still not fully understood, but it is known to act as a potassium channel opener, promoting hyperpolarization of cell membranes. This process results in vasodilation and angiogenesis, thereby improving blood flow and nutrient delivery to hair follicles [7].

Approximately 60% of male patients may not respond to topical minoxidil therapy due to reduced initial levels of sulfotransferase, an enzyme necessary to activate minoxidil into its active metabolite, requiring sometimes resorting to other therapeutic options [13].

3.1.2. Finasteride

Finasteride, a synthetic compound known as 4-azasteroid, is another FDA-approved medication for alopecia treatment. Like minoxidil, finasteride was serendipitously discovered as a hair growth promoter. Before being used in alopecia treatment, finasteride was commonly prescribed to treat prostate enlargement in men. This medication is prescribed only for male patients experiencing hair loss, as it acts by inhibiting the enzyme 5-alpha-reductase, responsible for converting testosterone to dihydrotestosterone (DHT). By blocking this conversion, finasteride helps to reduce the effects of DHT on hair follicles, thus promoting hair growth. It is important to note that this drug does not treat the underlying genetic cause of androgenetic alopecia, and therefore, hair loss may return after treatment discontinuation. Additionally, this medication is contraindicated for women, especially during pregnancy, due to its potential teratogenic effects [7,14]. Regarding the topical use of this drug, it occurs through a 0.25% spray or 1% topical finasteride gel, applied twice daily to the scalp [3].

In recent years, there has been an increase in the use of topical finasteride as a viable alternative to systemic therapies. The efficacy of topical finasteride 0.25% daily has been proven in clinical trials, demonstrating a less pronounced reduction in dihydrotestosterone serum levels compared to oral administration [15]. Additionally, topical finasteride can also be administered once daily but must be used chronically. Furthermore, there are no available data on patient adherence [6]. The most commonly observed adverse effects are itching, burning, irritation, contact dermatitis, and scalp erythema [3].

3.2. Oral Treatment

3.2.1. Minoxidil

Recently, the use of low doses of oral minoxidil has received more attention as a treatment option for androgenetic alopecia (AGA). Oral minoxidil is available in 2.5 mg tablets, which can be divided in half or quarters, allowing dose adjustment according to patient and healthcare provider preferences [3]. However, despite the recommended initial dose to treat male hair loss being 2.5 mg per day, it is often increased to 5 mg per day [16].

Furthermore, recent research indicates that reduced doses of oral minoxidil 2.5-5 mg/day for men and 0.25-1.25 mg per day for women with androgenetic alopecia) may offer safety and efficacy, but should be administered cautiously in patients with a predisposition to cardiovascular events [17].

The advantages of oral minoxidil over topical minoxidil involve its convenience, aesthetic aspect, cost, and treatment adherence. Oral administration of minoxidil is more convenient than its daily topical application. Additionally, from an aesthetic standpoint, oral minoxidil is more effective, as it does not cause changes in the color of gray hair and leaves no product residues as occurs with topical minoxidil. Moreover, due to its convenience, there are reports of good patient adherence to oral minoxidil therapy [13].

The most commonly reported adverse effect of oral minoxidil is hypertrichosis. This occurrence is more frequent among patients receiving higher doses of minoxidil (5 mg per day), while those receiving doses of 2.5 mg per day tend to have a lower incidence of hypertrichosis. Additionally, cardiovascular effects such as hypotension, tachycardia, pericardial effusion, lower extremity edema, and electrocardiogram (ECG) changes (tachycardia, premature ventricular contractions, changes in the T wave) are concerning complications that make oral minoxidil less favorable compared to topical formulation. Overall, the side effects of oral minoxidil are generally dose-dependent and reversible with medication discontinuation [15].

Other unfavorable conditions reported in the literature include: reduced libido, reduced ejaculatory volume, decreased total sperm count, erectile dysfunction and ejaculatory dysfunction, excessive menstruation, growth of hair in distinct areas of the scalp, dizziness, and testicular pain [4, 9-12].

3.2.2. Finasteride

In 1997, finasteride was approved at a dosage of 1 mg/day for the treatment of male AGA. This drug acts as a selective inhibitor of type II 5α-reductase enzyme, also FDA-approved for the treatment of AGA in men. In the scalp, testosterone is converted to dihydrotestosterone (DHT) by the enzyme 5α-reductase. The pathogenesis of AGA suggests that DHT-mediated hair follicle miniaturization is responsible for the condition, resulting in follicles' inability to penetrate fully into the epidermis and, consequently, progressive hair loss, especially in men. This theory is supported by evidence indicating that men with deficiency of type II 5α-reductase enzyme show no signs of AGA [13], it is important to note that 60% to 70% of DHT is reduced during the use of this active ingredient [18].

Oral finasteride is used at a dose of 1 mg/day, allowing the progressive reduction of AGA. The maximum effect of this treatment has been observed after one year of treatment. Additionally, maintenance therapy is essential to promote continued growth [13]. In this context, although finasteride reduces hair loss, promotes hair growth, and reduces DHT levels, it presents a risk of teratogenicity in premenopausal women, making its use cautious in women of reproductive age [17].

Long-term studies have investigated the association between finasteride and prostate cancer. Prostate cancer prevention research has revealed that finasteride may be associated with an increased risk of developing high-grade prostate cancer [19]. Medical treatment should be continued indefinitely, as the benefit will not be maintained after therapy discontinuation. It may take up to a year of treatment before any clinical response is noticeable [20].

The main adverse effects are: gynecomastia, muscle atrophy, reduced libido and potency, sexual dysfunction, depression, and congenital defects, with sexual problems affecting between 1% to 40%, depending on the duration of use and dose [21,22].

3.3. Combination of Minoxidil and Finasteride

The combination of topical minoxidil and oral finasteride becomes interesting, as for patients treated with topical minoxidil, the main reason for discontinuing treatment was the perceived lack of improvement. Therefore, adopting a combined therapy, using topical minoxidil and topical finasteride, may potentially increase adherence to androgenetic alopecia treatment, due to its faster efficacy compared to using either of these treatments alone. Thus, the combination of 5% minoxidil lotion and 0.25% finasteride spray formulation in patients with AGA showed significantly greater clinical and instrumental efficacy compared to monotherapies, with comparable tolerability and safety profile [23].

In a study by Rossi et al. [24], it is evidenced that topical finasteride at 0.5% combined with a 2% minoxidil solution was effective against AGA, however, topical use of finasteride alone is not effective in this case. In other contexts, a combined therapy of 2% minoxidil and systemic 1 mg finasteride is recommended, as it has shown superiority in results compared to monotherapies [25]. Additionally, it is interesting to note that the combination of topical minoxidil and oral finasteride presents good results. However, it is observed that after hair stabilization, oral finasteride can be replaced by topical use as maintenance therapy, contributing to the reduction of possible adverse effects [1].

3.4. Critical Analysis, Limitations, and Controversies in the Literature

A critical analysis reveals that a major limitation observed in many reviewed studies is the lack of standardization in long-term follow-up protocols. Most robust trials report data up to 12 or 24 months, making sustained efficacy and long-term adverse effects less clearly defined, an especially relevant limitation for a chronic condition such as AGA, which requires indefinite treatment.

A significant controversy revolves around Post-Finasteride Syndrome (PFS). Although studies often cite a low incidence of persistent sexual side effects [12], a subset of anecdotal reports and smaller studies [15] suggests severe and persistent emotional, cognitive, and physical impairments. This highlights the need for greater clinical sensitivity and further research using prospective cohorts to fully characterize the prevalence and mechanisms of these long-term symptoms.

Furthermore, the evidence base for women's treatment is notably weaker. While topical Minoxidil is the standard, the use of Finasteride in premenopausal women remains controversial due to teratogenic risk and a less conclusive efficacy profile compared to men [19]. Future research should prioritize high-quality, long-term studies focusing specifically on the female population with AGA. These limitations should be considered when assessing the risk-benefit profile for individual patients, particularly regarding shared decision-making about Finasteride use.

4. FINAL CONSIDERATIONS

The pharmacological treatment of androgenetic alopecia (AGA) has traditionally been based on the use of two licensed and approved medications: minoxidil and finasteride, available in topical and oral forms. Topical therapy, especially with minoxidil, is an effective option for patients with mild to moderate hair loss who wish to avoid potential systemic side effects associated with oral medications. However, it is important to consider potential adverse effects such as scalp irritation and hypertrichosis when using topical minoxidil, especially in formulations with higher concentrations.

Finasteride, whether in oral or topical form, is another widely used option in the treatment of AGA, particularly in men. However, oral finasteride use is associated with potential risks such as sexual side effects and an increased risk of high-grade prostate cancer, highlighting the importance of a careful risk-benefit assessment before prescribing.

The combination of topical minoxidil and oral finasteride may be an interesting strategy to enhance treatment efficacy, especially in patients who do not adequately respond to monotherapy. However, close monitoring of adverse effects and treatment response is crucial, adjusting therapy as needed to optimize outcomes. Additionally, future studies are needed to evaluate the long-term safety and efficacy of this combined approach, as well as to identify potential biomarkers to predict treatment response in different subsets of AGA patients.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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