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REVIEWS

Does Propecia Cause More Harms than Good: Assessing Reproductive and Non-Reproductive Effects of Finasteride on Male Health

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Finasteride (marketed as Propecia) is a potent 5α-reductase inhibitor used as first-line treatment for male pattern baldness. Despite finasteride's efficacy in promoting hair growth, there is concern about its impact on male reproduction because finasteride use has been linked to reduced libido, erectile dysfunction, and potential spermatogenic failure. The drug has also been documented to induce nonreproductive adverse effects such as depression. Current research suggests that finasteride's alteration of neurosteroid hormone levels may be contributing to these adverse effects. This article used evidence-based research to evaluate finasteride's short- and long-term effects on male reproductive health. In summary, there appears to be contradictory evidence within the literature with data both in support and in opposition of finasteride's adverse effects. There does, however, seem to be consensus on the incidence of these cases being quite low within both research and clinical settings.

Introduction

Male androgenetic alopecia (AGA), or male pattern baldness, is a progressive hair loss disorder that has profound physical and psychological consequences. This chronic, often psychologically debilitating, condition is characterized by gradual hair loss that commences with the recession of the hairline and eventually progresses to the loss of hair in the frontal, vertex, and temporal scalp regions. AGA contributes to a substantial burden of disease, affecting 30% to 50% of white men by age 50 years.[1]

There exist both pharmacological (finasteride, minoxidil, dutasteride) and surgical (hair transplant) treatment options for AGA. Finasteride (marketed as Propecia) is an oral drug used as first-line treatment for male pattern baldness.[2] Although finasteride has been shown to have therapeutic benefits, long-term daily use of the drug has been associated with increased reports to the US Food and Drug Administration (FDA) of sexual adverse effects such as erectile dysfunction, ejaculation issues, and reduced libido.[3] These risks of sexual dysfunction can pose a significant impact on an individual patient's quality of life and will be discussed further in this work. This article is a systematic review aimed at assessing the validity of these reports linking finasteride to sexual dysfunction.

Male Androgenetic Alopecia

AGA, or male pattern baldness, is characterized by the thinning and shedding of visible terminal hairs in the scalp.[1] Androgenetic alopecia can begin soon after puberty; however, notable changes in hair density are most commonly observed in middle-aged and elderly men. Male pattern baldness is a debilitating condition that can have a significant impact on patients' quality of life. Hair loss from this condition can lead to physical harm because hair protects the scalp from ultraviolet light, mechanical injury, and cold temperatures. Furthermore, the psychological distress and morbidity associated with the condition are well-documented, with patients with AGA often reporting feelings of self-conscious preoccupation, helplessness, and poor self image.[1] Cash[4] found that in men aged 18 to 70 years, those with greater hair loss reported more self-conscious preoccupation regarding their alopecia, more frequent negative socioemotional events, and lower body image satisfaction. While most participants reported moderate stress with hair loss, increased self-perceived stress of male pattern baldness significantly correlated with lower satisfaction in psychosocial functioning.[4] Alopecia was also found to influence the perceptions of men aged 21 to 68 years by recruited participants, where those with male pattern baldness were perceived to have less desirable personal, social, and physical desirability.[5] In a more recent study of male medical students aged 18 to 24 years by Prasanna et al,[6] students with increasing alopecia in addition to stress experienced greater scores of depression, loneliness, and internet addiction.

The pathophysiological mechanisms of male androgenetic alopecia remain unclear, but the condition does appear to have a strong genetic component.[1] The androgen dihydrotestosterone (DHT) has been shown to play a crucial role in male pattern baldness, and there exists robust evidence to support this association. First, male pattern baldness is typically not observed in individuals who do not have functional androgen receptors nor in individuals who do not have the 5α-reductase gene, the enzyme that synthesizes DHT from testosterone. Additionally, AGA often begins following the start of puberty, a period characterized by a marked increase in circulating androgens. Furthermore, men with AGA tend to have consistently elevated levels of DHT and 5α-reductase in the scalp. Both the type I and type II isoforms of 5α-reductase are expressed in scalp hair follicles; however, patients with AGA appear to have elevated activity of the type II isoform in particular.[1]

At the molecular level, normal hair growth is mediated by Wnt ligands that activate the β-catenin signaling pathway.[7] The molecular mechanism through which DHT induces male pattern baldness remains to be elucidated, but a study by Leirós et al[7] suggested that crosstalk between the β-catenin and androgen signaling pathways may result in the miniaturization of the hair follicle, ultimately resulting in AGA.

Treatment of Male Androgenetic Alopecia With Finasteride

Treatments for AGA aim to promote the regrowth of hair as well as prevent further hair loss.[3] Currently, there are 2 pharmacologic agents for male androgenetic alopecia approved by the FDA: oral finasteride (1 mg) and topical minoxidil (2% and 5%). Finasteride is a competitive inhibitor of the type II isoform of 5α-reductase, preventing the conversion of testosterone into DHT. Because the type II isoform is expressed both in hair follicles and the prostate gland, finasteride can be used as first-line treatment for both male pattern baldness and benign prostatic hyperplasia. Minoxidil is a potassium channel agonist that promotes regrowth of hair through vasodilation. Furthermore, dutasteride (marketed as Avodart) is another potent 5α-reductase inhibitor that has recently been used as off-label treatment for AGA. Although dutasteride has been approved by the FDA for benign prostatic hyperplasia, the drug has yet to be authorized for the treatment of AGA. Surgical procedures, such as hair transplant, have also been used to treat AGA, in which hair follicles from denser areas of the scalp, such as the side or back of the head, are surgically transferred to more balding areas.

Through its inhibition of the 5α-reductase enzyme within hair follicles, finasteride blocks the production of a key mediator in male pattern baldness: DHT.[2] In a double-blind, placebo-controlled randomized clinical trial (RCT), treatment with finasteride was found to reduce serum and scalp DHT levels by 70%.[8] Overall, the clinical efficacy of finasteride has been well-established. An RCT following up patients for 5 years reported finasteride to be significantly more effective at increasing hair density and slowing hair loss in comparison with placebo.[9] However, this study also found that discontinuation of finasteride resulted in reversal of hair growth as well as DHT levels increasing back up to pretreatment levels. These results, therefore, suggest that finasteride must be taken long-term in order for treatment effects to be maintained. Furthermore, a recent meta-analysis comparing nonsurgical therapies of androgenetic alopecia found finasteride, minoxidil, and dutasteride to have approximately equivalent effects on mean change hair count, suggesting that the clinical efficacy of finasteride is comparable with that of other AGA pharmacological agents.[2]

Impacts on Reproduction of Finasteride

Sexual Dysfunction

The literature currently describes conflicting data regarding the effects of finasteride on sexual dysfunction. Clinical trials have documented that sexual adverse effects occur in 4.4% of patients treated with finasteride compared with 2.2% of patients who took placebo.[10] Despite this, in the clinical setting, sexual adverse effects are reported far less frequently at an incidence of 0.5% for patients with AGA taking the clinically recommended dose of 1 mg of finasteride.[10]

In a case-control study that used the Arizona Sexual Experience Scale to evaluate sexual dysfunction in men taking finasteride compared with nonusers, the authors found that there was no significant difference between finasteride users and controls in reporting sexual adverse effects.[11] On review of this article, it should be noted that there was variability in the treatment duration of patients included in this study. Additionally, the study lacked segregation of data to establish clinical significance for specific types of sexual dysfunction.

A contrasting retrospective study reviewed the FDA Adverse Event Report System (FAERS) database to assess potential links between finasteride and sexual dysfunction.[3] Researchers reviewed reports of adverse events over 10 years to determine whether there was an association between reports of patients taking finasteride and sexual dysfunction, whether there was a relationship between duration of use and development of symptoms, and whether increased media attention regarding adverse effects increased the number of submitted reports. This study revealed an association of finasteride use with sexual dysfunction, controlling for confounding factors such as age, dosage, or treatment duration. Despite this association, the incidence of these adverse effects was found to be rare.[3]

The discussion regarding the impact of finasteride on sexual dysfunction can be more specifically understood through the lens of the following subcategories: erectile dysfunction and libido.

Erectile dysfunction

While the mechanism of action of finasteride on erectile dysfunction (ED) is unclear, some studies have suggested that inhibitory action of finasteride could result in altered hypothalamus activity leading to dysregulated downstream effects.[12]

One of the earliest conducted RCTs evaluating the impact of finasteride on ED was a sleep-related erection study by Cunningham and Hirshkowitz.[13] In this study, researchers examined nocturnal penile tumescence, a naturally occurring, spontaneous phenomenon that takes place during the rapid eye movement phase of sleep in all sexually potent men. In comparison with the placebo group, researchers found that finasteride did not consistently suppress sleep-related erections.[13] In reviewing the physiology, the investigators hypothesized that oral finasteride did not inhibit 5α-reductase activity to a sufficient extent within the areas of the brain responsible for maintaining erection.[13]

Further supporting this observation, Tosti et al[14] conducted a multicenter study to evaluate ED in patients before and 4 to 6 months after the initiation of finasteride therapy. Using the International Index of Erectile Function, investigators surveyed 186 patients and found there to be no significant changes in ED after 4 to 6 months of treatment.

Contrastingly, 2 large pharmaceutical-funded clinical trials assessing the adverse effects of finasteride on sexual dysfunction found that patients taking finasteride had significantly greater reports of ED in comparison with the placebo group (1.4% in the treatment vs 0.9% in the control group for the first clinical study).[15] Of note, the investigators stated that ED eventually resolved in many of the patients who continued with finasteride use.[15]

The controversy surrounding finasteride extends to its long-term impact on ED following discontinuation of the drug, colloquially termed *post-finasteride syndrome*. Currently, very few studies have provided a detailed analysis on the percentage breakdown of men who experience this condition as a result of finasteride use. However, investigators have explored the prevalence of ED in those who did report persistent adverse effects following a regimen of finasteride. A 2017 prospective, longitudinal, case-control clinical trial was conducted to assess otherwise healthy men with AGA who reported persistent sexual and mental health adverse effects after discontinuation of finasteride. All patients in this study showed some degree of ED, with 62.5% reporting severe ED and 37.5% reporting more mild to moderate forms.[12]

Libido/Anhedonia

Many of the studies reviewing finasteride's effects on libido are limited by a small sample size, lack of RCTs, and inadequate methods of study. Amory et al[15] conducted 1 of the few RCTs in 2008 and found a slight, statistically significant decrease in libido ratings (on a scale of 0-8, with a 0 indicating a low libido score rating, and an 8 indicating a high score rating) at week 26 of treatment compared with placebo (a score of 5.48 in the treatment group vs 6.09 in the placebo). The clinical significance of this reported association between finasteride and slightly decreased libido still remains unclear, but the overall satisfaction score did not change, suggesting that these slight changes in libido may not adversely impact global sexual function. In a study conducted by Rahimi-Ardabili et al[16] on the impacts of finasteride on depression, they reported that the only finasteride-associated adverse effect specifically reported by patients were libido effects (reported by 9.4% of patients). Although significant, this study was limited by the lack of a control group.[16] Further supporting the negative impact of finasteride on libido, Irwig and Kolukula[17] conducted standardized interviews with 71 otherwise healthy men aged 21 to 46 years who reported a new onset of sexual adverse effects associated with the temporal use of finasteride. The evaluation showed that among the affected group, 94% developed low libido,

and that after being reevaluated 12 months later, 89% reported continued sexual dysfunction. Of note, the nature of this study precluded itself to selection bias because the participants were recruited from propeciahelp.com and the authors' clinical practice.[17] In contrast, in a survey-based, single-center, controlled study using the Arizona Sexual Experience Scale in a population of 762 men, the researchers found no significant association between the loss of libido in the control group and the finasteride-experienced patients. Rather, this study alluded to evidence supporting the nocebo effect (ie, an adverse effect that is not a direct result of the pharmacologic action of the drug), and suggested that patients who were counseled on potential sexual adverse effects were at an increased risk to experience said adverse effects.[11]

Spermatogenesis

Finasteride may also have adverse effects on spermatogenesis and the overall sperm maturation process. An early RCT conducted by Overstreet et al[18] examined the impacts of finasteride on sperm concentration, total sperm per ejaculate, percentage motile sperm, and percentage sperm with normal morphology. Compared with placebo, finasteride daily use for 48 weeks had no statistically significant effects on the previously mentioned parameters.[18] This study served as the largest placebo-controlled clinical study evaluating the impact of finasteride on sperm parameters. While more recent studies have attempted to evaluate similar findings, they have differed in methodology and size.

One such study is a retrospective examination that provided differing results on spermatogenesis in males undergoing systemic therapy with finasteride. At 6 months following initial treatment, investigators noted a statistically significant worsening of total sperm number and abnormal sperm forms (analysis revealed a statistically significant difference between T0 and T6 sperm concentration (80.0×10^6/mL vs 49.5×10^6/mL; $P = .005$), total sperm count (224.0 vs 146.4×10^6/ejac.; $P = .013$), and abnormal forms (78.0 vs 82.5; $P = .05$).[19]

Persistence of abnormal sperm forms in patients taking finasteride continued for 12 to 24 months after initial treatment.[19] The results of this study appeared to be quite robust due to the strong treatment protocol (semen samples were analyzed in the same laboratory and by the same biologist) and stringent exclusion criteria (preexisting pathological conditions that could put patients at increased risk for impaired spermatogenesis were excluded from the trial) that were used. Overall, the authors suggested that given the impact of finasteride on spermatogenesis, patients should undergo a full andrological screening prior to initiation of finasteride therapy.

Hormonal Changes

In a prospective, longitudinal, case-control study, post-finasteride users exhibited significant changes in neuroactive steroid hormone levels obtained from cerebrospinal fluid (CSF) and plasma samples.[12] Neurosteroid hormones are endogenous steroids produced in the brain and act as potent modulators on the $GABA_A$ receptor, such as pregnenolone, progesterone, DHT, and 17-β-estradiol.[20] Researchers in the aforementioned study found that levels of pregnenolone, progesterone, DHT, and 17-β-estradiol had decreased, while dehydroepiandrosterone, testosterone, and 5-α-androstane-3α-17-β-diol had increased. These findings lay the critical groundwork for understanding that due to its mechanism of action, finasteride can play a significant role in impacting the excitability of neurons and, on a more macro scale, a patient's clinical presentation and behavior.[21]

In contrast, an alternate study investigating the potential association between post-finasteride use and sexual dysfunction reported conflicting results in comparison with the 2 previously outlined studies.[22] After reviewing serum total and free testosterone, DHT, luteinizing hormone, follicle-stimulating hormone, estradiol, and sex hormone-binding globulin levels, investigators determined that the hormone levels of the finasteride and control groups did not significantly differ; specifically, patients who had previously used finasteride were indeed within the normal range for healthy young men. These contradictory findings could be explained by the Basaria et al[22] study only recruiting participants younger than 50 years old in an effort to avoid confounding from age-related changes in hormone levels. Although this exclusion criteria may have been valid, it is also important to recognize that the mean (SD) age of finasteride users is 37.8 (10.0) years, with the overall age ranging from approximately 20 to 79 years.[23] Therefore, excluding a large portion of finasteride users older than 50 years could lead to confounding results.

Nonreproductive Effects of Finasteride

A recent study looking at other adverse effects linked to finasteride found that men reporting sexual symptoms following finasteride use also experienced depressed moods and negative affect balance scale scores.[22] These additional symptoms are necessary to discuss because negative affect and depressed moods could tie into perceived negative sexual experiences.

The study analyzed 3 groups: symptomatic finasteride users (presence of adverse effects), nonsymptomatic finasteride users, and nonfinasteride users. The exclusion criteria included men who had used any steroid or steroid-altering drugs or supplements (eg, androgens, antiandrogens, aromatase inhibitors) in the preceding 4 months of the study; those who were recently ill; had a history of cancer, diabetes, or depression; and had a body mass index greater than 40 (calculated as kilograms divided by meters squared).

The study's findings were measured through functional magnetic resonance imaging (fMRI) brain activity, the Patient Health Questionnaire-9 depression scale, the Beck Depression Inventory, the Hamilton Depression Scale 17, and the Positive and Negative Affect Scale.[24] The fMRI used to assess brain activity operates by analyzing which cells and areas in the brain are requiring a greater amount of blood flow. This study used 2 separate fMRI probes to analyze 2 main symptoms that participants were experiencing: depression and sexual dysfunction. A critical point to be noted here is that although researchers selected participants aged 18 to 50 years, which aids in the validity of the study, the basis of inclusion was unsystematic because it was merely informed by the researchers' clinical experience and judgment of whether a participant's hair loss was considered significant.

Proposed Pathophysiological Mechanisms Contributing to Sexual Dysfunction

Adverse effects and symptoms of 5α-reductase inhibitors are thought to occur due to changes in neurosteroids.[21] 5α-Reductase plays a significant role in the metabolism of testosterone, progesterone, cortisol, and other neurosteroids that are thought to mediate male sexual function.

The medial preoptic area (MPOA) and paraventricular nucleus (PVN) of the hypothalamus are essential brain areas for male sexual function. Penile erection and sexual interest have been shown to be dependent on oxytocin in the PVN and MPOA. In the PVN, oxytocin injection triggers erections in male rats.[25] Lesions to the PVN in these rats reduced penile erections in response to either oxytocin injection or noncontact erections stimulated by the presence of female rats. Oxytocin injection in the MPOA promotes sexual intercourse in sexually experienced male rats, while oxytocin antagonists reduce sexual efficiency and increase the time required for intromission.[26] Hormonal imbalances due to 5α-reductase inhibition may, therefore, dysregulate oxytocin signaling within these circuits to induce sexual dysfunction during finasteride therapy and post-finasteride syndrome.

Oxytocin-dependent mechanisms during erections have been demonstrated to be mediated by γ-aminobutyric acid type A (GABA-A) receptor signaling. Rats injected with muscimol, a positive allosteric modulator (PAM) of GABA-A receptors, into the PVN demonstrated diminished penile erections in a dose-dependent fashion.[27] Many neurosteroid metabolites related to 5α-reductase exert similar allosteric effects, including 5α-dihydroprogesterone and allopregnanolone (Table 1 and Figure 1).[28] Indeed, Haage et al[29] found that allopregnanolone acts as a PAM of GABA-A receptors in the MPOA, while Uchida et al[30] showed that allopregnanolone enhances GABA release in the MPOA. 5α-Reductase inhibition may consequently diminish function and libido through altered GABA-A signaling.

Table 1. Modulatory Effects of Neurosteroids and their Cerebrospinal Fluid Concentrations between Post-finasteride Patients and Controls

Neurosteroid	Receptor	Allosteric Modulation	Relation to 5α reductase	CSF Concentrations in pg/μl	
				Control	PFS
5α-Dihydroprogesterone (DHP)	GABA-A	Positive	Downstream	2.83 ± 1.86	0.56 ± 0.90*
Allopregnanolone (THP)	GABA-A	Positive	Downstream	2.01 ± 4.23	0.18 ± 0.21
Isopregnanolone	GABA-A	Negative	Downstream	0.11 ± 0.03	Under Detection Limit
Pregnenolone (Pregnenolone sulfate)[a]	GABA-A	Negative	Upstream	0.31 ± 0.21	0.12 ± 0.11*
	NMDA	Positive			
Progesterone	Nicotinic	Negative	Upstream	0.19 ± 0.14	Under Detection Limit*

Inhibition of 5α-reductase by finasteride is shown to alter neurosteroid concentrations in cerebrospinal fluid (CSF) between post-finasteride syndrome (PFS) patients and controls (Melcangi et al. 2017). Increases or decreases in concentration can be predicted by whether the neurosteroid is upstream or downstream of 5α-reductase metabolism. Pharmacological studies demonstrate how these neurosteroids modulate receptor signaling (Belelli et al. 1996).

* indicates $p < 0.001$ for PFS versus control using the Mann-Whitney U test.

[a]Pregnenolone is a pro-neurosteroid that is converted to pregnenolone sulfate

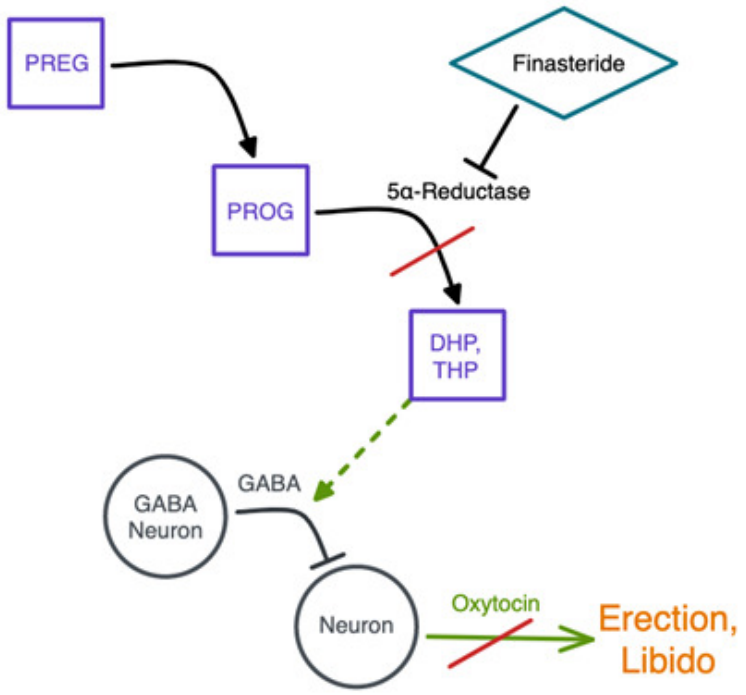

Figure 1. Proposed Pathophysiology of Adverse Effects caused by Finasteride and Post-Finasteride Syndrome

Finasteride may alter GABAergic regulation of oxytocin release from the hypothalamus by reducing levels of positive allosteric modulators (DHP and THP) of GABA-A signaling. Reduced GABAergic regulation may result in disorganized hypothalamic activity and oxytocin release that lowers male sexual function. DHP = 5α-Dihydroprogesterone, THP = Allopregnanolone, PROG = Progesterone, PREG = Pregnenolone.

The direct pathophysiological relation between 5α-reductase inhibitors, GABA, and male sexual function is unclear and understudied. In studies using ovariectomized rats, oscillating GABA release in the MPOA is thought to synchronize release of gonadotropin-releasing hormone.[31] To our knowledge, there are no previous studies to suggest a similar pattern in the regulation of oxytocin. Measures of brain activity using fMRI correlate

increasing activity in the hypothalamus with worsening sexual function in patients with persistent sexual dysfunction following finasteride treatment.[22] This increase in hypothalamic activity is consistent with disinhibition of local GABA, although the first use of more precise measures, such as invasive electroencephalography or local field potential recordings, would be required to confirm in humans. Finasteride has been shown to heighten central nervous system arousal and activity consistent with reduced allopregnanolone and GABA-A receptor signaling in sheep fetuses.[32] Although confounding, the diminishing effect of GABA-A PAMs on penile erections found by Melis et al[27] may reflect descending pathways in erectile termination that are masked in ED. In summary, reduction of certain neurosteroids via 5α-reductase inhibition by finasteride may disrupt hypothalamic GABA that is critical to regulating male sexual function (Figure 1).

Neurosteroids that act as GABA-A PAMs in the MPOA and PVN are primarily downstream metabolites of 5α-reductase and would, therefore, be reduced in CSF concentration by inhibition. Studies by Melcangi et al[12] and Caruso et al[33] examined changes in both CSF and plasma 5α-reductase metabolites as biomarkers in post-finasteride patients. 5α-Reductase metabolites, including 5α-dihydroprogesterone and allopregnanolone, showed statistically significant decreases in CSF concentration in both studies compared with controls (Table 1). Pregnenolone, an indirect negative allosteric modulator of GABA-A receptors, increased and decreased in both studies. This discrepancy may be due to the varying phenotype of post-finasteride patients included in the study, where all patients exhibited sexual dysfunction, but only 50% of patients demonstrated major depressive disorder associated with sexual dysfunction. As such, these CSF biomarkers support the proposed mechanisms for sexual dysfunction related to GABA dysregulation.

Disrupted signaling in the hypothalamus may induce downstream effects that alter the physiology of erections and spermatogenesis. Post-finasteride patients were shown to have lower DHT concentration in CSF.[12] Another study examining post-finasteride patients found increased androgen receptor expression in epithelial and stromal cells of the prepuce skin.[34] These findings point to possible mechanisms related to local androgen supersensitivity following inhibition of DHT by finasteride. In transgenic mice, upregulated androgen receptor expression specific to sertoli cells induced infertility,[35] suggesting that normal DHT levels after finasteride treatment with increased androgen receptor may underlie impaired spermatogenesis.

Overall, preclinical and clinical studies have suggested 5α-reductase and its associated metabolites play a critical part in the neural circuitry necessary for sexual functioning. 5α-Reductase inhibition may disrupt oxytocin and other

possible hormone-releasing pathways involved in triggering erections as well as maintaining spermatogenesis. Further clinical studies are needed to elucidate these mechanisms in both healthy and post-finasteride patients.

Treatment Alternatives Including Topical Finasteride

Topical finasteride is currently being explored as a potential treatment alternative for male pattern hair loss. Recent preliminary RCTs have shown topical finasteride to have similar efficacy as well as fewer adverse effects associated with sexual dysfunction in comparison with oral finasteride.[36-38] Although topical and oral finasteride have the same mechanism of action, topical application allows for reduced systemic exposure to finasteride and, therefore, may explain the less severe sexual dysfunction adverse effects. A randomized, double-blind study also has shown that although oral and topical finasteride have similar efficacy, topical finasteride's lower systemic exposure has a lower impact on serum DHT levels, and thus improves hair count.[38] Overall, there is a significant need for more evidence-based research on topical finasteride prior to its integration into clinical use.

Conclusions

Currently, oral finasteride is one of the only FDA-approved drugs available to treat male androgenic alopecia. Despite finasteride's proven efficacy in treating this condition, there have been reported adverse effects of ED, ejaculation problems, and decreased libido, all of which are factors that can negatively impact sexual and reproductive capabilities. Additional adverse effects, such as mood disorders and anhedonia, have also been reported, which can have a secondary role in decreased sexual functioning. The proposed mechanism for these effects is related to neurosteroids that play a key role in male sexual function.

Overall, the literature assessing finasteride's impact on reproduction is conflicting, with RCTs, cohort studies, and case studies showing data both in support and in opposition of finasteride's adverse effects. Taken together, it is difficult to ascertain a definitive conclusion on the impact of finasteride on reproduction. Of note, in the studies showing a correlation between finasteride and reproduction, the incidence of cases were reported to be very low, suggesting that these adverse effects are rarely encountered in clinical practice. This could perhaps point to a discrepancy between data presented in the literature as statistically significant and actual clinical significance. Despite this, the potential impact of sexual dysfunction, hormonal changes, and depression can pose a serious risk to the individual patient's quality of life. While rare, clear communication between patients with AGA and clinicians about the risks and benefits of finasteride use should be held prior to initiating treatment.

In looking to future directions of research, a greater body of knowledge is required to more accurately define the risk factors that predispose some patients to developing these adverse effects following finasteride use. There is also a significant need for more research on treatment alternatives with comparable efficacy and an improved safety profile such as topical finasteride.

Conflict of Interest Statement

None reported.

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