DOI: 10.1111/jdv.17216 JEADV

REVIEW ARTICLE

Review of oral minoxidil as treatment of hair disorders: in search of the perfect dose

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Abstract

Topical minoxidil has been used for many years as treatment for different hair disorders. Even though it is an effective therapy, many patients show poor compliance due to the cosmesis, cost and side-effects. During the last few years, low-dose oral minoxidil has proven to be an alternative for patients with alopecia. We performed a literature search including all the articles that used oral minoxidil as a primary treatment in various hair diseases in order to evaluate the efficacy and safety of low-dose oral minoxidil as an alternative to topical minoxidil. Androgenetic alopecia was the most common studied condition, but others included telogen effluvium, tractional alopecia, postchemotherapy-induced alopecia, monilethrix, loose anagen hair syndrome, alopecia areata and scarring alopecias (frontal fibrosing alopecia and lichen planopilaris). Larger randomized comparative studies including standardized objective measurements should be done in order to clarify the best treatment protocol, including dosage and treatment duration. Oral minoxidil has proven to be a successful and well-tolerated alternative for patients with hair loss, including those with poor adherence to other therapies. Different dosing regimens have been utilized in scarring and non-scarring alopecia, varying from 0.25 to 5 mg daily. Higher doses have not been studied in men or women. Available literature suggests women require lower doses, from 0.25 to 2.5 mg daily, while men require higher doses for maximal efficacy, from 1.25 to 5 mg a day.

Received: 12 November 2020; revised: 14 February 2021; Accepted: 24 February 2021

Conflicts of interest

None declared.

Funding sources

None.

Introduction

Minoxidil is a potent direct vasodilator that reduces systolic and diastolic blood pressure. It was first used as treatment of severe recalcitrant hypertension in the 1970s.[1] The therapy is associated with significant side-effects, including peripheral oedema, congestive heart failure and pulmonary oedema, as well as hypertrichosis.[2] After discovering this adverse effect, topical formulations were tested, demonstrating success in non-scarring alopecias.[3] Topical minoxidil (TM) and finasteride are the only approved treatment for male androgenetic alopecia, while for women only TM is approved. Nowadays, it is used widely in different hair disorders including scarring alopecias.[4] For a long time, minoxidil has been utilized as 2% or 5% topical solution; later, 5% foam was also commercialized.[5]

The exact mechanism of action is not fully understood. It upregulates vascular endothelial growth factor propagating vasodilatory effects, increasing oxygen and growth factors delivery.[3] Also, it opens potassium channels located in smooth muscles of peripheral arteries, shortening the telogen phase and prolonging the anagen phase,[6] with a progressive growth in diameter and length of hair follicles.[1,5] Minoxidil also moderates concanavalin A, an intermediary in the activation process of T lymphocytes, having an immunomodulatory effect, with possible positive outcomes in autoimmune alopecias.[3] It is a prodrug that requires conversion by the sulfotransferase enzymes to minoxidil sulphate to be biologically active. The isoenzyme SULT1A1 is the predominant sulfotransferase responsible for the minoxidil sulphonation in the outer root sheet of the hair follicle. A positive association between SULT1A1 activity in the outer root sheet and the clinical response to TM has been found; however, a lower activity threshold is required for bioactivation of oral minoxidil compared with TM. This could be because of

the extensive metabolization of OM by the SULT1A1 located in the liver.[7]

Topical minoxidil has been found inconvenient for some patients because of its cosmesis, cost and side-effects (pruritus, desquamation and hypertrichosis),[8] which let us to search for new therapies. Oral minoxidil (OM) was not used for alopecia because of its dose-related adverse effects; usually, a dose of 10–40 mg daily is given for hypertension.[5] The use of low-dose oral minoxidil (LDOM) overcomes this limitation and has become popular for its efficacy and safety. This article aimed to review the available literature on LDOM for hair diseases, including dosage and related adverse effects.

Material and methods

We conducted a literature search in October 2020 regarding hair disorders and oral minoxidil in PubMed, The Cochrane Library, Embase, Google Scholar, EBSCO and Scopus. The search included articles published before 14 October 2020 containing the following keywords: "oral minoxidil" and "systemic minoxidil" in combination with "alopecia", "hair disorders", "hair disease". All published articles were reviewed, and the most relevant articles (case reports, case series, prospective and retrospective studies, clinical trials, reviews and meta-analyses) were included. References were also revised to include articles that could have been missed. A summary of the included articles is shown in Tables 1 and 2.

Oral minoxidil in hair disorders

LDOM has been studied in different hair disorders, including androgenetic alopecia (AGA) (men and women) (n = 10), telogen effluvium (TE) (n = 1), alopecia areata (AA) (n = 2), frontal fibrosing alopecia (FFA) (n = 1) and lichen planopilaris (LPP) (n = 1), permanent chemotherapy-induced alopecia (n = 1), tractional (TA) (n = 1), monilethrix (n = 1) and loose anagen hair syndrome (n = 1).

Female pattern hair loss (FPHL)

In 2017, Sinclair published the first article of patients with FPHL treated with LDOM (0.25 mg) in combination with spironolactone 25 mg.[9] One hundred women with Sinclair stage 2–5 FPHL were treated with a once-a-day capsule containing minoxidil and spironolactone; they were followed prospectively for 12 months. Women with a baseline blood pressure of less than 90/60 or history of postural hypotension had 50 mg of sodium chloride added to their capsules. Side-effects were seen in eight patients, including urticaria (2), postural hypotension (2) and facial hypertrichosis (4). Six of these patients continued treatment, and the two women who developed urticaria discontinued the drug. Of the patients who developed hypertrichosis, one managed it by plucking and the other three by waxing. Also, 22 patients reported temporary increase in hair shedding (the majority ceased within four weeks). Mean reduction in hair loss was 0.1 at 3 months, 0.85 at 6 months, 1.1 at 9 months and 1.3 at 12 months. LDOM was well tolerated in the majority of included patients.

Beach carried out a retrospective study including patients with AGA and TA diagnosed clinically by the author.[8] Twenty patients were included; 15 were female patients with AGA, two male patients with AGA and three female patients with TA (one patient presented both FPHL and TA). The patients were prescribed with oral minoxidil 1.25 mg nightly for an initial 3-month course. Two were discouraged to use the drug due to the prescription warning. The medication was continued by 78% of the patients (14/18). Of the patients who discontinued minoxidil, two cited aversion to pills, one forgetfulness and another headache non-drug related. Among the adverse events reported, the most common was hypertrichosis in 39% (7/18), yet all patients continued the medication because of the perceived benefit for the scalp hair. One patient reported urticaria for 8–10 days and hypotensive symptoms. Six of 18 patients reported decreased hair shedding, while five patients reported increased scalp hair.

In a retrospective study published by Vastarella *et al.* which included 12 patients with AGA treated with oral minoxidil, starting at 0.50 mg daily for 3 months and afterwards increasing the dose to 1.5–2 mg daily, an overall 38% and 23% improvement of hair density in the frontal and vertex area respectively was observed after 24 weeks.[10] The most common adverse events found were mild hypertrichosis in 25%, mild postural dizziness in 8.3% and mild peripheral oedema in 25%. A statistically significant increment on the number of terminal hairs in frontal area (65.63 $\pm$ 20.00 vs. 98 $\pm$ 38.98; P = 0.027) and in triple follicular units in vertex (11.54 $\pm$ 32.61 vs. 16.81; P = 0.05) was observed at 24 weeks.

Rodriguez-Barata and colleagues described the largest series of patients with FPHL treated with LDOM.[11] They designed a retrospective study including patients diagnosed clinically and by trichoscopy with FPHL who were taking OM for a minimum of 6 months. A total of 148 women were included, the dose varied between 0.25 and 2 mg (median 1 mg). Twenty-three patients received OM as monotherapy, and 125 received other concomitant treatment. Regarding effectiveness, 20.3% presented stabilization of the alopecia, while 79.7% presented clinical improvement; no patients worsened. Adverse effects were observed in 19% (29 patients). The most common was hypertrichosis, found in 17%. Other effects were tachycardia (two patients), lower limb oedema and general malaise, each found in one patient.

A randomized clinical trial that compared the efficacy of oral and topical minoxidil was conducted by Ramos *et al.*[12] Fifty-two female patients with FPHL were enrolled. The patients were randomly assigned either to 1 mg of OM or to 1 mL 5% TM once a day for 24 weeks. Fifty patients completed the trial, dropouts were non-treatment related. The total hair density at 24 weeks increased by 12% (95% CI: 8.0–16.1%) in women taking OM

Table 1 Summary of studies including the use of oral minoxidil in androgenetic alopecia

Authors	Hair disorder	Study design	Patients (*N*)	Treatment	OM daily dosage	Side-effects	Results
Beach 2018	AGA and TA	Retrospective. Case series. Average duration of treatment was 6 months	20 patients, 15 women with AGA (one with AGA and TA), 2 men with AGA and 3 women with TA	OM monotherapy	1.25 mg	39% hypertrichosis, 1 patient urticaria and hypotension, 4 patients discontinued therapy for non-therapy related events, and 2 were discouraged by prescription warning	33% reported decreased shedding, and 5 patients increased scalp hair
Tanaka *et al.* 2018	MAGA	Prospective, single arm. Treatment for >6 months. Follow-up for 6 and 12 months	18 918 men	Combination of 1 mg oral finasteride and 2.5 mg OM daily, 5% solution TM BID and a combined injection once a month	2.5 mg	Swelling and dizziness associated with OM was observed in 0.22% and 0.15%	96% and 80% of the patients reported satisfaction after 6 and 12 months, respectively
Jimenez-Cauhe *et al.* 2019	MAGA	Retrospective Case series. Minimum of 6 months of treatment	41 men (10 patients 2.5 mg and 31 patients 5 mg)	39% patients OM as monotherapy, 61% previous therapies (18 dutasteride, 9 mesotherapy dutasteride, 3 finasteride, 2 TM, 1 topical finasteride)	OM 2.5 mg	20% slight hypertrichosis and 10% shedding	90.2% clinical improvement, 26.8% of this presented marked improvement and 9.8% stabilization
					OM 5 mg	25% patients hypertrichosis, 6% lower limb oedema.	
Pirmez *et al.* 2019	MAGA	Retrospective. Case series. At least 24 weeks of follow-up	25 men	OM monotherapy	0.25 mg	4% pedal oedema, 16% hair shedding, 20% body hypertrichosis	Improvement or stabilization in frontal scalp –NTH: 48%, NH: 52%, DTH: 40%, THD: 60%. Vertex-NTH: 44%, NH: 40%, DTH: 44%, THD: 40%
Panchaprateep *et al.* 2020	MAGA	Prospective, single arm. 24 weeks	30 men	OM monotherapy	5 mg	Abnormal EKG findings 20%, pedal oedema 10%, and hypertrichosis found in 90 and 93% patients at 12 and 24 weeks.	A significant increase in total hair count from baseline was found, at 12 (mean change + 26, range 182.5– 208.5 hairs/cm^2) and at 24 weeks (mean change + 35.1, range 182.5–217.6 hairs/cm^2) (both $P = 0.007$)
Jha *et al.* 2020	MAGA	Case series. 24 weeks	32 men	OM monotherapy	1.25 mg	No adverse effects were reported	Marked and mild improvement was seen in 43.8% and 40.6%. Average total hair density per unit area and hair shaft diameter at 24 weeks revealed statistically significant improvement

Table 1 *Continued*

Authors	Hair disorder	Study design	Patients (*N*)	Treatment	OM daily dosage	Side-effects	Results
Sinclair *et al.* 2017	FAGA	Prospective, single arm	100 women	Once-a-day capsule containing minoxidil 0.25 mg and spironolactone 25 mg ± 50 mg sodium chloride	0.25 mg	Urticaria 2%, postural hypotension 2% and facial hypertrichosis 4%	Mean reduction in hair loss was 0.1 at 3 months, 0.85 at 6 months, 1.1 at 9 months and 1.3 at 12 months
Ramos *et al* 2019	FAGA	Prospective, randomized, comparative. 24 weeks	52 women	Patients randomly assigned to 1 mg of OM or 1 mL 5% TM once a day	1 mg	Hypertrichosis in 27% of patients with OM and 4% in TM. Scalp pruritus in 19% of TM and pretibial oedema in 4% of OM	Total hair density increased by 12% (95% CI: 8.0–16.1%) in women taking OM and 7.2% (95% CI: 1.5–12.9%) in women applying TM, with no significant difference
Vastarella *et al.* 2020	FAGA	Retrospective. 24 weeks	12 women	Starting dose of 0.5 mg daily for 3 months, then increased to 1.5–2.5 mg daily	0.5–2.5 mg	Mild hypertrichosis 25%, mild postural dizziness 8.3%, and mild peripheral oedema 25%	Statistically significant increment on the number of terminal hairs in frontal area (65.63 ± 20.00 vs. 98 ± 38.98; $P = 0.027$) and in triple follicular units in vertex (11.54 ± 32.61 vs 16.81; $P = 0.05$)
Rodriguez-Barata *et al.* 2020	FAGA	Retrospective. Mean time of 9 months (range 6–27)	148 women	23 OM monotherapy, 125 received other concomitant therapy	0.25–2 mg (median 1 mg)	Hypertrichosis 17%, 2 tachycardia, 1 lower limb oedema, 1 general malaise	20.3% presented stabilization of the alopecia, while 79.7% presented clinical improvement; no patients worsened

AA, alopecia areata; AGA, androgenetic alopecia; BID, twice a day; CTE, chronic telogen effluvium; DTH, density of terminal hair; FAGA, female androgenetic alopecia; FFA, frontal fibrosing alopecia; HSS, hair shedding score; LPP, lichen planopilaris; MAGA, male androgenetic alopecia; NH, new hairs; NTH, new terminal hairs; OM, oral minoxidil; TA, traction alopecia; THD, total hair density; TM, topical minoxidil.

Table 2 Summary of studies including the use of oral minoxidil in other types of alopecia

Authors	Hair disorder	Study design	Patients (*N*)	Treatment	OM daily dosage	Side-effects	Results
Perera *et al.* 2017	CTE	Retrospective. 12 months	36 women	OM monotherapy	0.25–2 mg (most patients 1 mg)	38% facial hypertrichosis, 5% postural dizziness and 3% ankle oedema	Mean HSS improved 3.9 and 3.05 at 6 and 12 months, respectively. Reduction in mean HSS scores from baseline to 6 months of 1.7 ($P < 0.001$) and to 12 months of 2.58 ($P < 0.001$). 86% improvement of shedding
Fiedler *et al.* 1987	AA	Prospective, single arm. Mean 53 weeks of treatment (range 10–115)	65 patients (27 men and 38 women)	OM monotherapy	5 mg BID	Sodium and fluid retention, occasional episodes of headaches, depression or lethargy in women, episodes of palpitation or tachycardia after caffeine, alcohol or decongestant, and facial hypertrichosis in 17%	Response was seen in 80% of patients, cosmetic response in 18% (which maintained regrowth during treatment)
Wambier *et al.* 2019	AA	Retrospective. At least 6 months of treatment.	12 patients (7 women and 5 men)	Tofacitinib 5 mg BID and OM 2.5 mg daily for women and 2.5 mg BID for men	2.5 mg women 2.5 mg BID men	50% hypertrichosis, 16% acne	Eight patients (67%) achieved SALT75 (≥75% scalp hair regrowth) and 4 patients (33%) achieved SALT11–74 (11–74% scalp hair regrowth) (Fig.
Vano-Galvan *et al.* 2020	LPP	Retrospective. Mean duration of 21 months (range 6–87)	51 patients (36 women and 15 men)	No changes in concomitant treatments in the previous 6 months	Started at 0.25–1 mg and titrated up (median 1 mg)	Hypertrichosis 27%, postural hypotension 5%, tachycardia 4% and 2% weight gain	Hair thickness improved in 39%, remained stable in 53% and worsened in 8%
Cranwell *et al.* 2016	FFA	Case report. 36 months of treatment	1 woman	Dutasteride 0.1 mg, OM 1 mg, hydroxychloroquine 400 mg and intralesional triamcinolone	1 mg	No side-effects were reported	Stabilization of disease
Cranwell *et al.* 2018	Loose anagen hair syndrome	Case report. 12 months of treatment	1 girl (11 years)	OM monotherapy	0.5 mg	Change in hair colour from reddish-brown to light brown	Shedding and hair density improved in an even pattern. No recurrence after cessation
Yang *et al.* 2015	Permanent chemotherapy-induced alopecia	Case report. 24 months of follow-up	1 woman	OM monotherapy	1 mg	No side-effects	Regrew of significant amount of hair, increased number of growing follicles and cosmetically meaningful lengthening
Sinclair 2016	Monilethrix	Case series. One patient 24 months and the second 18 months	2 women	OM monotherapy	First patient 0.25 mg 0.25 mg for 3 months, then 0.5 mg	No side-effects No side-effects	Significant hair growth with reduced breakage and increased hair volume and length

AA, alopecia areata; BID, twice a day; CTE, chronic telogen effluvium; FFA, frontal fibrosing alopecia; HSS, hair shedding score; LPP, lichen planopilaris; OM, oral minoxidil; TM, topical minoxidil.

and 7.2% (95% CI: 1.5–12.9%) in women applying TM, with no significant difference. Among the adverse effects, the most frequent was hypertrichosis in 27% of patients with OM and 4% in TM. Scalp pruritus was noted in 19% of TM and pretibial oedema in 4% of OM group. Their results reveal that LDOM provides an improvement that does not differ from TM 5% solution.

Male androgenetic alopecia

The largest study on male AGA treated with OM was made by Tanaka *et al*.[13] They included 18 918 male patients aged 18–81 years. A combination of 1 mg oral finasteride and 2.5 mg OM daily, 5% solution TM twice a day and an injection (2 mL of 1% lidocaine, and 2 mL of a solution that contained minoxidil, arginine, aspartic acid, caffeine, copper tripeptide, lysine, niacin, panthenol, propanediol, propylene glycol, retinyl palmitate, pyridoxine, sodium hyaluronate and ubiquinone) once a month for more than 6 months was given to the patients. Significant improvement was observed in all patients. Ninety-six per cent and 80% of the patients reported satisfaction with the results after six and 12 months, respectively. Minor adverse effects were observed in 4.2% of the patients. Regarding minoxidil use, swelling and dizziness associated with OM were observed in 0.22 and 0.15% of the patients and itching and erythema in 0.04 and 0.02% related to the use of TM.

In 2019, Jimenez-Cauhe *et al*.[14] published a retrospective study in male patients treated with OM. Forty-one men with a mean age of 44 years were included; they were given a daily dose of 2.5 mg (10 patients) or 5 mg (31 patients). Sixteen patients received monotherapy with OM, and 25 received concomitant therapy. Clinical improvement was observed in 90.2%, with 26.8% presenting marked improvement. Nine per cent showed stabilization, and no patient worsened. In the group treated with OM as monotherapy, 37.5% showed marked improvement. Adverse effects were observed in 29.3% (12 patients). Ten patients presented hypertrichosis, two patients lower limb oedema and one patient shedding. Most of the adverse events appeared with the dose of 5 mg, except for two patients who presented slight hypertrichosis and one hair shedding with 2.5 mg.

In a retrospective review of 25 male patients treated with a very low dose of OM (0.25 mg/day) as monotherapy for AGA, no significant improvement was found.[15] Adverse effects reported were pedal oedema in one patient, hair shedding in four and body hypertrichosis in five. They concluded that higher doses might be necessary in order to produce significant effects in men. Afterwards, Jah and colleagues reported 32 men with AGA treated with OM monotherapy dosed at 1.25 mg/day for 24 weeks.[16] Marked and mild improvement were seen in 43.8% and 40.6%. Average total hair density per unit area and hair shaft diameter at 24 weeks revealed statistically significant improvement. No adverse effects were reported. As a conclusion, authors stated that a dose of 1.25 mg/day can be used in male patients with AGA, although higher doses may be required if despite 6 months treatment, the response is suboptimal.

Recently a prospective study that included 30 male patients aged 24–59 years was made.[17] Patients were asked to take 5 mg of OM daily for 24 weeks. A significant increase in total hair count from baseline was found, at 12 (mean change + 26, range 182.5–208.5 hairs/cm^2) and at 24 weeks (mean change + 35.1, range 182.5–217.6 hairs/cm^2) (both $P = 0.007$). Photographic assessment of the vertex displayed 100% improvement, with 43% showing excellent response. Frontal area presented significant response. Regarding adverse effects, abnormal EKG findings were found in six patients (20%), pedal oedema in three patients (10%), and the most common side-effect was hypertrichosis found in 27 and 28 patients at 12 and 24 weeks. The most common locations were forearms and face (forehead, temples and over malar prominences).

Chronic Telogen effluvium

Only one article describing the use of oral minoxidil in telogen effluvium has been published.[18] Thirty-six female patients with chronic telogen effluvium were included in this retrospective study. The oral minoxidil dosage varied between 0.25 and 2.5 mg, with most patients being given 1 mg. Mean hair shedding scores (HSS) improved 3.9 and 3.05 at 6 and 12 months, respectively. A reduction in mean HSS from baseline to 6 months of 1.7 ($P < 0.001$) and from baseline to 12 months of 2.58 ($P < 0.001$) was noted. Fourteen patients developed facial hypertrichosis; six patients did not require treatment, four waxed and three practised laser hair removal. Two patients presented postural dizziness that resolved after continued therapy, and one developed ankle oedema.

Alopecia areata

The first study evaluating the efficacy of OM in AA was conducted in 1987 by Fiedler-Weiss *et al*.[19] Sixty-five patients (27 men and 38 women) with severe alopecia areata were enrolled in the study. Each patient received a dose of 5 mg OM every 12 h for a median duration of 53 weeks. Response to OM was seen in 52 (80%) of the 65 patients, in 21 (100%) of 21 patients with baseline scalp hair loss less than 75%, and in 31 (70%) of 44 patients with baseline scalp hair loss greater than or equal to 75% with a mean time to response of 9.3 weeks. Sodium and fluid retention, episodes of headaches, depression and lethargy were the adverse events most frequently reported; tachycardia and facial hypertrichosis were also reported. Recently, a retrospective study assessing the efficacy on hair regrowth with the combination of tofacitinib and oral minoxidil treatment was conducted in 12 patients with severe alopecia areata.[20] All patients were treated with 5 mg twice daily tofacitinib, women combined with 2.5 mg OM daily and men 2.5 mg twice daily OM. Scalp hair loss was assessed using the Severity of Alopecia Tool (SALT). Eight patients (67%) achieved SALT75 (75% scalp

hair regrowth), and four patients (33%) achieved SALT11-74 (11–74% scalp hair regrowth). Hypertrichosis (six patients) and acne (two patients) were the side-effects described.

Lichen planopilaris

To date, only one article describing the use of LDOM in LPP has been published.[21] Fifty-one patients (36 women and 15 men) with LPP were included in this retrospective study. The median OM dosage was 1 mg (0.5 mg for females and 2.5 mg for males) with a mean duration of therapy of 21 months. Twenty patients (39%) showed an improvement of hair thickness, while 27 patients (53%) remained stable. Interestingly, better results were reported in patients presenting diffuse LPP ($P = 0.005$) and higher doses of LDOM in male patients were associated with better outcomes. Thirty-seven per cent of patients reported mild side-effects including hypertrichosis, postural hypotension and tachycardia.

Frontal fibrosing alopecia

There is no standardized treatment for patients affected by FFA. Treatments include hydroxychloroquine, finasteride and dutasteride, mycophenolate mofetil, corticosteroids (oral, intralesional and topical), oral retinoids, topical calcineurin inhibitors, doxycycline or topical minoxidil. In literature, there is only one case describing the use of oral minoxidil in a premenopausal 46-year-old woman with rheumatoid arthritis and FFA affecting the temples bilaterally. The patient was treated with hydroxychloroquine (400 mg daily) and methotrexate (20 mg weekly) for the rheumatoid arthritis and a combined treatment of 0.1 mg daily oral dutasteride and 1 mg daily oral minoxidil reporting a satisfactory disease stabilization.[22]

Hair shaft disorders

The efficacy of systemic minoxidil has also been demonstrated in hair shaft disorders. In literature, a case of loose anagen hair syndrome, an autosomal dominant disorder characterized by abnormal anagen hair anchorage, treated with OM has been described. The 11-year-old girl was treated with 0.5 mg daily OM resulting in improvement of shedding and hair density within 3 months. They also explain a change in hair colour, as a sign of treatment response. No recurrence was described after cessation of treatment.[23] In 2016, Sinclair *et al.* reported the case of two women with monilethrix, an autosomal dominant genodermatosis characterized by hair fragility, keratosis pilaris and pathognomonic beading of the hair shaft, successfully treated with 6-month treatment of LDOM. Treatment with oral minoxidil resulted in significant hair growth with reduced breakage and increased hair volume and length in both patients.[24]

Permanent chemotherapy-induced alopecia

One article describing the use of OM in permanent chemotherapy-induced alopecia (PCIA) has been published.[25] A 39-year-old Caucasian woman with previous acute myeloid leukaemia reported PCIA after treatment with cyclophosphamide and busulfan chemotherapy. A dosage of 1 mg daily OM was given in association with anti-androgen drugs. A subjective increase in hair growth was reported after 6 weeks of treatment, and after 1 year, an increased number of hair follicles and meaningful lengthening of scalp hairs were reported. Histology showed significant decrease in telogen follicles and a reversal of follicle miniaturization. Treatment was well tolerated, and no adverse events were reported.

Discussion

Oral minoxidil is being increasingly used for the treatment of AGA and other types of hair loss.[26] Available data are still limited and result mainly from low-evidence studies that prevent the assessment of the efficacy of OM or the comparison with TM. Many approved therapies, such as 5α-reductase inhibitors or spironolactone, are inappropriate for some patient populations, as well as for women of childbearing potential.

Several studies assessed OM to be effective in both male and female AGA usually reporting objective clinical improvement, with decreased shedding and increased length.[7] The largest prospective cohort study was conducted in Asia and spanned several years, involving 18.918 male AGA patients treated with a daily combination of 1 mg oral finasteride, 2.5 mg oral minoxidil and 5% topical minoxidil twice daily.[12] Significant improvement was observed in all patients. Ninety-six and 80% of the patients reported satisfaction with the results after 6 and 12 months, respectively. In AA, OM has been used alone (5 mg twice daily) to treat cases refractory to 5% TM or combined with oral tofacitinib, reporting in both cases an increase in terminal hair regrowth.[19,20] Use of oral minoxidil to treat scarring alopecia, such as LPP or FFA, is limited to few case reports, obtaining good response in hair growth.[21,22] Few cases reporting the efficacy of LDOM in PCIA and monilethrix have also been reported in literature.[23–25] Oral minoxidil has demonstrated to be a well-tolerated drug in both female and male patients. The adverse events most frequently reported are hypertrichosis, tachycardia and fluid retention, in most cases not severe enough for patients to suspend treatment.[5] Contraindications are limited, including drug hypersensitivity and history of pheochromocytoma.[26] Since minoxidil is renally cleared, patients with renal failure or dialysis may require smaller doses, but those with severe hepatic impairment should be monitored closely as well.[3] Examining routine laboratory values during treatment is not generally recommended. It is considered to be safe in women with childbearing potential, however should be removed when seeking pregnancy since it is pregnancy category C and has been found excreted in breast milk.

LDOM is an emerging therapy for alopecia, characterized by its good safety profile and few contraindications that allow it to be prescribed for most patients. LDOM has been used with different dosing regimen varying from 0.25 to 5 mg daily in

scarring and non-scarring alopecia. Higher doses have not been studied in men or women. Available literature suggests women require lower doses, from 0.25 to 2.5 mg daily, while men require higher doses for maximal efficacy, from 1.25 to 5 mg a day. Few cohort studies on large sample size assessing the efficacy of oral minoxidil have been conducted, with most studies ranging from cases to small case series. Further studies using standardized methods of measuring clinical hair regrowth, such as quantitative trichoscopy, will need to be completed to determine oral minoxidil's therapeutic effect in different hair disorders. A better understanding of long-term adverse events and duration of therapy is needed to provide general conclusions.

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