GETKA, Beata, PRZYBOROWSKA, Kinga, RUKAT, Mateusz, ŁATA, Michał, KWIECIEŃ, Justyna and WIEJAK, Katarzyna. Platelet-rich plasma therapy in the treatment of androgenic alopecia – review. Journal of Education, Health and Sport. 2024;53:187-197. eISSN 2391-8306. https://dx.doi.org/10.12775/JEHS.2024.53.014
https://apcz.umk.pl/JEHS/article/view/47810
https://zenodo.org/records/10532346

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 05.01.2024. Revised: 17.01.2024. Accepted: 17.01.2024. Published: 19.01.2024.

Platelet-rich plasma therapy in the treatment of androgenic alopecia – review

1. Beata Getka [BG]
Military Medical Institute, Warsaw
Szaserów 123 street, 04-349 Warszawa
https://orcid.org/0009-0004-1951-7680
beata.getka@gmail.com

2. Kinga Przyborowska [KP]
The National Institute of Medicine of the Ministry of Interior and Administration, Warsaw
Wołoska 137 street, 02-507 Warszawa
https://orcid.org/0009-0009-8320-1580
kmprzyborowska@gmail.com

3. Mateusz Rukat [MR]
Mazovian Provincial Hospital in Siedlce
Poniatowskiego 26 street, 08-110 Siedlce
https://orcid.org/0009-0003-7742-6499
mateuszrukat97@gmail.com

4. Michał Łata [MŁ]
District Medical Center in Grójec
Piotra Skargi 10 street, 05-600 Grójec
https://orcid.org/0009-0001-0462-1141
michal.lataa@gmail.com

5. Justyna Kwiecień [JK]
District Medical Center in Grójec
Piotra Skargi 10 street, 05-600 Grójec
https://orcid.org/0000-0002-1969-209X
kwiecien.jstn@gmail.com

5. Katarzyna Wiejak [KW]
Medical University of Warsaw, UCK WUM
Stefana Banacha 1a street, 02-097 Warszawa
https://orcid.org/0009-0006-2128-7612
kasia.wiejak@gmail.com

Abstract

Hair loss is a problem that affects many people around the world. Androgenic alopecia (AGA) is the most common cause of hair loss affecting up to 50% of men and 40% of women over the age of 50. This type of hair loss is mediated by androgens, the strongest of which is dihydrotestosterone (DHT). This hormone influences the weakening hair follicles. The problem of excess DHT and the associated androgenic hair loss may concern people practicing sports, especially aerobic disciplines of moderate and high intensity. In the recent decades, many topical and oral therapies have been introduced to delay and stop hair loss. However, commonly used medications have only a partial and temporary effect, therefore alternative treatment methods are needed. Platelet-rich plasma (PRP) is known, among other things, for its use in orthopedics. The use of PRP may benefit athletes in the treatment of

injuries to tendons, ligaments, muscles and cartilage. Many publications indicate good results with the use of PRP in the treatment of hair loss.

The aim of this study is to summarise the published reports on the effect of platelet-rich plasma (PRP) on hair loss prevention in people with androgenic alopecia (AGA) and to analyse the papers discussing androgen levels in physically active people.

Key words: androgenic alopecia, platelet-rich-plasma, dihydrotestosterone, androgens, sport activity

Introduction

The platelet-rich plasma (PRP) preparation obtained from the patient's own blood is an autologous, biocompatible product. Regeneration and biostimulation of skin cells occur as a result of the action of growth factors contained in the plasma: PDGF (platelet-derived growth factor), TGF-β (transforming growth factor β), VEGF (vascular endothelial growth factor), EGF (epidermal growth factor), IGF-1 (insulin-like growth factor), and FGF (fibroblast growth factor). [1] In recent years, the use of platelet-rich plasma in the treatment of alopecia has been widely researched. Hair loss accompanies many diseases and is divided into non-scarring and scarring. PRP is used as a therapy for some types in the case of non-scarring alopecia, and new findings relate to its possible use in the treatment of scarring alopecia. [2]

The role of platelet-rich plasma growth factors (PRP)

Growth factors obtained by the degranulation of the platelet alpha-granules stimulate hair regrowth. IGF-1 and TGF-β1 initiate keratinocyte proliferation. VEGF activates angiogenesis, and PDGF stimulates macrophages and fibroblasts to secrete endogenous growth factors, including: TGF-β1, which accelerates the synthesis of new collagen. [3]

Androgenic alopecia (AGA)

The development of AGA depends on several factors: genetic predisposition, the presence of an appropriate level of androgens, androgen receptors and their coactivators. Although the genetic background of AGA has long been assumed, the mode of inheritance is still unclear. Several studies have shown that genetic variants in the androgen receptor (AR)

gene on chromosome Xq12 are associated with this type of alopecia. The involvement of the X chromosome confirms the influence of the mother, but does not explain the inheritance from the father. Subsequent genetic tests proved polygenic inheritance of AGA. [4]

As the name itself suggests, androgens are the main mediators of androgenic alopecia. Androgens shorten the lifespan of anagen. Each hair follicle goes through three main phases: catagen, telogen and anagen. In the first stage, the hair follicle undergoes apoptosis (catagen), in the second stage this is resting phase (telogen), and in the third stage the hair follicle re-enters the growth phase (anagen) to initiate the formation of a new hair. In addition, androgens promote miniaturisation of hair follicles. They transform terminal hair into thinner and softer. The cells of hair follicles from balding areas show higher levels of 5-alpha reductase than the cells from non-balding areas. It is an enzyme that converts testosterone into dihydrotestosterone, which is the strongest androgen.[5]

The diagnosis of AGA can usually be confirmed only on the basis of medical history and physical examination. A trichogram can be useful in assessing the progression of hair loss. A scalp biopsy is of a diagnostic nature, but is not usually required.

In the recent decades, many topical, oral and surgical therapies have been introduced to delay and stop hair loss, as well as to restore the presence of hair in the balding areas. However, drugs such as minoxidil, finasteride and dutasteride only provide partial and temporary effects. [6] 2% minoxidil solution stimulates new hair growth and helps to stop hair loss in men and women with androgenic alopecia. Higher concentrations of this preparation increase its effectiveness. [7] Finasteride is a 5-alpha reductase inhibitor, which is the mechanism of action of this drug in hair growth in androgenic alopecia. Various clinical trials of finasteride have confirmed its beneficial effects on hair loss in men but not in women. The above drugs do not have high efficacy, therefore alternative methods of treating androgenic alopecia are needed.

The study conducted by Shapiro included 35 patients, 17 women and 18 men, aged 18–58 years, with androgenic alopecia of 3 to 5 grade using the Norwood-Hamilton scale (men) and of 1 to 2 grade using the Ludwig scale (women). Two squares measuring 7.6 cm x 7.6 cm were tattooed on the scalp of the study subjects. The areas were randomly assigned for intradermal injections of PRP or saline. The patients underwent a total of three treatment sessions at 1-month intervals, with the last follow-up visit taking place three months after the last treatment. At final evaluation, hair density in the PRP-treated areas increased from 151 ± 39.82 hairs/cm^2 to 170.96 ± 37.14 hairs/cm^2, an average increase of approximately 20

hairs/cm^2 ($P < 0.05$). However, hair density in placebo-treated areas also increased from 151.04 ± 41.99 hairs/cm^2 to 166.72 ± 37.13 hairs/cm^2 ($P < 0.05$). [8]

Male androgenic alopecia (MAGA)

Androgenic alopecia affects 50% of men up to the age of 50 and as many as 80% of men up to the age of 80 and is caused by genetic factors. It develops as a result of hereditary hypersensitivity of hair roots to dihydrotestosterone (DHT), which is produced in the body from the male hormone testosterone. The rate of progression is individual. Racial differences are observed in terms of incidence and clinical presentation. It most often occurs in Caucasian men. In Asian men, preservation of the frontal hairline, the Ludwig pattern, is observed, while in Caucasian men, the classic Norwood Hamilton pattern prevails. As an androgen-dependent disease, MAGA may present soon after puberty. Its early onset can cause significant psychological distress. Currently, topical minoxidil and oral finasteride are the only FDA-approved treatments for MAGA. Given the progressive nature of the disease, almost all treatments require lifelong adherence in order to ensure continued improvement. [9]

Bayat conducted a study on 19 men with androgenic alopecia ranging from grade 3 to grade 5 on the Norwood Hamilton scale. All of the obtained liquid (5 ml) was injected into approximately 125 points on the scalp. This procedure was repeated at week 4 and 8. The results showed significant upward trend in hair thickness and number over the study period ($P < 0.001$). The number of hair follicles during follow-up was significantly higher than the baseline value. The study showed that the use of PRP as a new and safe method may be effective in the treatment of androgenic alopecia. [10]

Female androgenic alopecia (FAGA)

Female androgenic alopecia is a common cause of non-scarring alopecia in women. In Caucasian women, the incidence of FAGA increases with age: from 3–12% in the third–fourth decade of life, to 14–28% in women over fifty and 29–56% in the population over 70 years of age. Clinically, it manifests as diffuse thinning of hair on the mid-scalp, while the frontal hairline is usually preserved. FAGA can have a significant psychological impact, leading to anxiety and depression. For this reason, early diagnosis is very important to delay the progression of the disease.

Endocrine diseases associated with hyperandrogenism include polycystic ovary syndrome (PCOS), hyperprolactinemia, adrenal hyperplasia and, rarely, ovarian and adrenal tumors. Estrogen plays a protective role on the hair. This is indicated by an increased

incidence of FAGA after menopause, extension of the anagen phase period during pregnancy. There are documented cases of hair regrowth in transgender people with androgenic alopecia taking estrogen. Women taking tamoxifen or aromatase inhibitors for breast cancer suffer from hair loss due to estrogen inhibition.[11]

In PCOS, the ovaries produce up to 60% of androgens, while the adrenal glands produce the remaining 40%. The excessive secretion of luteinising hormone (LH), both basic and occurring in response to GnRH, is a characteristic trait of this disease. This is the main abnormality in the classic PCOS that causes the excess of androgens. [12] The typical clinical symptoms of PCOS include hirsutism, acne, alopecia, weight gain, infertility or menstrual disorders. [13]

After menopause, estrogen levels drop dramatically, which stimulates LH to secrete androgens. At this time, the level of sex hormone binding globulin (SHBG) also decreases, which also causes an increase in the level of free androgens. [14] FAGA can be observed in postmenopausal period due to long-term limitation of the hair cycle, with the existing hair becoming thinner and drier. However, during premenopausal period, women prone to centro-parietal alopecia may experience noticeable thinning. [15]

Although the key drugs used in FAGA are topical minoxidil and oral antiandrogens, platelet-rich plasma (PRP) may be an alternative in patients for whom the standard treatment does not bring satisfactory results. PRP is a treatment method that has gained popularity for FAGA over the years due to its autologous nature, minimal invasiveness, lack of serious side effects, better compliance and greater affordability compared to hair transplantation.

The aim of the study conducted by Agarwal was to compare the efficacy of 2% minoxidil solution (topical application) with combined therapy: 2% minoxidil solution (topical application) and PRP, groups 1 and 2, respectively. 26 patients with FAGA were included in the treatment (12 in group 1 and 14 in group 2). The inclusion criteria included women aged 18 to 55 years with a diagnosis of FAGA 1-3 on the Ludwig scale based on clinical and trichoscopic examination. There was a statistically significant change in hair density for both groups, the average change was 34.92 ± 8.39 hairs/cm^2 in group 1 ($P < 0.001$) and 31.21 ± 8.30 hairs/cm^2 in group 2 ($P < 0.001$). There was no statistically significant difference between the two groups. The combination therapy with minoxidil and PRP is an effective treatment for FAGA, but is not superior to topical therapy with 2% minoxidil alone. However, PRP is an effective therapy, especially in patients with high platelet counts. It may be recommended for people who have problems with compliance or intolerance to itching caused by minoxidil. [16]

Platelet-rich plasma (PRP) in follicular unit extraction (FUE) hair transplantation therapy

Platelet-rich plasma can also be used as an additional treatment in hair transplant therapy. The FUE technique is a common surgical procedure in treating severe hair loss. The aim of the study conducted by Alshahat was to investigate the effect of platelet-rich plasma and assess its role in hair transplantation using the FUE technique. The prospective, randomised, controlled study included 20 patients aged 25 to 60 years, suffering from androgenic alopecia (AGA). This group was divided into two subgroups, subgroup A - 10 patients treated with FUE, and subgroup B - 10 patients treated with FUE with the administration of platelet-rich plasma (PRP) after 1, 2 and 3 weeks after surgery, then monthly for the next three months. An early increase in hair density and length was observed in the PRP subgroup compared to the non-PRP subgroup. However, after a long-term follow-up of one year, no differences were found between the subgroups. [17]

The impact of physical activity on androgen levels

The problem of hair loss affects also people with high physical activity. In this population, increased levels of dihydrotestosterone (DHT), which is the strongest androgen that contributes to the weakening of hair follicles, are observed. The randomised, controlled clinical study conducted by Hawkins included 102 men aged 40–75 with a sedentary lifestyle. They were randomly assigned to two groups. The first group performed specific physical exercises for 12 months, while in the second group no changes were made to daily activity. The combined programme of exercises at the sports facility and at home consisted of moderate/high intensity aerobic exercises for 60 min. daily, 6 days a week. Serum concentrations of testosterone, free testosterone, dihydrotestosterone (DHT), 3α-androstanediol glucuronide (3α-Diol-G), estradiol, free estradiol, and sex hormone binding globulin (SHBG) were measured at baseline and then after 3 and 12 months. After 3 months, DHT levels increased by 14.5% in the exercising subjects compared to 1.7% in control subjects. The study found that moderate to high intensity aerobic exercises increase DHT levels. [18]

The physical effort-induced changes in serum sex hormone levels have been reported in many studies. For example, testosterone levels were reduced during marathon running and treadmill running. On the contrary, repeated sprinting exercises (consisting of 10 repetitions lasting 30 s.) were the cause of the increase in the levels of total testosterone, free testosterone

and dihydrotestosterone (DHT) in healthy, active young men. Exercises on a bicycle ergometer increased testosterone levels after 20 minutes from the start of the exercise, but this level returned to baseline values within 10 min. after completing the exercises In another study, physical activity lasting 2 hours increased testosterone levels by 18-25%. [19]

In healthy young men, dihydrotestosterone (DHT) levels increase after sprinting exercises. In the study conducted by Smith, 14 healthy, active young men performed a series of sprints. Venous blood samples were collected before the exercise and 5 and 60 minutes after the exercise. Five minutes after the exercise, there was a significant increase in total testosterone ($P < 0.001$), free testosterone ($P < 0.001$), and DHT ($P < 0.004$) levels, which returned to baseline values after 1 hour. Summing up, these results show that DHT levels are significantly elevated after a sprint cycle exercise. [20]

Summary

The presented literature review demonstrates that platelet-rich plasma (PRP) increases hair density. Additionally, an increase in the thickness of the epidermis, an increase in the number of follicular hairs, and an increase in the number of small blood vessels within the hair follicles have been observed after the use of plasma mesotherapy. Studies confirm the efficacy of the PRP therapy in patients with androgenic alopecia, both males and females.

The most potent androgen that has the greatest impact on the weakening of hair follicles is dihydrotestosterone (DHT). The level of DHT in the blood closely correlates with physical activity, especially sprinting exercises. It seems that increased levels of DHT in the group of people practicing sports may intensify hair loss. PRP not only brings benefits in the treatment of androgenic alopecia, but it can also cause an early increase in hair density and length in people after FUE hair transplantation.

Disclosures

Funding statement: No external funding statement was received to perform this review

Conflict of interest: The authors declare no conflict of interest

Authors contribution: Conceptualization: Beata Getka, Justyna Kwiecień, Michał Łata; methodology: Kinga Przyborowska, Katarzyna Wiejak, Mateusz

Rukat; formal analysis: Michał Łata, Kinga Przyborowska, Justyna Kwiecień; investigation: Beata Getka, Mateusz Rukat, Justyna Kwiecień; writing-rough preparation: Beata Getka, Kinga Przyborowska, Katarzyna Wiejak; writing-review and editing: Michał Łata, Justyna Kwiecień, Mateusz Rukat; visualization: Beata Getka, Kinga Przyborowska, Katarzyna Wiejak

All authors have read and agreed with the final, of the manuscript.

Board statement: Not applicable - this review included analysis of the available literature.

Bibliography:

1. Gupta S, Paliczak A, Delgado D. Evidence-based indications of platelet-rich plasma therapy. Expert Rev Hematol. 2021 Jan;14(1):97-108. doi: 10.1080/17474086.2021.1860002. Epub 2020 Dec 17. PMID: 33275468.
2. Alves R, Grimalt R. Platelet-Rich Plasma and its Use for Cicatricial and Non-Cicatricial Alopecias: A Narrative Review. Dermatol Ther (Heidelb). 2020 Aug;10(4):623-633. doi: 10.1007/s13555-020-00408-5. Epub 2020 Jun 17. PMID: 32557337; PMCID: PMC7367994.
3. Gentile P, Garcovich S. Advances in Regenerative Stem Cell Therapy in Androgenic Alopecia and Hair Loss: Wnt pathway, Growth-Factor, and Mesenchymal Stem Cell Signaling Impact Analysis on Cell Growth and Hair Follicle Development. Cells. 2019 May 16;8(5):466. doi: 10.3390/cells8050466. PMID: 31100937; PMCID: PMC6562814.
4. Alsantali A, Shapiro J. Androgens and hair loss. Curr Opin Endocrinol Diabetes Obes. 2009 Jun;16(3):246-53. doi: 10.1097/med.0b013e32832b100a. PMID: 19396986.
5. Abdin R, Zhang Y, Jimenez JJ. Treatment of Androgenetic Alopecia Using PRP to Target Dysregulated Mechanisms and Pathways. Front Med (Lausanne). 2022 Mar 16;9:843127. doi: 10.3389/fmed.2022.843127. PMID: 35372424; PMCID: PMC8965895.
6. Martinez-Lopez A, Montero-Vilchez T, Sierra-Sánchez Á, Molina-Leyva A, Arias-Santiago S. Advanced Medical Therapies in the Management of Non-Scarring Alopecia: Areata and Androgenic Alopecia. Int J Mol Sci. 2020 Nov 9;21(21):8390. doi: 10.3390/ijms21218390. PMID: 33182308; PMCID: PMC7664905.

7. Lucky AW, Piacquadio DJ, Ditre CM, Dunlap F, Kantor I, Pandya AG, Savin RC, Tharp MD. A randomized, placebo-controlled trial of 5% and 2% topical minoxidil solutions in the treatment of female pattern hair loss. J Am Acad Dermatol. 2004 Apr;50(4):541-53. doi: 10.1016/j.jaad.2003.06.014. PMID: 15034503.
8. Shapiro J, Ho A, Sukhdeo K, Yin L, Lo Sicco K. Evaluation of platelet-rich plasma as a treatment for androgenetic alopecia: A randomized controlled trial. J Am Acad Dermatol. 2020 Nov;83(5):1298-1303. doi: 10.1016/j.jaad.2020.07.006. Epub 2020 Jul 9. PMID: 32653577.
9. York K, Meah N, Bhoyrul B, Sinclair R. A review of the treatment of male pattern hair loss. Expert Opin Pharmacother. 2020 Apr;21(5):603-612. doi: 10.1080/14656566.2020.1721463. Epub 2020 Feb 17. PMID: 32066284.
10. Bayat M, Yazdanpanah MJ, Hamidi Alamdari D, Banihashemi M, Salehi M. The effect of platelet-rich plasma injection in the treatment of androgenetic alopecia. J Cosmet Dermatol. 2019 Dec;18(6):1624-1628. doi: 10.1111/jocd.12907. Epub 2019 Mar 20. PMID: 30895745.
11. Starace M, Orlando G, Alessandrini A, Piraccini BM. Female Androgenetic Alopecia: An Update on Diagnosis and Management. Am J Clin Dermatol. 2020 Feb;21(1):69-84. doi: 10.1007/s40257-019-00479-x. PMID: 31677111.
12. Krishnan A, Muthusami S. Hormonal alterations in PCOS and its influence on bone metabolism. J Endocrinol. 2017 Feb;232(2):R99-R113. doi: 10.1530/JOE-16-0405. Epub 2016 Nov 28. PMID: 27895088.
13. Cussen L, McDonnell T, Bennett G, Thompson CJ, Sherlock M, O'Reilly MW. Approach to androgen excess in women: Clinical and biochemical insights. Clin Endocrinol (Oxf). 2022 Aug;97(2):174-186. doi: 10.1111/cen.14710. Epub 2022 Mar 29. PMID: 35349173; PMCID: PMC9541126.
14. Yoldemir T. Postmenopausal hyperandrogenism. Climacteric. 2022 Apr;25(2):109-117. doi: 10.1080/13697137.2021.1915273. Epub 2021 May 14. PMID: 33988479.
15. Zouboulis CC, Blume-Peytavi U, Kosmadaki M, Roó E, Vexiau-Robert D, Kerob D, Goldstein SR. Skin, hair and beyond: the impact of menopause. Climacteric. 2022 Oct;25(5):434-442. doi: 10.1080/13697137.2022.2050206. Epub 2022 Apr 4. PMID: 35377827.
16. Agarwal A, Mendiratta V. Comparative Efficacy of Topical Minoxidil Alone Against Combination of Topical Minoxidil and Platelet Rich Plasma in Women with Female Pattern Hair Loss-A Pilot, Open Randomised Trial. Indian J Dermatol. 2023 Jan-

Feb;68(1):121. doi: 10.4103/ijd.ijd_461_22. PMID: 37151237; PMCID: PMC10162769.

17. Alshahat, O., Taha, A., Abdulaziz, M. (2020). 'Assessment The Role Of Platelet Rich Plasma In Follicular Unit Extraction Hair Transplantation', *Al-Azhar International Medical Journal*, 1(5), pp. 140-151. doi: 10.21608/aimj.2020.29351.1217
18. Hawkins VN, Foster-Schubert K, Chubak J, Sorensen B, Ulrich CM, Stancyzk FZ, Plymate S, Stanford J, White E, Potter JD, McTiernan A. Effect of exercise on serum sex hormones in men: a 12-month randomized clinical trial. Med Sci Sports Exerc. 2008 Feb;40(2):223-33. doi: 10.1249/mss.0b013e31815bbba9. PMID: 18202581; PMCID: PMC3040039.
19. Sato K, Iemitsu M. Exercise and sex steroid hormones in skeletal muscle. J Steroid Biochem Mol Biol. 2015 Jan;145:200-5. doi: 10.1016/j.jsbmb.2014.03.009. Epub 2014 Apr 3. PMID: 24704257.
20. Smith AA, Toone R, Peacock O, Drawer S, Stokes KA, Cook CJ. Dihydrotestosterone is elevated following sprint exercise in healthy young men. J Appl Physiol (1985). 2013 May 15;114(10):1435-40. doi: 10.1152/japplphysiol.01419.2012. Epub 2013 Mar 7. PMID: 23471952.