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Caffeine and Hair

I was recently asked to give a talk on the topic, "Does caffeine stimulate hair *in vitro* and *in vivo*?" My knowledge on this topic was limited to acknowledging that there is scientific evidence supporting this question and there are products based on this stimulation. However, I had not seen any robust evidence to support the use of these products for hair loss patients.

BACKGROUND ON CAFFEINE

Caffeine is a phytochemical (plant source) that is found in coffee beans, tea leaves, cocoa beans, and nuts such as the kola nut. It is a small nitrogen-containing structure with a composition like adenosine. Because of this structural similarity, it can compete with adenosine cell receptors A1 and A2. This leads to an increase in the neurotransmitter acetylcholine.[1]

When ingested, caffeine is absorbed through the gut with peak levels at 45 minutes, and it has a half-life of 4-7 hours. The majority (97%) is metabolised in the liver to active metabolites: paraxanthine (increases lipolysis), theobromine (dilates blood vessels), and theophylline (dilates smooth muscle). The remainder is excreted in the urine unchanged.

There are many modes of action, including cerebral effects, that include action as a eugeroic (wakefulness promoter) or as a mild cognitive enhancer to increase alertness and attentional performance. It also potentiates other drugs and is often found in combination with pain relief medications such as ibuprofen. It affects smooth muscle in the lungs, and cardiac effects lead to increased heart rate and raised blood pressure.[1] For this reason, many hair transplant surgeons ask patients to refrain from caffeine-containing drinks pre- and intraoperatively.

Caffeine's most well-known mechanism of action is that it increases cyclic AMP through non-selective inhibition of phosphodiesterase, which leads to a decrease in micro-inflammation and an increase in cell proliferation. Both are relevant to hair growth modulation. Caffeine is also an antioxidant and is postulated to be a 5-alpha reductase inhibitor.[2-4]

CAFFEINE AND HAIR

In 2019, there was a very good review on phytochemicals and hair loss.[5] The authors reviewed the available articles including those involving mouse studies. Findings included mechanism of action with topical treatment showing *in vitro* stimulation of outer root sheath cell proliferation and a decrease in apoptosis and cell necrosis (via decreased TGF-beta2 and increased IGF-1 and KGF).[6] *Ex vivo* studies demonstrated stimulation of hair follicle keratinocytes, 5α-reductase inhibition, increased cell proliferation, reduced apoptosis, reduced oxidative stress, and decreased UV-induced damage of the epidermis and hair follicle. The review also highlighted the work of Otberg et al in 2007 and 2008.[7,8] They showed that caffeine entered the blood after topical application through hair follicle channels at a faster rate than through interfollicular skin. Caffeine is a small hydrophilic molecule that was shown to attach to hair fibres externally and thus has the potential to aid in other molecules attaching to hairs. This could be used to increase water attachment and other molecules that could be used to increase fibre strength or plasticity.[5]

DISCUSSION & CONCLUSION

Caffeine products are classified as a cosmetic not as a drug and as such claims cannot be made about its action on hair follicle growth modulation. If you look at commercially available products, however, many do make claims that it reduces hair loss or causes regrowth. But on a positive note, it is a natural product that is easy to obtain, so for this reason is an option for patients wanting a non-pharmaceutical option for hair loss.

I must admit that my initial thoughts on the use of caffeine were somewhat misguided. It is only through looking at the available research that I now see the value of this very versatile chemical. Caffeine has a proven effect on hair follicles, but it remains to be seen if the dosage and frequency have been optimised to treat AGA.

References

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