

The Hair Follicle Niche: Its Role in Baldness and Long Lashes

These findings about stem cell activation and quiescence has helped explain two human variations: male pattern baldness and long eyelashes. Male pattern baldness, which is characterized by a decrease in hair follicle size, appears to be caused by the progressive inability of the HFSCs to generate progenitor cells. Indeed, in aged mammals, inhibitory compounds from outside the niche may keep the HFSCs in a dormant state. This cessation of progenitor cell production appears to be due to the prolonged synthesis of prostaglandin PGD₂, which is normally used to stop hair growth at the end of the anagen phase. Bald men have higher levels of this factor, and transgenic mice that overexpress the enzymes leading to prostaglandin PGD₂ synthesis have hair loss. Moreover, the genes encoding the enzymes producing this prostaglandin are upregulated by testosteroneⁱ (Garza et al. 2011, 2012) and repressed by the Wnt pathway—the same pathway implicated in tooth regeneration. Epithelial Wnt secretion is necessary for adult hair follicle growth and regeneration, and older mice have much higher levels of Wnt inhibitors (such as Dickkopf) than younger mice (Myung et al. 2013; Chen et al. 2014). Normally, PGD₂ probably acts as a counterbalance to the positive growth effects of related prostaglandins PGE₂ and PGF_{2α}. These latter two prostaglandins appear to stimulate the growth of hair by prolonging the anagen phase (Johnstone and Albert 2002; Sasaki et al. 2005). Indeed, solutions containing these prostaglandins or their analogues have been approved for the cosmetic use of lengthening eyelashes.

Literature Cited

Chen, C. C. and 7 others. 2014. Regenerative hair waves in aging mice and extra-follicular modulators follistatin, dkk1, and sfrp4. *J. Invest. Dermatol.* 134: 2086–2096.

[PubMed Link](#)

Garza, L. A. and 10 others. 2011. Bald scalp in men with androgenetic alopecia retains hair follicle stem cells but lacks CD200-rich and CD34-positive hair follicle progenitor cells. *J. Clin. Invest.* 121: 613–622.

[PubMed Link](#)

Garza, L. A. and 14 others. 2012. Prostaglandin D2 inhibits hair growth and is elevated in bald scalp of men with androgenetic alopecia. *Sci. Transl. Med.* 4:126ra34.

[PubMed Link](#)

Johnstone, M. A. and D. M. Albert. 2002. Prostaglandin-induced hair growth. *Surv. Ophthalmol.* 47: S185–202.

[PubMed Link](#)

Myung, P. S., M. Takeo, M. Ito and R. Atit. 2013. Epithelial Wnt ligand secretion is required for adult hair follicle growth and regeneration. *J. Invest. Dermatol.* 133: 31–34.

[PubMed Link](#)

Sasaki, S., Y. Hozumi and S. Kondo. 2005. Influence of prostaglandin F2a and its analogues on hair regrowth and follicular melanogenesis in a murine model. *Exp. Dermatol.* 14: 323–328.

[PubMed Link](#)

All the material on this website is protected by copyright. It may not be reproduced in any form without permission from the copyright holder.

© 2023 Oxford University Press |

ⁱ Testosterone and (more importantly, as we saw in Chapter 6) its derivative hydrotestosterone are critical in producing male pattern baldness. Ancient civilizations noted that eunuchs (castrated males) did not become naturally bald. Testosterone does not appear to play a role in female hair thinning (Kaufman 2002)