

The fine-tuning of stem cell metabolism to prevent hair loss

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Hair loss is one of the most noticeable signs of ageing and has attracted research interest in recent years. Epidermal tissues, such as the skin and hair follicles are susceptible to environmental damage from ultraviolet radiation every day. The damaged content is discarded and replaced continuously by specialised and highly proliferative stem cells. The functioning of the replaced tissue depends on the interaction and health of these stem cells. Their ageing results in impaired function or degeneration. Although the essential role of stem cells in ageing is defined, the processes governing the long-term maintenance of these vital cells remain poorly understood. A team of researchers has demonstrated that RICTOR (rapamycin-insensitive companion of mammalian target of rapamycin), a protein that helps monitor the oxygen consumption, growth, and energy of cells in mice, plays a crucial function in cellular metabolism and survival of stem cells in hair follicles. The team studied the transcriptional and metabolic profiles of two cell populations, stem cells and their differentiated daughter cells to explain the functional independence of stem cells. Also, their study predicted that RICTOR, an essential but comparatively not well-studied part of the mammalian target of rapamycin (mTOR) pathway is involved. The transmission of the mTOR signal regulates processes, such as cell growth and oxygen consumption. After the end of each hair follicle regeneration cycle, the stem cells return to a dormant state with low oxygen availability till the start of the next cycle. In an environment of inadequate oxygen supply, the stem cells survive by using up glucose which acts as a carbon source for energy and protein synthesis rather than glutamine. The low oxygen concentration and RICTOR signalling pathway prompt this change. The elimination of RICTOR protein disrupts the stem cells' ability to return to their dormant state and causes age-dependent stem cell fatigue and age-induced hair loss. It was discovered that, the use of a glutaminase inhibitor in RICTOR-deficient mice was able to recover stem cell activity and proved the theory that manipulating metabolic pathways may be an effective way to improve the regenerative ability of hair follicle stem cells. Further research in this area of study would provide improved options for the clinical treatment of hair loss and ageing.

Keywords: Hair loss, Stem cells, RICTOR, Cellular metabolism, Glucose, Glutamine, Oxygen concentration

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