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Table S1. Comprehensive List of Antibodies Used for Immunostaining in the Study

This table provides a detailed overview of the antibodies employed for the immunostaining of horizontal sections of xenotransplants before and after transplantation. Each entry includes the target antigen, host species, dilution used, and the supplier.

Antigen (Ag)	Origin & Specificity	Brand	Cat. No.	Titer ($\mu\text{g/ml}$)	Protocol used for Ag Retrieval/ Fixation
SIRT1	Rabbit anti-human	Abcam	Ab32441	0.5	EDTA
p16 ^{INK4a}	Mouse anti-human	Ventana	725-4713	1	Sodium citrate
Collagen17A	Rabbit anti-human	Abcam	EPR-14758	1	EDTA
VEGF-A	Mouse anti-human	Abcam	Ab1316	2	EDTA
MTCO-1	Rabbit anti-human	Abcam	Ab45918	1	Sodium citrate
PGC1 α	Rabbit anti-human	Abcam	Ab54481	2	Sodium citrate
PRDX	Rabbit anti-human	Abcam	Ab15571	1	EDTA
HO-1	Mouse anti-human	Abcam	Ab13248	2	EDTA
p-S6	Rabbit anti-human	Invitrogen	MA5-16397	1	Sodium citrate
Lamin B1	Rabbit anti-human	Thermo Fisher Scientific	PA5-19468	1.4	Sodium citrate
Porin/VDAC	Rabbit anti-human	Thermo Fisher Scientific	55259-1-AP	0.8	EDTA
Glutathione reductase	Rat anti-human	Abcam	Ab106843	1	EDTA

Table SII. Expression changes of various key aging biomarkers in mpAGA xenotransplants treated with minoxidil. This table delineates the significant alterations in cellular aging and mitochondrial function markers, oxidative stress response and angiogenesis induced by minoxidil treatment. Each entry outlines the specific protein affected, the nature of its expression change, and the statistical significance of this alteration.

Category	Protein Marker	Trend in Expression	p-Value	Role in Cellular Processes
Cellular Aging Markers	Lamin B1	↑	<0.05	Structural protein associated with nuclear integrity and cellular aging (13). Decreased Lamin B1 is linked to increased inflammatory responses in hair follicles, further exacerbating the aging process (S1).
	Collagen XVIII	↑	<0.03	A vital transmembrane protein facilitates interactions between stem cells and their extracellular matrix niche (S2). Its increased proteolysis is associated with reduced stem cell activity, hindered hair growth, and visible signs of aging (3,7).
	SIRT1	↓	<0.05	A deacetylase protein plays a pivotal role in cellular regulation, impacting aging, inflammation, and metabolism. Elevated SIRT1 levels are linked to prolonged cellular life, diminished inflammation, and strengthened hair follicle integrity (S3).
	p16INK4A	↓	<0.03	A cellular senescence marker that increases with age, acting as an inhibitor of the cell cycle (7). Its expression is indicative of aging hair follicles and is often linked to the decline in regenerative potential of hair follicle stem cells (14).
	Phosphorylated-S6	↓	<0.02	Associated with the mTOR signaling pathway, often linked to cellular aging, reduced autophagy, and increased protein synthesis. High p-S6 levels can signify aged or stressed follicles, characterized by reduced cellular efficiency and impaired hair growth (S3).
Mitochondrial Function Markers	PGC1 α	↑	<0.02	Regulates mitochondrial biogenesis and function Diminished PGC1 α expression is associated with reduced mitochondrial energy production, leading to decreased cellular vitality and the onset of aging characteristics (17).
	MTCO1	↑	<0.04	A core protein of the mitochondrial respiratory chain and is essential for efficient cellular respiration and energy production. In aged hair follicles, decreased MTCO1 expression can signify compromised mitochondrial function, leading to energy deficiency and cellular aging (7,18).
	Porin/VDAC	↑	<0.05	Acts as a regulator of mitochondrial function, facilitating the transport of ions, ATP, and metabolites across the mitochondrial outer membrane. Reduced Porin/VDAC expression can be linked to impaired energy metabolism and increased oxidative stress, leading to follicular aging and hair thinning (18).
Oxidative Stress Response	HO-1	↑	<0.01	Play a crucial role in mitigating oxidative stress in aged hair follicles. Maintaining the balance of oxidative and reductive reactions. A decline in their levels exacerbates oxidative damage, leading to hair thinning and loss (7,19,S4).
	PRDX	↑	<0.03	
	Glutathione reductase	↑	<0.001	
Angiogenesis, Anti-Oxidative & Rejuvenation Player	VEGF-A	↑	<0.002	Promotes angiogenesis, anti-oxidative processes, and skin rejuvenation (7). Diminished VEGF-A expression in aged hair follicles is associated with reduced angiogenesis and a compromised antioxidant defense system. The deficiency in VEGF-A impacts the follicles' structural integrity and functional vitality. It leads to increased susceptibility to oxidative stress and accelerates the aging process. The restoration of VEGF-A levels can rejuvenate aged hair follicles by enhancing angiogenesis, up-regulating antioxidant genes and proteins, and improving follicular health and resilience against aging factors (6).

SUPPLEMENTARY REFERENCES

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- S3. Hao L, Nam KH, Lee GJ, Kim D, Shin JM, Lee Y, et al. SIRT1 downregulation provokes immune-inflammatory responses in hair follicle outer root sheath cells and may contribute to development of alopecia areata. *J Dermatol Sci* 2023; 111: 2-9.
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