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Cell proliferation and differentiation during epidermis renewal

Key words: Epidermis renewal; Stem cell proliferation; Asymmetric cell division; Basement membrane dynamics; Single-cell omics; Mechanotransduction

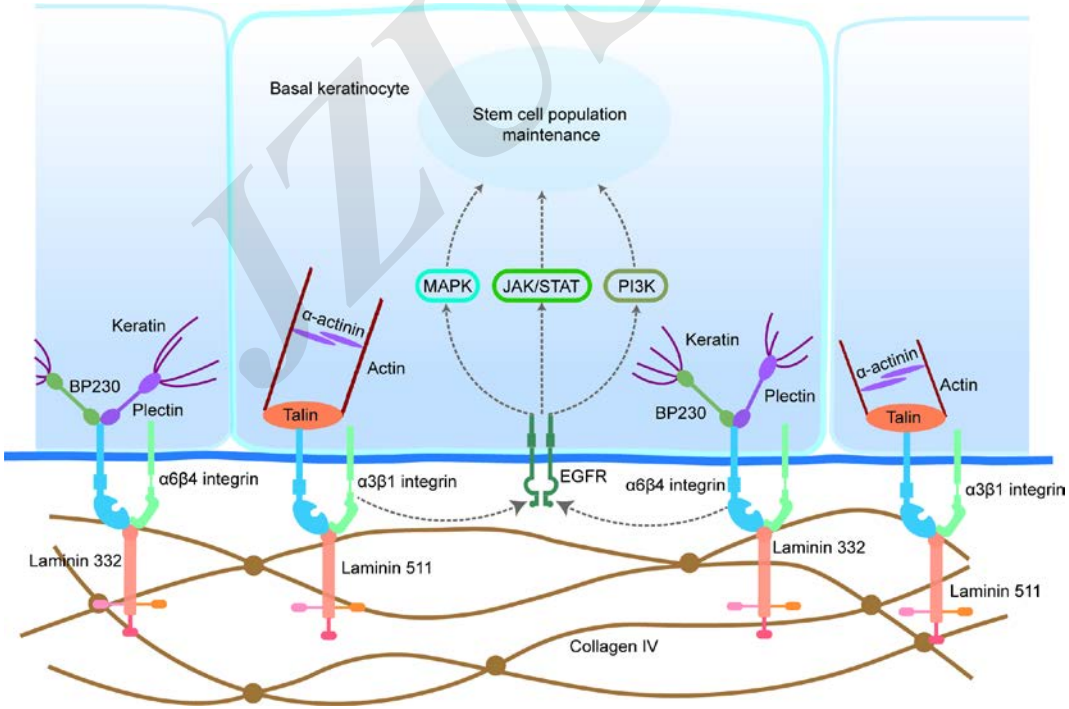
Research Summary

This review explores the intricate mechanisms of cell proliferation and differentiation during epidermis renewal, emphasizing the balance between symmetric and asymmetric cell divisions and the role of the basement membrane.

The study highlights how basal stem cells dynamically regulate epidermis renewal through precise division patterns.

It examines the basement membrane's role in signaling and mechanical support for cell fate decisions.

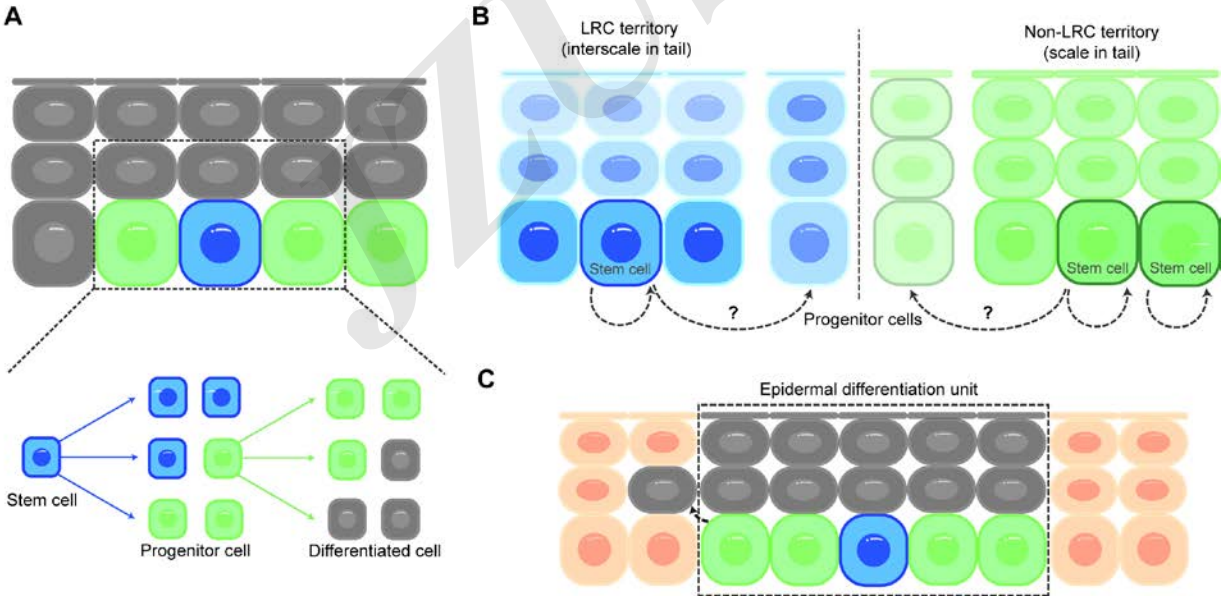
Advanced techniques like single-cell omics and AI-driven modeling are discussed for unraveling epidermal homeostasis.



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Innovation points

1.We introduce the concept of two distinct stem cell populations (LCR and Non-LCR) in mouse tail epidermis, challenging the traditional hierarchical view by showing their independent roles in proliferation and differentiation.
2.We visually demonstrate how basal stem cells stochastically commit to differentiation, with most cells migrating vertically within epidermal units while a minority switches units, revealing spatial dynamics in tissue renewal.
3.The model suggests unresolved questions about progenitor potential, hinting at plasticity between stem and progenitor states, which could redefine epidermal homeostasis paradigms.



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Innovation points

4. Spindle orientation in basal cells is not predetermined but dynamically established during prometaphase through centrosome movement, challenging the traditional theory of predetermined mitotic polarity.

5. For the first time, elucidates the molecular pathway by which the apical polarity complex (Par3/aPKC/Par6) links to adherens junctions via Merlin-α-catenin and recruits the LGN-Gαi-NuMA complex, bridging the gap between cortical polarity establishment and spindle orientation.

6. Pioneeringly integrates mechanical signals from the basement membrane (e.g., integrins) with intrinsic polarity networks, proposing a novel mechanism where microenvironmental mechanical properties directly regulate spindle rotation through β1/β4 integrins.

