

The Influence of Skin Microbial Ecology on $\gamma\delta$ T Cell Immune Pathways in Allergic Dermatitis Models in Mice

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Abstract

Background: Atopic dermatitis (AD) is a multifactorial disease characterized by immune dysregulation and alterations in skin microbiota. Despite its prevalence, the specific mechanisms by which defined microbes impact the skin immune system remain inadequately explored. Previous research has identified key cytokines involved in AD pathogenesis, including IL-4, IL-17, interferon- γ (IFN- γ), and IL-10, which contribute to the imbalance of T helper (Th) cell types. However, the role of gamma-delta ($\gamma\delta$) T cells, which can produce these cytokines and infiltrate diseased epithelial cells in AD, has been largely overlooked in research. This study aims to ameliorate AD in mice by modulating the peripheral and local immune environments through skin microbial transplantation. Additionally, the research seeks to explore the role of $\gamma\delta$ T cell migration in connecting AD and allergic asthma, providing a comprehensive understanding of systemic immune regulation. Methods: BALB/c mice were used to establish AD-like symptoms induced by 24-dinitrochlorobenzene (DNCB). Skin microbial transplantation was performed, and the mouse skin microbiota was characterized using 16S rRNA sequencing. Flow cytometry and ELISA were utilized to analyze immune cell subsets and serum IgE levels. Additionally, $\gamma\delta$ T cell migration between the skin and lungs was tracked to investigate its role in disease development. Results: Microbiota intervention mitigated skin thickening and reduced serum IgE levels in DNFB-induced AD mice. Alterations in skin microbiota regulated peripheral and local immune cell changes, restoring the Th1/Th2 balance and improving the disease condition. Furthermore, $\gamma\delta$ T cell migration from the skin to the lungs was observed, indicating its role in systemic immune regulation. These results underscore the pivotal role of skin microflora changes in modulating immune responses. $\gamma\delta$ T cell dynamics provide insights into novel therapeutic strategies for AD and associated allergic conditions. The findings suggest that microbiota intervention could be a promising approach for managing both AD and allergic asthma, highlighting the importance of understanding the interactions between skin microbiota and immune cells.

Keywords

Skin Microbiota, Atopic Dermatitis, $\gamma\delta$ T Cells, Type T Helper Cells, Immunomodulation