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Humanized Mouse and Rat Models with Full-Thickness Human Skin: a Comprehensive Investigation

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Abstract

This research paper explores the development and characterization of humanized mouse and rat models incorporating full-thickness human skin grafts. The aim of this study is to create more physiologically relevant animal models for dermatological research, drug development, and transplantation studies. We present a detailed methodology for generating these humanized models, assess their viability, and discuss the implications of using such models in advancing our understanding of skin biology and pathology. Our results demonstrate the successful integration of full-thickness human skin into rodent hosts, opening new avenues for translational research in dermatology.

Introduction

Humanized animal models play a crucial role in advancing medical research by providing a platform for studying human-specific diseases, testing therapeutic interventions, and improving preclinical assessments. In dermatology, the use of humanized mouse and rat models with full-thickness human skin grafts holds great potential to bridge the gap between in vitro studies and clinical trials[1]. This paper discusses the rationale behind the development of these models, highlighting the significance of their contribution to dermatological research[2].

The field of dermatological research has witnessed remarkable progress over the years, fueled by advancements in technology and a deeper understanding of the complexities underlying skin biology and pathology[3]. While in vitro models and traditional animal models have contributed significantly to our knowledge, there remains a critical need for more physiologically relevant systems that closely mimic the human skin microenvironment. In response to this imperative, the present study endeavors to explore the development and characterization of humanized mouse and rat models incorporating full-thickness human skin grafts—a groundbreaking approach that seeks to revolutionize translational dermatological research[4].

The skin, being the largest organ in the human body, serves as a dynamic interface between the internal milieu and the external environment, playing a pivotal role in maintaining homeostasis and defending against a myriad of environmental stressors. Dermatological disorders, ranging from common conditions such as eczema and psoriasis to more severe pathologies like melanoma and non-melanoma skin cancers, pose significant health challenges globally[5].

Despite extensive research efforts, translating findings from bench to bedside remains a formidable task, primarily due to the inherent differences between human and animal skin[6].

In recent years, the advent of humanized animal models has emerged as a promising avenue for overcoming the limitations of traditional models. The integration of full-thickness human skin grafts into immunocompromised mice and rats offers a unique opportunity to bridge the translational gap, providing researchers with a more accurate representation of human skin physiology and pathology. This innovative approach addresses the limitations of existing models, allowing for the exploration of dermatological diseases, the evaluation of novel therapeutics, and the advancement of skin transplantation studies in a more clinically relevant context[7].

This paper presents a comprehensive investigation into the development and characterization of humanized mouse and rat models with full-thickness human skin grafts. By delineating the methodology employed, assessing the viability of these models, and interpreting the implications of our findings, this study aims to contribute significantly to the advancement of dermatological research[8]. The successful integration of human skin grafts into rodent hosts not only holds the potential to revolutionize our understanding of skin biology but also promises to reshape the landscape of drug development and therapeutic interventions for a spectrum of dermatological conditions. As we delve into the intricacies of these humanized models, we anticipate that our findings will pave the way for transformative breakthroughs, ushering in a new era in translational dermatology[9].

Methods

2.1 Donor Human Skin Acquisition:

Full-thickness human skin samples were obtained from consenting donors undergoing elective surgeries. The procurement process adhered to ethical guidelines and institutional regulations.

2.2 Rodent Host Selection:

Immunocompromised mice and rats were chosen as hosts to facilitate graft acceptance. NOD-SCID or nude mice and athymic rats were used to minimize host rejection.

2.3 Skin Grafting Procedure:

Full-thickness human skin grafts were transplanted onto the dorsum of the rodent hosts. Graft viability, integration, and vascularization were closely monitored throughout the study.

2.4 Assessment of Graft Integration:

Histological analysis, immunohistochemistry, and molecular profiling techniques were employed to assess the integration of human skin grafts into the rodent hosts. Key markers of graft viability, such as keratinocyte proliferation and neovascularization, were evaluated.

Results

Our results demonstrate successful engraftment of full-thickness human skin onto immunocompromised mice and rats. Histological examination revealed proper epidermal and dermal layering, indicating the structural integration of human skin. Immunohistochemical analysis confirmed the presence of human-specific markers within the graft, showcasing the functional viability of transplanted tissue. Molecular profiling further highlighted the expression of key genes associated with skin homeostasis and immune response.

Conclusion

The development of humanized mouse and rat models with full-thickness human skin grafts represents a significant advancement in dermatological research. These models provide a more accurate representation of human skin biology and pathology, offering a valuable tool for studying diseases, testing therapeutics, and advancing skin transplantation research. The successful integration of full-thickness human skin into rodent hosts opens new avenues for translational studies, with the potential to reshape the landscape of dermatological research and therapeutic development.

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