Comparison of Healing Potential of Stem Cells in Different Types of Burn Wounds

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ABSTRACT

Background: Chronic burn wounds are unappreciated and detrimental tissue injuries which hold many significant public health issues. Data from multiple cross-sectional studies of Pakistan has shown that more than 1500 people were victims of severe burn injuries in the study duration of 2010-2016 (Siddiqui, *et al*., 2015). These injuries have long lasting devastating effects on the victims and cause multiple complications including bacterial infections, necrosis, and immune responses (local and systemic) that continue to be a challenge despite advances in wound care management (Jeschke, M. G., *et al*, 2020, Elloso, M., *et al*, 2020). The severity spectrum of such injuries is based on the multiple factors i.e. etiology of burn, patient's age, immune status, and effected total body surface area (TBSA) which may additionally necessitate complex treatments by burn surgeons and extensive care services that are not constantly available in all regions of the world (James, S. L., *et al*, 2020). Conventional therapies regarding these injuries are insufficient as they cannot heal wounds easily and effectively. The main pitfalls of these therapies include delayed healing with contraction, hypertrophic scarring, and fibrosis. These consequences require a better and more effective treatments for complete wound regeneration. Under this consideration, Cell based therapy has emerged as an active current area in research for burn clinical trials (Hu *et al*.,2018). Therefore, potential of stem cell therapy in the field of regenerative medicine outweigh the traditional treatment procedures. It has not only been shown that stem cells promote better and faster healing process, but also reduce the levels of inflammation with minimal scarring and fibrosis.

Aims and Objectives: The present study was planned to evaluate the therapeutic role of stem cells in the healing of different types of burn wounds. Three different types of burn wounds were developed and analyzed with reference to time points after burn induction and cell transplantation. Main objectives,

1. Isolation, propagation, and characterization of human umbilical cord-derived mesenchymal stem cells (hUCMSCs).
2. Development of three different types of burn wound models (thermal, cold, and chemical).
3. Local transplantation of hUCMSCs into the *in vivo* burn wounds
4. Comparison between the healing pattern of all burn wounds and analyses of control groups (without treatment) and treated groups (with transplanted MSCs) *via* gross macroscopic examination and histological analysis.

Methodology: Stem cells were harvested from human umbilical cord tissues after getting ethical consent from donor (patients), and characterized via the techniques of immunophenotyping and immunocytochemistry. Different types of burn wound models were successfully developed and stem cells were injected subcutaneously around wound peripheries. Wound healing patterns of different burn wounds

were investigated by gross macroscopic examination and histological analysis at different time points of post-wounding.

***Results**:* Our results revealed that wound closure of all burn wounds post-transplantation of hUCMSCs were remarkably reduced in comparison to the untreated control. Histological analysis was further executed to analyze the structural integrity of the wounded tissues after treatments.

Conclusion: This study concluded that hUCMSCs were able to accelerate wound closure with enhanced neovascularization, and reduced inflammation in all types of burn wounds. Thus, this study suggests and leads to an improved cell based therapeutic option for the enhanced healing of skin wounds and can also be useful in designing future clinical trials for the treatment of both acute and chronic burn wounds in human.

Keywords: Thermal Burn; Chemical Burn; Cold Burn; hUCMSCs; Wound healing; Macroscopic and Microscopic Evaluation

ACKNOWLEDGMENT

This study was financially supported by Dr. Panjwani Center for Molecular Medicine and Drug Research, International Center for Chemical and Biological Sciences, University of Karachi. Human umbilical cord sample was provided by the Zainab Panjwani Memorial Hospital after getting consent from donor parents.

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