BIOLOGICAL BIOMATERIAL IN CUTANEOUS REGENERATION: EXPERIMENTAL STUDIES

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Introduction. Biological biomaterials derived from decellularized extracellular matrix (ECM) represent an important direction in regenerative medicine due to their structural similarity with native tissue and their ability to support cellular adhesion, proliferation, and tissue remodeling. The present study aimed to develop and experimentally evaluate biological wound dressings obtained through tissue engineering techniques and to assess their regenerative potential in cutaneous wound healing.
Materials and Methods. Biomaterials were obtained from porcine dermis and small intestinal submucosa (SIS) using decellularization protocols based on Triton X-100 and sodium deoxycholate treatments to remove antigenic cellular components while preserving the ECM architecture. *In vitro* biocombatibility was evaluated using the MTT assay on human dermal fibroblasts. The regenerative capacity of the biomaterials was investigated *in vivo* using a full-thickness excisional wound model in Wistar rats. Wound healing progression was monitored macroscopically and microscopically at 7, 14, and 21 days. Histological and immunohistochemically analyses included CD31 for angiogenesis, CD68 for inflammatory response, collagen IV for basement membrane reconstruction, and AE1/AE3 for epithelial regeneration.
Results. The MTT assay demonstrated high cellular compatibility of the biomaterials, with fibroblast viability reaching approximately 103 % after 72 hours compared to control cultures. *In vivo* experiments revealed accelerated wound healing in animals treated with biological dressing compared with saline-treated controls. The SIS-based collagen scaffold combined with povidone –iodine induced enhanced angiogenesis, with average vascular density of approximately 45 CD31-positive vessels per microscopic field, whereas wounds treated with decellularized dermal matrices combined with gentamicin presented about 30 vessels per field. CD68 staining showed an initial macrophage aggregation in the early inflammatory response and progressive stromal organization. Collagen IV immunostaining revealed more continuous basement membrane reconstruction in the SIS-based biomaterial group. AE1/AE3 staining confirmed progressive re-epiteliazation and restoration of epidermal architecture during advanced healing stages.
Conclusions. Biological dressings derived from porcine extracellular matrices demonstrated good biocompatibility and significantly improved cutaneous regeneration by stimulating angiogenesis, extracellular matrix remodeling, and epithelial restoration. The findings support the potential clinical application of ECM-based biomaterials in regenerative medicine and reconstructive surgery for the treatment of complex skin wounds.
Keywords: tissue engineering, extracellular matrix, biological dressings, skin regeneration, angiogenesis, wound healing.