# REGENERATIVE MEDICINE IN LIVER DISEASES AND CELLULAR MECHANISM OF LIVER REGENERATION AND CELL-BASED THERAPIES

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**Background.** Liver transplantation remains the gold standard for end-stage liver diseases, but donor shortages necessitate regenerative alternatives. Induced pluripotent stem cells (iPSCs), liver progenitor cells (LSPCs), and hematopoietic stem cells (HSCs) represent a game-changer in liver regenerative medicine. Although iPSCs can be used to produce patient-specific hepatocytes, drawbacks including redifferentiation deficiency and tumorigenicity have not yet enabled their clinical application. This study explores bioengineered liver constructs, focusing on decellularization/recellularization strategies and bioprinting approaches as potential solutions to organ shortages.
**Materials and Methods.** A literature review was conducted, analyzing preclinical and clinical studies on scaffold-based tissue engineering, whole-organ decellularization, and 3D bioprinting, from PubMed, NCBI, Hindawi. Molecular pathways related to liver regeneration, hepatocyte differentiation, and immune response modulation were examined.
**Results.** Liver tissue engineering employs two primary strategies: (1) Decellularization/recellularization of liver scaffolds and (2) 3D bioprinting of liver tissues. The decellularization approach preserves the extracellular matrix (ECM) and vascular networks, facilitating cellular repopulation. Experimental rat and pig models have demonstrated partial liver function restoration, yet graft survival remains limited due to inadequate vascularization and long-term cell viability. Bioprinting, leveraging 3D printing and bio-inks, offers an alternative pathway to generating structured liver tissues. Researchers are working to address these challenges through advances in biofabrication, microenvironmental control, and scaffold optimization. HLA-matched iPSC lines offer a potential solution, with research suggesting that a small number of iPSC donors could match up to 90% of recipients, paving the way for off-the-shelf bioengineered liver constructs.
**Conclusions.** The liver bioengineering and iPSC technology is reshaping regenerative medicine, offering innovative solutions to address organ shortages. While fully functional liver constructs remain a long-term goal, bioartificial liver devices and cell-based therapies offer near-term solutions for bridging transplantation gaps. Future research should focus on enhancing iPSC differentiation efficiency.