

# Lec 6\ Stem Cells Applications in Regenerative Medicine and Disease Therapeutics

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**Regenerative medicine**, the branch of medical science, deals with functional **restoration of tissues or organs for the patient** suffering from severe injuries or chronic disease.

The spectacular progress in the field of stem cell research has laid the foundation for cell based therapies of **disease which cannot be cured by conventional medicines**. The indefinite self-renewal and potential to differentiate into other types of cells represent stem cells as frontiers of regenerative medicine.

The transdifferentiating potential of stem cells varies with **source and according to that regenerative applications also change.**

Advancements in gene editing and tissue engineering technology have endorsed the **ex vivo** remodeling of **stem cells grown into 3D organoids and tissue structures** for personalized applications.

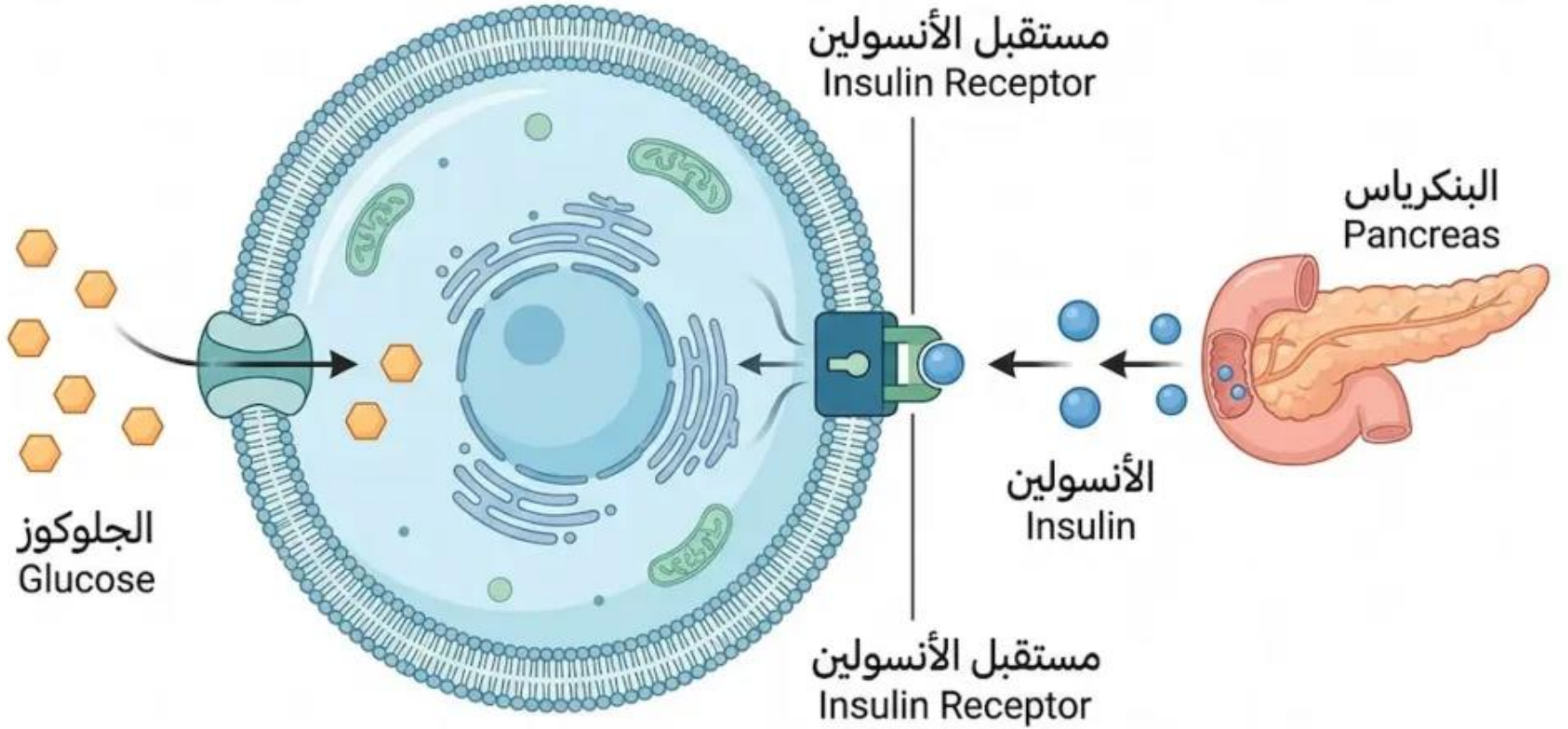
## Application of stem cell therapy

Stem cells could be stimulated in **vivo or in vitro** to develop various numbers of specialized cells that represent sources **of cells useful** for transplantation in cell-based therapy of genetic and degenerative diseases.

# SCT for the treatment of diabetes mellitus

-The potential of stem cell to differentiate into **insulin-producing beta cells** could be the new and effective therapeutic approach for the **treatment of diabetes mellitus type 1**. Although much work remains to be done, considerable progress has been achieved in defining conditions necessary for beta cell differentiation from stem cells. Differentiated cells are characterized by the **expression of the beta-cell transcription factors PDX1, NKX6-1 and MAFA**.

However, differentiated cells have an impaired **ability to respond to glucose stimulation in vitro**. It seems that complete differentiation of insulin-producing beta cells must occur in vivo. **One to three weeks after engraftment into a mouse, the cells acquire the ability to respond to glucose and begin to secrete human insulin and C-peptide in response to high glucose.**



# BENEFITS OF STEM CELL THERAPY FOR DIABETES

✦ Restored insulin production

✦ Possible insulin independence

✦ Long-term solution

✦ Minimally invasive

✦ Targets the root cause

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In **vivo** hyperglycemia is an important factor for stem cell differentiation into insulin producing beta cells capable of normalizing hyperglycemia in a diabetic animal model. Due to their differentiation ability, capacity for self-renewal and capability for regulation of immune response, stem cells are, in experimental models, used in the therapy of diabetes mellitus type 1 in experimental models.

This **disease is immune** mediated and stem cells could be used as new therapeutic agents for the treatment particularly due to their immunomodulatory ability.

Stem cells are able to alter immune response through **cell-to-cell contact** or through **producing soluble factors** and altering dendritic cells secretion profile,

which **results in increased production of anti-inflammatory cytokine IL-10** and decreased production of inflammatory cytokines IFN-g and IL-12. MSCs **inhibit T cell** proliferation by engagement of the inhibitory molecule programmed death 1 (PD-1) to its ligands PD-L1 and PD-L2 and by producing anti-inflammatory cytokines TGF beta and IL-10 increasing at the same time immunosuppressive T regulatory cells and **inhibiting proliferation and IgG secretion of B-cells.**

## -SCT for the treatment of liver disease

Numerous studies have concentrated on investigating the ability of a variety of stem cells that can be readily **isolated from the patient with liver failure** to give rise to personalized, immunologically matched hepatocytes or other functional hepatic elements. Depending on the source of cells and aetiology of disease, the outcome will differ significantly in terms of numbers and how hepatocytes are being generated.

Umbilical cord blood HSCs more consistently generate higher levels of hepatocytes following transplantation than HSCs isolated from BM or from peripheral blood. However, HSCs with the highest hepatocytic potential are adult BM-derived **CD34+ Lin- CD38-** cells.



# Stem Cell Treatment for Liver Cirrhosis

## Stages of Liver Disease



Fatty Liver

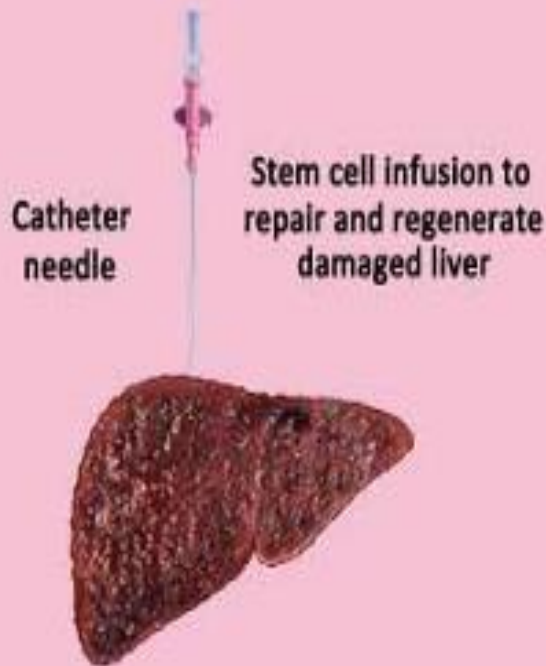


Liver Fibrosis



Liver Cirrhosis

## Stem Cell Implantation



## After Stem Cell Treatment

It is possible to  
stimulate liver function  
and reduce scarring



