Exosomes cargo

Exosomes derived from human umbilical cord Wharton's Jelly mesenchymal stromal/stem cells (hWJ-MSCs) carry a diverse cargo of biomolecules, including proteins, lipids, and nucleic acids such as mRNA and non-coding RNAs. These components play essential roles in cell-to-cell communication, tissue repair, and regeneration. The detailed cargo of exosomes from hWJ-MSCs may vary depending on the specific cell source, isolation method, and culture conditions.

However, some key components typically found within these exosomes include:

1. **Proteins:** Exosomes derived from hWJ-MSCs are enriched in proteins involved in various cellular processes such as cell adhesion, migration, proliferation, differentiation, and immunomodulation. Some of the most important proteins found in these exosomes include:
    - **Tetraspanins** (CD9, CD63, CD81): Tetraspanins are a family of proteins that play a crucial role in exosome biogenesis and cargo sorting. They also serve as exosome markers and are involved in cell adhesion and signal transduction.
    - **Heat shock proteins** (HSP60, HSP70, HSP90): Heat shock proteins are molecular chaperones that facilitate protein folding, stability, and degradation. They play a role in cellular stress responses and can modulate immune responses.
    - **Cytoskeletal proteins** (Actin, Tubulin): These proteins are involved in maintaining exosome structure and integrity. They also play a role in cellular processes like cell adhesion, migration, and invasion.
    - **Extracellular matrix protein**s (Collagens, Fibronectin, Laminin): These proteins contribute to the structural support and organization of tissues. They are involved in cell adhesion, migration, and differentiation, playing crucial roles in tissue repair and regeneration.
    - **Growth factors** (TGF-β, VEGF, FGF, EGF, PDGF, IGF): Growth factors are essential signaling molecules that regulate cellular processes such as proliferation, migration, and differentiation. They play a critical role in tissue repair, angiogenesis, and wound healing.
        - Transforming Growth Factor-beta (TGF-β): TGF-β is a multifunctional growth factor that regulates cell proliferation, differentiation, migration, and apoptosis. It also plays a critical role in immunomodulation and extracellular matrix remodeling.
        - Vascular Endothelial Growth Factor (VEGF): VEGF is a potent angiogenic factor that promotes the growth of new blood vessels, enhances endothelial cell proliferation, migration, and survival. It is essential for wound healing and tissue regeneration.
        - Fibroblast Growth Factors (FGFs): FGFs are a family of growth factors involved in various biological processes, including cell proliferation, differentiation, migration, and angiogenesis. They can promote wound healing, tissue repair, and regeneration.
        - Epidermal Growth Factor (EGF): EGF stimulates cell growth, proliferation, and differentiation. It plays a significant role in wound healing, tissue repair, and skin regeneration.
        - Platelet-Derived Growth Factor (PDGF): PDGF is a potent mitogen for cells of mesenchymal origin, such as fibroblasts, smooth muscle cells, and glial cells. It is involved in cell proliferation, migration, and differentiation, as well as wound healing and tissue repair.

- Insulin-like Growth Factor (IGF): IGFs are growth factors that regulate cell growth, proliferation, differentiation, and survival. They play essential roles in tissue regeneration, wound healing, and cellular metabolism.

- **Cytokines** and **chemokines** (IL-6, IL-8, IL-10, MCP-1, TNF-α, SDF-1, RANTES MIP-1α, MIP-1β): These proteins are involved in modulating immune responses, inflammation, and cell recruitment. They can influence tissue repair, regeneration, and immune regulation. Some of the most important cytokines and chemokines found in these exosomes include:
    - Interleukin-6 (IL-6): IL-6 is a pleiotropic cytokine with both pro- and anti-inflammatory functions. It plays a role in immune regulation, acute-phase responses, and hematopoiesis.
    - Interleukin-8 (IL-8): IL-8, also known as CXCL8, is a chemokine that acts as a potent chemoattractant for neutrophils and other immune cells. It plays a role in inflammation, angiogenesis, and wound healing.
    - Interleukin-10 (IL-10): IL-10 is an anti-inflammatory cytokine that downregulates the expression of pro-inflammatory cytokines, such as IL-1, IL-6, and TNF-α. It plays a crucial role in modulating the immune response and preventing excessive inflammation.
    - Monocyte Chemoattractant Protein-1 (MCP-1/CCL2): MCP-1 is a chemokine that attracts monocytes, memory T cells, and dendritic cells to sites of inflammation and tissue injury. It plays a role in immune cell recruitment, inflammation, and tissue repair.
    - Tumor Necrosis Factor-alpha (TNF-α): TNF-α is a pro-inflammatory cytokine involved in immune cell activation, inflammation, and apoptosis. It can be present in hWJ-MSC-derived exosomes but in lower amounts compared to other cytokines, as hWJ-MSCs are known for their immunomodulatory
    - Stromal Cell-Derived Factor-1 (SDF-1/CXCL12): SDF-1 is a chemokine that attracts various immune cells, including T cells, B cells, monocytes, and hematopoietic stem cells. It is involved in immune cell trafficking, tissue repair, and angiogenesis.
    - Regulated upon Activation, Normal T cell Expressed, and Secreted (RANTES/CCL5): RANTES is a chemokine that attracts T cells, monocytes, eosinophils, and basophils. It plays a role in immune cell recruitment, inflammation, and the immune response to pathogens.
    - Macrophage Inflammatory Protein-1 alpha (MIP-1α/CCL3) and Macrophage Inflammatory Protein-1 beta (MIP-1β/CCL4): These chemokines attract and activate various immune cells, including monocytes, macrophages, and T cells. They are involved in immune cell recruitment, inflammation, and the immune response to pathogens.

2. **Nucleic acids**: The exosomes contain various types of nucleic acids, including mRNA and non-coding RNAs like microRNAs (miRNAs), long non-coding RNAs (lncRNAs), and circular RNAs (circRNAs). These RNA molecules play vital roles in gene regulation, cellular differentiation, and tissue regeneration. Some of the most important nucleic acids found in these exosomes include:

    - **microRNAs** (miRNAs): miRNAs are small non-coding RNAs (~22 nucleotides long) that play crucial roles in post-transcriptional gene regulation. They can modulate various cellular processes, such as proliferation, differentiation, migration, apoptosis, and immune responses.

Specific miRNAs found in hWJ-MSC-derived exosomes may differ depending on the source and experimental conditions, but some examples include miR-21, miR-146a, miR-155, and miR-let-7 family members.

- **Long non-coding RNAs** (lncRNAs): lncRNAs are a class of non-coding RNAs longer than 200 nucleotides. They have diverse roles in gene regulation, epigenetic control, chromatin remodeling, and transcriptional regulation. Some important lncRNAs identified in hWJ-MSC-derived exosomes include MALAT1, HOTAIR, and TUG1.
- **Circular RNAs** (circRNAs): circRNAs are a class of non-coding RNAs characterized by their circular structure. They can act as miRNA sponges, modulate transcription and splicing, and interact with RNA-binding proteins. Although their presence and roles in hWJ-MSC-derived exosomes are not well-established, they might be important players in gene regulation and cellular communication.
- **Messenger RNAs** (mRNAs): Exosomes derived from hWJ-MSCs can also contain mRNAs that encode proteins involved in various cellular processes, such as cell adhesion, migration, proliferation, differentiation, and immunomodulation. The transfer of these mRNAs to recipient cells can contribute to the functional effects of hWJ-MSC-derived exosomes in tissue repair and regeneration.

3. **Lipids**: Exosomes derived from hWJ-MSCs have a lipid bilayer membrane composed of various lipids such as phospholipids, sphingolipids, and cholesterol. These lipids contribute to the stability structure, and biological functions of exosomes. Some of the most important lipids found in these exosomes include:
    - **Phospholipids**: Phospholipids are the primary lipid components of exosome membranes. They form a lipid bilayer that provides structure and stability to the exosomes. Phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylserine (PS), and phosphatidylinositol (PI) are some of the most common phospholipids found in exosomes.
    - **Sphingolipids**: Sphingolipids are a class of lipids that play essential roles in exosome biogenesis, membrane microdomain organization, and cellular signaling. Some important sphingolipids found in exosomes include sphingomyelin (SM) and ceramide.
    - **Cholesterol**: Cholesterol is a sterol that helps maintain exosome membrane fluidity and integrity. It is involved in the formation of lipid rafts, which are membrane microdomains enriched in certain lipids and proteins and play a role in exosome biogenesis and cargo sorting.
    - **Glycosphingolipids**: Glycosphingolipids are a type of sphingolipids with one or more sugar moieties attached. They are involved in cell recognition, adhesion, and signaling. Gangliosides, such as GM1, GM2, and GM3, are examples of glycosphingolipids found in exosomes.
    - **Phosphatidic acid** (PA): PA is a phospholipid involved in membrane curvature and fusion events. It has been implicated in exosome biogenesis and can regulate the activity of proteins involved in vesicle trafficking.