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Conceptual Paper

Structured Review of PRP, Stem Cell, and Gene Therapy in Sensorineural Hearing Loss (SNHL)

Brajpal Singh Tyagi*

Professor, Harsh ENT Hospital, RDC, Ghaziabad, India

***Corresponding Author:** Brajpal Singh Tyagi, Professor, Harsh ENT Hospital, RDC, Ghaziabad, India.

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Platelet-Rich plasma (PRP) therapy

Concept

PRP is an autologous concentrate of platelets containing growth factors (PDGF, VEGF, TGF-β, IGF, etc.).

These factors promote tissue repair, angiogenesis, and neural regeneration.

- Mechanism in SNHL:
  - Improves cochlear microcirculation.
  - Supports survival/regeneration of cochlear hair cells and spiral ganglion neurons.
  - Reduces oxidative stress and apoptosis in the inner ear.
- Clinical Use:
  - Injected intratympanically (into middle ear, near round window).
  - Studies show improvement in hearing thresholds up to 8 db and speech discrimination in sudden or chronic SNHL [1].

Stem cell therapy

Concept

Stem cells (Bone marrow mesenchymal cells, embryonic, and induced pluripotent) can differentiate into auditory hair cells, supporting cells, and neurons.

- Mechanism in SNHL:
  - Replace lost/damaged sensory hair cells.
  - Release trophic factors to protect spiral ganglion neurons.
  - Promote regeneration of synapses between hair cells and auditory nerve fibers.
- Approaches:
  - Intracochlear injection of stem cells.
  - Systemic infusion (less effective due to blood–labyrinth barrier).
  - Biomaterial scaffolds for cell survival inside cochlea.
- Status:
  - Animal models show partial recovery of hearing.
  - Human clinical trials are ongoing (early phase) [2].

Gene therapy

Concept

Uses viral or non-viral vectors to deliver corrective or protective genes to the inner ear.

- Mechanism in SNHL:-
  - Gene replacement → restore function in genetic deafness (e.g., otoferlin, connexin mutations).
  - Neurotrophin gene delivery → protect spiral ganglion neurons.
  - Atoh1 gene therapy → induce regeneration of supporting cells into hair cells.

- CRISPR-Cas9 editing → correct point mutations causing hereditary SNHL.
  - Delivery methods:
- Adeno-associated virus (AAV) vectors injected into the cochlea.
  - Lipid nanoparticles and novel non-viral vectors under research.
- Status:-
  - Success in mouse and primate models.
  - Early human clinical trials underway for genetic hearing loss.
  - Safety, targeted delivery, and long-term effects remain key challenges. Gene therapy in human is ongoing treatment in USA and Sweden [3].

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