Targeting NanoTherapies to the Ear, Tooth & Brain

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Recent research in preventing hearing loss and tinnitus following trauma pointed to the need for localized delivery of therapy to the inner ear only.

We developed a method using magnetic nanoparticles to deliver steroids to the organ of hearing (the cochlea). We found the platform to be universal at delivering a variety of drugs, molecules, and stem cells to a variety of hard to reach parts of the body.

Future research aims at delivering novel therapeutics such as peptides, photo-releasable drugs, for instance antibiotics, siRNA and other molecules or stem cells into hard to reach parts of the body, with high target specificity, using nanoparticles or liposomes.

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Rat model of noise trauma-induced tinnitus

Behavorial measurement
- Modified “prepulse inhibition of startle reflex” if rat detects silent gap in tone, startle reflex is inhibited

Midbrain results
Neural correlates of tinnitus appear a week after trauma

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Target | Inner Ear | Middle Ear | Teeth | Eye | Brain | Others (liver etc)
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**Indications**<br>- Sudden hearing loss<br>- Cisplatin ototoxicity<br>- Tinnitus<br>- Ear infections (acute and chronic)<br>- Glue ear<br>- Fillings<br>- Sensitivity<br>- Root canals<br>- Uveitis<br>- Diabetic retinopathy<br>- Essential tremors<br>- Glioblastoma<br>- Tumors<br>- Hyperthermia

**Advantage**<br>- Micromolar, uniform drug concentration. Levels are elevated for days.<br>- Antibiotic in middle ear only. No MRSA.<br>- No “ear tube”<br>- Stronger restorations. No root canal.<br>- Remains sterile.<br>- No intraocular injection.<br>- No associated infections.<br>- Targeting of deep brain structures without surgery.<br>- Case dependent.

**Examples**
**Drug distribution in cochlea**<br>Therapeutic steroid levels can be achieved within an hour of magnetic injection.

**Teeth**
Fluorescence

**Brain**
- Immunochemistry
- Cortex Thalamus

**Liver**
Without & with magnetic chaining