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Modular Cell and Drug Delivery Cannula System

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Technology description

Researchers at UCSF have designed a catheter-based stem cell and drug/gene delivery system for the therapeutic treatment of neurological disorders. The novel design significantly improves the distribution of cells from the delivery area, as well as the cell viability of stem cell-based therapeutics, with both dilute and highly concentrated cell populations being well tolerated. For example, in vitro and in vivo testing of the prototype using subcortical injections produced a radial pattern of infusate delivery up to 2 cm from the initial penetration tract. Furthermore, these early studies showed that, by varying the implantation depth, the rotation and radial distance of the assembly components, the new design was capable of delivering cells and therapeutic agents throughout the entire putamen, at a volume of over 4 cm^3.

Another significant advantage of the new device is that the dead volume typically associated with syringe delivery systems is radically reduced yet still allows for controlled microinjection delivery volumes, a feature essential for the delivery of expensive therapeutic agents. Issues related to uncontrolled infusate reflux are also dramatically attenuated. Indeed, an in vivo study comparing the prototype with the current catheter design on the market showed that infusate reflux was significantly reduced from approximately 75% of the material to almost nothing. The new device can be incorporated into current catheter guide tube systems for insertion into a body cavity or region, existing clinical stereotactic platforms, and stereotactic planning software. The investigators have also generated a prototype of the device from MRI-compatible materials, allowing for easy visualization of the device using intraoperative MRI systems and direct targeting of the infusate to specified locations.

The use of cell transplantation in the brain shows great promise for the treatment of human neurological diseases, such as Parkinson's disease or stroke. Indeed, pre-clinical studies in animal models have shown significantly improved neurological function following cell grafting. However, in human trials the results have been considerably more variable. This has, in part, been attributed to concerns with poor cell distribution within the target area. A further issue that has arisen with the challenge of scaling up from animal models to humans is the increase in the number of transcortical penetrations required to deliver therapeutic agents. For surgical cell transplantation approaches, cell sedimentation and impaired graft viability are also concerns that need to be addressed to optimize the use of this therapeutic avenue.

Publication

Silvestrini MT, Yin D, Coppes VG, Mann P, Martin AJ, Larson PS, Starr PA, Gupta N, Panter SS, Desai TA, Lim DA. Radially Branched Deployment for More Efficient Cell Transplantation at the Scale of the Human Brain. Stereotact Funct Neurosurg. 2013 Jan 22;91(2):92-103.

Application area

Cell transplantation
Stereotactic surgery
Drug delivery
Gene targeting

Advantages

Delivery of controlled microinjection volumes
Improved viability of delivered cell populations
Significantly reduced catheter dead volume
Attenuated uncontrolled infusate reflux
Fewer injections required for therapeutic agent delivery
Decreased risk of intracranial hemorrhage
Compatibility with intraoperative MRI systems
Compatibility with existing stereotactic surgical systems

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