Camera catheter for gene therapy delivery and therapeutic interventions in the subarachnoid space

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Technology description

Brief Description:
Minimally invasive microcatherter with an integrated camera (MIMIC) to reach suboccipital space of the cisterna magna via lumbar puncture for drug and gene-therapy delivery to the brain
Problem:
Open surgery is the standard of care for access to the diseased brain and spinal cord, but such surgeries are invasive, associated with significant morbidity, and can require long recovery times. Recent advances in gene therapy hold the potential to cure devastating neurological diseases. In order to be effective, circumvention of the blood brain barrier (BBB) is required for gene therapy treatment of neurological disorders such as Parkinson’ s disease and glycogen storage diseases. One method to bypass the BBB is to place a needle via suboccipital puncture into the cisterna magna, a relatively large subarachnoid space located in the cranial vault. However, there is hesitation to utilize this technique due to potential for catastrophic injury to the brain and spinal cord.
Solution:
Dr. Bryan Pukenas, M.D., at the Hospital of the University of Pennsylvania, has developed a minimally invasive catheter that enables direct access for focal delivery of gene therapy vectors to the suboccipital space of the cranial vault in a minimally invasive manner. Traditionally, catheters are navigated using fluoroscopic guidance. However, navigating catheters with only fluoroscopic guidance in the spinal canal poses significant risk of spinal cord or nerve injury since one cannot see these structures using this method. The MIMIC catheter utilizes an embedded micro-camera permitting real-time visualization of the spinal canal contents during catheter navigation and gives operators to ability to avoid vital structures like the spinal cord and nerves as the catheter is directed from the lumbar canal to the cranial vault.
In addition to increased safety and simplicity, this approach is expected to reduce the amount of required gene vector material by 10-100 fold since gene transduction is much more efficient when delivered into the cisterna magna. The technology will change the procedure of gene therapy delivery to the brain from an inpatient surgery performed by an interventionalist/neurosurgeon to an outpatient procedure. Gene therapy may become accessible for patients who otherwise would not clinically qualify for gene therapy treatment due to risks associated with surgery and post-surgical care.

Moreover, the cost of care will be dramatically reduced by moving towards an outpatient model and decreasing the amount of vector required for treatment.
This invention has received over $90,000 in support from the Penn Medical Device Accelerator. The device has been tested in bench top spine models and a human cadaver. Technology is being further developed for additional application such as treatment of aneurysms, chemotherapy for brain tumors, epilepsy, laser ablation for brain tumors, etc.

Application area

• Localized delivery of gene therapy vectors to the brain from a lumbar puncture entry site
• Potential for delivery of drugs, laser and thermal ablation therapies, cryotherapy, brain tumor treatments, aneurysm repair and focal epilepsy interventions in the brain

Advantages

• Device is built using FDA-compliant Quality Management and Design Control
• Device is ISO13485 compliant
• Safer procedure compared to direct access to suboccipital space
• Minimally invasive delivery of gene and other therapies to the brain
• Reduced complications and decreased resources for post-operative care
• Shortened recovery time
• Reduced cost of treatment and patient care

Institution

University of Pennsylvania

Inventors

Bryan Pukenas
Radiology

联系我们

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com