Virus Surfs Nerves to Deliver Brain-healing Genes

New approach can access remote brain cells to treat diseases such as Parkinson's and Alzheimer's

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A harmless virus that can deliver therapeutic genes to hard-to-access brain cells could be used to treat diseases such as Parkinson's and Alzheimer's.

The approach, being developed by researcher Wang Shu and colleagues at the Institute of Bioengineering & Nanotechnology in Singapore, uses the body's own axons—cable-like structures that neurons use to communicate—to transport therapeutic genes to damaged areas located deep within the nervous system.

"The use of axonal transport for neuronal gene transfection allows viral vectors to target neurons in remote parts of the circuit," says Shu. "By injecting the virus into the body in a more accessible region, we can target other neurons deep within the central nervous system or minimize the damage to sensitive regions, which may be caused by the injection procedure."

Difficult delivery

Gene therapy is a technique that involves replacing, silencing or otherwise altering disease-causing genes with therapeutic genetic material. A carrier molecule called a vector—usually a disabled virus—is used to ferry therapeutic cargo to target cells.

Gene therapy has shown promise for treating many diseases. The widespread distribution of affected neurons and their remote location, however, have been obstacles to the use of gene therapy for such diseases as Alzheimer's and Parkinson's.

Several viruses, such as the herpes virus, are capable of overcoming such problems by using axonal transport, by which viruses travel along axons to target cells located deep within the nervous system.

These viruses, however, can elicit an immune response—a defensive measure taken by the immune system to defend against foreign and potentially harmful substances.

Axonal transport

Recently, Shu and colleagues came up with the idea of using a type of virus called a baculovirus to target cells in the central nervous system by axonal transport.

Primarily infecting insects, baculoviruses can also enter cells of other organisms but do not become infectious in them.
Unlike the herpes virus and other viruses, baculoviruses are relatively safe in humans and don't cause as much damage to the body, says Shu.

Besides their promise for treating neurological diseases, baculoviruses could also be used to trace neuronal pathways. By using a baculovirus that has been genetically modified for imaging purposes, for example, researchers could track the virus as it traveled a subject's central nervous system.

The researchers have already begun testing their new method on animal models of Parkinson's disease.

The research will be reported in an upcoming issue of the journal *Molecular Therapy*.

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