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The Waszczak laboratory at Northeastern University is focused on **developing an intranasal gene therapy for Parkinson's disease (PD) and opioid use disorder (OUD)**. The approach uses DNA nanoparticles (NPs) encoding glial cell line-derived neurotrophic factor (GDNF), a protein known to support the survival and function of midbrain dopaminergic neurons. One group of these neurons die in PD, and another group becomes deficient in dopamine after long term use of addictive drugs. If given early in PD, it is widely believed that GDNF could arrest disease progression and promote the recovery and regeneration of the surviving dopamine neurons. If given to patients in recovery from OUD, it may correct the underlying dopamine deficit to reduce drug craving and suppress relapse.

The main obstacle is getting GDNF into the brain by a non-invasive route of administration. To that end, we are pursuing intranasal administration of plasmid DNA NPs that can bypass the blood-brain barrier (BBB) to transfect cells in the brain, thereby generating a long-lasting source of GDNF production within the brain. We have shown that intranasal pGDNF NPs provide significant protection of dopaminergic neurons in a rat model of PD, and we are currently testing whether this gene therapy reduces relapse potential in a rat model of OUD.

The Waszczak lab works in collaboration with Copernicus Therapeutics Inc., a biotechnology company in Cleveland, which has optimized the GDNF plasmid and formulated the NPs for these studies. Northeastern University and Copernicus jointly hold a patent on this approach (US 9,486,540 B2, issued November 2016) and are actively seeking industry partners to commercialize and market this intranasal gene therapy for central nervous system disorders.

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