Just one shot to make quitting a success

Cigarette smoking is a common addiction, largely thanks to nicotine. When inhaled, nicotine passes across the alveoli in the lungs, into the bloodstream, and reaches the brain. There, it results in the production of dopamine, which induces pleasure, reduces stress, alters blood pressure and heart rate, heightens alertness and increases information-processing ability in the smoker. But smoking cigarettes also can cause severe health problems, including chronic obstructive pulmonary disease and lung cancer, and is associated with increased risk of cardiovascular disease and non-lung cancers. Smoking-related health care costs top $190 billion per year in the US, and cigarette smoking accounts for one of every five deaths in the US.

Current strategies for smoking cessation are largely ineffective; an estimated 70–80% of attempts result in a return to smoking within 6 months. But now, researchers at Weill Cornell Medical College (New York, NY) led by Ronald G. Crystal have developed a new vaccine that successfully protected mice against nicotine addiction for their entire lifetime with just a single dose. It remains to be determined whether their results will translate to human studies.

Previous attempts to produce vaccines that use antibodies to bind nicotine in the blood, preventing it from entering the brain, have proven ineffective in clinical trials. These vaccines directly delivered the nicotine antibodies, which persist for only a few weeks and thus require repeated injections. Crystal's team took their vaccine one step further. Instead of delivering the antibodies themselves, their vaccine uses an adenoviral vector to deliver the genetic sequence of an engineered nicotine antibody to liver cells, where it is inserted into the DNA of the cells, enabling them to produce the antibodies. When the researchers administered the vaccine to mice that were also given nicotine injections, the antibodies bound >80% of the nicotine before it reached the brain (*Sci. Transl. Med.* **4**, 140ra87; 2012). The liver cells continued producing antibodies for at least 18 weeks.

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"As far as we can see, the best way to treat chronic nicotine addiction from smoking is to have these Pacman-like antibodies on patrol, clearing the blood as needed before nicotine can have any biological effect," Crystal said in a press release. "Our vaccine allows the body to make its own monoclonal antibodies against nicotine, and in that way, develop a workable immunity." Crystal's group is planning to test the vaccine in rats and then in primates before proceeding to clinical trials.

Monica Harrington

TINY OXYGEN PARTICLES KEEP BREATHLESS ANIMALS ALIVE

Low blood oxygen tension, or hypoxemia, occurs in a variety of critical illnesses, such as airway obstruction and acute respiratory distress syndrome, and is associated with increased mortality.

In the past, doctors have tried to treat low levels of oxygen in the blood by injecting free oxygen gas directly into the bloodstream. This can be dangerous, however, because the free oxygen gas can accumulate into larger bubbles and form potentially lethal blockages called pulmonary embolisms. In a new study, researchers oxygenated the blood using newly developed oxygen-filled microparticles and were able to keep rabbits with obstructed airways alive for up to 15 min (*Sci. Transl. Med.* **4**, 140ra88; 2012).

The microcapsules developed by Francis X. McGowan, Jr., and colleagues at Children's Hospital Boston (MA) consist of single-layer spherical shells of lipids, each surrounding a small bubble of oxygen gas. The gaseous oxygen is thus contained and so cannot form larger bubbles. These microcapsules are made by exposing the lipid components to sonic sound waves in an oxygen environment, a process called sonication. The scientists were able to make microparticles containing up to 90% oxygen gas. The most stable of these exhibited 20% loss in 2 weeks, though the researchers suggest ways in which the shelf-life may be improved once the particles are made.

To confirm that the microparticles worked, the researchers first mixed a foam suspension of the particles with human blood in tubes. Once the microparticles were injected, they mingled with circulating red blood cells. The oxygen transferred into the blood cells within seconds of contact, while the remaining lipids were simply reabsorbed by the body. Next, they tested the efficacy of the microparticles in living animals, administering them to asphyxiated rabbits. The injected rabbits survived for up to 15 min, had normal blood pressure and heart rate and did not experience any damage to major organs.

While it may be possible to increase survival time to up to 30 min, any longer would require continually infusing fresh microparticles into the blood, which presents new dangers. This technique is therefore better suited to emergency situations than to long-term life support.

This approach to oxygenating the blood while bypassing the lungs could save the lives of people with impaired breathing or obstructed airways and could prevent cardiac arrest and brain injury induced by oxygen deprivation. Though the researchers caution that further refinements to the technique are needed, the microparticles offer a valuable future intervention for hypoxemia.

Kara Rosania