Researcher develops an injectable antidote for carbon monoxide poisoning

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Lt. Joseph Roderque, M.D., conducts his injectable carbon monoxide antidote research in a VCU lab.

When Joseph Roderique was a first-year student in the Virginia Commonwealth University School of Medicine, he had an idea for an injectable antidote for carbon monoxide poisoning. It was a big idea, one that could have dramatic and wide-ranging results if he could make it work.

One day, Roderique decided to find a lab where he could pursue his brainchild. Starting on the 10th floor of Sanger Hall, he began to knock on the doors of lab directors and pitch them his idea and preliminary research. He was turned down over and over again until he had descended to the sub-basement level, where he knocked on the door of Bruce Spiess, M.D., professor of anesthesia and director of the VCU Blood Utilization Committee and Practicing Excellence in Transfusion Therapies.

That's where Roderique's determination paid off. Spiess saw the value in the project and offered to help. Ultimately, Spiess would support Roderique as he pushed forward with his research, including helping him secure sponsorships from the Department of Anesthesiology, Division of Plastics and Reconstructive Surgery and the Department of Surgery, in which trauma surgery played a major part by using some of their trauma research funds.

This enabled Roderique to take a year away from clinical medical student training to work in the anesthesiology and VCU Reanimation Engineering Shock Center laboratories developing a unique reduced form of vitamin B12 and demonstrating in multiple levels of experimentation that it could be an effective treatment for experimental carbon monoxide poisoning.

In the years since, Roderique's research has flourished. Now an alumnus of the School of Medicine, Lt. Joseph Roderique, M.D., is a surgery resident with the U.S. Navy Medical Corps. He recently was named "Best Young Investigator" for his research titled, "Cure for the Silent Killer: An Injectable Antidote for Carbon Monoxide Poisoning," at the Military Health Research Symposium, the premier scientific meeting of the U.S. Department of Defense.

Spiess said Roderique's research could have far-reaching, exciting

benefits.

"Dr. Roderique's work creates a potential breakthrough in medicine and pharmaceutics that has plagued mankind since the discovery of fire," Spiess said. "This research is a major breakthrough, in that up to now medicine has not had a way to treat carbon monoxide poisoning, the most common toxic compound killing human beings, other than just giving oxygen treatment and supportive medical therapy."

Carbon monoxide is an odorless, colorless gas that can cause sudden illness and death. It's found in combustion fumes produced by cars and trucks, small gasoline engines, generators, stoves, lanterns, burning charcoal and wood, gas ranges and heating systems. Carbon monoxide from these sources can build up in enclosed or semi-enclosed spaces.

Breathing this gas causes the body to replace oxygen in the blood with carbon monoxide. This blocks oxygen from the body. Common symptoms include headache, dizziness, weakness, nausea, vomiting, chest pain and confusion. High levels of carbon monoxide inhalation can cause a loss of consciousness and death.

Carbon monoxide inhalation is the No. 1 cause of lethal poisoning worldwide. In the U.S., isolated carbon monoxide exposure results in 15,000 emergency room visits, 5,000 neurologic injuries and up to 500 deaths per year. There are only two therapies available to date – atmospheric pressure oxygen and hyperbaric oxygen. No low-cost, nontoxic, easily administered antidote exists.

Roderique's recognition at the Military Health Research Symposium, which attracted researchers and physicians from more than 10 countries, demonstrates the strength of his work so far. The MHSRS received a record 1,135 submissions this year, with 132 submitted to the young investigator category. Of those, 13 were selected for oral presentation.

Roderique presented his research, which had been done during a five-year period, and captured first place in his category for it.

Since winning the competition, Roderique has been asked to submit manuscripts to the *Journal of Trauma and Acute Care Surgery* and the Journal of Military Medicine. He is planning on producing and publishing at least three to seven major medical manuscripts within the next year. Intellectual property and patent claims have been filed based upon his and his research team's discoveries.

"This represents a game-changer, a true paradigm shift in the way we treat carbon monoxide poisoning," Roderique said. "For the first time ever we could have a medication that an EMT or firefighter could give to a victim of carbon monoxide poisoning that can dramatically improve their condition within seconds to minutes.

"In addition, this same medication could also be used to increase blood pressure in a case of hemorrhagic or septic shock, and can treat cyanide and smoke inhalation injuries. It can do all of this, yet is low volume so a single provider could carry multiple doses, which could be a major benefit in a mass casualty incident such as an office building or apartment fire."

"This is especially important for military personnel who often work in austere environments where oxygen therapy may not be readily available, and of course being around smoke and fire is a part of everyday life for deployed combat forces."

At the present time, Roderique's research team is writing grants for further support and work is ongoing to take the drug and findings to a human trial within the next three years. Roderique will be pursuing further research work within the structure of the U.S. Navy.

Roderique said the early support he received from Spiess was critical to the advancement of his research.

"Dr. Spiess was my constant supporter and advocate," said Roderique. "He fought for me every step of the way and without him none of this would have happened or really even begun."

Roderique said his research and its beginnings demonstrate the kind of ambitious work that can find its footing at VCU.

"I really think that things are heading in the right direction for VCU and for future students like me with way outside-the-box ideas."

Provided by Virginia Commonwealth University