Nitric Oxide Deficiency Raises Cardiovascular Disease Risk in African Americans

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ATHENS, Ohio - African Americans suffer from cardiovascular diseases at a rate about five times higher than the rest of the U.S. population. In a new study, scientists may have found a culprit: a serious deficiency of nitric oxide, a small molecule vital in the regulation of blood flow and blood pressure.

The research team, led by Ohio University biochemist Tadeusz Malinski, examined the blood vessel cells of 12 white and 12 black healthy female subjects. Using a system of nanosensors, they discovered that the cardiovascular systems of African-American subjects as young as 20 years of age could show signs of an unbalanced nitric oxide system that could become increasingly worse as they grow older, according to research published in a recent issue of Circulation, a journal of the American Heart Association.

"What we found was the basic mechanism of the cardiovascular dysfunctions at the molecular level," said Malinski, the Marvin and Ann Dilley White Professor of Biochemistry at Ohio University.

In the early 1990s, Malinski, a leading expert on nitric oxide and its physiological functions, developed nanosensors capable of detecting the nitric oxide and other molecules in single cells and neurons. Nitric oxide performs critical functions throughout the body, but survives only a few seconds after it is created by cells and neurons. Malinski and other researchers have since proven that nitric oxide is a fundamental regulator of bodily functions -- such as blood pressure, beating of the heart and the relaxation of blood vessels -- and that imbalance between levels of nitric oxide and oxidative stress can be a sign of dysfunction and disease.

In the new study, the scientist found that the cardiovascular system of black subjects has more enzymes to produce nitric oxide and can be more efficient than those of white subjects. However, black subjects did not produce enough of the amino acid L-arginin to complete the process of nitric oxide production. Instead the enzyme produces another oxidative molecule, superoxide, which reacts with nitric oxide to create an even more powerful and damaging oxidant, peroxynitrite.

Peroxynitrite not only attacks cell DNA and RNA, making black subjects more susceptible to cancer and various dysfunctions, but it gobbles up ever-increasing amounts of nitric oxide, which can lead to hardening of the blood vessels, increase of blood pressure and other cardiovascular problems. As the balance in the system shifts to greater amounts of peroxynitrite relative to nitric oxide, the danger of cardiovascular dysfunctions and diseases increases as well, said Malinski, whose research was supported in part by Ohio University's Marvin and Ann Dilley White Professorship Endowment.

"At the age of 20, you have perhaps twice as much of these oxidants as in other ethnic groups, and that causes an acceleration of aging and the dysfunction of the entire cardiovascular system," Malinski said. "The final outcome is a heart attack or stroke."

Malinski and his colleagues argue, however, that this new understanding of nitric oxide and related molecules' behavior in the African-American cardiovascular system can point to better treatment and prevention of diseases.

"What is amazing is that this system has a great potential to produce nitric oxide and can be corrected very efficiently and at a relatively early age," he said. "Based on our research, a diagnosis of this dysfunction of the system will be possible -- probably very soon -- and will be treatable with some existing cardiovascular drugs."

The research also opens the door for the development of new drugs designed specifically to maintain healthy levels of nitric oxide in the cardiovascular system.

Collaborators on the study were Iwona Dobrucki, a graduate student in biochemistry, and Leszek Kalinowski, a postdoctoral fellow, both at Ohio University.