Link found between excess "free radicals," high blood pressure

UCI research finds antioxidant vitamins E and C increase nitric oxide, curb hypertension

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Irvine, Calif., July 31, 2000

A team of UC Irvine College of Medicine researchers has found that high blood pressure can be induced—and brought back to normal—by changing levels of highly reactive oxygen molecules called free radicals and nitric oxide, which currently is being studied for its role in cardiovascular disease and other functions in the body.

The study, which appears in the August issue of Hypertension, is believed to be the first to prove that increases in free radicals found in the diet and the atmosphere reduce levels of nitric oxide and can cause high blood pressure. The research suggests that multiple antioxidants in the diet, including vitamins E and C, may help prevent and treat certain types of high blood pressure.

Dr. Nostratola Vaziri, professor of medicine, and his team found that rats whose food contained ingredients that caused "oxidative stress," a chemical imbalance linked to heart disease, had lower amounts of nitric oxide and higher blood pressure than did rats with normal food. In addition, the antioxidant vitamins E and C together helped to reduce blood pressure and reverse oxidative stress.

Oxidative stress has been linked to heart disease, inflammation, Alzheimer's disease and a host of other disorders. It is caused by the production of free radicals, which damage DNA and alter the structure of key proteins.

"These findings tell us that oxidative stress produced by increased free radical levels induces hypertension by lowering the levels of nitric oxide in the body," said Vaziri. "Lowering these levels has resulted in hypertension, showing that nitric oxide is a key component to regulating blood pressure. While antioxidants could help bring back blood pressure levels close to normal, they could not fully restore blood pressure, indicating that these vitamins play a partial role in blood pressure regulation."

Vaziri's team confirmed the role of oxidative stress and nitric oxide by following "Koch's postulates," techniques designed more than a century ago by German microbiologist and Nobel laureate Robert Koch. The postulates are a series of experiments that determine the existence of a suspected disease-causing microbe, rule out other factors that could lead to disease and finally induce the disease using the microbe.

In this case, Vaziri's group artificially lowered levels of a natural antioxidant chemical called glutathione to produce oxidative stress. The glutathione-depleted rats showed significant reductions in nitric oxide levels and significantly higher blood pressure. Oxidative stress was alleviated by adding antioxidants vitamin E and C to the rats' diet, which raised levels of nitric oxide and lowered blood pressure by as much as 50 millimeters of mercury (the traditional method of reading blood pressure).

"This shows us that although hypertension is a highly complex disorder that can arise from a number of causes, nitric oxide and oxidative stress play a major role in regulating blood pressure," Vaziri said. "We think this study provides the first insight into the interaction between oxidative stress and nitric oxide; we hope it could someday result in better treatments for hypertension and the cardiovascular disorders that arise from it. Antioxidants are powerful

regulators of blood pressure, and our studies show that multiple types of these chemicals, found in a diet heavy in fruit and vegetables, could help mitigate high blood pressure."

Hypertension is one of the most pervasive disorders in the United States, affecting about 50 million people. It is estimated by the American Heart Association to have contributed to the deaths of 210,000 Americans in 1997 by bringing about heart disease, stroke and kidney disorders; in most cases, its cause is unknown.

Vaziri and his team are now looking at how blood pressure and nitric oxide can be affected by other antioxidants and how diet can play a role in regulating levels of free radicals and nitric oxide, thus affecting the regulation of blood pressure.

Vaziri's colleagues in the study included Xiu Wang, Fariba Oveisi and Behdad Rad of UCI.

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