Addressing how cigarettes cause cardiovascular disease

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Although cigarette smoking has long been linked to cardiovascular disease, scientists are still on the lookout for insights into how smoking causes this disease. A team of researchers at Pacific Northwest National Laboratory and the University of Utah has determined that cigarette smoking and chronic obstructive pulmonary disease (COPD) can both influence oxidative modifications on specific proteins in blood plasma. Specifically, smoking and COPD can affect the levels of 3-nitrotyrosine, a biomarker associated with many pathological conditions. The results of this study demonstrated that smoking was consistently associated with a decrease in protein nitrotyrosine levels compared with non-smokers but that the presence of COPD in smokers was associated with an increase in protein nitrotyrosine levels.

Cardiovascular disease is the primary cause of death and disease associated with either active cigarette smoking or passive exposure to side-stream smoke. For example, in the United States in 2005, it was estimated that environmental smoke exposure caused 3,000 deaths from lung cancer and 46,000 deaths from coronary artery disease. Even so, the processes by which cigarette smoke cause cardiovascular disease are not clear. A better understanding of these underlying processes may lead to interventions that reduce cardiovascular disease.

Protein nitrotyrosine is a marker for inflammatory or oxidative stress processes (characteristic of COPD) and may also indicate endothelial dysfunction (systemic malfunctioning of the inner lining of blood vessels), a common cause of cardiovascular disease. These two detrimental processes would be expected to have opposite effects on nitrotyrosine levels, and therefore either increased or decreased nitrotyrosine levels should be useful for discriminating between these processes in humans. The study results are consistent with a mechanism by which smoking induces endothelial dysfunction and thereby increases the risk of cardiovascular disease.

The researchers used a custom sandwich-ELISA (enzyme-linked immunosorbent assay) microarray platform to evaluate 23 candidate biomarkers in plasma samples from 458 people that were current or past smokers, non-smokers at high risk for exposure to side-stream smoke, or never smokers. A portion of the smokers had COPD.

The platform can analyze multiple biomarkers quickly and efficiently, as demonstrated by the fact that a total of 458 plasma samples were analyzed in triplicate, with 23 ELISA analyses per sample-replicate, in a single experiment. In total, this experiment included over 30,000 ELISA analyses.

More information: Jin H, et al. 2011. "Smoking, COPD, and

3-Nitrotyrosine Levels of Plasma Proteins." *Environmental Health Perspectives* 119(9):1314-1320. DOI:10.1289/ehp.1103745