Air pollution linked to heritable genetic mutations

Air pollution is associated with increased rates of death from cardiopulmonary disease and lung cancer. The precise mechanisms by which particulate matter contributes to malignant disease remain unclear. It is generally believed that airborne chemicals cause somatic mutations in lung parenchymal cells, which then become malignant. Somers and colleagues provide new evidence that air pollution can also cause mutations in germ cells that result in heritable genetic changes to offspring.

For their study, the authors housed 2 groups of mice in an urban industrial site near 2 steel mills and a major highway in Hamilton, Ont. The first group was exposed to unfiltered ambient air and the second group to ambient air cleaned with a high-efficiency particulate-air (HEPA) filtration system. They also housed 2 other groups of mice under identical treatment conditions at a rural location, 30 km away, for comparison.

Nine weeks after the exposure the authors bred the mice and compared germline mutation rates among the groups. They found that the offspring of the mice exposed to the unfiltered ambient air at the industrial site had mutations of paternal origin 1.9 to 2.1 times as frequently as the offspring of mice in any of the other 3 groups. Furthermore, they found that the paternal mutation rates were 52% lower among the mice exposed to the HEPA-filtered air at the industrial site than among mice exposed to unfiltered air at the same location.

Although the findings from the study by Somers and colleagues are compelling, further research is needed to determine whether they can be extrapolated to humans. We also do not know whether the mutations had any health effects on the offspring of the mice. As well, an underlying premise to Somers and colleagues' findings is that inhaled pollutants were absorbed systemically and caused mutations to germ cells. Presumably, circulating mutagens would also affect other cell lines. The detection of other mutations, although not the focus of their study, would further strengthen the causative link between air pollution and heritable mutations.

Nevertheless, this simple study provides us with evidence that pollution in the air that we breathe can cause mutations in mammalian germ cell DNA that are passed on to future generations. It is logical to infer that this may occur in human DNA. Although further research is needed to clarify the precise mechanisms of DNA damage, improving air quality in urban industrial areas clearly must become a higher priority for industry and government. Waiting for hard epidemiological data to prove that airborne carcinogens disrupt germ cells in humans and lead to subsequent diseases in our offspring is unacceptable. (Somers et al. *Science* 2004;304:1008-10)

DOI:10.1503/cmaj.1040962

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Self-propagation of pancreatic β cells

The potential therapeutic use of pluripotent embryonic stem cells for organ regeneration and repair has attracted much interest. Diabetes has long been considered by scientists to be an ideal disorder that would be amenable to stem-cell therapy through the regeneration of insulin-producing β cells. Previous evidence has indicated that new β cells in adults arise from stem cells. However, Dor and colleagues, using a method that allowed them to trace cells and their progeny, have recently shown that β cells retain the capacity to self-replicate throughout adult life and are themselves the primary source of new β cells.

Their research raises the question of whether the inherent life-long proliferative capacity of β cells may be exploited to treat diabetes. If so, this would obviate the need for embryonic stem cells, the acquisition of which has been fraught with technical and ethical issues. (Dor et al. *Nature* 2004;429:41-5)

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