

“Honorary Biomedical Sciences & Health Information Lecture Series”



A WHALE OF A TALE: LESSONS FROM MOBY DICK'S DESCENDANTS ABOUT GLOBAL CHROMIUM POLLUTION

A Distinguished Lecture

By

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Abstract: The concept of ‘one’ environmental health posits that humans, pets and wildlife share a common environment and therefore, what affects the health of one group impacts the health of all groups. However, while toxicological impacts on human health are readily investigated, toxicological-impact studies in wildlife and domesticated species lag far behind. We have been pioneering a ‘One Environmental Health’ approach in carcinogenesis using chromium as a model toxicant. Hexavalent chromium [Cr(VI)] is a well-established genotoxicant and carcinogen in humans and laboratory animals. By contrast, its impacts in wildlife are rarely investigated. Using great whale species such as the North Atlantic right whale (*Eubalaena glacialis*), the Southern right whale (*Eubalaena australis*), the bowhead whale (*Balaena mysticetus*) and the sperm whale (*Physeter macrocephalus*), we discovered that whale Cr skin levels are dramatically elevated in even the most remote ocean locations. In some individuals, Cr levels were remarkably high and are comparable to levels measured in humans with Cr-induced lung cancer. Whales are exposed to Cr(VI) through both water and air, and thus, likely encounter both particulate and soluble forms of Cr(VI). In humans, the particulate form is more potent, though particulate Cr(VI) effects appear to be mediated through the release of soluble chromate ions. We investigated the cytotoxic and genotoxic effects of both soluble and particulate Cr(VI) in whale skin fibroblasts. Cytotoxicity was measured by clonogenic survival assay and genotoxicity was measured as induction of chromosome aberrations. Both forms of Cr(VI) induced concentration-dependent increases in cytotoxicity and genotoxicity, indicating that Cr(VI) is toxic to whale cells. Interestingly, comparing the effects in whale cells to those in human cells revealed whales may be more resistant to the genotoxic effects of Cr. Thus, using a One Environmental Health approach we have been able to ascertain that whales, like humans, are exposed to chromium at levels of concern and that whales may have evolved protective mechanisms that can provide insight into preventing metal-induced human cancer.

Key Words: Chromium, One Health, Whale, cytotoxicity, genotoxicity

Acknowledgments: This work was supported by supported a grant from the National Institute of Environmental Health Sciences (#ES016893 to J.P.W. Sr.)