OCCUPATIONAL EXPOSURE TO ANTINEOPLASTIC AGENTS

Introduction

The adverse health effects associated with antineoplastic agents (cancer chemotherapy drugs, cytotoxic drugs) in cancer patients and some non-cancer patients treated with these drugs are well documented. The very nature of antineoplastic agents make them harmful to healthy cells and tissues as well as the cancerous cells. For cancer patients with a life-threatening disease, there is certainly a great benefit to treatment with these agents. However, for the healthcare workers who are exposed to antineoplastic agents as part of their work practice, precautions should be taken to eliminate or reduce exposure as much as possible. Pharmacists who prepare these drugs or nurses who may prepare and/or administer them are the two occupational groups who have the highest potential exposure to antineoplastic agents. Additionally, physicians and operating room personnel may also be exposed through the treatment of patients. Hospital staff, such as shipping and receiving personnel, custodial workers, laundry workers and waste handlers, all have potential exposure to these drugs during the course of their work. The increased use of antineoplastic agents in veterinary oncology also puts these workers at risk for exposure to these drugs.

In addition to acute or short-term effects related to treatment with antineoplastic agents, there are a number of long-term or chronic effects that have been identified in patients. These include liver and kidney damage, damage to the bone marrow, damage to the lungs and heart, infertility (temporary and permanent), effects on reproduction and the developing fetus in pregnant women, hearing impairment and cancer. The International Agency for Research on Cancer (IARC) in Lyon, France has identified a number of antineoplastic agents and two combination therapies as having an association with cancer in patients who are treated with them. These include both cancer and non-cancer patients. IARC currently lists eleven agents and two combined therapies as Group 1 (Human carcinogens), twelve as Group 2A (Probable human carcinogens) and eleven as Group 2B (Possible human carcinogens).

A number of studies have documented environmental and worker exposure to the antineoplastic agents. A variety of biological endpoints have been used to evaluate worker exposure. These include, urine mutagenicity, chromosomal damage, sister chromatid exchange, micronuclei induction, DNA damage, HPRT mutations, and thioether excretion.

Additionally, analytical methods have been used to document worker exposure to antineoplastic agents by measuring these drugs and/or their metabolites in the urine of healthcare workers.

Similar analytical methods are currently being employed to measure the level of environmental contamination in the workplace. Although the studies on air sampling are
limited, there have been numerous studies published on environmental wipe sampling for these drugs.

In September, 2004, The National Institute for Occupational Safety and Health (NIOSH) published an Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings (DHHS (NIOSH) Publication No. 2004-165). This topic page is an expanded bibliography of related publications drawn from the published literature related to the Alert. Additional information on this topic can also be found on the NIOSH Hazardous Drug Exposures in Health Care topic page.

Publications, Guidelines, Review Articles and Surveys

Recent Publications
This page contains articles published within the past three years on all topics related to occupational exposure to antineoplastic agents. These include articles on exposure studies, adverse health effects, evaluation of protective equipment and guidelines for safe handling.

Guidelines, Recommendations and Regulations for Handling Antineoplastic Agents
This page includes guideline for the safe handling of antineoplastic agents from professional organizations, government agencies and international groups. Links to relevant sites are included.

Review Articles
This page lists reviews of the literature published on the topic of safe handling of antineoplastic agents which provide background information on the topic.

Surveys
This page includes surveys conducted by researchers and organizations on handling procedures used when working with antineoplastic drugs. The surveys deal with work practice issues and compliance with published guidelines.

Effects of Occupational Exposure

Acute Effects
Many acute or short-term effects have been observed in patients treated with antineoplastic agents. Some of these same effects have been seen in health care workers who handle them. The acute effects associated with exposure to antineoplastic agents, such as skin rashes, allergic-type reactions, hair loss and others, are included in the publications listed in this page.

Chronic Effects
Chronic or long-term effects of exposure to antineoplastic agents are described in the articles listed in this page.

Effects on Fertility and Reproductive Outcomes
The effects of antineoplastic agents on fertility and reproduction are well documented in patients treated with these drugs. This page includes articles published on the effect of exposure to antineoplastic agents on fertility and reproduction, such as low birth weight, malformations and others. Several studies have reported adverse reproductive outcomes in female health care workers who were exposed to antineoplastic agents.

Association of Exposure to Antineoplastic Agents with Cancer
Because many of the antineoplastic agents are known or suspected human carcinogens, cancer is an area of concern when exposed to these agents. Although limited, some information exists on the relationship of occupational exposure to antineoplastic agents with cancer in health care workers.
Occupational Monitoring

Biological Studies
Several biological endpoints have been employed to monitor health care workers’ exposure to antineoplastic agents. Most of these endpoints measure various types of genotoxic damage.

Urinary Mutagenicity
Because many of the antineoplastic agents are mutagenic, studies have employed methods to study the mutagenicity of urine as an indication of exposure to these agents.

Chromosomal Aberrations
Chromosomal aberrations are known to be present in the cells of patients treated with antineoplastic agents and have been used to monitor health care workers exposed to these drugs.

Sister Chromatid Exchanges
Sister chromatid exchanges have been used as an indicator of exposure to agents that cause DNA repair and are useful for monitoring health care workers exposed to antineoplastic agents.

Micronuclei Induction
Micronuclei induction is another indicator of exposure to DNA-damaging agents and has been used to monitor health care workers exposed to antineoplastic agents.

DNA Damage
Direct damage to the DNA in the cells of health care workers is another method that has been employed as an indicator of exposure to antineoplastic agents.

HPRT Mutations
HPRT mutations in the cells of health care workers exposed to antineoplastic agents has seen limited use as a method to monitor exposure.

Thioether Excretion
The excretion of thioethers in the urine is a non-specific indicator of exposure to certain compounds and has been used in a small number of studies to monitor health care workers exposed to antineoplastic agents.

Analytical Studies
Over the past several years, the direct measurement of antineoplastic agents and/or their metabolites in body fluids of health care workers has been employed to assess exposure to these agents. Methods for a number of the more common agents are included in the citations on this page. Currently, these techniques are only used in research settings and not for routine monitoring of health care workers.

Urinary Excretion of Antineoplastic Agents
Recently, sensitive methods have been developed to measure specific antineoplastic agents in the urine of health care workers exposed to these drugs.

Environmental Sampling, Decontamination, and Protective Equipment
Environmental Sampling for Antineoplastic Agents
Sensitive methods are currently available to measure specific antineoplastic agents in surface wipe samples and air samples in the workplace environment. Studies to date have focused more on wipe sampling than on air sampling due to technical problems associated with air sampling methods for these drugs.
Decontamination and Deactivation of Antineoplastic Agents
Methods are available to chemically deactivate some of the antineoplastic agents in order to reduce their toxicity.

Evaluation of Protective Equipment for Handling Antineoplastic Agents
Various types of personal protective equipment have been evaluated for reducing healthcare worker exposure to antineoplastic agents. These include biological safety cabinets, gloves, protective gowns and closed-system devices.