

Carcinogenicity of Substances and Factors in the Environment

Introduction

Environmental epidemiology of cancer aims at identifying risk factors in environmental and occupational settings and evaluating the risk. Many chemicals classified as carcinogens by the International Agency for Research on Cancer (IARC) were first evaluated at the work place. In the last decades, occupational exposure to carcinogens has actually decreased in many countries as the awareness of their hazards has increased. In recent years the field of occupational cancer epidemiology is balancing on a turning point, i.e. on one hand, it seems that major occupational carcinogens have already been identified and on the other hand we have a long list of substances from which epidemiological data remains inconclusive. Still many occupational carcinogens remain to be identified; this can be illustrated by the association between cancer and industrial occupations for which the specific agents have not been identified. This means that workers continue to be exposed to hazardous substances but are not yet recognized as such.

Carcinogen or Mutagen

A carcinogen is a substance that has the ability to cause cancer (somatic mutagen, but not necessarily), while a mutagen is a substance/agent (physical or chemical, may also be biological like oncoviruses {e.g. HPV} and helicobacter pylori) that can increase or induce the frequency of mutations.

Mutagen Classification

1. Base analogues (become inserted into DNA strand during replication resulting in alteration of complementarity and base substitution mutations)
2. Direct acting agents (directly react with DNA and cause structural changes that lead to miscopying of the template strand when DNA is replicated)
3. Indirect acting agents (require the help of metabolism to produce direct acting agents)

Epigenetic Mutagens

This is the process of altering the activity of genes without changing their structure, i.e. altering the activity of DNA repair enzymes thus increasing the frequency of mutations.

Teratogens

These are agents that causes physical defects. Disruption of fetal development resulting in congenital defects which are Not hereditary. The first 8 weeks, is the most critical period for teratogenic action. Some teratogens include, Alcohol, tobacco, caffeine, PCB (polychlorinated biphenyls), dioxin, radiation, Herpes virus, CMV, Rubella, syphilis.

Xenobiotic Agent

This is a compound alien to humans but found in the body. Some are harmless, many are harmful. They may be present in soil, food, air, water.

- Natural: aflatoxins
- Artificial: nitrates (smoked meat). PAH formed from incomplete combustion!
- Metals: arsenic, lead, asbestos, mercury.
- Chlorine in water
- Air: traffic, industry, heating

IARC Classification and Examples

This is a list of substances classified according to their dangerousness, based on the Ames Test (IARC) follows. IARC stands for International Agency for Research on Cancer.

Group 1 Carcinogens

[107 agents]: The agent (mixture) is definitely carcinogenic to humans. The exposure circumstance entails exposures that are carcinogenic to humans. There is enough evidence of the agents in this group to support carcinogenicity in humans. In some cases an agent (mixture) may be in this class when evidence of carcinogenicity in humans is less than enough, however there is enough evidence in experimental animals and more than enough evidence in exposed humans.

Aflatoxin	Benzidine	HIV
Arsenic	Ethanol	2-Naphthylamine
Asbestos	Vinyl Chloride	Helicobacter pylori
Benzene	Benz[a]pyrene	HPV

Group 2A Carcinogens

[58]: The agent (mixture) is probably carcinogenic to humans. The exposure circumstance entails exposures that are probably carcinogenic to humans. This IARC class is used when there is little evidence of carcinogenicity in humans but enough evidence of carcinogenicity in experimental animals. Occasionally an agent may be classified in this category when there is less than enough evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals and strong evidence that the carcinogenesis is mediated by a mechanism that also operates in humans.

Inorganic lead	Acrylamide	Dibenz[a,h]anthracene
UV	Benz[a]anthracene	Chloramphenicol

Group 2B Carcinogens

[249]: The agent (mixture) is possibly carcinogenic to humans. The exposure circumstance entails exposures that are possibly carcinogenic to humans. This class is used for agents, That show little evidence of carcinogenicity in humans and less than adequate evidence of carcinogenicity in experimental animals. It can also be used when there is inadequate evidence of carcinogenicity in humans but there is enough evidence of carcinogenicity in experimental animals.

Lead	Caffeine	Acetaldehyde
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Group 3 Carcinogens

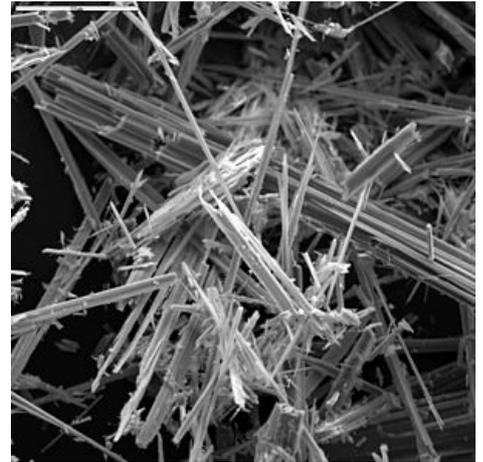
[512]: The agent (mixture or exposure circumstance) is not classifiable as to its carcinogenicity to humans. This class is used mostly for agents, for which the evidence of carcinogenicity is less than enough in humans and less than enough or little in experimental animals. Exceptions include when agents for which the evidence is less than enough in humans but enough in experimental animals can be situated in this category when there is strong evidence that the mechanism of carcinogenicity in experimental animals is not the same in humans.

Acrylic fibers

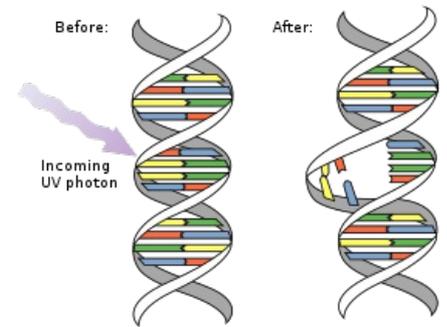
Group 4 Carcinogens

[1]: The agent (mixture) is probably not carcinogenic to humans. Caprolactam

Caprolactam



Asbestos



UV radiation influence

Carcinogen Vs Associated Cancer

Carcinogen	Associated Cancer
Asbestos; (Became popular among manufacturers and builders in the late 19th century because of its sound absorption, average tensile strength, and its resistance to heat, electrical and chemical damage.)	Mesothelioma, Lung ca (Bronchogenic carcinoma)
Benzene; (Trace amounts of benzene may result whenever carbon-rich materials undergo incomplete combustion. It is produced in volcanoes and forest fires, and is also a component of cigarette smoke. Benzene is a principal component of combustion products produced by the burning of PVC (polyvinyl chloride).)	Leukemias or Lymphomas
Vinyl chloride; (Vinyl chloride is a chemical intermediate, not a final product. Due to the hazardous nature of vinyl chloride to human health there are no end products that use vinyl chloride in its monomer form. Polyvinyl chloride is very stable, storable, and less acutely hazardous than the monomer. Vinyl chloride liquid is fed to polymerization reactors where it is converted from a monomer to a polymer PVC)	Hepatoendothelial sarcoma (hemangiosarcoma)
Alcohol	Oral and Esophageal cancer
Aniline dyes; (The principal use of aniline in the dye industry is as a precursor to indigo, the blue of blue jeans.)	Bladder cancer
UV (sun, artificial solarium)	Melanoma, basal cell carcinoma, spinocellular ca.
Aflatoxins; (Produced by many species of Aspergillus. Aflatoxins are common and widespread in nature. They can colonize and contaminate grain before harvest or during storage. The native habitat of Aspergillus is in soil, decaying vegetation, hay, and grains undergoing microbiological deterioration)	Liver, stomach ca.
HPV	Cervical (primarily), laryngeal ca.
Radon (tobacco smoke, also indoors)	Lung cancer

Links

Related Articles

- IARC Classification
- Genotoxic Substances

Bibliography

- BENCKO, Vladimir, et al. *Hygiene and Epidemiology : Selected Chapters*. 2nd edition. Prague. 2008. ISBN 9788024607931.