Nov.Fall.2012

Environmental Factors and Cancer

Introduction

- The nature of cancer
- Carcinogenesis
- Carcinogens
  - Microorganisms and cancer
  - Radiations
  - Air pollution
  - Biocides and pesticides
  - Food contaminants and food additives
  - Metal and metalloids
  - Medicines and products of personal care
- Evaluation of carcinogens, the ACS & IARC

Introduction

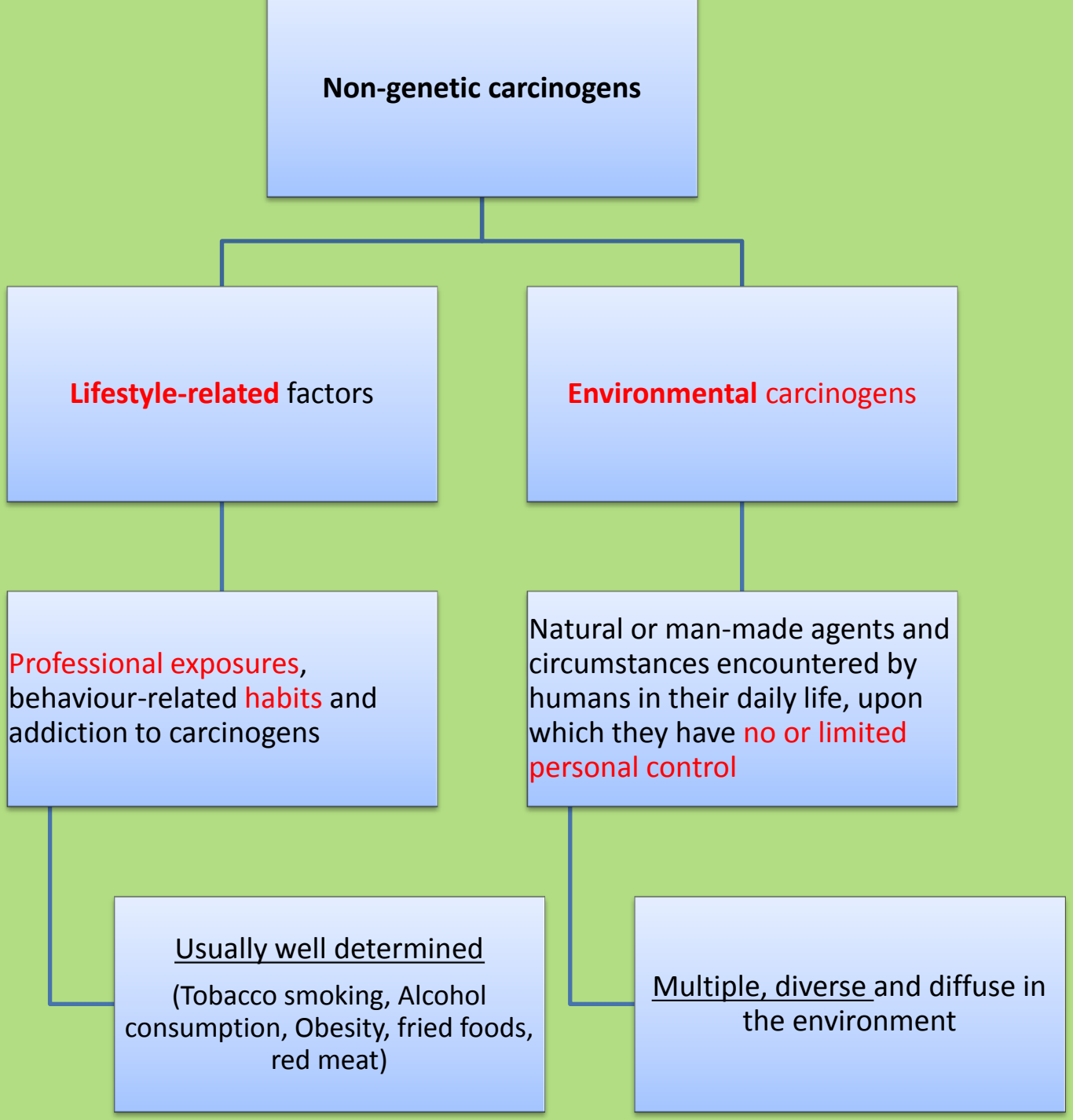
- Cancer is caused by a web of multiple factors
  - Multi-factorial
  - Multi-stage
- Cancer causation is very complex
- ~23% of the total deaths in the USA
- 2nd most common cause of death after heart diseases
- By 2020, ~15 million new cancer pt.

Carcinogenesis

- The existence of several *successive mutation* events impacting a given cell clone and inducing its gradual escape from the mechanisms ensuring *regulation* of cell division and the maintenance of *genomic integrity*

Carcinogenesis

- Genetic factors
  - Inherited mutated genes
  - 5-10% cancer cases
  - Cannot be modified
- Non-genetic factors
  - 90-95% of all cancer cases have their roots in the environment and lifestyle
  - Tobacco, diet, radiation, infectious organisms
  - Modifiable


Non-genetic carcinogens
Lifestyle-related factors
Environmental carcinogens
Professional exposures, behaviour-related habits and addiction to carcinogens
Natural or man-made agents and circumstances encountered by humans in their daily life, upon which they have no or limited personal control
Usually well determined
(Tobacco smoking, Alcohol consumption, Obesity, fried foods, red meat)
Multiple, diverse and diffuse in the environment

Evaluation & Classification of Carcinogens

- American Cancer Society (ACS)
  - Trusted source of information
    - http://cancer.org
  - Cancer prevention
  - Minimize or eliminate exposure to known or probable carcinogens & provide the public with information
  - To classify substances according to their carcinogenicity, ACS relies on
    - International Agency for Research on Cancer (IARC) of the WHO

Evaluation & Classification of Carcinogens

IARC

Group 1	Carcinogenic to humans
Group 2A	Probably carcinogenic to humans
Group 2B	Possibly carcinogenic to humans
Group 3	Not classifiable as to its carcinogenicity to humans
Group 4	Probably not carcinogenic to humans

http://monographs.iarc.fr/ENG/Classification/index.php

Environmental Factors and Cancer

Environmental Carcinogens
Viruses and other microorganisms
Radiations
Outdoor air pollution
Indoor air pollution
Biocides and pesticides
Food contaminants and food additives
Metal and metalloids
Medicines and products of personal care

Environmental Factors and Cancer

Viruses and other microorganisms

- Oncogenic Viruses
  - Viruses account for most infection-caused cancers
  - 17% of neoplasia (worldwide)
  - Range from < 10% in H-income countries to 25% in Africa
- Other microorganisms
  - Parasites such as *Opisthorchis viverrini* or *Schistosoma haematobium*
  - Bacteria such as *Helicobacter pylori*

Environmental Factors and Cancer

Radiations

- Up to 10% of total cancer cases may be induced by radiation

Exposure to	Associated with cancer in
Radon & radon decay products (home, workplace (mines))	Lung
X-rays in medical settings (diagnostic or therapeutic)	Breast cancer among girls exposed to chest radiation around the age at puberty
UV rays (sunlight & sunbeds)	Skin (basal cell, squamous cell carcinoma and melanoma)
Electromagnetic fields (EMF) of VLF or ELF (power lines & all types of electrical equipments)	Childhood acute leukemia, Brain and breast

Environmental Factors and Cancer

Outdoor air pollution

- Polycyclic aromatic hydrocarbons (PAH)
  - Combustion of organic substances
  - Factory smoke, waste incinerator emission & vehicle exhaust
  - Mutagens & increase risk of lung cancer
- Nitrogen dioxide (NO_2)
  - Traffic, power plants & waste incinerator emission
  - Lung cancer

Environmental Factors and Cancer

Indoor air pollution

- Environmental tobacco smoke (ETS)
- Biocides
- Formaldehyde
- Volatile organic compounds (VOC)
  - Benzene
    - Leukaemia and lymphoma

Environmental Factors and Cancer

Biocides and pesticides

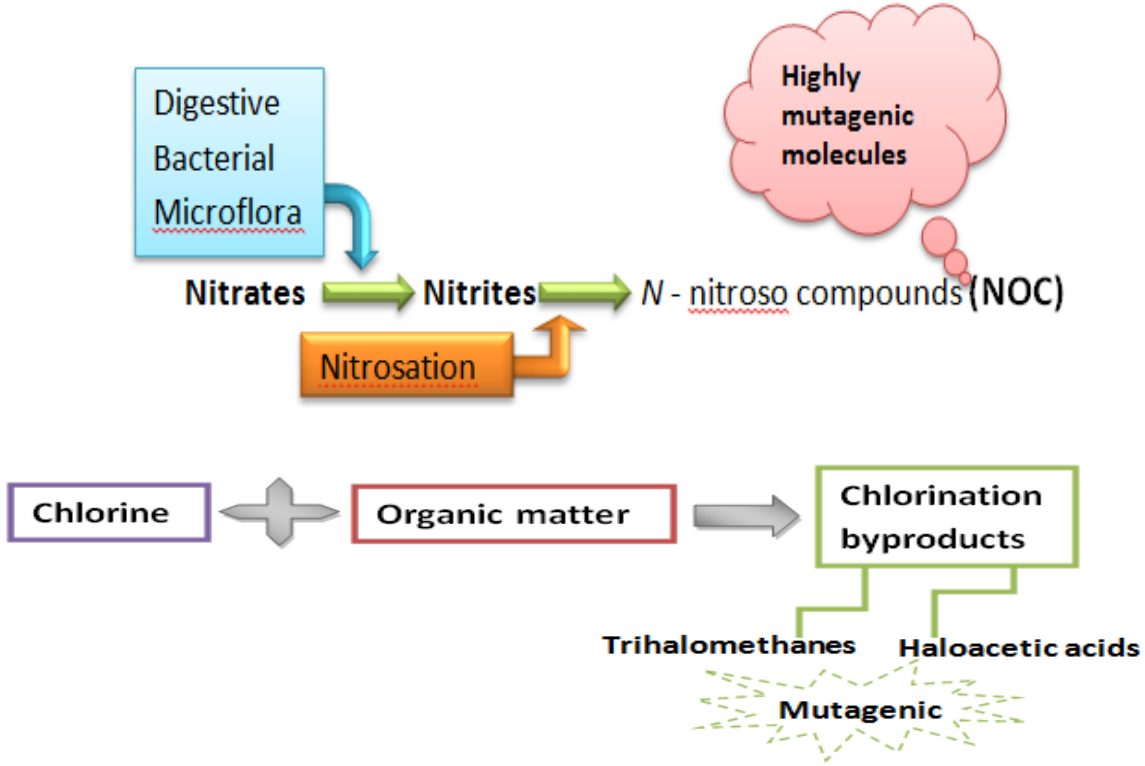
- Endocrine disruptors (Molecular structure close to estrogens or androgens)
- Can persist over long periods in the environment
- Parental or child exposures
  - leukaemia, NHL, brain tumors, Wilm's tumors, Ewing's sarcoma and germ cell tumors

Environmental Factors and Cancer

Food contaminants and food additives

- Nitrates, pesticides and dioxins can contaminate
  - Drinking water
  - Food
- Nitrates and nitrite preservative
  - Non-Hodgkin lymphoma
  - Colon cancer
  - Childhood brain tumors
    - N-nitroso compounds
- Chlorinated drinking water
  - Bladder cancer
  - Colorectal cancer
  - Adult leukemia

Environmental Factors and Cancer



Environmental Factors and Cancer

Metals and metalloids

Exposure to	Associated with cancer in
Arsenic oxides (inhalation)	Lung
Arsenic oxides (p.o)	Bladder, kidney & liver
Lead, hexavalent chromium, nickel	Lung
Hexavalent chromium, nickel	Nasopharyngeal
Lead, mercury	Brain
Lead, cadmium	Kidney
Cadmium	Prostate

Environmental Factors and Cancer

Medicines and products of personal care

- Hormonal products
  - Oral contraceptive
  - Hormone replacement therapy
  - Anti-estrogens (tamoxifen)
- Anticancer chemotherapeutic agents
  - Secondary cancer
- Cosmetics
  - Formaldehyde, parabens (underarm deodorants & breast cancer)
  - Permanent hair-dyes (aromatic amines)
    - Bladder cancer
    - Adult acute leukemia
    - Lymphoma
    - Myeloma

References

- Elizabeth T. H. Fontham American Cancer Society Perspectives on Environmental Factors and Cancer CA CANCER J CLIN 2009;59:343–351
- P. Irigaray et al Lifestyle-related factors and environmental agents causing cancer: An overview Biomedicine & Pharmacotherapy 61 (2007) 640e658
- J. W. Cherrie, M. van Tongeren and S. Semple Exposure to Occupational Carcinogens in Great Britain Ann. Occup. Hyg., Vol. 51, No. 8, pp. 653–664, 2007
- Anand et al Cancer is a Preventable Disease that Requires Major Lifestyle Changes Pharmaceutical Research, Vol. 25, No. 9, September 2008

&
Thank you