

CANCER AND ENVIRONMENT

Paolo Mocarrelli

Corresponding author's address:
Prof. Paolo Mocarrelli
Univ. Dept. Laboratory Medicine
Hospital of Desio
Piazza Benefattori, 1
20033 Desio - Milano, Italy

The term cancer refers to a group of diseases in which cells multiply and spread beyond any limit within the body.

Cancer is diagnosed in about 10 million people worldwide, and more than 6 million die from this disease. In the United States, the incidence rate for prostate cancer is 170 per 100,000 individuals and 135 per 100,000 for breast cancer; lung and stomach cancer have an incidence rate of 80 in males and 50 in females.

Cancer arises from the loss of normal cell growth. This loss is comparable to the failure of the cell's ability to begin the process of "apoptosis", which is a biological program of self-destruction. Thus, a crucial problem lies in the identification of those agents, the so-called "cancerous agents", that are responsible for tumour induction.

Carcinogens act through a multiphasic process, which begins with a series of genetic mutations and stimulates the cell toward uncontrolled proliferation.

These phases can take decades to evolve employing a long period of time to bring about cancer development. This is the case of the carcinogens contained in cigarette-smoke whose action can engage twenty to thirty years.

Since the progress of cancer requires numerous mutations, the probability of cancer increases with increasing age; a 75 year old has a 1,000 times greater chance for developing cancer than a 25 year old. Obviously, this is also due to the longer exposure to the cancerous agents.

What causes cancer? Various factors: besides heredity, which seems to be minimally involved, three main categories of elements exist: chemical factors (smoking, diet, environment), radiation, bacteria or viruses.

All of these contribute toward the development of cancer by stimulating genetic modifications.

Chemical substances and radiations act by damaging genes; viruses introduce their own genetic material into the cell; individual

hereditary predisposition transfers genetic alterations that allow a greater susceptibility towards cancer.

These spontaneous or carcinogen-induced mutations can give rise to three gene classes: Oncogenes, Tumour suppressor genes, and DNA repair genes. Oncogenes are produced by mutations of proto-oncogenes. Oncogenes encode for a modified structure or for an excessive protein responsible for cell growth. The lack of oncosuppressor genes, the best known being p53, can lead to tumour development. DNA repair genes correct the errors occurring during replication.

Here are some examples of cancerous agents:

Cigarette smoke contains more than 24 chemical substances capable of causing tumours. It accounts for about 30% of deaths in the United States and is the leading cause of death from cancer worldwide. There is a direct relationship between cancer and number of cigarettes smoked. Some carcinogens are concentrated in certain work environments: arsenic, asbestos, benzene, chromium, naphthylamine, radon, vinyl chloride, and wood dust. Benzene exposure can lead to a high risk of leukaemia.

Recently, a particular class of carcinogens has been defined: "Endocrine Disruptor Chemicals" (EDC). These can be drugs, pesticides, chemical contaminators, and heavy metals. They seem to be one of the multifactorial agents involved in breast cancer. DDE exposure, a DDT metabolite, may be associated with a high risk of breast cancer, as also is the case with Dieldrine an organochlorate. Dioxin also belongs to this family of compounds and its effects have been studied in Seveso, where an increase in colorectal cancer, lymphopietic tissue malignancies, Hodgkin disease, and myelogenous leukaemia, has been observed. It appears that EDCs may be implicated in the augmented endometrial, testicular, and prostate cancer rates.

Industrial contamination alone does not seem to be one of the major causes of increased tumour incidence. Radio-frequency waves along with magnetic fields do not appear to be responsible for brain tumour development. However, radiation is known to raise tumour rates. Ultraviolet rays increase the risk of melanoma.

There are viruses as well that are associated to human tumours. EBV induces Burkitt's lymphoma. HPV causes uterine cervical cancer; HBV is responsible for liver cancer, HTL brings about T-cell leukaemia, and Kaposi sarcoma virus determines Kaposi sarcoma. Recently, *Helicobacter pylori*, a bacteria which causes peptic ulcer, has been connected with stomach cancer. New findings in the fields of molecular biology and genetics have allowed the molecular characterization of tumours and the search for new biomarkers.

The laboratory will play a major role in pharmacogenomics and in the identification of new biomarkers.

Prevention is of primary importance. Avoid smoke-filled environments, obesity, a sedentary life, and a meat and saturated

fats rich diet. At this moment in time, this seems to be the best system for reducing the risk against cancer.

References

1. Edwards, Richard. The problem of tobacco smoking. *BMJ* 2004;328(7433):217-9.
2. Bognolo, Giulio editorial registrar. Calculating the risk of disease. *BMJ* 2004;329(7459):237.