TOXIC SUBSTANCES, A CAUSE OF CANCER – A REVIEW
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ABSTRACT
Cancer is the second leading cause of death. It accounts for one in four deaths. There are over 100 different types of cancer. “Environmental” causes of cancer include using tobacco products, occupational exposure to toxic chemicals. Every day we come in contact with different chemicals. These chemicals can become toxic, when a person comes into contact with large doses. Effect of these chemical depends on: Toxicity of chemicals, Dose of chemicals used, Duration of exposure, Frequency of exposure, general health, age and lifestyle.

Depending on how chemical is processed or metabolized in your body, three types of carcinogens exist. Chemicals that can cause cancer (Direct acting carcinogens), after metabolism they changed and cause cancer (Procarcinogens), Chemicals causes cancer only if given with another chemical (Cocarcinogens). Carcinogens according to National Toxicology Program, U.S. Department of Health and Human Services: Known human carcinogen and reasonably anticipated to be human carcinogen.

Key words: Environmental causes of cancer, Toxic chemicals, Carcinogens, Known human carcinogen, reasonably anticipated to be human carcinogen

INTRODUCTION
Cancer is the second leading cause of death. It accounts for one in four deaths. There are over 100 different types of cancer. Some of the most frequently diagnosed cancers include lung, breast, prostate, and brain cancer. In addition to pain and suffering caused by the disease, cancer places an enormous economic burden on our society.

“Environmental” causes of cancer include using tobacco products, poor diet, lack of physical activity and obesity, unprotected exposure to the sun, and occupational exposure to chemicals. Exposure to environmental carcinogens can occur in the workplace and in the home, as well as through consumer products, medical treatments, and lifestyle choices.1

World Health Organisation (WHO) and the International Agency for Research into Cancer (IARC) have estimated that 3% of all cancers caused due to pollution and chemicals in our environment.2

What is cancer?
All cells normally grow and multiply to replace old cells to keep the body healthy. A cell becomes cancerous when it grows quickly and uncontrollably. In most cancers, this process leads to the growth of tumours. A tumour is an abnormal growth of tissue.
resulting from uncontrolled cell growth. Tumours are either benign or malignant. Benign tumours are not cancer. Cells from benign tumours do not spread to other parts of the body. Benign tumours are not usually life threatening. Malignant tumours are cancer. Cancer cells can spread to other tissues and organs near the tumour. They can also spread to other sites in the body through the bloodstream or lymphatic system. This spreading is called metastasis. People of all ages get cancer, but it is most common in people older than 55.

Substances known to cause cancer are called carcinogens. Depending on how chemical is processed or metabolized in your body, three types of carcinogens exist.
- Chemicals that can cause cancer (Direct acting carcinogens)
- Chemicals that do not cause cancer unless they are changed metabolized (Procarcinogens)
- Chemicals that do not cause cancer by themselves but can act with another chemical to cause cancer (Cocarcinogens).

Damage to DNA in cells can lead to cancer. However, cells can often repair DNA damage. If the damage is extreme, the cells may die. Unrepaired DNA damage can lead to mutations, or changes, in genes, and mutations in certain genes can cause cancer.

Response of cells to Chemical Injuries

<table>
<thead>
<tr>
<th>Cell Dies</th>
<th>Cell Repairs DNA</th>
<th>DNA Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead Cell</td>
<td>Healthy Cell</td>
<td>Cancer Cell</td>
</tr>
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</table>

Every day we come in contact with different chemicals. These chemicals can become toxic, when a person comes into contact with large doses. Effect of these chemical depends on: Toxicity of chemicals, Dose of chemicals used, Duration of exposure, Frequency of exposure, general health, age and lifestyle.

List of carcinogens according to National Toxicology Program, U.S. Department of Health and Human Services:

A) “Known human carcinogen” - Requires evidence from human studies.
1) Arsenic
2) Asbestos
3) Alcoholic drinks
4) Benzene
5) Benzidine
6) Beryllium
7) Cadmium
8) Chromium
9) Formaldehyde
10) Tobacco smoke
11) Vinyl chloride

B) “Reasonably anticipated to be human carcinogen”. Gathers evidence mainly from animal studies.
1) Acetaldehyde
2) Chloroform
3) Cobalt
4) DDT
5) Diaxone,
6) Lead
7) Naphthalene
8) Pesticides

A) “Known human carcinogen” -
1) Arsenic and Inorganic Arsenic Compounds
Humans exposed to arsenic or arsenic compounds for medical treatment, in drinking water, or occupationally have demonstrated that exposure to arsenic and inorganic arsenic compounds increases the risk of cancer. Cancer tissue sites include the skin, lung, digestive tract, liver, urinary bladder, kidney, and lymphatic and hematopoietic systems.5

2) Asbestos
Exposure to asbestos causes respiratory-tract cancer, mesothelioma of the lung and abdominal cavity (pleural and peritoneal mesothelioma), and cancer at other tissue sites.5

3) Alcoholic Beverage Consumption
Consumption of alcoholic beverages has been shown to cause cancer of the mouth, pharynx, larynx, and oesophagus.5 Long-term alcohol misuse is associated with cancers of the mouth, throat, oesophagus, liver, colon, and breast.5

4) Benzene
Occupational exposure to benzene increased the risk of mortality from leukemia (mainly acute myelogenous leukemia). Benzene exposure increased the risks of total lymphatic and hematopoietic cancer, total leukemia, and specific histologic types of leukemia, including chronic lymphocytic leukemia, as well as acute myelogenous leukemia. Little evidence was found for an association between benzene exposure and multiple myeloma or non-Hodgkin’s lymphoma.5

5) Benzidine
There is a strong association between occupational exposure to benzidine and urinary-bladder cancer.5

6) Beryllium and Beryllium Compounds
There is increased risk of lung cancer in occupational groups exposed to beryllium or beryllium compounds.5

7) Cadmium and Cadmium Compounds
Exposure to various cadmium compounds increased the risk of death from lung cancer.

8) Chromium Hexavalent Compounds
There is an increased risk of lung cancer among workers engaged in chromate production, chromate pigment production, and chromium plating.5

9) Formaldehyde
Formaldehyde exposure increases risks of nasopharyngeal cancer; sinonasal cancer, and lymphohematopoietic cancer, specifically myeloid leukemia among individuals with higher measures of exposure to formaldehyde (exposure level or duration). The evidence for nasopharyngeal cancer is somewhat stronger than that for myeloid leukemia.5

10) Tobacco-Related Exposures
a) Tobacco Smoking
Tobacco smoking has been shown to cause cancer of the lung, urinary bladder, renal pelvis, oral cavity, pharynx, larynx, oesophagus, lip, and pancreas in humans. The risk of death from lung cancer increases with increasing duration of smoking and with increasing numbers of cigarettes smoked.

Tobacco contains more than 2,500 chemical constituents, many of which are known human carcinogens. These include carbon oxides, nitrogen oxides, ammonia, hydrogen cyanide, volatile aldehydes and ketones, nonvolatile alkanes and alkenes, benzene, hydrazine, vinyl chloride, isoprenoids, phytosterols, polynuclear aromatic compounds, alcohols, nonvolatile aldehydes and ketones, phenols, quinones, carboxylic acids, esters, lactones, amines and amides, alkaloids, pyridines, pyroles, pyrazines, N-nitrosamines, metals, radioactive elements, agricultural chemicals, and chemical additives. The nicotine in tobacco is addic-
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tive and produces several pharmacological and toxicological effects.\textsuperscript{5}

b) Environmental Tobacco Smoke

There is an increased risk for developing lung cancer following prolonged exposure to environmental tobacco smoke. At least 69 of the toxic chemicals in secondhand tobacco smoke cause cancer. These include Arsenic, Benzene, Beryllium, Cadmium, Chromium, Ethylene oxide, Nickel, Vinyl chloride, Formaldehyde.\textsuperscript{6}

c) Smokeless Tobacco

Cancer of the oral cavity has been associated with the use of both chewing tobacco and snuff. Smokeless tobacco products contain many known or reasonably anticipated human carcinogens, such as volatile and nonvolatile nitrosamines, tobacco-specific N-nitrosamines (TSNAs), polynuclear aromatic hydrocarbons, and polonium-210.\textsuperscript{5}

ii) Vinyl Chloride

Vinyl Chloride has widespread industrial use, especially in the plastics industry, and the primary route of occupational exposure is inhalation. Numerous epidemiological studies of occupational exposure have shown that vinyl chloride causes cancer of the blood vessels of the liver (hepatic angiosarcoma) in humans.\textsuperscript{5}

B) “Reasonably anticipated to be human carcinogen”\textsuperscript{5}

i) Acetaldehyde

Administration of acetaldehyde in drinking water increased the incidences of hemolymphoreticular cancer (leukemia and lymphoma combined), benign tumors of the pancreas (islet-cell adenoma), and cancer of the bone (osteosarcoma) and nasal cavity (carcinoma) in males and benign mammary-gland tumors (fibroma or fibroadenoma) in females.\textsuperscript{5}

2) Chloroform

Exposure to chlorinated water found excesses of cancer at several tissue sites, particularly the urinary bladder.\textsuperscript{5}

3) Cobalt

Excess lung-cancer mortality among cobalt–tungsten carbide hard-metal manufacturing workers across studies is noted.\textsuperscript{5}

4) Dichlorodiphenyltrichloroethane (DDT)

DDT is a chlorinated aromatic hydrocarbon insecticide. It caused primarily malignant primary liver-cell tumors (hepatocellular carcinoma) in mice of both sexes and in rats.\textsuperscript{5}

5) Diaxone

Administration of 1, 4-dioxane in drinking water caused benign or malignant liver tumors (hepatocellular adenoma or carcinoma) in mice of both sex, female rats, and male guinea pigs. It also caused cancer of the nasal cavity (squamous-cell carcinoma) in rats of both sexes and gallbladder cancer (carcinoma) in male guinea pigs. Dermal exposure to 1, 4-dioxane promoted the induction of skin tumors (squamous-cell carcinoma, sarcoma, and papilloma).\textsuperscript{5}

6) Lead

Lead exposure has been associated with increased risk of lung, stomach, and urinary-bladder cancer in diverse human populations.\textsuperscript{5}

7) Naphthalene

Exposure of rats to naphthalene by inhalation caused nasal tumors, which are rare in this species. Two types of nasal tumor were observed: olfactory epithelial neuroblastoma of the nose and respiratory epithelial adenoma.\textsuperscript{5}

8) Pesticides

Lindane, Hexachlorocyclohexane and Other Hexachlorocyclohexane Isomers

Farming communities have higher rates of leukemia, non-Hodgkin lymphoma, multiple
myeloma, and soft tissue sarcoma, as well as cancers of the skin, lip, stomach, brain, and prostate.\textsuperscript{6} Research suggests an increasingly likely connection with cancers such as non-Hodgkin lymphoma (especially among farmers), multiple myeloma, and prostate, kidney and lung cancers. Studies on pesticides and childhood cancer show a possible connection with leukemia, brain tumours and non-Hodgkin lymphoma.\textsuperscript{7}

**CONCLUSION**

Cancer is a common disease. Pollution, tobacco smoke, exposure at work to chemicals are the environmental factors that causes cancer. If we can do some changes in lifestyle the risk of getting cancer may be reduced. We can prevent cancer by not smoking, avoiding smoke from others, maintaining a healthy weight, exercising, and being careful about the chemicals you use in your home. You can check for harmful ingredients. You can wear a mask, gloves, or other protective clothing to reduce your exposure to household chemicals. Read product labels and follow the directions carefully. Store household chemicals safely and prevent chemicals from spilling, leaking, and coming into contact with children.

**REFERENCES**

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