OCCUPATIONAL CANCERS

Prof. Dr. Nazmi Bilir

Director, Institute of Public Health , Hacettepe University

Environmental factors play a big role in the formation of cancer. According to what we know today, 80% of cases of cancer are caused by the effects of environmental factors. Included among the environmental factors are those that can be found in the workplace and occupational factors. The first comprehensive investigation in this field was conducted by R. Doll and R. Peto in 1981. In their research it was found that 2-8% of cases of cancers were caused by the effects of occupational factors.

Knowledge concerning cancer dates to many years in the past. However, the earliest knowledge found regarding the effects of occupation in cases of cancer can be traced back to a finding by Percival Pott in 1775. Dr. Pott, an English doctor, had indicated that scrotum cancer could be observed in people who had worked as chimney sweeps as children. Historically, it is very important that such an observation was recorded, especially in a period where there was not enough knowledge about diseases and the causes of cancer. Dr. Pott claimed that the disease was due to exposure to soot found in the chimneys. Previous to this claim, it was thought that this was an illness contracted by sexual intercourse. At the beginning of the 20th century, a study was conducted where skin cancer was bought about by exposing mice to coal tar in Japan in 1918. In 1932, years after the observations of Dr. Potts, benzpyrene and benzanthracene were the first substances to be identified as carcinogenic.

One of the very first information about cancer to be identified was by Dr. Bernardino Ramazzini. Ramazzini is known to be the founder of occupational health. In 1713, Ramazzini indicated that nuns had a high risk of suffering from breast cancer. The number of cases and intensities of factors increased the workplace and the number of occupational fields increased in the years that followed the Industrial Revolution. This resulted in the increased observation of various health problems, including cancer, due to exposure to certain risk factors in the working environment. For example, in 1895, Rehn indicated that the number of employees with urinary bladder cancer working in the paint industry was high. Later on, it was identified that the occurrences of cancer was due to the effects of aromatic amines. The increased use of asbestos bought with

it an increased number of diseases related to asbestos and the first case of asbestos related lung cancer was recorded in 1935. In the years that followed, cases of vinyl chloride related liver tumors and benzene related leukaemia was also seen. Amongst these developments, it is historically important to note that Dr. Muzaffer Aksoy (et al) also noted that the cases of leukaemia were reported for those who worked as shoemakers.

THE REASONS OF OCCUPATIONAL CANCERS

The International Agency for Research on Cancer (IARC) differentiates between the substances that play a role in causing cancer by categorising substances into four different groups. The basis for the grouping is the role of the substance as a factor in causing cancer. Substances were categorised into separate groups according to their carcinogenic characteristics as a result of laboratory research and epidemiological evidence. These groups are as follows:

Group 1. Definitely Carcinogenic Substances: The substances under Group 1 are those for which "sufficient evidence" was found in terms of being carcinogenic to humans. Among the substances which are known to definitely cause cancer are such substances as asbestos, aromatic amines, benzene, chrome and nickel. The main substances within this group and the field of work and cancer type related in conjunction with the relevant occupation can be seen in Table 1.

Table 1. Main Substances which are Definitely Carcinogenic for Humans (Group-1)

Substance	Related field of work	Related type of cancer
Aflatoxin	Agricultural work	Liver tumour
Amino biphenyl	Tyre industry	Urinary bladder
Arsenic and compounds	Pesticide works	Lung, skin
Asbestos	Isolation works	Lung, pleura
Benzene	Paint, footwear	Leukaemia
Benzidine	Tyre and paint work	Urinary bladder
Cadmium	Battery manufacture, metal work	Prostate
Chrome	Chrome coating	Lung
Naphtylamine	Tyre and paint works	Urinary bladder
Nickel	Nickel refinery	Nasal, lung
Radon	Mining	Lung
Vinyl chloride	Plastics industry	Liver angiosarcoma
Ionising radiation	Medical work	Leukaemia, lung, bone
Ultraviolet rays	Agriculture, maritime work	Skin

Group 2 A. Probably Carcinogenic Substances: The substances included in this group are not defined as definitely carcinogenic but are those for which there is strong evidence to suggest that they are carcinogenic. The main substances in this group can be seen in Table 2.

Group 2 B. Possibly Carcinogenic Substances: The substances under this group are those for which there is no sufficient evidence to show that they are carcinogenic but some weak evidence exists to suggest that they may be carcinogenic.

Group 3. Substances which are not in either Group 1 or 2: This group of substances includes those substances for which their role in causing of cancer is not apparent. Some studies have shown weak connections but there is contradicting information amongst studies.

Table 2. Some Carcinogenic Substances which are Probable to Cause Cancer in Humans (Group 2A)

Substance	Related field of work
Acrylamide	Acrylic work
Diesel exhaust gas	Automotive industry
Diethyl sulfate	Chemical industry
Epichlorohydrin	Manufacturing of resin, solvent
Formaldehyde	Tissue preservation, chemical industry
Tetrachloride ethylene	Dry cleaning
Toluidin	Manufacture of azo dyes
Styrene oxide	Chemical industry

Group 4: Probably Not Carcinogenic to Humans: Substances for which no evidence has been found in studies conducted to show that they are carcinogenic to humans.

TYPES OF OCCUPATION RELATED CANCERS

The most common occupation-related cancer is lung cancer. Besides lung cancer, the other most frequently occurring cancers due to occupational factors are skin cancer, urinary bladder cancer and leukemia. As it can be seen, occupation-related cancers are not different in type in comparison with other occurring cancers. Therefore, the most important matter when assessing whether a cancer has been caused due to occupational reasons is to know the accurate information of the history and details of the patients work life. If a cancer patient is working in a high cancer risk occupation, the details of the patients work history and the role of the occupational exposure should be taken into consideration. The fact that persons do not always work in one job or occupation their whole life should not be overlooked; it may not be sufficient to

investigate the persons current occupational conditions while attempting to find a link between the patients illness and occupation. It is beneficial to also obtain information about the patient's previous occupation or field of work.

Of all cases of cancer, it is estimated that 5% of cases are occupational cancers. Of the occurrences of occupational cancer, 15% are found to be cases of lung cancer. In comparison, cancers of the digestive system due to occupational factors are only approximately 1%. Occupational cancers more frequently occur at a younger age than other incidences of cancer. The cases of males with occupational cancers compared to females are higher because a higher number of males work in occupations that have a higher risk of cancer.

Lung cancer: This type of cancer is one which is most frequently seen in humans. In terms of its etiology, although cigarette smoking is the most important risk factor, occupational factors also play an important role in the occurrence of lung cancer. Recent data shows that approximately 15% of cases of men with lung cancer and 5% of cases of women with lung cancer are due to factors incurred in the workplace. The occupational factor known to most commonly cause lung cancer is asbestos. Of the various kinds of asbestos, chrocidolite (commonly known as blue asbestos) is the form which is known to be the most carcinogenic. White asbestos (chrysotile asbestos) is not known to have a high risk carcinogenic characteristic. There is a relationship between exposure to asbestos and cigarette smoking in the occurrence of lung cancer. Employees who are smokers have a higher risk. Arsenic, chloro-methyl ether, chrome, silica dust, nickel, poly-cyclic aromatic hydro-carbons and radon gas also lead to lung cancer.

Mesothelioma: The only known factor for the occurrence of this disease is asbestos and substances containing erionite and similar substances in its fibres. All cases of mesothelioma occur as a result of occupation or environmental exposure to asbestos. The first findings of mesothelioma amongst asbestos workers were seen in the 1940's. Later on, Wagner in 1960 and Selikoff in 1964 provided evidence for occurrences of mesothelioma in asbestos workers based on their epidemiological mesothelioma frequency studies. 90% of the cases of mesothelioma are found to be in the pleura and 10% in the peritoneum. The illness is most commonly seen in those who work with blue (chrocidolite) asbestos. It is known that there are many cases of mesothelioma cases in Turkey due to asbestos and erionite.

Leukaemia and other haematologically malign illnesses: Ionising radiation and benzene are among the highest occupational risk factors which play a role in the occurrence of these illnesses. In addition to these, it is also known that exposure to asbestos and trichloride ethylene, agricultural work and employment in the plastics industry is an important factor in haematologically malign illnesses.

Urinary bladder cancer: The relationship between this type of cancer and occupational risk has long been known. Exposure to aromatic amines is an important factor in the occurrence of urinary bladder cancer. The main occupations that are a risk for the occurrence of this cancer is the paint and tire industry.

Hemangiosarcoma of the liver: Angiosarcoma is a rarely seen type of tumour which is an illness that is observed in those working in the plastics industry. It is known that exposure to vinyl chloride monomeric (VCM), the primary constituent of polyvinyl chloride (PVC) used in the plastic industry is the cause of such a disease.

Breast cancer: Breast cancer is the most frequently occurring cancer in women. It is known that breast feeding is a protective measure against breast cancer. Incidences of breast cancer are more often seen in women of some professions (physicians, lawyers, dentists, nurses, etc.). In addition, those who work in the chemical industry, the pharmaceutical industry and hairdressers have a high risk of breast cancer.

Prostate cancer: Besides eating habits, occupational and environmental factors also play a role in prostate cancer, a cancer which is most frequently seen in elderly males in developed countries. This disease is rarely seen in men under the age of 50. The occupations for which incidences of prostate cancer most often occurs are farmers, teachers, welders and metal workers, textile workers, in the tire industry and manufacturing of batteries. It was been shown that there is a relationship between exposure to cadmium and prostate cancer.

Brain tumours: It is not a type of tumour which is very frequent but it is one which is life threatening due to its location. These tumours have different clinical and pathological types. There is evidence to suggest that some occupational factors may play a role in the occurrence of a brain tumour. Vinyl chloride, formaldehyde, some solvents, lead, ionising radiation and electromagnetic fields are some of these substances. The risk of brain tumours in relatively higher for agricultural workers, firemen, those working at petrol refineries and the tire industry.

Skin cancer: As skin is the largest organ of the body, skin cancer is one of the most commonly occurring tumours. It is known that exposure to ultra-violet rays have an effect on the occurrence of melanoma and non-melanoma related skin cancers. Beside this, arsenic, poly-cyclic aromatic hydrocarbons and ionising radiation also play a role in the occurrence of skin cancer.

Besides the types of cancers already mentioned, there is also data to suggest that occupational factors may also be a factor in the occurrence of such cancers as endometrial cancer, cervical cancer, ovarian cancer, thyroid cancer, cancer of the stomach, colorectal cancer, cancer of the pancreas and some other types of cancer.

PREVENTING OCCUPATIONAL CANCERS

Illness prevention can be conducted at three levels: primary, secondary or tertiary level prevention. Amongst these, the most effective level is primary prevention. In order to ensure protection from an illness at the primary prevention level, the person should be prevented from coming into contact with the risk factor. This approach is the most basic form of risk prevention in terms of occupational health and safety. The causes of occupation-related cancers are clearly identified. Persons come into contact with the risk factor in the work environment or during the process of the work being conducted. This being the case, contact with the risk factor can be eliminated by implementing a series of technical prevention and protection approaches. The common practices which can be implemented toward this aim are as follows:

(1) Not using carcinogenic substances: The most effective method of protection. The principle underlying this practice is to replace the carcinogenic substance with another substance (substitution). For example, after the dangers of benzene were identified, the open use of benzene (solvents, use as adhesive) was prohibited. Other substances that are not carcinogenic (such as toluene, xylene and styrene, hexane, etc.) have begun to be used in the relevant fields instead of benzene. Similarly, some substances which include synthetic matter in their fibres have begun to be used instead of those that contain asbestos.

(2) Closed systems: In some situations, it is necessary to continue to use the hazardous substance in the related occupational field. In cases such as this, contact with this substance can be prevented by ensuring that working with the substance in conducted closed systems. For example, this approach could be effective for persons and work places using radioactive substances.

(3) Isolation: Sometimes it may be possible to provide isolation from the hazardous process altogether. If the hazardous process is only in one section of the work place, this section may be able to be isolated from the other sections. By doing so, contact with the hazardous substance will have been avoided by a large number of people at the workplace. Those working in the isolated hazardous section can be protected with special risk prevention methods or, if possible, opting to use robots in this area may be another option.

(4) Ventilation: A common preventative method in the work place is ventilation. Hazardous substances generally enter the body by respiration. For this reason, in order to eliminate contact with the hazardous substances, the ventilation system should be installed in a lower position in comparison to the level of respiration so that it can remove the contaminated air from the environment before it can be respired. This type of ventilation is called “exhaust ventilation”.

(5) Use of personal protective items: If persons may be affected by the hazardous substance, even after attempts to control it at its source, then it may be possible to attempt using the personal protective items when use or contact with the substance is necessary. Contact with the hazardous substance is most frequently through the respiratory tract therefore, the primary protective item should be a mask to provide protection from the effects of inhalation. Besides masks, other protective clothing such as special gloves, shoes, eye and face protecting eyewear can be worn. However, one important point must be noted: personal protective clothing or items are the "last resort" when handling or exposure risk is eminent. Before the need for personal protective items arise, it must be made sure that the one or more of the approaches mentioned above are implemented in the use of the source of the risk factor. If all efforts made are no longer applicable, only then is it viable to approach the matter by use of the personal protective items. It is inappropriate to practice the approach of protective clothing and items on its own without taking the necessary precautions concerning the source of the risk factor.

(6) Other precautions: Besides the practices mentioned above, further betterment may be ensured for precautionary practices with various administrative (management) approaches. For example, the hours of the working day could be reduced for those working with hazardous substances with the aim of reducing the duration of exposure. This is being practiced for those working with radioactive substances and radiation as a precaution. Besides a shorter working day, another approach is to ensure that the staff working with hazardous substances are scheduled to work on a rotational basis.

In addition to the above mentioned primary prevention approaches, those working with hazardous substances, especially those which are carcinogenic, should regularly undergo medical check-ups. By doing so, any health problems can be identified in its early stages. This approach is known as secondary prevention in the context of preventative medicine. Any health problem detected in its early stage either be prevented from becoming worse or can allow the person to regain their health. Conducting regular medical check-ups of those employees working under heavy and dangerous conditions have been outlined in occupational health and safety regulations.

Health and safety education is important in the prevention and protection against occupation-related cancers. Training should be provided to both employers and employees in the work place. Information about high risk substances, their effects on health and various kinds of exposure should be given in the training provided. It is also important to inform those involved about protective and precautionary practices.

References:

1. Mesleksel Kanserler, N. Bilir, İş Sağlığı ve Güvenliği [Occupational Cancers, N. Bilir, Occupational Health and Safety] (N. Bilir, AN Yıldız) cited from pp. 235-243, Hacettepe Üniversitesi Yayını, Ankara, 2004.
2. Cancer, MB Russi, Textbook of Clinical Occupational and Environmental Medicine (Ed. L. Rosentock, MR Cullen, CA Brodkin, CA Redlich), pp. 727-824, Elsevier, Second edition, 2005.
3. Carcinogens, H. Frumkin, M. Thun, Occupational Health (BS Levy, DH Wegman) cited from, pp. 335-353, Lippincott Williams and Wilkins, 2000.
4. Cancer Epidemiology, Principles and Methods, IS Silva, IARC, Lyon, 1999.
5. Fundamental Principles of Occupational Health and Safety, BO. Alli, ILO, Geneva, 2001.
6. Encyclopaedia of Occupational Health and Safety, Fourth Edition, ILO, Geneva, 1998.