THE CONSIDERATIONS RELATING TO THE EFFECTS OF TOXIC SUBSTANCES FROM THE ENVIRONMENT ON THE ORGANISM

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ABSTRACT: This paper presents aspects regarding the toxic effects that certain substances such as polycyclic aromatic hydrocarbons, heavy metals and other carcinogens exert on the human body and how they influence the health of the population. The harmful, toxic effects that carcinogens present in the workplace and life have on the human are essential in assessing the risk to his health.

KEY WORDS: toxic, carcinogenic effect, organism

1. INTRODUCTION

The presence of toxic compounds in the environment, due in particular to pollution processes that are becoming more intense lately, obviously attracts the risk of illness. The quantification of the individual or synergistic actions of such substances, is based on their identification in the external environment, knowledge of the mechanism of action on the body, of the medical risk they have, but especially of the prevention methods.

The toxicity of some gaseous air pollutants depends first of all on the chemical nature and therefore on the toxic potential of the respective substance. In achieving a higher or lower concentration, as well as in achieving a special receptivity, a number of factors compete, which can be grouped into three categories: factors related to toxic, factors related to the external environment and factors related to receptivity of the exposed body. Their mode of action may be very different, their distribution in the blood or in different organs depending on the nature of the toxicant. In general, the toxicants may affect all tissues or may injure certain organs, with suffocation, narcotic or systemic action, their toxicity being selectively manifested on certain organs or systems.

The receptivity to toxic gases and vapors is different depending on a number of conditions, such as the case of children and adolescents who are more receptive.

Out of the properties of the external environment, those that most influence the toxicity of a gaseous substance are the physical properties of the air, namely temperature, humidity and air currents.[1]

2. POLYCYLE AROMATIC HYDROCARBONS, GRAY METALS AND OTHER CANCERIGEN SUBSTANCES AND THEIR ACTION ON HEALTH

Polycyclic aromatic hydrocarbons (PAHs) are chemicals that are found in gaseous or particulate matter. Their properties are in accordance with the total of the condensed cycles, being made up of two or more condensed benzene cycles.
Polycyclic aromatic hydrocarbons (PAHs) are present in air, water or food. Among the most important carcinogenic potentials in relation to the frequency and concentration in the environment are: 3,4- benzpiren, methylcholanthrene, benzfluoranthrenes, benzantracenes, tetramethylphenanthrene, dimethylantracenes. To these are added analogues of PAHs from benz- and dibenzacridine series, respectively dibenzcarbazole [2].

Aromatic polycyclic hydrocarbons are formed by the incomplete combustion of organic materials from various industrial branches and constitute a serious threat to the environment. I reach remarkable concentrations in asphalt tar preparation stations or oil refineries and even in internal combustion locomotives. In the atmospheric air in urban centers the concentration of PAH is 0.006 ppm. PAHs are naturally formed through processes such as carbonization.

The main sources of air pollution with polycyclic aromatic hydrocarbons can be classified into: external sources such as emissions from motor vehicles (especially with diesel engines), industrial emissions and forest fires and internal sources such as domestic and commercial heating, tobacco smoke, etc. PAHs are also present in some coal tar based pharmaceuticals that are applied to the skin [3].

The food categories with most PAHs are cereals and cereal products, as well as seafood and by-products. Similarly, the use of vegetable oils and fats and coffee consumption exposes the population to PAH. For smokers, smoking can also be a significant source, most of the PAHs inhaled from tobacco smoke. Aromatic hydrocarbons are lipophilic. As the mass of these compounds increases, their volatility and solubility in water decreases. Due to these properties PAHs are polluting compounds that are most commonly encountered in the environment.

Heavy metals (Pb, As, Cd) and their effect on health

Lead is the most common metal, in the form of particles, in the atmosphere of large urban centers. The presence of lead in the air is mainly caused by urban traffic, through the use of ethylated petrol with organic lead salts (tetramethyl / lead ethyl).

The main sources that lead to air pollution are: extraction of lead from ores, thermoelectric power stations and other units that include combustion plants for solid and liquid materials, road traffic, through exhaust gases, paints, varnishes, enamels, based lead, various insecticides, plastics industry etc.

Exposure of the population to lead can be professional or unprofessional, in which case the contribution of lead is inevitable, most of the lead penetrated into the body being ingested with food and in a smaller quantity with water or by inhalation from the air. Once ingested in the body, the ingested lead is absorbed in the proportion of 5 ÷ 10%, while the inhaled lead is absorbed in the proportion of 30 ÷ 50%. Thus, it is noted that the smallest increases in the level of lead air pollution represent significant risks for lead absorption. Thus, at an air content of 1µg Pb/m³ the lead absorption would be 6÷10µg [5]. Lead is found in small amounts in plasma, most of which is fixed in blood vessels.
Lead is mostly stored in bones, especially in long bones. In the bone system is found about 50% of the lead existing in the human body and about 90% of the stored one. It is also stored in hair, nails, etc. With age, some of the lead metabolized tends to accumulate in the soft tissues as well [1,5].

However, the most important phenomenon is the risk of increased absorption in lead. Lead is a ubiquitous element, although it is not a bioelement, its absorption is inevitable. Up to certain levels of loading lead is perfectly tolerated by the body. Exceeding these levels, without causing signs of intoxication, can cause, especially in children, pathophysiological changes with repercussions in the state of health, characterized by nonspecific disorders. Lead loading thresholds that define increased absorption are more difficult to determine, which is why the best criteria are represented by biochemical tests.

The most commonly used load tests are plumbemia (25÷30 μg/100 cm³ total blood) and lead content of hair and teeth. Children represent a group with maximum risk, in case of increased absorption, dominating nervous signs such as irritability, difficult school adaptation, sleep disorders. There is also the possibility of poor neuropsychological development of children. Arsenic- sources of arsenic contamination are very numerous, these can be classified, according to the origin of inorganic arsenic contaminants, in the following categories: natural sources, minerals containing As, volcanic eruptions, groundwater (especially near geothermal activity areas).

The most important sources of anthropic pollution are the metallurgical processes, the burning of fossil fuels, the extractive industry and the processing of mining waste, the industrial processes of manufacture and manipulation of the chemical substances, the industry of the building materials pollute with powders in suspension. Due to the use of pesticides in agriculture, products can be contaminated with these toxic substances. Arsenic is normally found in human, animal, and plant tissue. In large quantities arsenic and its compounds are toxic. In the professional environment, absorption takes place by respiratory tract by inhalation of powders of inorganic arsenic compounds.

In the nonprofessional environment, arsenic poisoning can occur digestively by consuming water contaminated with inorganic arsenic compounds from natural sources. Arsenic is readily absorbed into the intestine and is eliminated from the body mainly through urine, skin, hair and nails. Acute exposure by ingestion of arsenic compounds or inhalation of arsine causes severe gastrointestinal (haemorrhagic) symptoms, nausea, vomiting, diarrhea, jaundice, renal failure and collapse, which can cause death. Chronic arsenic poisoning is difficult to diagnose. Abdominal pain, diarrhea, skin pigmentation, herpes, liver disease, kidney disease, peripheral neuropathy, encephalopathy may occur [5].

Cadmium is a heavy, toxic metal that is obtained from metallurgy of non-ferrous metal ores, especially from Zn, Cu and Pb. The pollution of the atmospheric air with cadmium is due to the emissions resulting from the plants that extract, process or use the metal for many purposes such as: obtaining dyes, manufacturing plastics, pesticides, metal coatings, preparing alloys, accumulators, etc. Considered one of the most toxic heavy metals, penetrated into the body disrupts protein, lipid and mineral metabolism.

Acute intoxication is manifested by headache, dry neck, burning in the stomach and skin. Chronic poisoning is manifested by inflammation of the nasal mucosa, impregnation of the teeth with a yellow coloration, reduction of sensory
perception, exposure to high doses can be fatal [6]. The evolution of the average annual concentrations of Cd and Pb from PM10 gravimetric, in the period 2010-2017, recorded in the county of Gorj is presented in fig 1 and fig 2 (data from the Gorj Environmental Protection Agency).

Fig.1. Evolution of the average annual concentrations of PM10-gravimetric Cd

Fig.2. Evolution of the average annual concentrations of PM10-gravimetric Pb

Toxic substances in tobacco and smoke resulting from its combustion

In tobacco and smoke resulting from the combustion there are over 4000 thousands of chemicals and at least 250 toxic compounds with potential carcinogen, mutagen, but the only one that determines satisfaction and dependence is nicotine, addictive drug, a liquid alkaloid that in contact with air it gets a yellow color. Alkalioses are organic compounds made of carbon, hydrogen and oxygen with harmful effects on health. Of the toxic substances found in cigarette smoke, we mention: polycyclic aromatic hydrocarbons and nitrosamines (benzepiren), carbon monoxide, nitrogen oxides, cyanhydric acid, acrolein, ammonia, nitrogen dioxide and formaldehyde, heavy metals (76 heavy metals, of which: nickel, arsenic, cadmium, chromium, lead), radioactive substances (Polonium 210, Potassium 40, Radium 226, Radium 228, Thorium 228). Nicotine stimulates the adrenal glands with epinephrine production known as adrenaline. This process increases blood pressure and accelerates heart rate. At the same time, nicotine stimulates the production of dopamine, causing the
sensation of pleasure and rewards in the brain. Once in the body nicotine is broken down in 80% of the liver enzymes and transformed into cotinine, which is a metabolite of nicotine that is used as an indicator of exposure. Nicotine is present in tobacco in a proportion of 0.7-3.5%, on average 1.5-2% [6]. Carbon oxide results from the incomplete burning that occurs in the cigarette, in a variable amount depending on the density of the tobacco and the type of smoking. He plays the role of blocking hemoglobin, transforming it into carboxyhemoglobin, 4-5% of circulating hemoglobin in moderate smokers and 10-15% in large smokers.

The polycyclic aromatic hydrocarbons result from the incomplete combustion of all the organic substances in the cigarette being very numerous and varied. Tobacco smoke contains all about 500 known carcinogens [5]. The mode of action of the substances present in tobacco is different, their distribution in the blood or in different organs depending on the nature of the toxic. The very short-term negative effects, a few minutes after the first smoke, materialize in: the heart rhythm accelerates, the larynx tissue becomes irritated, the carbon oxide enters the blood, the carcinogens immediately enter the lungs, the air is polluted, the eyes can be irritated, skin temperature drops.

Medium and long-term effects are manifested on the lungs, with smoking accounting for 80-90% of chronic obstructive bronchopneumopathies - chronic airway obstruction.

Also, statistics show that smoking is responsible for 85% of bronchopulmonary cancers, chronic bronchitis, inflammation of the neck, nose and other respiratory infections. The effects can last up to 20 years after giving up. Smoking also affects the heart and blood vessels, accounting for 30% of deaths from cardiovascular disease. Carbon monoxide from cigarette smoke increases the level of cholesterol in the blood, which ultimately results in its deposition on the walls of blood vessels. Smoking also causes stiffening of the arterial walls. Nicotine in cigarettes increases blood pressure, heartbeat and oxygen demand of heart muscle. It also causes constriction of the vessels, which can lead to myocardial infarction.

Blood coagulates faster in smokers than in non-smokers, which can lead to the formation of clots that can lead to clogging of blood vessels and the onset of heart attack. The effects can last up to 15 years after giving up. A very severe disease that manifests as a medium and long term effect of smoking is cancer. Smoking causes cancer of the lips, tongue, salivary glands, mouth, larynx, esophagus and pharynx. The onset of stomach cancer is also associated with smoking. Bladder cancer is one of the risk factors and smoking. Also, kidney, cervical and pancreatic cancer. There is a strong relationship of dependence between smoking and leukemia [6].

Toxic tobacco substances and cigarette smoke can cause hormonal problems. Thus, in women who smoke, the menopause settles on average 5 years earlier than in non-smokers. Smoking and nicotine can cause dysfunctions in the hormones involved in reproductive function.

As therapeutic means for quitting smoking, we mention nicotine substituents such as: nicotine-releasing patches over 24 hours, nasal spray, nicotine oral inhaler, nicotine gum or electronic cigarette.

3. CONCLUSIONS

A number of substances are known to have a harmful effect on the health status of the population living in the urban environment, as a result of the degradation of the ambient air quality. This process of air depreciation takes place as a result of the presence of
polluting agents resulting from increasingly complex industrial activities and most often pollution generators.

Immediate or acute effects are characterized by changes in health that follow shortly after exposure to atmospheric pollutants. In this type of effects we have acute toxic phenomena or changes in health, if exposure to increased concentrations of pollutants causes aggravation or decompensation of pre-existing diseases. In general, immediate effects are characteristic of high levels of air pollution.

Late or chronic effects are due to long-term exposure of the population to moderate concentrations of air pollutants. Their impact with the human body generates over time the appearance of pathological phenomena, which can be represented for years or decades.

Toxic substances found in the atmosphere as aerosols enter the body primarily through the respiratory tract, which increases toxicity due to the enormous surface area of contact with the internal environment that the respiratory system gives and the direct passage into the general circulation.

In the professional environment, absorption takes place by respiratory tract by inhalation of powders containing heavy metals or their compounds. In the nonprofessional environment, heavy metal poisoning can occur through the digestive tract by consuming water contaminated with inorganic compounds of As, contaminating food or acidic drinks with lead.

The polycyclic aromatic hydrocarbons result from the incomplete combustion of all the organic substances in the cigarette being very numerous and varied. Exposure to PAHs resulting from various sources of pollution is a known carcinogenic factor for lung cancer and skin cancer.

The mode of action of the substances present in tobacco is different, their distribution in the blood or in different organs depending on the nature of the toxic.

REFERENCES