THE HUMAN DIMENSION OF THE Pb POLLUTION ON THE ZLATNA AREA

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The environmental pollution entered the colloquial language not only as a result of the industrial emancipation but it broke into the scientists` preoccupation and conscience as a call and an imperative for implication.

The term pollution is a part of the usual scientific language and defines every action that has as a result a degradation of the existence environment. Within the ecosystem, the movement of the matter and of the energy is being realized circularly in the direction of auto-perpetuity and progress towards the achievement of the most stable energetic and chemical forms. In the case of pollution, the circular motion is transforming into a linear one leading to retrogression, a sudden and irreversible interruption of some vital processes.

Taking into consideration the implications of the pollution with heavy metals on the three factors of the environment: air, water, soil and implicit the repercussions on the health of the human component we considered that it is important to discuss, by means of this study, the heavy metals pollution and to evaluate its effects on peoples` health.

By presenting the distribution and the metabolism of the heavy metals (particularly of Pb) within the human organism we tried to emphasize the possibilities that could enable testing and early selection of the persons that present high risk at long exposure.

Before that presentation we will characterize the heavy metals pollution phenomenon and we will describe, in short, the sources of the pollution with heavy metals.

The characterization of the pollution with heavy metals

The pollution with heavy metals is a problem of major interest because of the negative implications of heavy metals on human organism both by impact pollution (influenced directly by human being) and by gist pollution.

Lately, the pollution of the environment with heavy metals draw attention on account of the complex problems of this phenomenon, because most of the heavy metals are not soluble in water or if they are, the respective chemical species comprise organic or inorganic ligands, fact that influences their toxicity.

As pollutants of the natural waters, the heavy metals are among the most toxic pollutants because of their long persistence in the solutions and the difficulty of transforming them into compounds insoluble in surface waters. The danger of contamination with heavy metals is increased in the presence of complexing agents that link these metals in soluble compounds, which cannot be removed when the water is being treated.

Even though the toxicity of these complexes is smaller than that of the free metals, by their decomposition during biological processes, the harmful properties of the heavy metals can freely manifest themselves.

As pollutants of the atmosphere, heavy metals by their oxides and vapours (which are transformed into oxides in the atmosphere), pollute especially the industrial regions from around the towns Baia Mare,

Zaltna, Copsa Mica etc. the pollution phenomenon becoming thus specific. Hereby, in Baia Mare the pollution is being caused especially by lead, in Zlatna by Pb, Cu, Cd, Zn, in Copsa Mica by Zn and Cd.

The sources of pollution with heavy metals

The main sources of pollution with heavy metals are:

- natural pollution sources;
- artificial pollution sources

Natural pollution sources. Considering that the dissolution action of the water on the surface or deep rocks (dependant of factors such as: the nature of the rock, temperature, contact time), the metals that enter the composition of the rocks or ores (e.g. galena) could make impure the potable water supply basins.

The artificial pollution sources: industry, transportations.

Industry is considered to be the most important pollution source with heavy metals, because of the chemical pollutants emissions, especially Chemical Industry and Metallurgy Industry with its industrial applications and the methods of obtaining water pipes, alloys, batteries, enamelled ceramics, dyes, insecticides, cigarettes etc.

Industrial pollution is being realized particularly by air and water.

Transportations is an important branch of the economy and therewith an important source of air, water and soil pollution considering the enhancement of air, maritime, fluvial and railway traffic, in which the operation of the means of locomotion is based on internal combustion engines.

The engines of this machines use petrol of high octane value, which contain a mixture of: tetraethyl, triethyl-methyl, diethyl-dimethyl, ethyl-trimethyl and tetraethyl lead, with 1-2 di-halogen-ethane in order to avoid the accumulation of the ethyl-lead decomposition products in the combustion chambers.

Lead halides, slightly stable, are being transformed into carbonates, basic carbonates fine divided. The pollution produced is increased with the number of the utilized vehicles, the distance of driveways of intense traffic, wind direction, precipitations, altitude, seasons, with a maximum on winter.

During combustion, tetraethyl Pb is decomposing into PbO, which forms di-halogen-ethane, especially with PbC1Br, with small quantities of sulphate PbSO4 and PbO.

The concentration of Pb in towns, in inverse proportion with the distance vis-à-vis the main traffic arteries, along which more or less fine particles are deposed, increases with their size from 0,5 μg Pb/m3 in the towns with 500,000 inhabitants at 0,5-2 μg Pb/m3 for those with 2 millions inhabitants.

A concentration of 2 μg Pb/m3, on a period of three months presents a public risk.

The distribution of the heavy metals and their metabolism within the human organism

The living organisms utilise for their own necessities a relatively reduced number of chemical elements, some of them are absolutely necessary for their development and the others possible tolerable essentials or inessentials might be substituted in the presence of the others.

The medical practice demonstrated that many diseases or metabolic disturbances are due to the excess of some metallic or non-metallic components. Of major importance are also the toxicological implications of the modification of the quantitative proportion between microelements, proportions that can be modified either by accumulation in time within human organism of some quantities of elements that jeopardize the health (the inhabitants from polluted zones).

The paths by which the heavy metals pass into the human organism in the industrialized zones are:

- *respiratory path* (as particles or oxides);
- *digestive path* – because of the defective hygiene or contaminated vegetable or animal nourishments, which are being consumed by peoples from affected areas;
- *cutaneous path*- is insignificant and presents interest only in the case of Pb shots or bullets implanted into tissues.

We will discuss the particular case of a heavy metal i.e **the lead** and we allude its distribution within the organism, its metabolism and toxicity.

PB toxicity. About its toxicity, we can say that in small quantities it does not affects any essential function of man, animals or plants, but in large quantities and especially in the case of a long exposure (in industrial zones) it presents a real danger for exposed persons. The lab results demonstrated that:

Pb can be toxic for central nervous system, provoking the disease called saturnism which is characterized by: anaemia; neurological disorders (ataxia, convulsions, coma); renal lesions (chronic nephropathy, Fanconi syndrome), the increase of over 5 times of urinary excretion of aminolevulin acid (ALA) and of the Pb content in blood > 80 μg/100ml blood.

Pb inhibits by occlusion, the thiol groups of some enzymatic systems, especially the ones that produce haemoglobin synthesis and provoke hypochromic anaemia;

Pb inactivates enzymes as a result of the displace of the bio-metals that are components of metal- enzymes or enzymes activated by metals, due to its affinity to ligands with aminic groups, carboxylic, including those of amino acids (lysine, glutamic acid, aspartic acid, phenoxy groups of tyrosine, imidazole etc.)

Pb distribution within the human organism

The distribution within the human organism depends on the quantity, chemical form and the path of passing into the organism.

In the tissues: the Pb passing into by digestive path leads to its retention in kidneys, especially in cortex, in liver and, in a smaller extent, in other tissues.

Within bones, the lead is deposited as phosphate mostly in the skeleton:

- 7,4 % in acute intoxication;
- 91% in the sub-acute one;
- 98% into the chronic one;

The Pb concentration in the bones being of 10-15 ppm fat- free bone is constantly growing along with age, probably of the isomorphic replacement of Ca2+ from hydrate-apatitas with Pb2+. In the conditions of an increased metabolic activity or hypo-phosphatemy, a mobilisation of Pb deposited in bones can take place, a poisoning with Pb may be posed over the initial affection.

The insolubility of Pb3 (PO4) 2 phosphate, with Ps=1,5. 10-32 and of Pb (OH) CI, limits the concentration of free ions of Pb2+, in physiological conditions, but prolongs the exposure of Pb on long periods of time.

Within blood, the concentration of Pb at human being, in normal environment conditions, is between 15-40 μg Pb/100ml with an average of 25 μg/100ml, being connected by erythrocytes in proportion of 90 %.

Non- erythrocitary Pb seems to be fixed by micro-ligands in plasma.

At human beings, normal tissular concentrations of Pb, in mg/100gTP are of:

- 0,67- 3,59 mg/100gTP in bones;
- 0,04-0,28 mg/100gTP in liver;
- 0,02-0,16 mg/100gTP in kidneys;
- 0,01-0,7 mg/100gTP in spleen;
- 0,04 mg/100gTP in heart;
- 0,01- 0,09 mg/100gTP in brain.

Lead metabolism

Pb absorption is slow and it takes place on gastro-intestinal path and seldom through

respiratory tract, as a result of delicate powders inhalation, of aerosols or volatile compounds, subcutaneous absorption or intramuscular being seen rarely and it presents interest only in the case of Pb shots or bullets implanted in tissues.

The digestive absorption of Pb is of 5-15% at human being, 10% at bovines, 1-25 at sheep, being superior at young organisms and it might be increased at organisms with Ca shortage.

The absorption mechanism is not known, being more active at the level of the stomach, duodenum and thin intestine and practically null in the terminal colon.

The degree of absorption is influenced by the solubility of the salts and nourishment composition, a high content of glucide, proteins, calcium, iron, phosphates, selenium, inhibits the absorption. The D vitamin deficit reduces Pb absorption and stimulates Ca absorption.

Pb excretion is being done through faeces, bile and urine, thus Pb gets to blood through absorption and then it gets to bones, soft tissues, including liver, from where is being excreted through bile into the thin intestine and then eliminated by faeces which contain along with small quantities of absorbed Pb also the majority of the unabsorbed one.

The majority of inhaled Pb is eliminated by urinary path, used when small quantities exist in the circulation; the presence in the circulation of an excess of Pb leads to the utilisation of the elimination biliary path. Ascorbic acid, Na citrate and Ca-EDTA or Na2-EDTA, increase Pb urinary elimination therefore the last two are being utilised as antidote for the intoxication with Pb.

Conclusions

As a conclusion of this paper, we consider that the fatal effects on the population from intensive populated zones impose the effectuation of early selection tests of the persons and especially of the children presenting high risk at long exposure.

The prominence of the aminolevuline acid (ALA) within the urine could constitute an early selection test of dangerous exposure to Pb, taking into consideration the increased levels of this acid within the urine of the persons intoxicated by Pb.

Considering the factors that influence the Pb distribution and retention within tissues (see the metabolism), and the elimination of shortages by supplementary Fe, Ca, etc. supplies, one could reduce the risk of intoxication with Pb and diminish the incidence of illnesses caused by this pollutant

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