Chernobyl clean-up workers: life under long-term oxidative stress. 15 years of experience.

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INTRADUCTION.

Chernobyl accident created a new problem for health professionals in Latvia, since 6475 people of Latvia participated in clean-up works in Chernobyl during 1986 – 1987. They were mainly health men – military and civilian of reproductive age. Most of these men were documented as having received ionizing radiation exposure. Doses, as they are recorded in the „Military Passport" may not always be accurate, data are thought to have been falsified (much smaller), thus contributing to the uncertainty in analytical epidemiological studies, in which individual doses have to be estimated.

During their work at the site they were exposed not only direct γ-radiation but as well inhaled toxic radioactive isotopes, volatile heavy metals derived from the reactor melt-down and other disorders thought their lungs, skin, gastro-intestinal tract and etc. All this damage factors produce different kind of oxidative stress; radiation, chemical, psycho-emotional, later – pain, inflammatory an others. From the other hand, at the same time radiation to reduce levels of antioxidants in body, thus developing situation much risky for organism. For example, radiation has been proposed to reduce levels of antioxidants that are used for DNA repair because antioxidants are used for removing free radicals that arise owing to radiation (A.P. Moller, et al., 2005). It has been suggested that this reduction in different antioxidants may be responsible for increased levels of mutation.

Proposal are started in 1998 as long-term investigation on the role of changes in the antioxidant defence system in manifesting the development of post-radiation (post-Chernobyl) syndrome in clean up workers from Latvia, who were involved in the recovery works following the Chernobyl NPP accident. This was randomized, double-blind, placebo-controlled, parallel group investigation involving 76 Chernobyl clean-up workers whom were detected: content of lipid hydro peroxides, oxydizability and lipid peroxidation processes ratio in blood plasma, activity of glutathione peroxidase, catalase and Cu,Zn-Superoxide Dismutase (SOD), such as content of Selen (Se), Zinc (Zn) and Copper (Cu).

RESULTS.

Primary results showed 5.5 times higher content of lipid peroxides and hydroperoxydes, 3.5 higher blood plasma oxidizability, lipid peroxidation ratio such us concentration of TBARS products. Accordingly, activity of GPx in blood plasma was significantly decreased. Data obtained show that the level of Se was very low (46 ± 7,8μg/L, lowest Se concentration in investigation groups were 17μg/L), Zn concentration in the serum of irradiated clean-up workers increased by 50%, Cu concentration in blood of examined patients was were high too (Barrow L. et all., 1988). All these data testify that there is high level of oxidative stress.

10 years later, 2nd stage results showed that content of Se in plasma have improved, intensity of lipid peroxidation, free radicals production and content of TBARS product were lower, but anyway quite high and remain nearly primary level. Similarly as before, concentration of Cu and Zn remained disharmony.

DISCUSSION.

Well know that oxidative stress provoke many different diseases and promote developing of some pathological conditions. It's clear, that practically all diseases whoever were appeared in medical examination, much or less are effected of (no) oxidative stress. Some of these diseases are very strongly bound with oxidative stress influence.

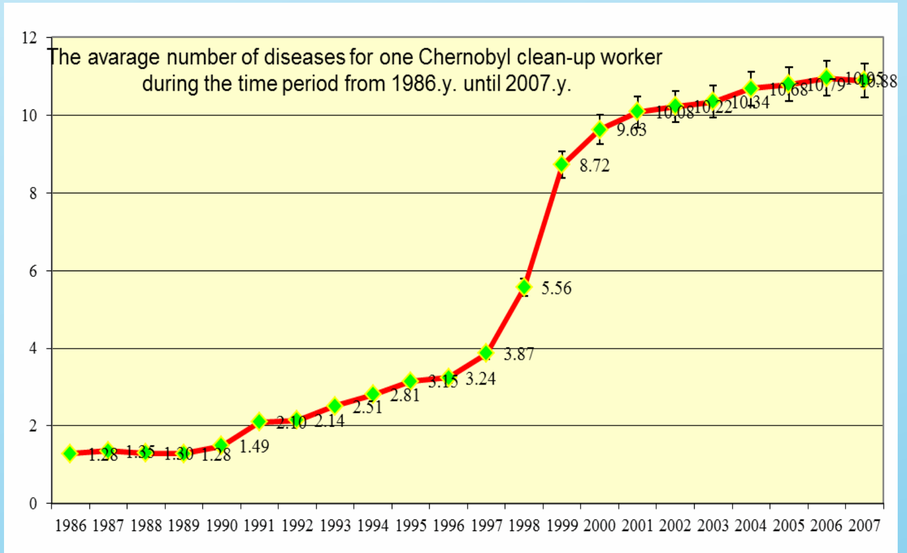
Most of the Chernobyl Nuclear Power Plant (NPP) disaster clean-up workers from Latvia have progressive multiple illnesses that exhibit tendency to progress; their morbidity exceeds that observed in general Latvian male population. Most of these workers have up to 11 and more different illnesses. Chernobyl Clean-up workers are characterized by significantly increased biological aging processes of the body systems – neuro-endocrinic, gastrointestinal, cardio-vascular, etc. Thus we can speak of poly-symptomatic diseases almost in all body systems.

According to data obtained during the thorough examination (1990-2007) of the Chernobyl clean-up workers from Latvia, great part of these people has progressive disturbances in functioning of immune system and increasing morbidity with oncological diseases (A. Kumerova et al., 2000; T. Zvagule et al., 2002) with evidence of prolonged systemic oxidant stress injury.

Oxidative stress is imposed on cells as a result of one of three factors: 1) an increase in oxidant generation, 2) a decrease in antioxidant protection, or 3) a failure to repair oxidative damage. Cell damage is induced by reactive oxygen species (ROS). The main source of ROS in vivo is aerobic respiration, although ROS are also produced by peroxisomal β-oxidation of fatty acids, microsomal Cytochrome P450 metabolism of xenobiotic compounds, and stimulation of phagocytosis by pathogens or lipopolysaccharides, arginine metabolism, and tissue specific enzymes. Under normal conditions, ROS are cleared from the cell by the action of SOD, Catalase, or GPx. The main damage to cells results from the ROS-induced alteration of macromolecules such as polyunsaturated fatty acids in membrane lipids, essential proteins, and DNA. Additionally, oxidative stress and ROS have been implicated in disease states, such as Alzheimer's disease, Parkinson's disease, cancer, and aging (H. Sies., 1991). Well know that oxidative stress provoke many different diseases and promote developing of some pathological conditions. It's clear, that practically all diseases whoever were appeared in medical examination, much or less are effected of (no) oxidative stress. Some of these diseases are very strongly bound with oxidative stress influence

In general, regardless of situation improvement (increased antioxidative defence and decreased some lipid peroxidations parameters), in organisms intensive long-term oxidative stress remain. Therefore, absolutely necessary, to do some activities for antioxidative situation versus pro-oxidative situation, correction and normalization. For this purpose some antioxidants and, possible, non-steroid anti-inflammatory drugs should be indicated for long-term application.

Cinical biochemistry /units/	**1998 – 1999yy.**	**2010.y.**
Lipid peroxides (conv.units)	**210,0** ± 30,7 [normal value < 80]*	**121,7** ± 10,84
Blood plasma oxydizability (conv. units)	450,0 ± 44,8 [normal value. < 200]*	440,6 ± 51,82
Lipid peroxidation processes ratio (conv. units)	**9,94** ± 1,01 [normal value. < 4,0]*	**6,67** ± 0,71
Selenium content in blood plasma (μg/L)	**56,1** ± 3,3 (min.17,0μg/L) [normal value. 80 - 120]*	79,8 ± 3,94 (min.43,0μg/L)
Glutathione Peroxidase in blood plasma (IU/L)	**380,0** ± 19,4 [normal value 450 - 600]*	**398,0** ± 21,8
Catalase (IU/gHb)	22,3 ± 2,03 [normal value 5,0 – 15,0]*	27,5 ± 3,56
Zn in blood (μg/dL)	**1050** ± 106,7 [normal value 460 - 670]*	**967,2** ± 90,4
Cu in blood (μg/dL)	**480,0** ± 51,8 [normal value 85 - 150]*	**426,9** ± 69,2
Se in blood plasma (μg/L)	**46.0** ± 7.8 (min 17.0) [normal value 80 - 120]*	79,8 ± 3,94 15.8% - 53.1 ± 1.56 31.7% - 73.1 ± 1.1 52.4% - 80 >
MDA in blood plasma (nM/mL)		**3.34** ± 0.14 [normal value < 2.5]*
GSH in blood (mg%)		38.25 ± 0.84 [normal value > 45]*
TGC (mM/L)		1.75 ± 0.22 [normal value < 1.7]*
NEFA (mM/L)		0.60 ± 0.04 [normal value 0.1 – 0.9]



Visitor's answer's for anamneses	**first visit**	
	No of visitors	%
High blood pressure	**14**	**18.9**
Other cardiovascular diseases	7	9.5
Pain in the joints (arthrosis. arthritis)	**38**	**51.4**
Headache or migraine	**27**	**36.5**
Other pain's	**17**	**23.0**
Depresion	10	13.5
Stomach troubles	**22**	**29.7**

CONCLUSION:

1. Data indicate that relatively low doses of ionizing radiation, other unhealthy factors, received, inhaled and absorbed by clean-up workers, after 10-years period caused some antioxidant enzymes, Se deficiency and some trace elements overload in blood that provoke the decrease of the antioxidative defence.
2. In the time from 1999 till 2008yy Chernobyl clean-up workers has high level of Oxidative Stress (intensive lipid peroxidation, free radicals produce, decrease of antioxidants and antioxidative defence in total), trace elements disharmony and extremely high number of different pathological processes and diseases. .

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