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RADIONUCLIDE AND LEAD CONTENT IN BREAST MILK AFTER CHERNOBYL ACCIDENT

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Abstract: Cesium-137, strontium-90 and lead content was estimated in breast milk of women from radionuclide contaminated and "clean" areas of Belarus. Cesium-137 content exceeded Republic permissible standards (RPS-92) only in 2.3% of samples taken in contaminated areas. At the same time strontium-90 content was significantly higher permissible one in 22.3% of these samples. Lead content in samples taken from all the studied areas was much hihger than it is permitted by WHO standards. Especially high it was in breast milk samples received from contaminated areas. A conclusion was made about the necessity of laboratory control of radionuclides and lead content in women's milk.

INTRODUCTION

Chernobyl accident has resulted in considerable changes of health status of newborns and the first-year-life infants living in radionuclide contaminated areas: their morbidity rate has increased; immune and hormonal disorders has become more pronounced in them; the pattern of some diseases has changed (8).

At present radiation effect on human body in radionuclide contaminated areas is realizing mainly by inner radiation due

to ingestion of radionuclide contaminated foodstuffs and their distribution over various organs, tissues and media of human body. Analogically heavy metals may be incorporated. Continuous intake of these substances by human body is especially dangerous for poorely resistent population groups to which according to designation of Scientific Committee on atom radiation effect attached to UNO children of any ages belong.

Women's milk is a basic product for a baby. Being a secret of breasts it may be a source of permanent and continious intake of radionuclides and heavy metals by an infant in case of incorporation of these substances in mother's body.

Few investigations on excretion of radioactive isotopes with breast milk, made after Chernobyl accident, related only to cesium-137 isotopes (2,9,10,11). However, strontium-90 may also represent a certain danger for human body. It is one of biologically significant radionuclides which were released into environment as a result of Chernobyl accident. There are only a few investigations on its migration from mother to infant through breast milk (7). We have no information on lead content in breast milk of mothers living in radionuclide contaminated areas. The lead was used during liquidation of Chernobyl accident aftereffects. Undoubtly, partly it was scattered over the adjacent territories and having been incorporated with foodstuffs in a mother's body it may be excreted to breast milk.

EXPERIMENTAL

An estimation of cesium-137, strontium-90 and lead content in breast milk of 96 breastfeeding mothers living in Kormyansky and Chechersky districts of Gomel region, Krasnopolsky and Slavgorodsky districts of Mogilyov region was made. All the women were divided into three groups depending on contamination degree of living territory with cesium-137. The first group were 29 women living in areas with contamination degree more than 15 Ci/sq.km; the second group were 44 women living in areas with contamination degree 5 to 15 Ci/sq.km; the third group were 23 paturients living in areas with contamination degree 1 to

5 Ci/sq.km.

Twenty-three breastfeeding mothers from conditionally "clean" Octyabrsky district of Gomel region were the controls.

Laboratory investigations were fulfilled in water systems radioecology laboratory of the Institute of Radiobiology of Belarusian Academy of Sciences. Cesium-137 content was determined by gamma-spectrometry utilizing amplitude analyzer AFORA LP-4900B and Ge(Li) detector ДГДК-100В-3 after preliminary probe concentration. Strontium-90 content was determined by radiochemical method utilizing beta-radiometer РКВ4-1еМ. Lead content was estimated by atomic-absorptive spectrophotometry.

Results are given in Table 1.

Table 1.

Elements	Groups of paturients			
	I	II	III	the controls
Cesium-137 Bq/l	16.2±2.60	11.7±1.70	7.1±1.50	18.5±0.90
Strontium-90, Bq/l	1.1±0.10	1.2±0.10	2.3±0.40	0.3±0.02
Lead mkg/l	46.7±3.60	41.0±3.40	41.9±3.40	31.7±2.50

Note: A confidence of resulted difference between estimated groups and the controls is marked with * ($P<0.001$).

We have found cesium-137 in all the estimated breast milk samples including those of the controls. Its lowest content was found in samples taken in women living in areas with contamination degree 1 to 5 Ci/sq.km. The higher territory contamination degree with cesium-137, the higher its content in breast milk,

with its maximum in breast milk of women living in the most contaminated areas. Nevertheless, only in 2.3% of estimated samples we have found cesium-137 content higher than RPS-92 permitted for any kind of infant's food ready for use. The highest index of its content was 59.6 Bq/l versus permissible one 37.0 Bq/l.

It was unexpected that cesium-137 content in breast milk of women living in "clean" Octyabrsky district, i.e. the controls, was somewhat higher than of those living in contaminated districts with distribution of individual indices in this group of women versus the rest ones being the least though RPS-92 were in no case exceeded. It makes to agree with some of researchers that in case of taking measures on liquidation of medical aftereffects of Chernobyl there is not enough only the data of territorial contamination maps, because highly contaminated agricultural products were found also in relatively "clean" areas of Belarus. In addition, people often neglect of possible intake of radionuclides with foodstuffs.

Results of direct measurements with scanning counter did not reveal with confidence a correlation between mothers' internal radiation dose and cesium-137 content in their breast milk.

Strontium-90 was found in all the estimated breast milk samples. Statistical processing of data received revealed with confidence its different content in breast milk of women living in conditionally clean and in radionuclide contaminated areas. Like cesium-137 strontium content in breast milk of the controls did not exceed RPS-92 permissible for all the ready for use infant's food values (1.85 Bq/l). However, almost in one/fourth (22.3%) of all the breast milk samples, taken in radionuclide contaminated areas, strontium-90 content exceeded permissible doses. There were 42.8% of such samples in the first group of women, 12.1% in the second group, and 20.4% in the third group of women; maximal revealed value of strontium-90 content accounted for 8.3 Bq/l, i.e. it was 4.5 times

higher than permissible dose. Thus, the amount of intolerably strontium-90 contaminated breast milk samples was maximal in the most radionuclide contaminated areas. Like in case of cesium-137, their relatively large amount in areas with the least contamination degree may be explained with unwatchfulness of people living in these areas.

Strontium-90 is especially dangerous as it is accumulated in skeleton and it is excreted extremely slowly, for a long period being a source of internal radiation (1,3,6). Taking into consideration a rapid bone tissue mineralization in young infants and competitive relationships of calcium and strontium-90 as they are absorbed in intestine accumulation of external strontium in these infants' body increases many times. Thus, it was found that strontium-90 content in a newborn's skeleton exceeds that in his mother's diet during pregnancy by 2,3 times. During breastfeeding period strontium-90 content in an infant's body rapidly increases and by 3,6 and 12 months of life multiple of its accumulation accounts for 41.5, 65.4, and 111.2 respectively. Calcium intake being insufficient, these values may increase. In this connection, a high concentration of strontium-90 found in breast milk of women living in radionuclide contaminated areas indicates the necessity of arrangement of laboratory control of its content in breast milk in these areas. One is of opinion that infant's food should not contain even traces of biologically significant artificial isotopes, namely Sr-90 and Cs-137 (4).

The lead was also found in all the estimated breast milk samples. Already in the controls its content was many times higher maximal permissible one (2 - 5 mcg/l) recommended by WHO/IAEA for breast milk (5). Lead content in breast milk of women living in radionuclide contaminated areas was higher than that of the controls.

High concentrations of lead in breast milk samples in women of all the investigated groups reflect a total ecologically unfavourable situation in areas under study. More likely that

it is due to utilization of ethylpetrol, combustion products of which are being released into environment together with exhausts. These combustion products contain a large amount of lead. At the same time proven high concentration of lead in breast milk samples from radionuclide contaminated areas may be an evidence of possible share of the lead, which was used for liquidation of Chernobyl accident aftereffects.

Thus, cesium-137 and strontium-90 radioisotopes, as well as high lead concentrations were revealed in breast milk of women living not only in radionuclide contaminated areas but in conditionaly clean region of the Republic Belarus. Penetrating with brest milk into a newborn's body, these substances may have an adverse influence on functioning of all the body organs and systems, and as a whole on a body health status.

Data received indicate the further estimation of radionuclides and other injurious to the first-year-life infant's health chemical substances content in breast milk; studying the mechanisms of their incorporation and excretion; investigation of lactation features and of breast milk ecological value; development of new acceptable in practice methods for laboratory tests of its quality as well as development of methodical recommendations on breastfeeding of babies living in regions suffered from Chernobyl accident. All the abovementioned is the major task of Belarusian pediatrics.

Especially actual for practice is an establishment of laboratory control services which would be able to estimate radionuclide content in brest milk just as functioning systems for foodstuffs control. Taking into account minor quantity of milk which may be taken for analysis without doing harm to a baby, such services suppose to utilize up-to-date devices permitting to make analysis in small volumes of biological material with high precision and confidence. We believe it is advisable to equip one or more centre in the Republic Belarus with such devices on the base of a laboratory department of sanitary or pediatric services.

As breast milk is the major infant's food (the only one in the first months of life) it shoul be included into republic permissible standards and sanitary norms controlling quality of food and foodstuffs as an independent product. It should be normalized according to permissible content in it of radionuclides and chemical elements which may cause a toxic effect in a young infant.

Finally, from scientific and practical point of view a development of specific technique which would permit both prevention of transfer of radionuclides, namely strontium-90, to a woman's breast milk and elimination of radionuclides without worsening biological value of breast milk, especially its immuno-biological properties. One of the perspective methods in this direction may be supplementary food both in a mother's and baby's diet.

REFERENCE

1. Булдаков Л.А., Москалев Ю.И. Проблемы распределения и экспериментальной оценки допустимых уровней Cs-137, Sr-90 и Ru-106.- М: Атомиздат, 1968.

2. Гаврилкин А.В. Некоторые токсико-радиологические показатели женского молока из различных районов Белорусской ССР // Научнопрактические аспекты сохранения здоровья людей, подвергшихся радиационному воздействию в результате аварии на Чернобыльской АЭС. - Тезисы Республиканской конференции. - Минск, 1991.- С. 19-20.

3. Журавлев В.Д. Токсикология радиоактивных веществ.- М: Энергоатомиздат, 1990.

4. Левкович А.Д. Пища как источник хронического облучения // Проблемы питания детей в условиях загрязнения среды радионуклидами.- Минск, 1993.- С. 27-32.

5. Микроэлементы в грудном молоке. Отчет о совместном коллаборативном исследовании ВОЗ/МАГАТЭ. - Женева: Всемирная организация здравоохранения, 1991.

6. Москалев Ю.И. Радиобиология инкорпорированных радионуклидов. - М: Энергоатомиздат, 1989.

7. Овсянкин Н.В., Тернов В.И., Гурская Н.В. О миграции стронция-90 в цепи: пища-женское молоко-ребенок // Материалы I Республиканской конференции по радиационной гигиене.- Рига, 1966.- С.135-136.

8. Устинович А.К. Охрана материнства и детства в свете Чернобыльской катастрофы // Здоровье детей Белоруси в современных экологических условиях.- Сборник материалов 6 съезда педиатров Республики Беларусь. - Минск, 1993. - С. 6-7.

9. Assimakopoulos P.A., Ioannides K.G., Pakou A.A., Lolis D., Zikopoulos K., Dusias B. Radiocesium levels measured in breast milk one year after the reactor accident at Chernobyl // Health Phys.- 1989.- Vol.56, N 1.- P. 103-106.

10. Gattavecchia E., Ohini S., Tonelli D., Gori G., Cama G., Gueressi E. Cesium-137 levels in breast milk and placenta after fallout from the reactor accident at Chernobyl // Health Phys.- 1989.- Vol.56, N 2.- P. 245-248.

11. Lindemann R., Christensen G.C. Radioactivity in breast milk after the Chernobyl accident //Acta Paediatrica Scandinavica.- 1987.- Vol.76, N 6.- P. 981-982.