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Evaluation of Lipo-peroxidation Stress on Sperm of Men Living in Ecologically Disadvantaged Areas of Aral Sea Region

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Abstract

This paper describes the results of studies on the effect of lipo-peroxidation stress on sperm count in the male population aged from 18 to 49 years conducted by the research team of Karaganda State Medical University on the territory of the environmentally disadvantaged areas of the Republic of Kazakhstan—village Shalkar of Aktobe region. A clinical examination was carried out on 225 men who have taken the test of ejaculate for macroscopic and microscopic examination. The test was divided into three age groups: 18-29, 30-39, 40-49 years. It was revealed that the accumulation of secondary products led to lipo-peroxidation stress in the sperm found in men of all age groups living in the areas of Aktobe region.

Keywords

Lipo-peroxidation stress; Aral Sea region; Male reproductive system; Malondialdehyde (MDA); Glutathione peroxidase (GPO); Middle molecules peptides (MMP)

Introduction

The Aral Sea crisis is one of the biggest environmental disasters of the planet. Intensive desertification, sustained irreversible degradation of the environment, and worsening living conditions have caused an increased incidence of new socioeconomic and environmental situations that require legislative solutions and legal regulation of social protection of the population living in ecologically unfavorable areas [1].

It is known from literature that the environmental problems of the Aktobe region are very serious, because in addition to the effects on the body of the dust and salt aerosols of the Aral Sea region, there are various production-related factors, such as oil pollution; presence of chromium, bromine, and heavy metals; and the combustion of associated gases being transferred by winds over large distances from the source of contamination, in this area [1-3].

In this regard, we believe that in the Aktobe region there are insufficiently addressed environmental problems, sanitary and hygiene issues, public health problems, and others. As we know the totality of these factors leads to increased harmful effects on the human body, which in the long run may contribute to the development various diseases [2,3].

The aim of this research was to study the condition of the products and lipo-peroxide cascade of antioxidant protection in the sperm of men living in the Aktobe region.

Materials and Methods

Research conducted as part of scientific project “An integrated approach to management of health of the population of the Aral Sea region,” included the examination of male population aged 18-49 years living in Shalkar village of Aktobe region. During the study 225 men were divided into different age groups (seventy-five men in the age group 18-29 years, seventy-five men aged 30-39 years, and seventy-five men aged 40-49). The criteria of inclusion were time of human habitation in the Aral Sea area being not less than five years and employment in occupations with the hazard level of no more than two class. All men of the study area underwent clinical examination to detect the symptoms of reproductive disorders and laboratory research was conducted to

determining the level of malondialdehyde (MDA) in the semen [4], the level of glutathione peroxidase (GPO) in the semen [5], as well as the level of middle molecules peptides (MMP) in the semen [6]. Statistical analysis was performed using the package STATISTICA 6.0 (Stat-Soft, 2001) and the program BIOSTATISTICA 4.03 [7].

Results and Discussion

It should be noted that reproductive disorders in the male population village Shalkar of Aktobe region in the majority of cases were presented to reduced fertility and fertilizing capacity of sperm.

Taking into account the above stated, we felt it appropriate to determine the level of secondary products of lipo-peroxidation stress. Mean MDA ($M \pm m$): group of 18 to 29 – 1.84 ± 0.14 ; in the group of 30 to 39 – 1.97 ± 0.17 ; in the group of 40 to 49 – 2.72 ± 0.17 .

Mean GPO ($M \pm m$): group of 18 to 29 – 2.12 ± 0.12 ; in the group of 30 to 39 – 1.85 ± 0.11 ; in the group of 40 to 49 – 1.66 ± 0.10 .

Weight average molecule include universal factor toxicity, as decomposition products of proteins that act as secondary endotoxins, causing breakdown of various physiological processes. Endotoxemia is accompanied by an increase in the concentration of MMP and can serve as an indicator of the degree of development of pathology. It is known that the accumulation of middle molecules have a negative impact on the body, as they accumulate on the membranes, leading to disruption of transport through the membrane, damage to the protein molecules, and activation of enzymes of antioxidant protection due to what is developing endogenous intoxication, leading to the development of various pathological processes the level of the reproductive system.

The mean value of the MMP ($M \pm m$): group of 18 to 29 – 1.01 ± 0.06 ; in the group of 30 to 39 – 1.57 ± 0.12 ; in the group of 40 to 49 – 0.83 ± 0.10 .

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Analysis of the contents of middle molecules in the sperm of men of all age groups living in village Shalkar showed a significant change in the content of middle-mass molecules, which indicates a high level of endogenous intoxication in the cells and is associated with changes in ecological trouble of the region.

The study of lipo-peroxidation stress in sperm count in the male population aged 18-49 years in the ecologically unfavorable Aral Sea region of the village of Shalkar of Aktobe region revealed:

1. Significant accumulation of MDA in the semen found in men of all age groups and living in areas of Aktobe region.
2. Inhibition of GPO activity is observed in the surveyed persons living in Shalkar, consistent results between the two studies (MDA and GPO in the semen of men in the region); this is due to the depletion of the antioxidant protection, and this change is due the weakening of compensatory possibilities of cells.
3. The accumulated average molecular peptides in the sperm, which is caused by the increased formation of excessive amounts of metabolites within the cell.
4. These changes may be related to environmental conditions of the region and the effect of dust and salt aerosols in the Aral Sea region.

Conclusion

Contamination of the environment under the influence of various chemical and physical factors leading to the development of environmentally related diseases, which are manifested in the form of clinical, immunological, and pathophysiological biochemical changes, adverse environmental factors negatively affect the health of the population living in the study regions of Kazakhstan [8]. Based on

our data, increased free-radical formation and development of lipo-peroxidation stress in sperm in men showed unidirectional change. In our opinion, a violation free radical cells leads to disruption of cell-cell contacts, membrane integrity, and cell signaling. In our opinion, a violation of free radicals lead to a change of the processes of spermatogenesis and on the stages of formation spermogonia, spermatocytes, and spermatids, as evidenced by the results of study of spermatogenesis in men living in the studied region of Kazakhstan.

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