

Non-Cancer Morbidity of Women Irradiated During Pregnancy Due to the Incorporation of I-131 as a Result of the Chernobyl Accident

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Abstract

The effect of relatively small doses of ionizing radiation on the occurrence of non-oncological human pathology has been studied extremely insufficiently and, until recently, the existence of such effect was questioned. In this work, we studied the effect of irradiation by the radioactive iodine on the Thyroid Gland (TG) in women who were at different stages of pregnancy at the time of the Chernobyl accident. The analysis of absorbed doses by the TG revealed that in 75% of women the doses were in the range of 0.06-0.07 Gy. The study of non-oncological cumulative morbidity from 1986 to 2016 showed a higher increase in pathology of all classes for pregnant women who were exposed to doses of more than 70 mGy compared to those who were exposed by lower doses, but this difference became significant only after 14 – 15 years. These data are of the preliminary nature and require specific detailing for individual classes of diseases.

Keywords: Chernobyl accident; Pregnant women; I-131; Somatic morbidity

Introduction

It is a well-known fact that malignant tumors develop after radiation exposure at a higher probability. At the same time, very little is known about the probability of the development of non-oncological pathology after the irradiation, especially if a person was exposed to small doses of radiation [1,2]. Moreover, there is a lack of data on the medical consequences of irradiation for pregnant women, since this category of Belarusian population was not exposed to radiation before the accident at the Chernobyl nuclear power plant.

In this work, we were interested in a long-term analysis of non-cancer morbidity in women whose TGs were irradiated due to radioactive iodine accumulation during pregnancy. It is known that I-131 (and its analogs) is the first dose-forming factor for the population in major radiation accidents [3]. Among the population, pregnant women are sure to be present, and they are characterized by specific features of metabolism caused by the physiological and psychological status of the organism. The knowledge on the radiation exposure consequences for pregnant women is important, since it can be used in order to prevent the risk of the development of adverse effects in the future.

Over 35 years have passed since the Chernobyl accident. This is the period after which one can make some specific conclu-

sions. In this regard, in this work, we analyzed the morbidity rate of women irradiated during their pregnancy for over a 30-year period.

Case Report

The sample group included women who were at different stages of pregnancy in April 1986 and lived in the Stolin district of the Brest region, through which a radioactive cloud passed from the damaged reactor of the Chernobyl nuclear power plant in the night of April 26, 1986. This area is located about 240 km east of the Chernobyl nuclear power plant. The main group consisted of 221 women. The interest in pregnant women is dictated by the need to find out the effects of radioactive iodine accumulation for the health of both mother and her unborn child. However, at the first stage of the study, we limited ourselves to analyzing the incidence of different pathologies in women only.

The absorbed doses for TG were calculated at the State Research Center of the V.I. A.I. Burnazyan of the FMBA of Russian Federation according to the semi-empirical model of the 2004 iteration.

The study took into account the exposure of women due to the living in the contaminated area, by calculating the total effective doses due to Cs-137 using the RESRAD-ONSITE ver-

Table 1: Descriptive statistics of pregnant women

Index	N	Mean	SD	SE	Min	Median	Max
Absorbed dose on TG, mGy	221	83	34,7	2,3	49	74	246
Age at Chernobyl accident, years	221	26	5,9	0,4	17	26	44
Pregnancy, weeks	183	22	8,6	0,6	4	22	40

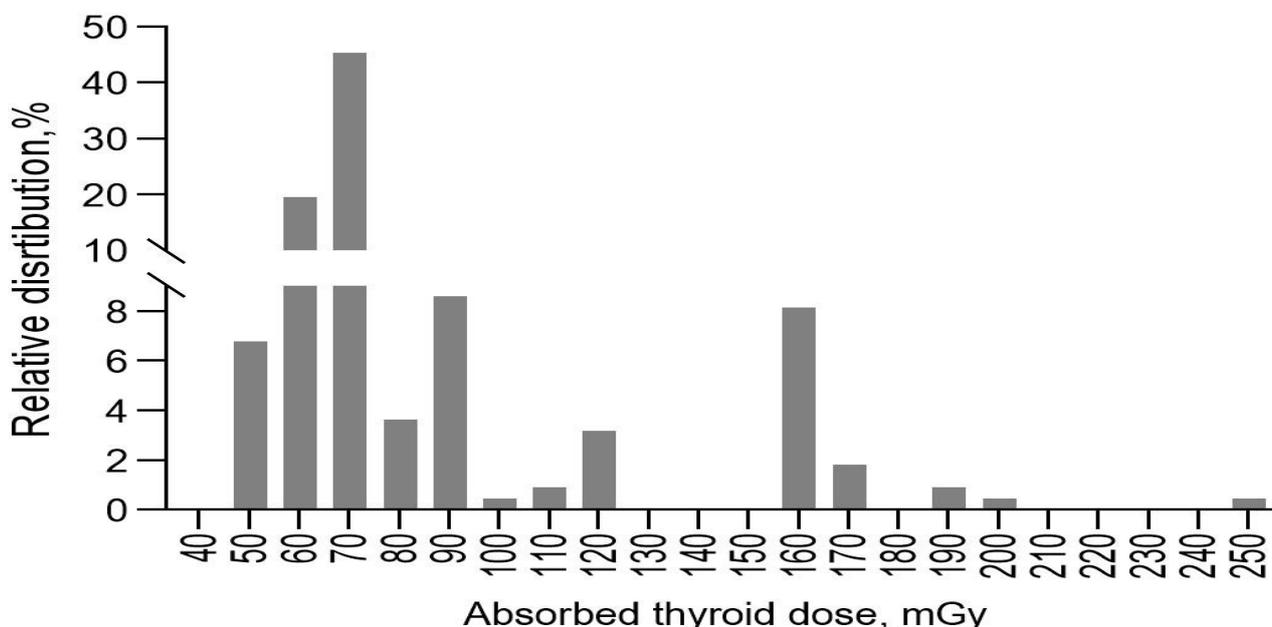


Figure 1: Relative distribution of absorbed doses on TG of pregnant women.

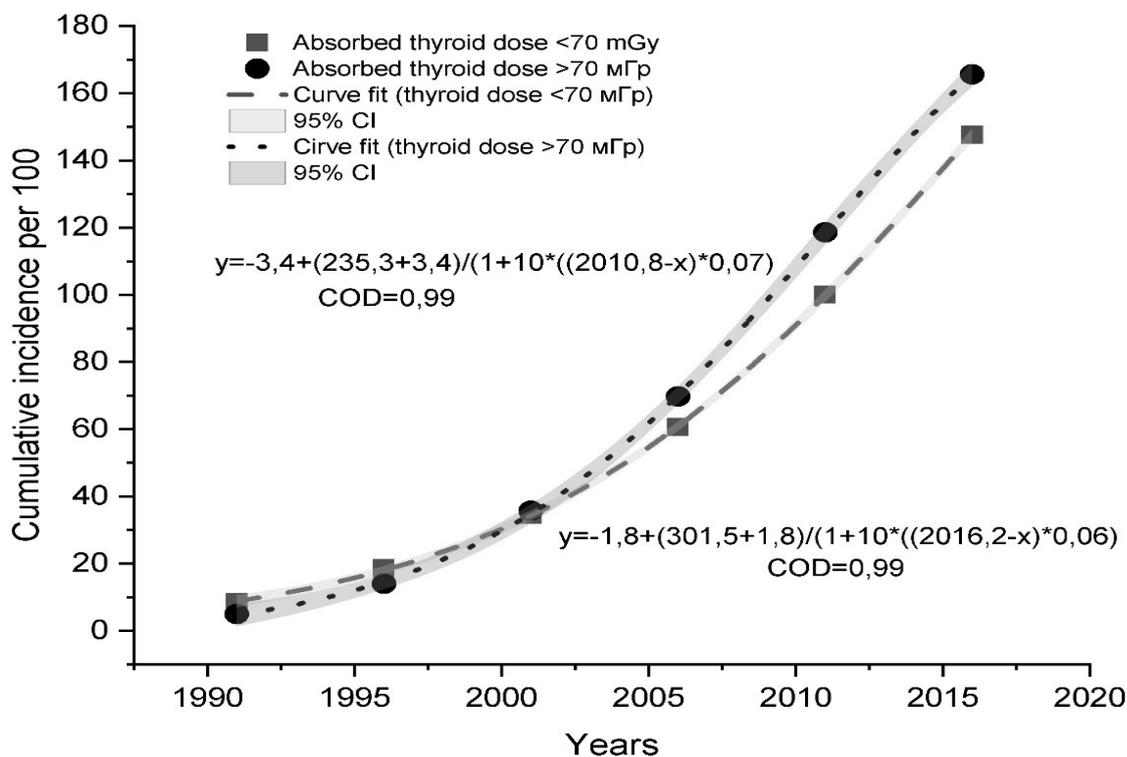


Figure 2: Cumulative incidence of different pathologies in women with low and high absorbed doses by their thyroid glands.

sion 7.2 (Environmental Science Division of Argonne National Laboratory, USA).

The verified data on primary morbidity were taken from the database of the State Register of Persons Affected by the Chernobyl Accident. The incidence rate was assessed according to the main classes of diseases according to ICD-10.

The data obtained were processed by the methods of variation statistics using the SigmaPlot 12.5 (Systat Software Inc., Germany) and Statistica 10.0 (StatSoft.Inc, USA) programs.

Table 1 shows the descriptive statistics of pregnant women included in the study.

Radioactive iodine from the radioactive cloud was either inhaled, or consumed with food products, and mainly with the whole milk [4]. This led to the formation of absorbed doses by the TG. Figure 1 shows the distribution of absorbed doses in a group of pregnant women.

It is clearly seen that in 75% of women absorbed doses were in the range of 60 – 70 mGy, and only in 10% of those irradiated women the dose exceeded 0.1 Gy.

Since TG plays an important role in the regulation of basal metabolism, it is of a great interest to find out how irradiation of this organ can affect the subsequent general somatic morbidity. For this purpose, the entire range of absorbed doses by the TG of affected women was divided into two subranges: we distinguished low (<70 mGy) and high doses (> 70 mGy). This division was purely arbitrary. Based on this division, the primary cumulative incidence of pathologies in women from the main group was calculated for the period from 1996 to 2016 (Figure 2). All classes of diseases were taken into account according to the ICD-10.

As it can be seen in Figure 2, in the group of women whose thyroid glands absorbed doses exceeded 70 mGy, a higher primary cumulative incidence of pathologies was recorded for all classes of diseases for 1986-2016. At the same time, in the first 14-15 years, those incidences after low and high doses are almost the same, and then they both begin to increase progressively. This may be interpreted as an evidence of the dose-dependent nature of the incidence of pathologies, however, for a more complete picture, a detailed and thorough analysis of the main classes of diseases is required.

Discussion

It is obvious that absorbed doses by the TG in pregnant women were formed due to the incorporation of I-131 after the Chernobyl accident, and that those absorbed doses were small in magnitude. It was established that in the first 14-15 years after the accident, incidences of pathologies in women with differ-

ent absorbed doses by the TG were almost identical: the primary morbidity for all classes of diseases remained the same. After this period of time, those women whose thyroid glands absorbed a dose that exceeded 0.07 Gy had a higher non-oncological morbidity. These data are primary and may indicate the existence of the influence of the irradiation of TG due to the incorporation of I-131 on the subsequent occurrence of general somatic pathology. This effect may be associated with the instability of thyrocyte genes as a result of irradiation with radioactive iodine of different intensity [5]. However, these data require clarification and consideration of the effect of radiation on specific groups of pathology.

Conclusion

As a result of the study, a dose-dependent effect of irradiation of the TG due to the incorporation of radioiodine on the development of non-oncological morbidity in pregnant women in the long term has been shown.

Authorship Criteria

Stojarov A.N. Concept and design of study. Guarantor.

Khrustalev V.V. Revising manuscript critically for important intellectual content.

Odinzova-Stojarova D.A. Acquisition of data, analysis and interpretation of data.

Conflicts of Interest

There is no conflict of interest

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