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Thyroid cancer in Belarus

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Abstract

The Chernobyl accident in April and May of 1986 promoted thyroid carcinomas in 1500 patients who were exposed to radiation at the age group under 18. The common type of malignancy was papillary cancer (93.5%). For the period from 1990 to 2000, thyroid carcinomas were diagnosed in 674 children (age group under 15), in 262 adolescents (age group between 15 and 19) and in 564 young adults (age group from 19 to 33). The highest number of thyroid malignancies in children and adolescents was diagnosed in Gomel and Brest oblasts located closer to the Chernobyl Nuclear Power Plant. For 15 years (1986–2000), spontaneous (non-radiogenic) thyroid carcinomas appeared only in 17 children. Thyroid cancer promoted by radiation in children possesses the behavior to form the regional (73%) and distant (16.6%) metastases, mainly in lung. As a result of performed risk analysis for the cohort exposed at the age group under 18, the following values were obtained: 1.93 (1.79–2.06) per 104 PYGy for the absolute risk coefficient, and 37.66 (35.06–40.26) per Gy for the excess relative risk coefficient.

Keywords: Thyroid cancer; Estimated risk; Chernobyl accident; Incidence

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1. Introduction

The Chernobyl accident greatly affected thyroid cancer incidence rate in Belarus [1]. It was for the first time that the patients with thyroid cancer induced by radiation appeared on the territory of the republic [2]. This resulted in considerable incidence growth of differentiated forms of tumors, mostly of papillary cancer, in people of all ages in all the six regions of Belarus [3–5]. After Chernobyl, thyroid cancer in children appeared to become the most frequent oncological pediatric disease [6].

2. Materials and methods

The research is conducted on materials of the Thyroid Cancer Center. The therapeutic and follow-up data were analysed. The materials of the National Cancer Registry were used also. The cases of thyroid cancer proved in 1990–2000 years are included in the analysis.

An assessment of thyroid cancer risk considering gender difference was performed for the cohort of people exposed in the 0–18-year-old age group. Thyroid dose reconstruction was performed using radioecological model elaborated to include specific for Belarus parameters. Demographic data was calculated based on Census data for 1989 using methods of age–gender pyramids, correction of absolute age structure and back movement of age groups [7,8].

3. Results and discussion

After Chernobyl, in comparison with pre-accident period, the thyroid cancer incidence increased in children by 88.5 times, in adolescents—by 11.8 times, in adults—by 4.6 times (Table 1).

From 1990 to 2000, thyroid cancer was detected in 6905 patients, including 691 children (among them 674 were born before the accident), 262 adolescents and 5952 adults (Table 2).

Predominantly there was papillary thyroid cancer (Table 3).

The highest amount of cancer cases has been registered in Gomel region. Children and adolescents have compounded 29.8% (Table 4).

Table 1
Thyroid cancer in Belarus before and after the Chernobyl accident

Patients' age	1971–1985	1986–2000	Total
0–14	8	703	711
15–18	21	267	288
19+	1465	6719	8184
Total	1494	7689	9183

Table 2
Age of thyroid cancer patients at the time of diagnosis; cases revealed in 1990–2000

Gender	Number of patients	Age (years)				
		0–4	5–9	10–14	15–18	19+
Male	1328	1	62	199	94	972
Female	5577	5	105	319	168	4980
Both genders	6905	6	167	518	262	5952
%	100	0.1	2.4	7.5	3.8	86.2

Table 3
Histological type of thyroid cancer

Histological type of thyroid cancer	Number of cases	Age at the time of cancer detection (years)					
		0–14		15–18		19+	
		n	%	*n*	%	*n*	%
Papillary	5998	651	94.2	245	93.5	5102	85.7
Follicular	580	35	5.1	14	5.3	531	8.9
Medullary	127	4	0.6	3	1.2	120	2.0
Undifferentiated	168	1	0.1	0	0	167	2.8
Squamous	32	0	0	0	0	32	0.6
Total	6905	691	100	262	100	5952	100

Cancer in children and adolescents was diagnosed nearly throughout the territory of Belarus, but predominantly in the Gomel and Brest regions (Fig. 1).

The dramatic growth of pediatric cancer patients began in 1990 (in 4 years after the Chernobyl accident) [1,2], has lasted for 6 years and reached its peak—90 cases—in 1995 [6]. The years that followed were characterized by a gradual decrease of cancer incidence in children and the increase of it in adolescents (Fig. 2).

In 2000, the incidence rate per 100 000 children, adolescents and adults of the Gomel region amounted to 5.4, 33.7 and 15.9 cases, respectively (Fig. 3).

The high frequency of thyroid cancer in regions is marked apart, where the radiation dose of the thyroid gland was more than 1 Gy (Fig. 4).

Table 4
Thyroid cancer among population of Belarus by region

Region	Cases	Children and adolescents	
		n	%
Gomel	1693	504	29.8
Minsk-city	1218	70	5.7
Mogilev	1016	55	5.4
Vitebsk	923	14	1.5
Brest	872	219	25.1
Minsk	760	46	6.1
Grodno	423	45	10.6
Belarus	6905	953	13.8

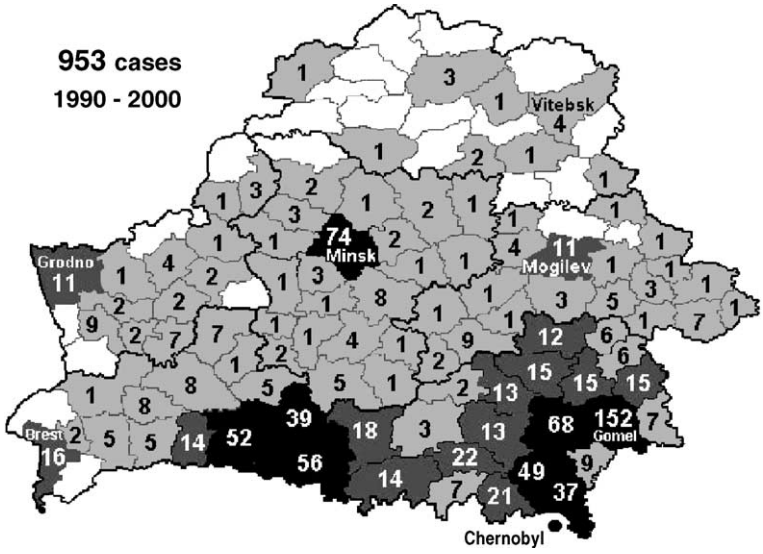

Fig. 1. Distribution of 953 cases of children and adolescent thyroid cancer revealed in 1990–2000 by district of Belarus.

The cohort was divided into the following groups according to the estimated absorbed thyroid dose: 0–0.3; 0.3–0.6; 0.6–1.0; 1.0–2.0; 2 Gy or more. In accordance with the calculated individual doses for persons with the thyroid cancer, the percent distribution of excess thyroid cancer cases for dose intervals was the following: 37.7% thyroid cancer cases among people exposed to doses less than 0.3 Gy, 45.4% to 0.3–1 Gy, and 16.9% to more than 1 Gy.

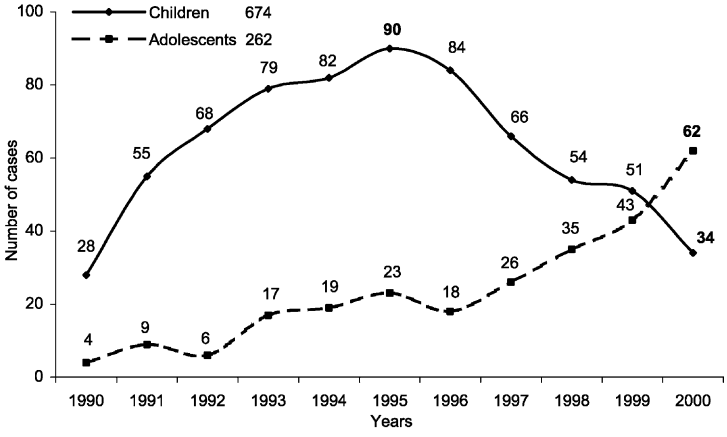

Fig. 2. Annual number of children and adolescent thyroid cancer cases in Belarus.

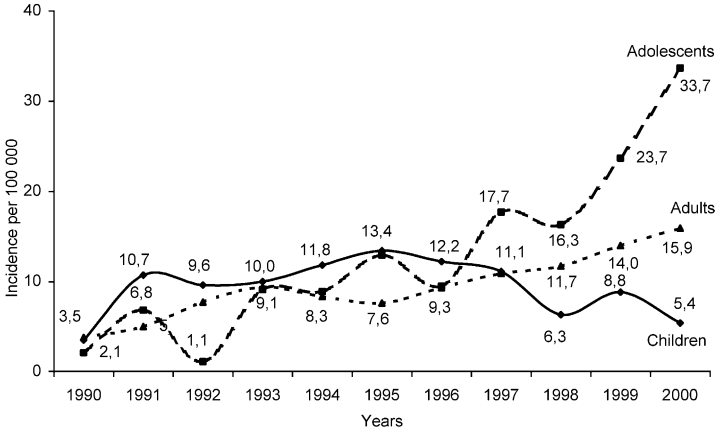

Fig. 3. Annual incidence (per 100 000) of thyroid cancer in Gomel region.

It is known that the level of average dose is higher for those exposed at a younger age. Therefore, cohort of exposed at a younger age had higher collective dose than those exposed at an older age. Consequently, more cases of thyroid cancer were observed among children exposed at a younger age (Fig. 5). Analysis of the correspondence between the number of excess thyroid cancer and the level of collective dose for different age groups showed that for the age group under 11 the number of cases is proportional to the collective dose for boys and girls. For the older cohort (age group between 11 and 18), this proportionality is violated with ratio being higher for girls than for boys.

Radiation induced differentiated thyroid cancer has highly aggressive characteristic features (the lung metastasis in children have arisen in 16.6% of cases).

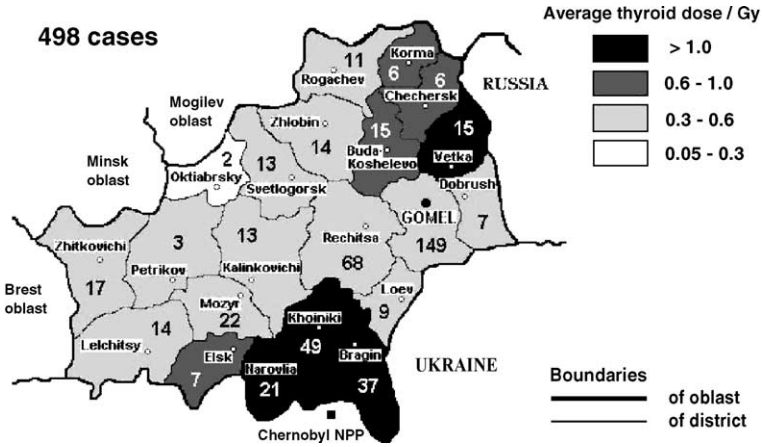

Fig. 4. Distribution of 498 children and adolescent thyroid cancers by district of Gomel region with average thyroid dose.

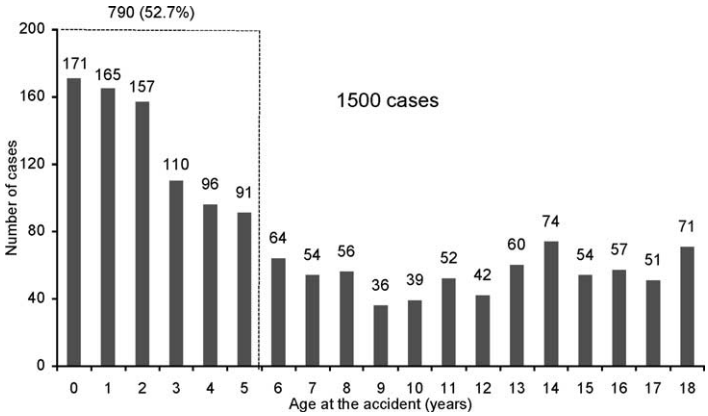

Fig. 5. Number of thyroid cancer cases by age at the accident (0–18 years of age).

From 1500 patients with irradiated thyroid glands during accident, 11 patients (three children, two adolescents and six adults) have died because of distant metastases that has compounded 0.7%.

Even microcarcinoma of 3–9 mm diagnosed in 377 patients (age group from 6 to 33) often resulted in multifocal growth (17.0%), extrathyroid tissue invasion (8.0%), regional metastases (47.2%) and lung metastases (3.7%).

4. Conclusion

Within the period of 30 years (1971–2000), spontaneous thyroid cancer in Belarus occurred in 25 children, 17 of which were born after the accident.

Out of 1635 cases, 691 cases—in children, 262—in adolescents, 564—in young adults (age group from 19 to 33) may be referred to as radiation-induced cancer patients irradiated at the age of 18 including 135 liquidators. The irradiation doses and pathogenetic interconnection with radiation for the rest of the 5270 adult thyroid cancer patients are still to be cleared out.

The Chernobyl tragedy concerning only children is finished. A new period of considerable thyroid cancer incidence growth in young adult population (age group from 15 to 33) has commenced. The aggressive character of pediatric radiation-induced cancer still cannot be explained.

The value of excess absolute risk coefficient calculated for the first nine years period of Plato after the 4-year latent period for the cohort of people exposed at the age group under 18 is 1.93 (1.79–2.06) per 104 PYGy; excess relative risk of 37.66 (35.06–40.26) per Gy. For girls, the absolute risk was calculated as 2.6 (2.4–2.86) per 104 PYGy, for boys—1.3 (1.17–1.5) per 104 PYGy. The ratio between boys and girls for absolute risk coefficient is 1:2 for the total cohort under consideration, however, there is a significant variation for different age groups.

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