

Minimizing the Health Effects of the Nuclear Accident in Fukushima on Thyroids

Shigenobu Nagataki

Nagasaki University, Ito Hospital, and Radiation Effects Association, Tokyo, Japan

Key Words

Fukushima · Guidelines · Management · Nuclear accident · Radiation · Screening · Ultrasound

Abstract

Results of the Screening of Thyroids: Because of the March 2011 nuclear accident in Fukushima, Japan, the Fukushima Prefecture initiated a thyroid ultrasound examination program. The first cycle of examinations on all children (more than 300,000) of the Fukushima Prefecture identified 116 patients as having malignant or suspected malignant thyroid nodules, and in the second cycle 59 new cases were identified. According to the available data, the thyroid cancers found by the screening are unlikely to be due to radiation, but the possibility cannot be excluded. **Urgent Measures:** The current thyroid ultrasound examination program has been detecting thyroid cancers, regardless of the cause, in all children in the Fukushima Prefecture. Fukushima Prefecture is already taking measures against thyroid cancer, even if an increase occurs in radiation-induced thyroid cancer in Fukushima Prefecture. Therefore, the urgent challenge is how to treat children with thyroid cancer found by the screening. **Future Directions of the Measures:** At the end of each cycle, the findings must be carefully discussed with ex-

perts around the world and among stakeholders in Fukushima, and a consensus must be reached regarding whether the current program will be continued or needs improvement. In addition, the survey should be improved as an epidemiological follow-up research program. Before starting this, a consensus must be reached with the inhabitants with regard to carrying out epidemiological research for several decades. Dialogue absolutely must continue among all stakeholders to determine how best to formulate a program to deal with urgent matters and to determine the next stage of any epidemiological research.

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Results of the Thyroid Ultrasound Examinations

In October 2011, as a result of the March 2011 nuclear accident at the Tokyo Electric Power Company's Fukushima Daiichi nuclear power station, the Fukushima Prefecture initiated a thyroid ultrasound examination program, i.e. the Fukushima Health Management Survey [1, 2].

The first cycle of examinations was conducted to the 2013 fiscal year on all children of the Fukushima Prefec-

Table 1. Overview of the thyroid cancers found in the Fukushima Health Management Survey

	First cycle (preliminary examination)	Second cycle (full-scale survey)
Period	2011 FY to 2013 FY	2014 FY to 2015 FY
Subjects, n	367,672	381,286
Participation rate, %	81.7	70.9
Patients with thyroid cancer ^a , n	116	59
Females, %	66.4	57.6
Age at the time of diagnosis, years	17.3±2.7 (8–22)	16.8±3.3 (9–23)
Age at the time of the accident, years	14.9±2.6 (6–18)	12.7±3.3 (5–18)
Tumor size, mm	13.9±7.8 (5.1–45.0)	10.4±5.5 (5.3–35.6)
Operated patients, n	102	34
Papillary cancers, n	100	33
Poorly differentiated cancers, n	1	0
Cancer (other), n	0	1
Benign tumors, n	1	0

Data are based on results published up to June 30, 2016. Values are presented as means ± SD (range) unless otherwise stated. FY = Fiscal year. ^a Diagnosed as malignant and suspected malignant thyroid cancer.

ture (residents aged 0–18 years at the time of the accident on March 11, 2011) [3, 4]. The participation rate was 81.7% (300,476 of 367,672 children), and 116 patients (39 males and 77 females) were identified as having malignant or suspected malignant thyroid nodules (by ultrasound examination and fine-needle aspiration cytology). Of these 116 patients, 102 underwent operations and the nodules were diagnosed as 100 papillary cancers, 1 poorly differentiated cancer, and 1 benign tumor.

The second cycle of examinations began in April 2014 and included all of the subjects of the first cycle plus children who had been born between April 2, 2011, and April 1, 2012 [5, 6]. The data for confirmatory testing were those reported as of June 30, 2016. The participation rate was 70.9% (270,379 of 381,286 children), and 59 new cases (25 males and 34 females) of malignant and suspected malignant thyroid nodules were detected. In total, 34 patients underwent operations, 33 were diagnosed with papillary cancers, and 1 with cancer (other type) (table 1).

The observed prevalence of thyroid cancer based on the number of thyroid cancer cases detected by the program (through the end of April 2015) was 160.1, and the expected prevalence calculated as a cumulative incidence via a life-table method using thyroid cancer incidence rates from 2001–2010 was 5.2, giving an observed/expected ratio of 30.8 [7].

Interim Reports from Prefectural and National Committees in Japan

The Interim Report of the Prefectural Oversight Committee of the Fukushima Prefecture [8], as well as the interim report from the Expert Meeting of the Ministry of the Environment, Japan [9, 10], indicated that the thyroid cancers found by the screening were unlikely to be due to radiation. The clear differences in radiation dose (fig. 1) [11], the age distribution of the affected children, and the short latency period of cancer after the accident, as well as the genetic characteristics of thyroid cancer, suggested that the circumstances in Fukushima clearly differed from those of Chernobyl. The conclusions of these interim reports are very similar to those of recent reports of international agencies [12, 13].

Current Topics in the Literature

Based on the results of the above ultrasound screenings, Tsuda et al. [14] suggested that the increased incidence of thyroid cancer was due to radiation from the accident and they proposed that immediate measures be taken. Their article, which appeared in *Epidemiology* in May 2016 [14], was accompanied by an article and many letters of criticism to the editor in the same issue [15, 16].

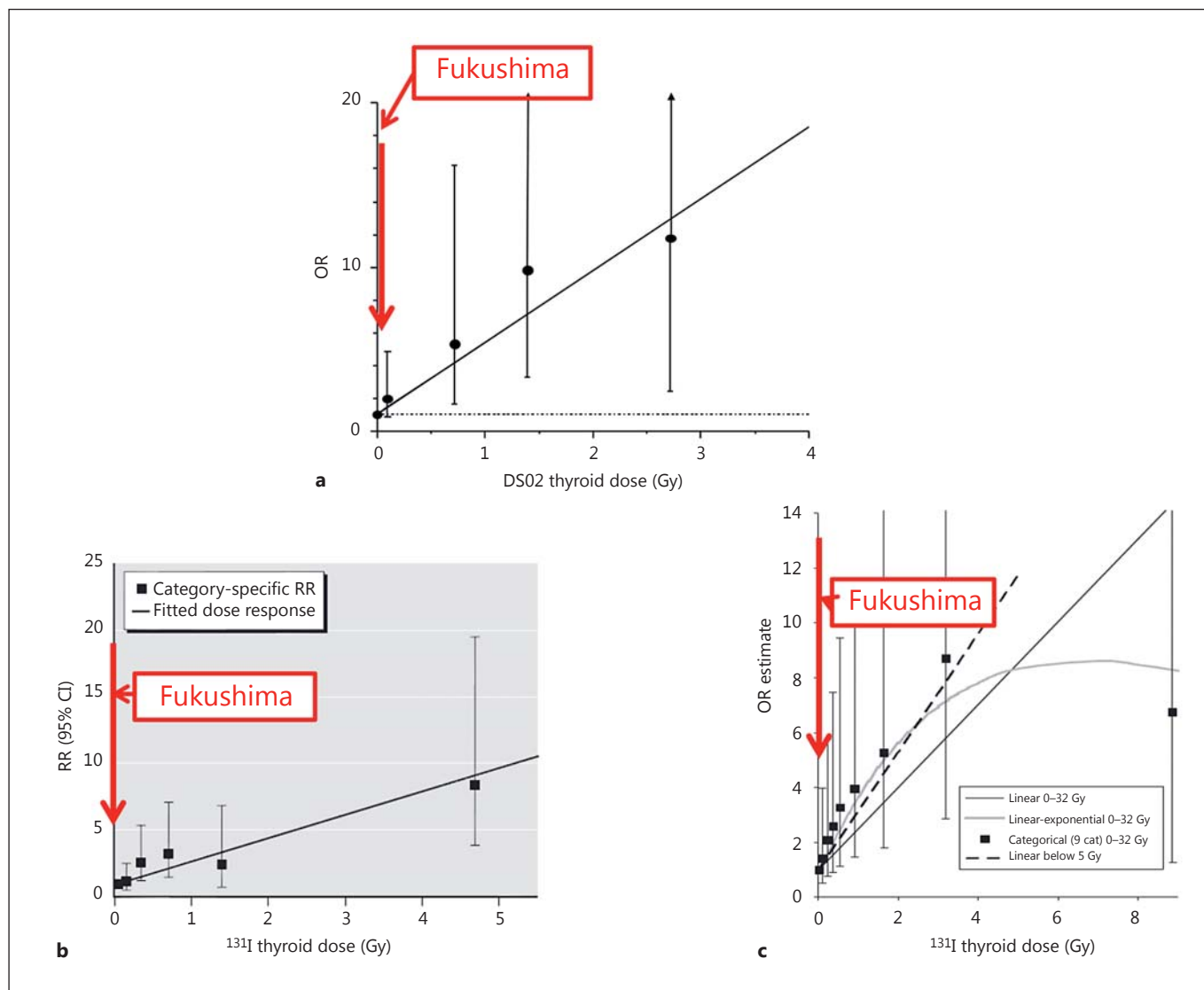


Fig. 1. Dose-response relationship between thyroid dose and thyroid cancer in Hiroshima and Nagasaki (atomic bomb survivors) (a), Ukraine (Chernobyl victims) (b), and Belarus (Chernobyl victims) (c) [11]. OR = Odds ratio; RR = relative ratio; cat = categories.

Other topics include overdiagnosis and overtreatment issues, as suggested by Shibuya et al. [17] and Katanoda et al. [7], which extend beyond the discussion of the possibility of radiation-induced thyroid cancers.

Urgent Measures

As mentioned, the current thyroid ultrasound examination program has been detecting thyroid cancers, regardless of the cause, in all children in the Fukushima

Prefecture. It has to be noted that Fukushima Prefecture is already taking measures against thyroid cancer, even if an increase occurs in radiation-induced thyroid cancer in Fukushima Prefecture.

The urgent challenge currently faced is instead how to treat the children who have thyroid cancer detected by the screening. The program may have led to overdiagnosis compared to the incidence without screening [18], but overtreatment must be avoided as much as possible. Some thyroid cancers will progress to clinically apparent thyroid cancer and should be surgically treated, while others

might never progress in the patient's lifetime (i.e. latent carcinoma); however, ultrasound examinations and aspiration biopsy cytology cannot differentiate between these types. The various guidelines available for the treatment of thyroid cancer are also based on experiences with adults, not children, and the natural course of thyroid cancer in children is not known [19]. Differentiation between radiation-induced cancer and sporadic thyroid cancer is also not possible by clinical examination alone.

However, treatment of patients given these unknown or uncertain circumstances is not uncommon in the medical world. Currently, in Japan, the medical side (i.e. the medical doctors and other medical staff) informs the patients of their health conditions and treatment options, and the patients' side (patients and/or guardians) express their choices. The patients then agree to the type of treatment by signing an informed consent form. Under the same medical circumstances, some patients may wish to be operated on immediately because of fear of radiation-induced thyroid cancer, while other patients may opt for long-term follow-up without operation because some thyroid cancers might never progress during their lives.

Harmonization of treatment with the intentions of the patient requires that a clear distinction be made between the treatment of thyroid cancers and the diagnosis of thyroid cancer which is based on a uniform thyroid ultrasound examination of the Health Management Survey. Protection of personal information should also be considered.

From the standpoint of research, the important issues are careful clinical observation of these children to learn the natural course of thyroid cancer in children, as well as basic research on how to differentiate thyroid carcinomas which will progress to clinically apparent cancer from those which will never progress during the patient's lifetime. Molecular makers may be one of the important topics [20].

Future Directions for Measures

In general, the rationale for conducting thyroid cancer ultrasound screening as a measure for protection against cancer lacks scientific evidence [19]. Nevertheless, thyroid ultrasound examinations have been conducted in Fukushima due to concerns about the possibility of an increased risk of thyroid cancer in children who might experience radiation exposure and in order to reduce the anxiety of the inhabitants and to manage their health.

Therefore, after each cycle of examination is completed, it is very important to go through the process of comprehensive and careful verification of all screening data, to discuss the findings with relevant persons (extensively among experts around the world and then among stakeholders in Fukushima), and to reach a consensus, especially with the inhabitants. Points of discussion must focus on how to minimize the health effects caused by the nuclear accident on the thyroids of children in the Fukushima Prefecture. The most important issues to discuss are whether to continue with the program or whether the program needs improvement.

In addition, the survey should also be further improved as an epidemiological follow-up research program in order to provide an adequate analysis of the relationship with radiation exposure. Before starting this research, a consensus must be reached with the inhabitants regarding carrying out epidemiological research for several decades.

Reaching a consensus among experts with regard to a research program on the health effects of radiation should not be difficult. However, the effects of the nuclear accident extend beyond simply the somatic effects to include mental effects and a wide variety of social effects. At the end of the fifth year, almost 100,000 evacuees were still unable to return to their homes. Dialogue absolutely must continue among all stakeholders, including experts, to determine how best to formulate a program to deal with urgent matters and to determine the next stage of any epidemiological research. Minimization of the health effects of the nuclear accident on thyroids should be the key point of any dialogue among the stakeholders.

Disclosure Statement

The author has nothing to disclose.

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