



Judgment for cause of radiogenic neoplasms for a thyroid cancer

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Background: Radiogenic neoplasms due to occupational exposure can be identified as occupational radiogenic neoplasms. We investigate the etiology of cancer in a patient with thyroid carcinoma.

Methods: Organ dose was estimated based on the individual monitoring results, or according to GB/T 16149-2012 “Specification of dose estimation for chronic radiation sickness from external exposure” when no individual dose was provided; PC (probability of causation) was calculated according to GBZ97-2009 “Judgment criteria for cause of radiogenic neoplasms”.

Results: The estimated cumulative dose was 20.4 cGy, organ dose of thyroid was 38.1 cGy, PC value from occupational exposure was about 37.8%, with its upper limit of the 95% confidence level was 82.6%.

Conclusions: The case can be judged as radiogenic neoplasm as the upper limit of the 95% confidence PC value is more than 50%. More attention should be paid to the examination of thyroid palpation and the thyroid B ultrasound for radiation workers, especially for those high-risk individuals engaged in radiation work in their early years.

Keywords: Radiogenic neoplasms; thyroid cancer; probability of causation (PC)

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Introduction

Radiogenic neoplasms are malignant tumors that occur after exposure to ionizing radiation and have a certain degree relationship with epidemiology etiology. Radiogenic neoplasms due to occupational exposure can be identified as occupational radiogenic neoplasms (1). Judgment and results for cause of radiogenic neoplasms for a thyroid cancer are reported as follows.

Data and methods

Data

Basic situation and professional history

The male patient was born in 1956 and has been engaged in radiological diagnosis in a clinic since 1975. He did fluoroscopy in the same room with examinees until 1979 the

operating room was separated from the examination room. Then he was transferred to a workers' hospital in 1982, also did fluoroscopy in the same room with examinees until 2004 the operating room was separated. From 2005 he was engaged in diagnostic radiology (compartment fluoroscopy) in a community health center until 2014, from 2010 he also did radiography until August, 2016. A total of about 40.5 years were engaged in radiation work.

Results for clinical and laboratory examination

A nodule size 11 mm × 8 mm was detected in the patient's right thyroid by B-ultrasonography during a physical examination in April 2016, with thyroid function test showed no abnormalities. Result of thyroid puncture examination in Zhongda Hospital was thyroid tumor, and further pathological diagnosis was thyroid papillary carcinoma.

Methods

Organ dose estimation

Organ (thyroid) dose was estimated either according to the individual monitoring results or by the normalized workload method according to GB/T 16149-2012 “specification of dose estimation for chronic radiation sickness from external exposure” (2) of the years without individual monitoring results.

Judgement for cause of radiogenic neoplasm

Judgement was based on GBZ 97-2009 “Judgment criteria for the cause of radiogenic neoplasms” (1). Probability of causation (PC) is the ratio of the increase in cancer probability to the total probability of cancer after a dose of radiation which indicates the possibility that an individual’s cancer is due to a previous dose of radiation. For thyroid cancer, the increase is expressed in excess relative risk (ERR).

Results

Absorbed dose of target organ (thyroid) was estimated. Results show a cumulative dose of 20.4 cGy (5.0 mGy per year), with the organ dose of 38.1 cGy in thyroid. The PC from occupational exposure was calculated to be 37.8%, with the 95% confidence upper limit to be 82.6% according to the formula of appendix F of GBZ97-2009 (1).

Conclusions

With a history of a certain dose of ionizing radiation and dose related data, a primary malignant tumor clinically diagnosed a certain incubation period after exposure, the calculated PC of the tumor due to exposure was 37.8% according to the patient’s gender, age of first exposure, age at onset and exposure dose data, the upper limit of 95% confidence PC value is 82.6%, more than 50%, met the standard of judgement criteria for radiogenic neoplasms.

Discussion

It has been the consensus of radiation protection that ionizing radiation can induce cancer. The judgment of occupational radiation induced cancer and its corresponding compensation is a social problem for the whole world (3). It has been widely recognized by the international authoritative organizations and many countries to determine the correlation between tumor and previous radiation exposure (4). The concept of PC was

first proposed by NIH as compensation basis to determine the radiogenic tumor so as to solve the relevant problem of compensation. PC >50% illustrates the contribution of radiation to cancer exceeds other carcinogenic factors (5).

In this case the patient has a long and complex occupational exposure history, with three exchanges of work units, several changes in working conditions, including fluoroscopy in the same room with examinees for about six years. Due to the limited personal dose data, results of absorbed dose in most of the years were obtained according to the normalized workload method. The estimated cumulative dose is about 20.4 cGy, with the average annual dose of 5.0 mGy, which was in the range of 0.9–12.3 mGy, the annual effective dose of medical X-ray workers of Jiangsu Province during 1950–2011 estimated by Xu *et al.* (6), which indicates results of estimated dose in this case are basically credible.

The added “calculation of upper limit of 95% confidence probability” in Appendix F is a big difference between GBZ97 (1) revised in 2009 and its previous version (7). In this case it cannot be diagnosed as radiogenic tumor for its PC value is less than 50% according to the old version while the upper limit of 95% confidence probability of PC is more than 50% and the patient was exposed to occupational radiation at a very early age. Wang *et al.* (8) reported the highest RR value of thyroid cancer for cancer risk assessment among those who were engaged in radiation work before the age of 20 compared to other radiation workers in China during the year of 1950–1980. It is reasonable and credible to be judged as a radiogenic neoplasm as the patient has a high risk of thyroid cancer according to Wang’s report. More scientificity, wider diagnostic criteria and more protection to workers can be found in the new GBZ 97 from this case. Thyroid nodules were found in the patient’s physical examination without any other discomfort, while the thyroid function tests were in the normal range, including the results of thyroid function tests every year. It is revealed that as a necessary examination (9), the thyroid function test is not enough for radiation workers. More attention should be paid to the examination of thyroid palpation. It is also necessary to take the thyroid B ultrasound as a necessary examination for radiation workers, especially for those high-risk individuals engaged in radiation work in their early years.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/jphe.2017.04.02>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Institutional ethical approval and individual informed consent were waived.

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