Radiation and Radioactive Materials Q&A (2)

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Introduction

Two years have now passed since the Great East Japan Earthquake of March 11, 2011 and the subsequent accident at the Fukushima Daiichi Nuclear Power Station. To the many victims of the disaster and all those who remain displaced and affected as a result of the tragic events, I again extend my deepest sympathies. This pamphlet is based on answers I wrote to "Radiation and Radioactive Materials Q&A", originally published serially in the Fukushima Minpo newspaper. For this compilation, I included questions I thought would be of particular interest to general readers. This edition also serves as a sequel to the "Radiation and Radioactive Materials Q&A" published in 2012. Ever since the nuclear accident, people have been inundated by information about radiation and its impact on health and I imagine that many are bewildered by it all. Like the previous edition, I therefore hope this pamphlet addresses some of the concerns of people living in or around Fukushima. I sincerely hope you find it useful.

Noboru Takamura
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What is the meaning of the “1 millisievert” reference level?

If genes in a cell are damaged
they can be restored in a short time, so there is no impact.

Q
In late February 2012, a prefectural health management survey estimated that 58% of Fukushima residents had an annual radiation exposure of less than 1 millisievert. This level of 1 millisievert is often referred to as a reference level. What is this quantity and what does it is mean in terms of health?

A
The International Commission on Radiological Protection (ICRP) recommends that the public be exposed to no more than 1 millisievert (mSv) of radiation per year under normal conditions. On the other hand, for an emergency like the one in Fukushima, the ICRP recommends that annual exposure to radiation be limited, as far as possible, to the range of 20 to 100 mSv. After the radiation source is under control it recommends that exposure be limited to between 1 and 20 mSv per year.

These recommendations are based on the assumption that radiation exposure levels of 100 mSv and above per year increase the risk of cancer or other adverse health effects. They set rational, achievable limits for annual radiation exposure – under normal conditions, exposure should be reduced as far as possible, whereas during emergencies it should be kept below 100 mSv. So what does a radiation exposure of 1 mSv actually mean?

As often discussed, if human cells are exposed to 1 mSv of radiation, genes inside the cell may become damaged. This damage does not have any immediate health effects, however, because human cells have a built-in mechanism for repairing damaged genes.

Any genetic damage caused by exposure to 1 mSv of radiation gets repaired in a short time. In fact, this same process of gene repair happens many tens of thousands of times per day in cells, in response to UV radiation exposure.

What is the difference between the health effects of “artificial” and “natural” radiation?

Both have the same properties.
What’s important is the radiation dose.

Q

I know that the radiation released from the Fukushima Daiichi Nuclear Power Station was “artificial” radiation, but I’ve also heard that there is “natural” radiation. Are there any differences between the two kinds of radiation, and do they affect the human body the same way?

A

There are two basic types of radioactive material. On one hand, there are materials like potassium 40 and carbon 14 that occur naturally in the physical world; these are called natural radioactive materials. And then there are materials like iodine 131, cesium 137 and cesium 134 that do not exist naturally; these are called artificial radioactive materials.

The radiation released by radioactive materials consist of alpha and beta-rays, which are actually small particles, as well as gamma-rays and X-rays, which are like waves.

The radiation released by natural and artificial radioactive materials is of exactly the same type. In each case the radiation consists of identical alpha-rays, beta-rays, gamma-rays, etc.

The radioactive materials released during the nuclear emergency were artificial, but that does not mean that the radiation was special in any way.

Therefore, the health effects of exposure to radiation from radioactive materials actually depend on how much radiation a person is exposed to – the radiation dose. Strictly speaking, the “Sievert,” the unit used to measure radiation, expresses the effect of radiation on the human body.

In Japan, the government has stipulated safety reference levels for radiation in food in order to minimize the biologic effects of internal exposure to radioactive cesium. These reference levels are calculated based on the radiation dose – the amount of exposure to radioactive cesium. Safety reference levels have been set for the radioactive materials present in foods, and these indicate the level for limiting total internal exposure to radiation to less than 1 mSv per year.

Does drinking water contain cesium?

Practically no cesium can be detected in filtered drinking water.

Q

After the release of radiation due to the accident at the Fukushima Daiichi Nuclear Power Station, I'm worried about the safety of the water we are drinking every day. I am especially concerned about radioactive cesium, because it has a long half-life. Now, more than a year after the accident, is it possible that there is still cesium in the water we have to use?

A

Radioactive cesium, like radioactive iodine, was released into the atmosphere at the time of the accident. However, whereas radioactive iodine was detected in tap water immediately after the accident, almost no radioactive cesium has been detected in tap water to date. The reason for this is related to the fact that cesium is easily filtered from water.

Typically, public water supply systems in Japan filter water that is stored in a reservoir or a storage tank in a variety of ways, and then sterilize the water to make it usable as tap water. As most of the cesium is removed in these filtering processes, it is rarely detected in tap water.

On the other hand, in the case of well water, if the well is covered by a lid any radioactive cesium in the atmosphere will be blocked, so the well water will not be contaminated. Some people believe that radioactive cesium in the ground would seep into well water. However, it is known that cesium is strongly attached to soil, and so remains close to the surface. For this reason, cesium does not penetrate deep into the ground, and is therefore unlikely to get into well water.

On its web site, Fukushima prefecture publishes the results of measurements of the concentration of radioactive materials in well water and subsoil water at various locations around the prefecture. To date, these measurements have found no radioactive cesium in well water or subsoil water. I would suggest that you go to the web site and check the condition of well water and subsoil water in the area where you live.

What about radioactive strontium?

If it gets in the body it accumulates in bones.
Its concentration in the environment is very low.

Q

Safety reference levels for foods give figures for radioactive cesium, but I've heard that the radioactive materials released from the Fukushima Daiichi Nuclear Power Station also includes radioactive strontium. What kind of material is this? And why is there no safety reference level for this?

A

Radioactive strontium cannot be measured easily, because unlike radioactive iodine and cesium, which emit gamma-rays and beta-rays, it only emits beta-rays.

Strontium has similar physical properties to calcium, and it is known that if radioactive strontium gets inside the body, it tends to accumulate in the bones. In fact, this property is utilized in treatment to relieve pain in cancer patients, when the disease spreads into bones, as often happens.

The results of radioactive strontium level measurements in the environment, released by the Ministry of Education, Culture, Sports, Science and Technology in September 2011, showed that concentration of radioactive strontium in the soil was on average of 1% or less compared to that of radioactive cesium. This is a very low level.

Based on these results, the cumulative effective dose of radioactive strontium over 50 years, at the point where the concentration was highest, would be around 0.12 mSv. This means that even if you stayed at this site for 50 years, the total amount of radioactive strontium that you would be exposed to – both externally and internally – would be quite minimal.

For this reason, if proper measures are taken to deal with radioactive cesium, these will probably be sufficient to deal with radioactive strontium. As for foods, in my opinion, if you keep track of the safety information and continue eating foods within the safety reference levels for radioactive cesium your exposure to radioactive strontium will also be low enough to avoid problems.

What are the effects if children play outside?

Getting proper exercise is extremely important.
Clean the opening of any wound thoroughly with water.

Q

In springtime children want to play outside, but we don't allow them out of concern about radioactive materials in the environment. Ever since the accident at the Fukushima Daiichi Nuclear Power Station, we've been very worried about this. What will be the effects on the children if they play outside?

A

The radiation detected in the air in and around Fukushima is thought to come from radioactive cesium that is on the ground, or stuck to buildings, trees and other objects. Actually, if radioactive materials in the air are measured but not detected, then I can't imagine that outdoor activities at school or anywhere else will lead to absorption of radioactive materials. In addition, the dose of radiation you would receive from a few hours of outdoor activity is very minimal.

Here's an example: On April 1, 2012, the Fukushima Prefecture website showed that the airborne radiation level was 0.78 microsieverts per hour in Fukushima City. Now, even if you performed outdoor activities for three hours every day, in one month you would have accumulated a total radiation dose of only 70 microsieverts – in other words, not more than 0.07 mSv.

Also, if a child falls over while playing or exercising outside, radioactive materials do not enter immediately into the body from the wound. As long as the wound is cleaned and rinsed well with water there will not be any problem. When children return from playing outside they may have some dirt or dust stuck to their hands, feet, hair, or other parts of the body, but if they take a bath or shower, there will be nothing to worry about.

It is very important for a child to get proper exercise. Lack of exercise makes the body weaker, and this will hinder the growth and development of the child. It will also make life more stressful. I understand the concerns about radioactive materials, but it's also important to avoid worrying too much, because this will do more harm than good to a child. It is essential to try and live in a balanced manner.

I’m worried about the results of an internal radiation exposure test.

Potassium 40 was detected at a level of 4,000 becquerels.
This is quite normal. It’s not a problem.

Q
When I received an internal radiation exposure test with a whole body counter, the results showed a potassium 40 level of 4,000 becquerels. I was surprised, because I’m careful about what I eat. Isn’t this a problem?

A
Potassium is a substance commonly found in brightly-colored vegetables and fruits such as bananas. It is indispensable for maintaining life, through its role in lowering blood pressure by expelling sodium from the body, and in regulating the water content of the body.

The human body contains approximately 2 grams of potassium for each kilogram of body weight. Most of this potassium is not radioactive, but around 0.01% is radioactive potassium 40. To put this into perspective, the Japanese staple food of rice contains around 33 becquerels of potassium 40 per 1 kg.

As potassium 40 emits beta-rays and gamma-rays, all humans are internally exposed to potassium 40 constantly. This internal exposure amounts to a dose of around 0.17 mSv per year.

Potassium is concentrated most highly in the muscles of the body, so the amount of potassium 40 absorbed is roughly proportional to a person’s muscle mass. Suppose there is a man and a woman, each weighing 60 kg. Generally, the man will have a higher amount of potassium 40 in his body. This is because women tend to have more body fat, but less muscle than men.

When a whole body counter is used to test for internal radiation exposure, the potassium 40 level it detects for adults is typically 3,000 to 6,000 becquerels. Therefore, a value of 4,000 becquerels is quite typical, and is nothing to worry about.

How does the time of exposure to radiation influence DNA?

“Acute” exposure causes DNA replication errors.
With “chronic” exposure DNA damage is repaired.

Q
It seems there are two kinds of exposure to radiation, a one-off dose of radiation called “acute” exposure, and slow, prolonged or “chronic” exposure, as in the case of people living near the Fukushima Daiichi Nuclear Power Station after the accident. Are there any differences between the health impacts of the two kinds of exposure?

A
For the same total dose of radiation, is there any difference between acute and chronic exposure in terms of the effect on the human body? Living on the surface of the earth, we are all exposed each year to an average dose of around 2.4 mSv. This is due to the radiation that pours down from outer space, as well as from radioactive materials here on earth.

There are also some places in the world where the level of radiation in the environment is particularly high – for example in the Indian state of Kerala, due to the presence of natural radioactive materials that are pushed up from the sea floor.

Past measurements in Kerala, made by having local people wear badge-type radiation dosage monitors, showed that the average annual radiation dose was 7 mSv, with a maximum recorded value of 14 mSv. A simple calculation indicates that it would take 15 years for the cumulative dose to exceed 100 mSv. To date, however, health studies in Kerala have not found any evidence to indicate a higher than normal incidence of cancer or other diseases, or any notable difference in life expectancy. This suggests that chronic exposure and acute exposure may have different effects on the body.

With acute exposure, the body is exposed in a single event to a large amount of radiation. This tends to cause genetic damage, leading to DNA replication errors. With chronic exposure, on the other hand, radiation is taken in little by little, and it appears that even if there is some genetic damage, the human body is equipped with a mechanism to repair the damage each time it occurs.

Apart from cancer, can exposure to radiation cause any other kinds of illness?

Many atomic bomb victims suffered from cataracts.
It is unlikely that people living around Fukushima are at any higher risk.

Q
We often hear that exposure to radiation can cause cancer, but can it cause any other kinds of illness? Also, how will the health of the people living close to the Fukushima Daiichi Nuclear Power Station be impacted?

A
Many people know that the incidence of leukemia and various kinds of cancer amongst the victims of the atomic bombings of Nagasaki and Hiroshima increased due to radiation exposure. Apart from cancers, another disease that many contracted was cataracts. In this disease the lens of the eye becomes cloudy, causing eyesight to deteriorate. It is a common condition of the elderly, and its frequency increases with age.

The reason exposure to radiation leads to cataracts was understood not long after Wilhelm Röntgen discovered X-rays, in 1895. Apparently, in 1897 after the inventor Thomas Edison was exposed to radiation while conducting an experiment using X-rays, he complained of a pain in his eye.

Among the atomic bomb victims, those who were exposed to high levels of radiation developed cataracts quite quickly—in one to two years—while those exposed to lower doses developed the disease more slowly. In the case of the nuclear power accident at Chernobyl, no study has yet conducted to check for an increase in the incidence of cataracts amongst people in surrounding areas.

In the case of the Hiroshima and Nagasaki atomic bomb victims, radiation exposure was mainly acute and external in character, whereas in the case of Chernobyl, exposure was mainly internal, from ingestion of radioactive iodine and cesium. It seems that this difference in exposure characteristics is connected to whether or not there is an increase in the incidence of cataracts.

In the present situation around Fukushima, the level of both external and internal exposure is extremely limited, so there is unlikely to be any increased risk of developing cataracts.

How will exposure to radiation affect children yet to be born?

There was no increase in rates of disease amongst "second-generation atomic bomb victims."
No effects are transmitted to future generations.

Q

I'm worried about how the children born in the coming years in and around Fukushima will be affected by their exposure to the radiation released from the Fukushima Daiichi Nuclear Power Station. Are they likely to develop any kind of sickness or disorder? Were the children born after the atomic bombings in Hiroshima and Nagasaki OK?

A

The generation of children conceived and born in Hiroshima and Nagasaki after the atomic bombings are known as "second-generation atomic bomb victims." The question of whether these second generations in the two cities would suffer any ill effects was a major concern, and a number of long-term studies right up to the present were conducted to shed light on this.

The results of these studies show no evidence of an increase in the incidence of cancer or any other illness amongst the second generation victims. On top of this, even 25 years after the Chernobyl nuclear accident, the generations born after the accident have not shown any abnormal health issues.

Animal experiments in which internal organ cells (somatic cells) of the body – in bone marrow or the thyroid, for example – are exposed to radiation indicate that the effects of radiation exposure are not carried over to the next generation. On the other hand, it has been shown that if reproductive cells, like those of sperm and ova, are subjected to high levels of radiation, the effects will be carried over to subsequent generations, with damage to chromosomes.

There are several reasons why no adverse health effects have been observed in second-generation atomic bomb victims. One possible reason for this is that compared to laboratory test animals, humans have very few offspring, so sperm and ova that are genetically damaged by radiation may not survive the long period between fertilization and birth.

Furthermore, when compared to the Hiroshima and Nagasaki bombings and Chernobyl, the levels of external and internal radiation exposure in Fukushima prefecture are relatively low, so it is unlikely that any adverse health effects will be passed on to future generations.

Pregnancy and X-rays. Will the fetus be OK?

There is no risk of harm from X-rays.
Relax and enjoy your birth.

Q
Due to nausea and loss of appetite, I went to the hospital and had an abdominal X-ray. Later, I learned that I was pregnant. I was three months pregnant at the time of the X-ray. Is there any chance the radiation from the X-ray harmed the fetus?

A
The International Commission on Radiological Protection (ICRP) states that "termination of pregnancy at fetal doses of less than 100 milligrays [in this case equal to 100 mSv] is not justified based upon radiation risk."

When the atomic bombs were dropped on Hiroshima and Nagasaki, the fetuses carried by women who were then pregnant were exposed to very high levels of radiation, and some of the babies that were subsequently born suffered from microcephaly and other disorders. However, at radiation doses of less than 100 mSv, cases of microcephaly have not been observed. The ICRP statement is based on this knowledge. This guideline applies equally to exposure from a radiation disaster and exposure from a medical procedure.

When getting an abdominal X-ray, the dose of radiation the baby in the womb is exposed to would be around 200 microsieverts—that is, 0.02 mSv. This is far less than the 1 mSv safety reference level.

There is absolutely no need to become anxious about the effects of this kind of exposure on the baby. In any case, if the mother's stress levels increase, it will only negatively influence the baby in the womb. Try to be as relaxed as possible about the childbirth.

Also, if you are pregnant, or suspect you may be pregnant, then it's important to consider not just radiation, but also what kind of medications you take. When you have a medical consultation or examination at a healthcare facility, mention your pregnancy or suspected pregnancy with the doctor or nurse and consult with them to decide what kind of test or treatment is best for you.

Radiation exposure and the thryoid

The Role of the Thyroid

The thyroid is an internal organ at the front of the neck, shaped like the open wings of a butterfly. In adults it has a mass of around 15 to 20 grams, so it’s a relatively small organ. Its role is to produce thyroid hormone.

The functions of thyroid hormone are to metabolize energy and regulate the autonomic nervous system—the vital work of ensuring that our movements are balanced. If the level of thyroid increases or decreases too much, various disorders can occur.

When thyroid hormone levels are too high, this condition is known as hyperthyroidism. A well known disease that features hyperthyroidism is Graves’ disease, which is particularly prevalent amongst young females. In addition to a swollen thyroid, some of the various other symptoms of Graves’ disease, all resulting from an excess of thyroid hormone production, are heart palpitations, increased appetite, weight loss and hand tremors.

Conversely, when thyroid hormone levels are too low, this condition is known as hypothyroidism. This is most common amongst middle-aged and older women. In addition to an enlarged thyroid, other symptoms include dry skin, constipation and weight gain.

Both diseases can be diagnosed by measuring the levels of thyroid hormone or associated hormones with a blood test, or checking for the presence of thyroid autoantibodies. If you have symptoms that make you suspect that you may have one of these conditions, please consult your family doctor or visit your nearest healthcare facility.

How does the thyroid absorb radioactive iodine?

It is accumulated to synthesize hormone.
A seaweed-rich diet means Japanese tend to take in excess iodine.

Q
I hear that internal exposure to radiation can occur if radioactive iodine released from the Fukushima Daiichi Nuclear Power Station is absorbed into the thyroid. How does the radioactive iodine get absorbed? And why is it said that Japanese people don't absorb iodine easily?

A
The thyroid hormone that is secreted by the thyroid is synthesized from iodine. For this reason, much of the iodine in the human body tends to get stored in the thyroid.

Iodine occurs naturally at high concentrations in marine products, particularly seaweeds. Japanese people typically eat seaweeds such as *kombu* and *wakame* on a daily basis. Even people who don't eat *kombu* often take in plenty of iodine by eating dishes prepared using *kombu dashi* (soup stock). Therefore, Japanese generally consume more than enough iodine – in fact, many people probably ingest too much.

Internationally, Japan is quite unique in this regard, because in many regions of the world, the average iodine intake is low. Particularly in inland areas, many people do not get enough iodine, because their diet contains too little of it. This common condition is known as "iodine deficiency." In areas where there is iodine deficiency the thyroid becomes swollen, or its function deteriorates. For this reason, in recent years iodine has been added to commercial salt in many places, to try and alleviate the problem.

Immediately after the Fukushima Daiichi nuclear accident in March 2011 radioactive iodine was released into the atmosphere. Like ordinary iodine, radioactive iodine tends to accumulate in the thyroid once it gets into the body, thereby becoming a source of internal radiation exposure. In view of this, immediately after the accident, a provisional safety reference level (now safety reference level) was set for iodine, to try and minimize internal exposure to radiation from the thyroid, due to an excessive intake of food contaminated with radioactive iodine.

How are thyroid examinations for children performed?

Examinations are conducted by touching and by measuring hormone levels.
Ultrasound is used for detailed assessments.

Q
As part of a prefectural health management survey in response to the release of radiation from the Fukushima Daiichi Nuclear Power Station, children are being given thyroid examinations. When examining the condition of the thyroid, what kind of points are checked, and how are they checked?

A
There are several methods for examining the thyroid. The thyroid is an internal organ, but it is located at the surface of the body. If it is swollen, it can therefore be checked simply by palpation – that is, by touching the front of the neck using fingers.

As the thyroid secretes a hormone, operation of the thyroid can be checked by measuring the secreted hormone as well as "thyroid stimulating hormone" secreted by the hypophysis (gland in the cerebrum), which functions to regulate the secretion of thyroid hormone.

For example, in conditions where thyroid functions becomes elevated, like Graves' disease, thyroid hormone levels increases while the level of thyroid stimulating hormone decreases. Conversely, in conditions where thyroid function becomes depressed, thyroid hormone levels decrease while the level of thyroid stimulating hormone increases.

It is also possible to diagnose the state of thyroid function by measuring thyroid antibodies.

The ultrasound test conducted in the primary examination of the prefectural health management survey is very useful. It can make a detailed assessment of thyroid condition, by observing both the shape of the thyroid, and its size, and in some cases even the amount of blood present in the thyroid. In recent years, the quality of ultrasound systems has improved markedly, with vastly higher image resolution. Finely detailed structures that could not previously be understood can now be clearly revealed.

Thus, there are various types of thyroid tests, which can be combined according to the particular illness and purpose of the examination.

Some children have developed cysts in their thyroids. Is this a problem?

It’s not unusual. Many people have them.
For cysts 20 mm or less in size there is no need for a detailed examination.

Q
Thyroid examinations performed as part of a prefectural health management survey to assess the impact of the accident at the Fukushima Daiichi Nuclear Power Station discovered that some children have lumps or cysts. However, it was decided that there was no need for a detailed examination in these cases. Is this really OK?

A
Ultrasound examinations (echography) of thyroids conducted on children found lumps or cysts in some cases. However, children who had lumps 5 mm or less in size or cysts of 20 mm or less in size in their thyroids were classified with an “A2” test result. Most of these A2 cases were children with thyroid cysts.

These thyroid cysts are actually due to sacs in the thyroid that contain liquid. In some cases these are there from birth; in other cases, they appear temporarily and eventually disappear as children grow. Thyroid cysts are detected quite frequently in ultrasound examinations, and they are certainly not rare in children.

In recent years, as the resolution of ultrasound systems has increased markedly, extremely small cysts that could not be detected using older equipment can now be discovered. This is the main reason that cysts have been reported the thyroids of so many children.

Cysts that are not accompanied by any solid mass can be considered benign, so in most cases they are not treated. On the other hand, cysts that contain some solidity can be malignant in rare cases, but in these cases they are not really cysts but rather tubers (lumps). If these are 5.1 mm or more in size, including the liquid sac, they are classified as “B,” which requires a secondary examination. Therefore, children assessed as “A2” do not need to undergo a detailed examination at the present time.

By the way, no large-scale survey on the thyroids of children that includes an examination of the frequency of abnormalities has ever been performed in Japan. A number of ultrasound examinations of the thyroids of children are currently being planned in Nagasaki and other areas outside of Fukushima, and the results of these will be compared with those from Fukushima in order to better understand the frequency of abnormalities.

Is the presence of a small lump in the thyroid of a child a problem?

It's not a rare thing. Such lumps are mostly benign.
In some cases they disappear as children grow up.

Q

As part of a prefectural health management survey conducted by Fukushima Prefecture and Fukushima Medical University, ultrasound examinations were conducted on the thyroids of children. I often hear that lumps were found in the thyroids of some children, but the experts are saying that there are no effects on health. Is there really nothing to worry about?

A
Some of the children who had their thyroids examined with ultrasound equipment in this survey were found to have lumps up to 5 mm in size or cysts up to 20 mm in size. These children were assessed as "A2." The majority of these "A2" cases were due to thyroid cysts (sacs containing liquid). Some people are born with these kinds of thyroid cysts, while in other cases, they appear during the growing process and ultimately disappear as children get older. Thyroid tubers (lumps) and cysts are definitely not unusual among children, and they are mostly benign.

For this reason, for the present time these children do not need a blood test, urine test or any other kind of secondary examination – just like the "A1" cases, where no cyst or lump was detected.

In this prefectural health management survey if a cyst with a solid mass or a lump, or tuber, of size 5.1 mm or more is detected, the result is classified "B," for cases requiring a secondary examination. It is known that thyroid cancer generally develops very slowly and that in most cases it is not fatal. It is unlikely that the impact of exposure to the radiation released from the Fukushima Daiichi Nuclear Power Station after the accident could have caused severe health effects in just over one year and three months since the accident. It's important to make long-term observations to draw clear conclusions.

The prefecture is currently conducting its first round of ultrasound thyroid examinations. When this is completed, a second round of examinations is planned. It is necessary to continue conducting tests, in order to confirm whether there has been any change in the lumps or cysts since the previous examination.

What kind of illness is thyroid cancer?

It is quite common, but it develops slowly.
Many people live a normal life without even realizing they have it.

Q

People are worried about getting thyroid cancer as a result of exposure to the radioactive iodine released as a result of the accident at the Fukushima Daiichi Nuclear Power Station. I've also heard that there was a high incidence of this kind of cancer after the Chernobyl nuclear accident. What kind of disease is thyroid cancer?

A

As the name suggests, thyroid cancer is a cancer that occurs in the thyroid. Based on the appearance under a microscope the disease can be classified into several types. The most common, accounting for 80% or more of thyroid cancers, is called papillary thyroid cancer.

Compared to all other types of cancers, including cancers of other internal organs, papillary thyroid cancer develops slowly, and one of its characteristics is the difficulty of detecting any symptoms. It often happens, therefore, that people with very small tumors of only a few millimeters in size live with the disease without even realizing they have it.

Studies that have looked at the proportion of people who have this cancer, by performing post-mortem dissections, found that 10 to 20% of people typically have the disease, although the proportion varies a little between countries. In other words, thyroid cancer is relatively common, and many people live a full life without even noticing they have it.

Thyroid cancer can be diagnosed by an ultrasound examination or by collecting cells that are suspected to be cancerous and observing them under a microscope. If thyroid cancer is diagnosed and it is determined that treatment is required, the usual procedure is to cut out the cancer in a surgical procedure. In addition, since the thyroid is needed to produce thyroid hormone, if most of the thyroid is removed the hormone cannot be produced. In such cases, it is necessary to take a thyroid hormone preparation and to regulate its intake to maintain the appropriate concentration of the hormone in the body.

Why did so many thyroid cancers develop after the Chernobyl accident?

Genetic damage due to radiation exposure
Risk due to DNA replication errors

Q

I heard that the half-life of the radioactive iodine released after the accident at the Fukushima Daiichi Nuclear Power Station is very short – only a few days. But I also heard that many people near Chernobyl developed thyroid cancer years or even decades after the nuclear accident there. Why is that?

A

The main form of radioactive iodine is the isotope called iodine 131. Iodine 131 has a half-life of 8 days, which is relatively short, but while it is decaying, it emits radiation in the form of beta-rays and gamma-rays.

After the accident at Chernobyl, children consumed large quantities of food – in particular milk – that was contaminated with iodine 131 and other radioactive iodine. This is how radioactive iodine got into people's bodies, where it accumulated at high concentrations in the thyroid, resulting in high doses of internal radiation exposure.

As radioactive iodine has a short half-life, it effectively disappears after several months. However, while it is in the body the radiation that it emits causes genetic damage. Most of the damaged genes can be restored to their original condition, by the action of DNA repair genes. However, when a very large number of genes are damaged at once from exposure to high doses of radiation, some genes may not get repaired correctly. Within a few years or decades, any defective genes resulting from DNA replication errors can lead to cancer.

After the Chernobyl accident, this was the process by which the incidence of thyroid cancer increased, after internal exposure to radioactive iodine, despite the short half-life of this substance. Learning from this lesson, immediately following the accident at Fukushima in March 2011, measures were taken to limit internal exposure to radiation due to the intake of foods contaminated with radioactive iodine, by setting provisional safety reference levels for common foods. Currently, stricter safety reference levels are in effect.

Conclusion

Since the Great East Japan Earthquake of March 11, 2011 and the subsequent accident at the Fukushima Daiichi Nuclear Power Station, I have given talks on radiation and health for the local residents of Fukushima prefecture, in my capacity as "Radiation Health Risk Management Adviser to Fukushima Prefecture." In December 2011, I was also invited to write a regular column in a Q&A format for the Fukushima Minpo newspaper, about radiation and health. I have been writing this column every week since. Although I was not used to writing a regular column, thanks to the feedback, questions, and words of encouragement from many people, I have somehow managed to continue the column until now.

This pamphlet is a sequel to a similar one published in March 2012, under the title "Radiation and Radioactive Materials Q&A." It is a compilation of selected questions and answers published in my newspaper column, with some editing on my part.

The previous edition of the pamphlet was well received, and in addition to the first printing of 25,000 copies, I heard that many municipal governments printed additional copies to distribute to residents in their communities. As an author, there is no greater satisfaction than this. I pray that this pamphlet will also be of some value to the people of Fukushima.

Finally, I would like to extend my gratitude to Hiroshi Sakuma, who has worked tirelessly on the Q&A series for Fukushima Minpo newspaper; Toshiya Suzuki, for his hard work on producing this pamphlet; and to all the staff at the Department of Global Health, Medicine and Welfare, Atomic Bomb Disease Institute, Nagasaki University, who have supported me constantly in all my efforts.

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