

TECTONICS, RADIATION, CANCER

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Abstract

The article deals with the results of the dependence of the level of the morbidity and mortality rate from cancer of the population of some Latvian areas on the tectonic faulting and heightened content of the radioactive radon gas in the subsoil air.

The State Cancer Register provided reliable lung cancer morbidity and mortality data. The article presents the study results and obtained dependences between the level of the mortality from lung cancer of the population of Latvia, tectonic faulting and level of the radon hazard in the area.

Key words: cancer, lung cancer, population, tectonic, radiation, radon gas

The statistical data of the World Health Organisation for the last decades confirm an increase of mortality from cancer. In the early 20th century, the mortality from malignant tumours comprised less than 6% in relation to all other causes of death, while in the 21st century it is becoming one of three main causes of the mortality of the population [1].

There is no single universally recognised theory explaining the causes of cancer. The main hypotheses are the **chemical**, **viral** and **radioactive** ones.

According to the **radioactive hypothesis**, **radioactive irradiation of humans** is the cause of the occurrence of cancer (in particular, lung cancer). The hypothesis has been proven true in the second half of the 20th century. Rather shortly after the discovery of radioactivity, it became known that "any, even very insignificant dose of radiation, increases the probability of the occurrence of cancer in humans, receiving that dose, and any additional dose of radiation increases that probability even more" [2]. Besides, it was discovered that the probability of the occurrence of cancer is directly proportional to the dose of radiation.

According to the present-day opinions, the radiation cancer is caused by mutations, which change the genetic nature of cells, making it possible for them "to effect reproduction without end, which cannot be controlled by the organism" [3].

Humans learned about the existence of radiation cancer only after the discovery of radioactivity (not very long ago – only 150 years ago), and that problem has not been investigated well enough.

Specialists of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) in the book "Radiation (Doses, Effects, Risks), United Nations Environment Programme. 1985" wrote that **"there is no direct data at all regarding the impact of doses of radiation received by the population in everyday life"** [2].

Since the time when that book had been written, the situation improved, but not significantly. Even today, there are countries, which do not have legislation, which protects the population from the impact of the excessive earth radiation. There are still only a few publications on the impact of natural radiation on the population of large areas in everyday life. Not all medical personnel are aware of the carcinogenic and mutagenic properties of natural radiation, the input of which in the average yearly effective equivalent radiation dose for the population of our planet comprises approximately 4/5, while radon is the main source of that irradiation [2].

The higher the radioactivity of the topsoil, the sedimentary cover and the crystalline basement, the closer its top is to the earth surface and the heavier the earth crust is faulted and fractured, the greater quantity of radon reaches the earth surface.

Depending on the geological structure of an area, vast or local zones with high anomalous values of the volume activity of radon in the subsoil air could be singled out.

Considerable variations in the total individual radiation dose for the population of different countries and areas are observed. At the locations, where that dose exceeds the values, which are permissible for the human organisms, heightened incidence of and mortality from lung cancer are observed.

Speaking about the insufficiency of knowledge regarding this problem, two main items could be singled out: the absence of the statistical basis for investigations and absence of purposeful funding for scientific research in that sphere.

The connection of the external factors with the incidence of the disease and demographic indices of the population has been studied by "Urboekologija" Ltd. for the last twenty years.

Zoning of the territories in ten Latvian administrative districts taking into consideration geological and geophysical impact of the Earth was conducted.

One of the investigated problems was the dependence of the incidence of lung cancer of the population on various types of geological and geophysical impact. The purpose of the studies was to establish the reasons of the incidence of the illness, its zoning and develop recommendations for the reduction of the incidence of the disease and mortality from lung cancer. The investigations have demonstrated that the level of the incidence of the disease and mortality from lung cancer considerably depend on tectonic dislocations in the Earth crust.

The dependence of the incidence of lung cancer on the degree of faulting in the area was investigated in eight Latvian districts (including Saldus, Dobele, Ogre, Valmiera, Aluksne and Madona districts).

It was ascertained as a result that the population living in the areas with the existing tectonic faults demonstrates the incidence of lung cancer, which is 1.5-2 times higher than that in the country as a whole.

Faults in the crystalline basement and the permeable sedimentary cover create convenient channels for the influx of radon on the Earth surface, while a high content of uranium and thorium in granitoids is the reason for the heightened content of Rn in the subsoil air of the Kekava Parish (2nd-3rd level of radon hazard).

Measurements of the volume activity of radon in the subsoil air in the area of the Katlakalns fault have demonstrated that the volume activity of radon increases towards the fault, reaching 40 thousand Bq/m³ [8].

A reduction in the volume activity of radon to normal (10 thousand Bq/m³) was observed at the distance of 150 m from the fault. The spread of radon is facilitated by artificial or natural areas with loose soil. In that area, those are ramparts consisting of sand and gravel, created for the protection from the floodwater of the Daugava.

The Rn measurements in the subsoil air of Latvia allow to characterise it as an area of the predominantly 1st – 2nd levels of radon hazard, which increases to the 2nd-3rd levels in the vicinity of faults.

During the 20th century, due to the global warming and melting of the Arctic ice, the tectonic activity of faults in the Earth crust increased. Faults have become more permeable for radon. The increase in the influx of radon to the Earth surface has led to the heightened incidence of lung cancer in Latvia and all over the world.

Foreign data also demonstrate that lung cancer (especially among males) is the most widespread type of cancer, and that the mortality from that illness is.

Conclusions

1. Investigations of the volume activity of radon in the subsoil air carried out by “Urboekologija” Ltd. have demonstrated that Latvia belongs to the areas of the 1st and 2nd levels of the radon hazard.
2. Radon enters the Earth surface as a result of the decay of radionuclides of the crystalline basement through “leaks” in the Earth crust (faults and fractures); it spreads to the distance of 150 m and more from faults.
3. The volume of the influx of radon on the Earth surface depends on:
 - 3.1. the difference between the lithospheric and the atmospheric pressure;
 - 3.2. the tectonic activity of faults;
 - 3.3. the depth of the crystalline basement in an area;

- 3.4. the composition and radioactivity of the rocks of the crystalline basement;
- 3.5. the degree of the dislocation of the crust by faults and fractures.
4. Due to the global warming and more active processes on the Earth, the volume of the influx of radon from the crystalline basement has increased. That process could continue until the end of the 21st century and stop after a relative stabilisation of the tectonic movements of the crust.
5. Due to the more active tectonic activity in the 21st century, further increase in the incidence of lung cancer and mortality of the population from it could be expected.
6. The incidence of lung cancer over faults and in the zone of their impact (approximately 500 m on both sides from the fault) is 1.5 – 2 times higher than the average for the country.
7. A reduction in the level of the incidence of lung cancer and mortality from it could be achieved:
 - 7.1. as a result of the passing of laws introducing obligatory radon check-ups in the territories planned for development;
 - 7.2. as a result of the passing of legal and administrative acts concerning check-ups in premises under reconstruction;
 - 7.3. by using a set of protective measures preventing the influx of radon into premises and in the environment (radon screens, gas proofing, ventilation etc.).

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