Priorities of iodine prophylaxis in Ukraine in context of ensuring radiation safety

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Abstract. The current problems were analyzed and the priorities of iodine prophylaxis in Ukraine in the event of a radiation accident at the nuclear power plant in the conditions of Russian military aggression against Ukraine were determined.

Keywords: radiation security priorities environmental security iodine prophylaxis military aggression
Russian military aggression against Ukraine led to the formation of new risks of radiation accidents at nuclear power plants with negative consequences for the population and the environment. The capture of the Zaporizhzhia Nuclear Power Plant (ZNPP) by Russian troops in early March 2022 significantly worsened its security level and created new threats to the radiation and environmental security of Ukraine and Europe.

Due to the dismantling and theft of important system elements by the Russian troops, the failure of computer equipment components, significant efforts and resources are needed to restore the physical protection system at the station. Also, due to the actions of the Russian military, the system of emergency preparedness and response at the ZNPP almost completely degraded [1].

Ukraine’s Zaporizhzhya Nuclear Power Plant (ZNPP) has been without external back-up power for three months now, leaving it extremely vulnerable in case the sole functioning main power line goes down again and underlining the importance of adhering to five principles established by the International Atomic Energy Agency (IAEA) for the protection of the facility during the military conflict [2].

In conditions of high probability of occurrence of emergency situations at nuclear power plants with release of radioactive substances into the surrounding natural environment, measures aimed at protecting the population from possible exposure come to the fore. One of the effective means of protecting the population in such cases is iodine prophylaxis.

When radioactive isotopes of iodine are released because of a nuclear power plant accident and enter the human body, the thyroid gland absorbs it and is exposed to radiation. If the potassium iodide (PI) is introduced into the body before or during the introduction of radioactive iodine, the entry of radioactive isotopes of iodine is blocked, which reduces or diverts radiation exposure of the thyroid gland and reduces the risk of negative consequences for human health. At the same time, PI does not protect the body from the biological action of other radionuclides that may be contained in the radiation emission.
Iodine prophylaxis is an urgent protective measure to prevent or reduce the absorption of radioactive isotopes of iodine by the thyroid gland, with the help of potassium iodide, aimed at protecting the thyroid gland. Iodine prevention belongs to urgent measures aimed at preventing the negative impact of the early phase of a radiation accident.

The risk of radiation damage to the thyroid gland can be reduced or even averted with the timely appointment of iodine prophylaxis as such or in combination with other radiation protection measures: restriction of exposure to open air, shelter, evacuation, radiation control of food products, including drinking water, etc.

In order to streamline the specifics of iodine prophylaxis of the population in the event of emergency situations at nuclear power plants and other nuclear installations with the release of radioactive substances, the Ministry of Health of Ukraine (MOH) in March 2021 adopted the Regulation on iodine prophylaxis in the event of a radiation accident [3].

The regulation establishes the following age groups and dosages of stable iodine (potassium iodide): children up to 1 month (infants and children who are breastfed) - 16 mg, children from 1 month to 3 years - 32 mg, children from 3 to 12 years old - 62.5 mg, adolescents from 13 to 18 years old, adults up to 40 years old, breastfeeding mothers - 125 mg.

If these data are compared with the recommendations of the World Health Organization (WHO), certain deviations can be noted [4] (table 1).

<table>
<thead>
<tr>
<th>Population group, age (MOH)</th>
<th>Dosage in milligrams of PI (MoH)</th>
<th>Dosage in milligrams PI (WHO)</th>
<th>Population group, age (WHO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babies (from birth to 1 month)</td>
<td>~16</td>
<td>16</td>
<td>Neonatal period (&lt;1 month)</td>
</tr>
<tr>
<td>Children from 1 month to 3 years</td>
<td>~32</td>
<td>32</td>
<td>Children from 1 month to 3 years</td>
</tr>
</tbody>
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The data indicate a certain inconsistency of the dosage of KI according to the standard of the Ministry of Health from the recommendations of the WHO for children from 3 to 12 years old, as well as for adults and children after 12 years old. It should also be noted that the WHO does not distinguish a separate age group under 40 years that is subject to protection of the thyroid gland from the accumulation of radioactive isotopes of iodine.

Today in Ukraine PJSC "Pharmaceutical firm "Darnytsia" produces tablets Potassium iodide-125-Darnytsia with a dosage of 125 mg in accordance with registration UA/19348/01/01 by order No. 693 dated 04/26/2022. According to the instructions for use and dosage of Potassium iodide-125-Darnytsia, after an official notification of a radiation accident and when there is a threat of radioactive iodine entering the body, it is recommended to prescribe:

- adults and children over 12 years of age: 125 mg (1 tablet) once a day;
- children aged 3 to 12 years: 62.5 mg (1/2 tablet) once a day.

A tablet or half a tablet can be taken after a meal with a small amount of water. For children, crush the tablet and take it after dissolving it in a small amount of water or milk. The optimal effect of taking the drug Potassium iodide-125-Darnytsia is possible if the drug is taken in advance (preventive) 6 hours or less before exposure.

Given the different doses of PI for the relevant population groups, it is advisable to resolve the issue of releasing potassium iodide tablets in the doses recommended by the WHO.

According to the Regulations of the Ministry of Health, in the event of a radiation accident, the need for iodine...
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prophylaxis arises, first of all, in relation to the population living in NPP satellite cities, as well as settlements located in the monitoring zones of nuclear installations. At the same time, the issue of iodine prophylaxis for the population outside the monitoring zone (30 km) remains open and requires further justification and resolution.

In this context, it should be noted that the Belgian government in 2016 decided to increase from 20 km to 100 km around the NPP the preventive distribution zone of stable iodine preparations to the population, which, taking into account the location of the NPP, covers the entire territory of the country [5].

In addition, the issue of defining emergency planning zones around NPPs in accordance with IAEA recommendations needs to be resolved. This is very important given that one of the reasons for the delay in responding to the accident at the Fukushima Daichi NPP, experts recognized the non-compliance of the zones defined around it with the IAEA recommendations on emergency planning zones [6].

Conclusions

Due to the seizure of the ZNPP by Russian troops, the risks to the state's radiation and environmental security have increased significantly. At the same time, the large-scale impact of negative consequences and effects for the environment from Russian armed aggression can spread to the territory of almost the entire European continent and, in general, will lead to a significant imbalance of ecosystems not only in Ukraine, but also in the EU for decades.

Taking into account that the experience of emergency drills at NPPs in other countries shows the difficulty of providing the population with iodine preparations in a timely manner, even when these preparations are available, it is necessary to carry out measures to conduct appropriate exercises with the involvement of all responsible structures of the Ministry of Health, State Emergency Situations, and regional military administrations.

Therefore, in order to improve the level of protection of the population and ensure iodine prophylaxis in the event of a radiation accident at a nuclear power plant in the
conditions of Russian military aggression against Ukraine, it seems appropriate for the Ministry of Health of Ukraine, with the involvement of pharmaceutical companies, to resolve the issue of releasing tableted potassium iodide in doses recommended by the WHO.

The State Emergency Service of Ukraine, together with the Zaporizhzhia Regional State Administration and other regional administrative authorities, must conduct emergency training in order to practice coordination and provide the population with iodine preparations in a timely manner in the event of a radiation accident. Based on the results of emergency training it is necessary to make an appropriate adjustments to the object and territorial response plans for radiation accidents.

References: