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URINARY IODINE EXCRETION FROM THE ^{125}I-RIA LABORATORY PERSONNEL IN INEP

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Summary: The aim of this study was to examine urinary iodine excretion from the ^{125}I-RIA-INEP laboratory personnel. Radiodosimetric measurements have shown that people received ionization energy doses that were significantly bellow the permissible levels, i.e. 0.15 0.45 mSv. The amount of iodide in urine varied from 123 to 396 μg/L (1.0 3.2 μmol/L) and the mean value was 264 μg/L (2.1 μmol/L; n = 25, SD = 75.3 μg/L or 0.60 μmol/L, CV = 28.5 %). On the basis of the obtained data it can be concluded that professionaly exposed individuals in the examined laboratory consume sufficient amount of dietary iodine, thus, minimizing a risk of internal accumulation of ^{125}I.

Key words: iodine excretion, RIA laboratory.

Introduction

Utilization of diagnostic tests that contain ^{125}I-labelled components requires a monitoring method that indicates a degree of environmental contamination and exposure of the personnel. Radiodosimetric measurements correlate with the intensity of the ionization energy received externally and they are not an indicator of the internal accumulation of a radioactive chemical. Iodine is a volatile chemical at room temperature and could be inhaled. It concentrates mainly in the thyroid gland. A detailed examination of thyroid radiocontamination is not a routine monitoring test and, when performed, it is applied to the workers that are involved directly in ^{125}I-labelling. Compared to several persons that perform labelling there are much more that spend years in routine diagnostic analysis using radioiodine-labelled compounds. The aim of this study was to investigate whether a dietary iodine intake by RIA-INEP laboratory personnel is sufficient to minimize a potential risk of ^{125}I accumulation.

The most reliable method for assessing iodine supplementation is 24 h urinary excretion, as urine is the predominant excretory route for iodide and, thus, reflects iodine intake (1). Acute changes in iodine intake can be observed in 24 h urine samples within 1 2 days (2), whereas long-term changes in urinary iodide output with full adaptation of thyroid metabolism take at least 4 months (3). Iodide measurement in this study was based on the catalytic effect of iodide on the redox reaction between ceric and arsenic ions (4). Iodide excretion of the examined workers was, also, compared to results obtained in population study of the same region (5).

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Materials and methods

Twenty-five workers from the Institute for the Application of Nuclear Energy (INEP) donated urine samples. Workers, aged 28 58 years, have spent 2 32 years in the laboratory for nuclear medicine. No one complained of having any thyroid disease.

Urine samples (0.5 mL) were pipetted into crusibles and incinerated at 600 ^{2}C in the presence of 17.5 mol/L KOH (0.2 mL). Freshly deionized bidistilled water as sample blank and assay standard (KI, 40 μg/L or 0.32 μmol/L) were treated in the same way; 5.0 mL of freshly deionized bidistilled water was added to the cooled crusibles and 1 h later suspensions were centrifuged at 3000 × g for 10 min. The redox reaction was performed in spectrophotometric cuvettes at 24 ^{2}C, using 1.0 mL 0.003 mol/L Ce-reagent (cerium-ammonium-sulphate), 0.5 mL supernate and 0.5 mL 0.02 mol/L As-reagent (arsen-trioxide) (6). After thorough mixing for 5 s the absorbance was monitored at 420 nm at 15 s intervals for 2 min. Standard iodide solutions ranged from 2 to 10 ng per reaction mixture. A slope $\Delta A/\Delta t$ was determined for each sample and the amount of iodide was calculated using a linear function $\Delta A/\Delta t = f(c\ I^-)$.

Data were analysed by Student's *t* probability distribution.

Results

Personal radiodosimeters registered monthly levels from 0.15 to 0.45 mSv, while the permitted monthly dose is 4 mSv. The amount of iodide in urine varied from 123 to 396 μg/L (1.0 3.2 μmol/L) and the mean value was 264 μg/L (2.1 μmol/L; n = 25, SD = 75.3 μg/L or 0.60 μmol/L, CV = 28.5 %). A probability distribution of the obtained values is presented in *Figure 1.*

Discussion

Examination of 30 workers performing routine ^{125}I-labelling in Brazil demonstrated that 25 of them presented a significant radioactivity of their thyroids (7). The maximum thyroidal concentration was 24 kBq (the specific activity of ^{125}I is 642 kBq/ng). Although the authors stated that all values were below maximal permissible burden, there is controversy regarding the defined annual limit on intake of ^{125}I. ^{125}I activities used for labelling in INEP range from 18 to 185 MBq. Concequences of thyroid radiation are numerous. After a latent period of 6 10 years after acute contamination, intrathyroidal adenomas and carcinomas may develop, followed by thyroid insufficiency and permanent hypothyroidism (8). Although radiation is the only well defined risk factor for thyroid carcinoma, no clear risk increase has been shown following diagnostic and therapeutic ^{131}I exposure (9). Physico-chemical characteristics of a particular radioisotope are, obviously, a determining factor.

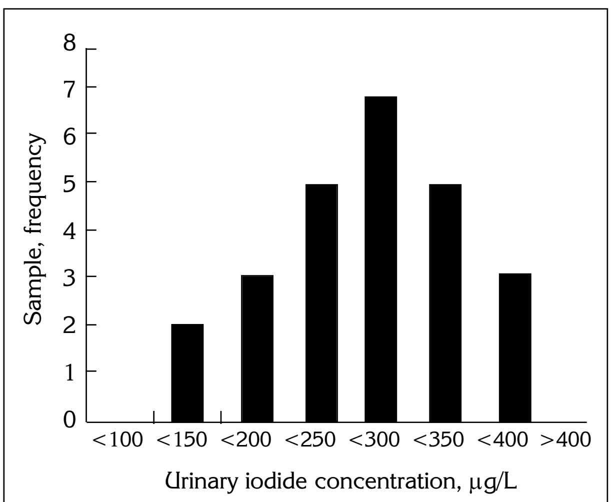

Figure 1. Probability distribution of the measured values for urinary iodide concentration in ^{125}I-RIA-INEP laboratory personnel.

$^{125}I_2$ from the atmosphere could enter the body via skin absorption or across mucous membranes. Acute iodine excess is usually a result of direct ingestion as a dietary iodine or administration of organic iodine compounds which release iodide during degradation (10). Dietary iodine is rapidly and almost completely absorbed from the gastrointestinal tract after being converted to inorganic iodide and protein sodium-iodide symporter (NIS) mediates iodine accumulation in thyrocytes against an electrochemical gradient (11). Some extrathyroidal tissues express iodide uptake activity to a minor extent (salivary glands, gastric mucosa, mammary glands), but there is no organification (12). High levels of hNIS mRNA were observed also in parotid gland, pituitary gland and thymus, while lower levels were found in heart, submandibular gland and nasopharyngeal mucosa (13). When discussing a problem of ^{125}I contamination, thyroid gland, therefore, is not the only organ affected, although 80 % of the total body iodine is confined to this gland (14).

Experimental results of this study showed that analysed workers received radioactivity doses far below the maximum permissible amounts. Urinary iodide content of all tested persons was at the level of Belgrade population (the mean value was 280 μg/L or 2.2 μmol/L) (5). The results also agree with those of Simić and coworkers (15), who examined iodine status of the school children (7 15 years) in Serbia. They have found urinary excretion to range from 20 to 803 μg/L, with the mean value of 158 μg/L. A large scatter of values (high CV), however, was noticed indicating individual variations in nutritional habits.

Monitored urinary iodide levels are considered to be good, since a daily recommended nutritional intake, according to World Health Organization (WHO), is 150 μg for adults (16). It is, also, significantly below the maximum tolerable intake which is 1000 μg a day (8.1 μmol/d) (17). Study of Ermans (18) demonstrated that the amount and the rate of radioactive iodine accumulation in thyroid gland is inversly proportional to dietary iodine intake. With urinary excretion of 250 μg iodide daily approximately 27 % of ^{131}I accumulated in the thyroid (measured as percentage of administered radioactivity dose). Appropriate stable iodine intake ensures minimum consequences of radioiodine contamination. The easiest way to augment total iodine intake is by using iodized table salt, as well as by consuming greater amounts of iodine rich food (17, 19).

IZLUČIVANJE JODA URINOM ZAPOSLENIH U ^{125}I-RIA LABORATORIJI INEP

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Kratak sadržaj: Cilj ovog rada je bio da se ispita izlučivanje joda urinom zaposlenih u ^{125}I-RIA-INEP laboratoriji. Radiodozimetrijska merenja su pokazala da su radnici bili izloženi dozama jonizujućeg zračenja koje su bile znatno ispod dozvoljenog nivoa, odnosno 0,15 0,45 mSv. Koncentracija jodida u urinu se kretala od 123 do 396 μg/L (1,0 3,2 μmol/L), a srednja vrednost je bila 264 μg/L (2,1 μmol/L; n = 25, SD = 75,3 μg/L ili 0,60 μmol/L, CV = 28,5 %). Na osnovu dobijenih podataka može se zaključiti da profesionalno izložena lica u ispitanoj laboratoriji unose dovoljne količine joda hranom, čime se rizik od unutrašnje akumulacije ^{125}I svodi na minimum.

Ključne reči: izlučivanje joda, RIA laboratorija.

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