SCIENTIFIC NOTE

OCCUPATIONAL EXPOSURE OF MEDICAL RADIATION WORKERS IN LITHUANIA, 1950–2003

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This study presents the summary of historical exposures, measurement practice and evolution of the recording of the individual doses of medical radiation workers during 1950–2003 in Lithuania. The aim of this study is to present occupational exposure of medical radiation workers in Lithuania since the earliest appearance period. Data from publications have been used for the earliest two periods prior to 1969; data from the archives of the largest hospitals, for the period 1970–1990 and data from Lithuanian Subdivision of Individual Dosimetry of Radiation Protection Center, for the period 1991–2003. The analysis of the data obtained from personal records allows to conclude that the average annual effective dose of Lithuanian medical radiation workers was greatly reduced in radiology, radiotherapy and nuclear medicine in all occupational categories from 1950 to 2003. During the last period 1991–2003 extremity doses clearly decreased and after 1994 were no longer present in Lithuania.

INTRODUCTION

There are quite a few known facts about practice of the measurement, validation of the radiation exposure of the medical radiation workers in Lithuania while it was incorporated in the USSR from 1950 to 1990. The main sources on radiation measurement practice and data on occupational exposures in the former USSR were summarised in manuals and the literature on radiation safety, measuring instruments and methods of measurements that were available since 1959 (1–6). The information on occupational exposure was limited to the broad occupational categories; no case–control or cohort data on radiologists were available. The information of doses for nuclear and medical radiation workers was being collected very precisely in the former USSR, but the access to data pertaining to individual doses was restricted. Nuclear workers were predominantly exposed to low occupational doses over a long period and, in general, reliable individual dosimetric data are usually available (7,8). The systematic radiation-related studies for medical radiation workers in Lithuania are being performed since 1991 (9–12).

The first information on medical radiation workers in Lithuania was obtained in 1972 (13,14). Studies of similar nature began in other countries of the former USSR (15,16) and worldwide almost at the same time, but only the cohorts in Japan, China and Canada had sufficient power to supply the featured dose information (17). There is a lack of studies about overall individual dosimetry among medical radiation workers.

The authors present a summary of the historical exposures and measurement practice and the evolution of recording of individual doses to medical radiation workers during 1950–2003 in Lithuania. The aim of this study is to present occupational exposure (the average annual effective dose) of medical radiation workers in Lithuania since the earliest appearance period.

MATERIALS AND METHODS

Medical radiation workers consist of three occupational categories, according to job classification: radiology, radiotherapy and nuclear medicine. The occupational exposure data for the radiology group were being traced in all available archives since 1950; for radiotherapy, since 1960 and for nuclear medicine, since 1970. These periods correspond to the start of extensive application of radiology, radiotherapy and nuclear medicine in Lithuania. Because the availability and quality of badge dose record data differs as per the period, the data were grouped into periods: prior to 1959, 1960–1969, 1970–1990, 1991–2003. For the earliest two periods prior to 1969 we have used data from publications (13,14), for the period 1970–1990, data from the archives of the largest hospitals; for the period 1991–2003, data from the Lithuanian Subdivision of Individual Dosimetry of Radiation Protection Center (RPC).

The average annual effective dose of medical radiation workers was estimated by correlating to the types of dosimeter in all periods and practices applied and compared with the doses of the medical radiation workers in other countries. Three methods of individual dosimetry were the most common in

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Table 1. Badge dose estimation methods by periods.

<table>
<thead>
<tr>
<th>Countries</th>
<th>Ionisation chambers, Film</th>
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<td>Norway, Netherlands</td>
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Figure 1. Types of dosemeters.

240
The measuring ranges, resolutions and frequency of monitoring of the dosemeters are shown in Table 2.

All types of dosemeters have been used during the period of time under consideration, so the value of 0.1 mSv was used as the minimum detectable level, and all doses below this value have been considered as zero doses. Our estimates of annual doses on occupational exposure for cohort of the Lithuanian medical radiation workers in the periods 1950–1959 and 1960–1969 are based on data from reports in the literature (13,14) of personal badge dose records. The dosimetry data on occupational exposure for the period 1970–1990 were taken from unpublished sources of the archives of radiology departments in the largest hospitals. The dosimetry data for the last period 1991–2003 was received from RPC. Current individual monitoring for external radiation is performed at the national RPC using the RADOS Thermoluminescence Dosimetry System (TLD), Finland.

RESULTS AND DISCUSSION

The number of monitored medical radiation workers in all occupational categories increased in Lithuania (Table 3). They are similar to the data from other countries (20–24).

The working basis in the former USSR includes a period 1950–1990. The next period started in 1991,
when Lithuania became independent. The average annual effective dose steadily decreased by a factor of 3 (from 1950 to 1960), a factor of 8 (from 1960 to 1970), and was constant (from 1970 to 1991) among radiology workers; decreased by a factor of 2 (from 1960 to 1970 and from 1970 to 1991) among radiotherapy workers and decreased by a factor of 2 (from 1970 to 1991) among nuclear medicine workers in Lithuania (Figure 2).

The evaluation of extremity and highest (max) doses for medical radiation workers in Lithuania confirmed the absence of doses >50 mSv (Table 4).

Considering the fact that the differences may be explained by a variety of monitoring procedures and practices, the different level of irradiation units used and different legislation of the occupational exposure in the countries, we have selected countries with analogous practices of TLD dosimetry, units used in same periods. We present this data in the Table 6. The occupational exposure was different among medical radiation workers in selected countries with analogous monitoring procedures and practices. For example, the study shows that in the period 1996–2000 the occupational exposure was twice as high in Lithuania and China than in Finland, Netherlands, Norway and Greece.

CONCLUSIONS

The occupational exposure of the Lithuanian medical radiation workers generally matches other published studies.

The analysis of data obtained from personal records allows to conclude that the average annual effective dose of Lithuanian medical radiation workers was greatly reduced in radiology, radiotherapy and nuclear medicine in all occupational categories from 1950 to 2003. During the last period 1991–2003, extremity doses clearly decreased and after 1994 were no longer present in Lithuania.

Although 78% of the Lithuanian medical radiation workers received individual doses below 5 mSv, the average annual effective doses were twice as high in Lithuania, China and Poland compared to other countries that were using analogous monitoring procedures and practice (TLD only) in the period 1996–2000.

REFERENCES