Hand Dose in Nuclear Medicine Staff Members

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ABSTRACT

Measurement of the hand dose during preparation and injection of radiopharmaceuticals is useful in the assessment of the extremity doses received by nuclear medicine personnel. Hand radiation doses to the occupational workers that handling ^{99m}Tc-labeled compounds, ^{131}I for diagnostic in nuclear medicine were measured by thermoluminescence dosimetry. A convenient method is to use a TLD ring dosimeter for measuring doses of the diagnostic units of different nuclear medicine facilities . Their doses were reported in millisieverts that accumulated in 4 weeks. The radiation doses to the hands of nuclear medicine staff at the hospitals under study were measured. The maximum expected annual dose to the extremities appeared to be less than the annual limit (500 mSv/y) because all of these workers are on rotation and do not constantly handle radioactivity throughout the year.

Key Words: *Finger radiation dose; TLD; Radiopharmaceuticals*

INTRODUCTION

The most commonly used radio-nuclides in nuclear medicine are ^{99m}Tc and ^{131}I. Their applications have been continuously increasing for diagnostic procedures in most of the nuclear medicine facilities in Egypt. Although such an increase is a positive trend for the benefit of patients, the associated risk of radiation exposure of staff needs to be properly evaluated. Generally, occupational workers are routinely monitored for their effective whole-body doses by use of chest badges in most of the nuclear medicine centers in Egypt. The equivalent doses to the fingers, which are closest to the radioactive sources during handling, are rarely measured. The measurement of radiation doses to the fingers of staff involved in handling large quantities of radioactivity not only indicates the level of radiation safety standards maintained at a given hospital but also can act as a guide for safe work practice.

Thermoluminescence dosimetry disks are normally used to measure radiation doses to the fingers of staff involved in handling radioactivity (*1*,*2*). The present study LiF,Cu,Mg,P TLD-100H which sensitive for low and high doses will use to estimate the radiation doses to the ring finger of staff handling large quantities of ^{99m}Tc and ^{131}I for diagnostic procedures.

MATERIALS AND METHOD

Thermoluminescence dosimeters (TLD; Harshaw. Inc.) consisting of square measuring 0.35 mm (diameter) by 0.35 mm (thickness) were used in this study for measuring finger

doses for staff handling ^{99m}Tc-labeled compounds and ^{131}I for diagnosis cases. . The sensitivity variations of the used TLD(s) were less than ±10%.

The TLD were inserted in a plastic ring holder that could be adjusted for any finger size. The occupational workers wore them at the base of finger of the operating hand. The workers wearing these TLD were advised to wear rubber gloves over them to avoid any possible radioactive contamination. The TLD were kept in a low-background-radiation area when not in use.

The workers were evaluated from the diagnostic unit. These workers handled ^{99m}Tc-labeled compounds and eluted ^{99}mTc (from the ^{99}Mo-^{99m}Tc generator) and the preparation of ^{99m}Tc-labeled compounds for diagnostic procedures. Doses to the finger base of diagnostic worker were measured.

A control ring was kept in a low-background-radiation area for measuring the background response of the TLD. The staff used the ring dosimeters for 1 wk and returned them for measurements. Some of them were issued another batch of ring dosimeters for the next week if they had to perform identical work. The process was repeated for 4 wk for some of the workers. Thus, we could measure the finger doses for workers for a period ranging from 1 to 4 wk.

Exposed TLD were read with a Harshaw TLD reader. The doses were expressed in microsieverts or millisieverts by use of the reference dose calibrator.

RESULTS

Irradiated TLD chips with different doses of ^{90}Sr irradiator were read by TLD-Reader. The individual response for each TLD-chip was obtained and corrected for background. The method used for the calibration procedure is described elsewhere [3]. The linearity of the different irradiated doses of irradiator against response of TLD-100H was presented in Fig.1. Table 1 shows the radiation doses to the hands of the diagnostic workers. As expected, the radiation doses to the hands of the nurses involved in intravenous administration were observed to be higher than those for the radiopharmacy staff whom are prepared the isotopes.

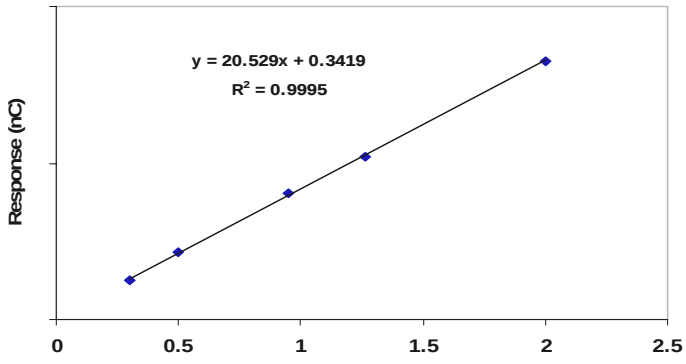

Fig.1. Doses Versus Response of TLD-100H

Table 1 Hand Doses for Group diagnostic workers Involved in handling I-131 and ^{99m}Tc-Labeled Compounds in two of the nuclear medicine facilities.

Workers	Activity handled/Month (GBq)	Dose (mSv) Accumulated in 1 Month
Radiopharmacy Laboratory		
1	29.6	2.40
2	37	0.99
3	29.6	1.20
4	44.4	1.48
Isotopes Injection		
5	29.6	0.5
6	22.2	0.12
Imaging technicians		
7		0.96
8		0.60
9		0.44
10		1.28

DISCUSSION

Staff preparing , administering and injecting radiopharmaceuticals in nuclear medicine, for diagnostic imaging application, may receive significant radiation doses to their hands, particularly the fingers. Ring dosimeters are useful for measuring doses at the fingers of staff handling large quantities of Radiopharmaceuticals in nuclear medicine facilities. Finger doses can serve as a guide to suggest any needed modification in work practice to minimize radiation doses to the extremities. For all of the workers in this study, doses to the ring fingers that accumulated in 4 weeks suggested that exposure was not likely to exceed the annual limit of 500 mSv/y in our facility.

In this study, relatively higher finger doses were observed for technician whom prepared radiopharmaceticals in hot laboratory , that gives indicator that the fume hood may be need to clean daily and check its negative pressure. The equivalent doses during injection were lower than that doses during preparation due to using lead syring during injection. The equivalent doses to extremities are lower than of the extremity dose limit during the measured periods. (The dose limit is 500 mSv/year) i.e the maximum dose received is lower than the dose limit . In our practice, exposure is not likely to exceed the annual limit of 500 mSv for any one of the staff members under normal prevailing work circumstances. [(4)]

CONCLUSION

The extremities annual doses were not exceed the annual dose limit. This gave indicator that the safety of the operational practice. To control exposure to the fingers, syringe shields made of lead or tungsten recommended to use to minimize the dose to extent, As Low As

Reasonable Achievable, (ALARA). It is advised to clean the fume hood and remove the contaminated sheet daily to minimize the doses for the extremity

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