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Assessment of extremity exposure during 18F-FDG injection with automatic injection system

The extremity exposure monitoring of nuclear medicine personnel is essential to control exposure in the workplace, to ensure that legal limits are not exceeded, to predict extremity doses and, if possible, to optimize workflow. Distribution of the doses over hand is nonuniform and the obtained doses by Hp(0.07) passive dosimeter can be significantly lower compared to fingertips. There are only limited scientific publications referencing detailed studies on hand exposure in the process of work with automated infusion and injection systems. The aim of this study was to assess the extremity exposure of nuclear medicine personnel working with automatic infusion system dedicated for 18F-FDG administration.
Materials and methods:
For the measurements of hand doses, thermoluminescent dosimeters (TLD-100 (LiF:Mg, Ti)) chips were used. The thickness of these dosimeters was 2 mm, the diameter 4.5 mm. TLD-100 chips were calibrated 18F source in a dose range of 0.25-2 mSv.
Dosimeters were attached to both hands on a palm side at 14 locations (dosimeters No. 1-14, 7 chips on each hand) under disposable gloves (Fig. 1.). Additionally, to evaluate and compare the difference between obtained doses from typical monitoring position (base of a middle finger of the dominant hand) and the most exposed part, dosimeter No. 15 was attached in part of the measurements while working with 18F. Each technologist working with 18F wore dosimeters from 5 to 6 working days depending on total radionuclide activity.
Working process include 18F-FDG administration in injection room with the automatic infusion/injection system IRIDE (Comecer).
The activity range of administration of 18F for one measurement of dosimeters was 10.76-16.65 GBq (average 12.48 ± 2.94). The right hand was the dominant hand of all radiology technologists. The measured doses were normalized per manipulated activity (mSv/GBq).

Fig. 1. TLDs positions on the radiology technologist palms.
Results and discussion:
Working with 18F, the distribution over different points of hands did not differ significantly, as the average hand dose for the left and the right hands resulted in the dose of 25.64 ± 12.38 and 25.72 ± 6.2 μSv/GBq, respectively. The highest doses were observed by the right hand thumb tip, index finger tip and middle finger tip resulting in doses of 36.1, 33.2, 35.4 μSv/GBq, respectively (Fig. 2.). The least exposed part was the right hand wrist (12.67 μSv/GBq).
In general, the monitoring of extremity exposure performed with one dosimeter wearing on one finger of dominate hand, but to ensure an appropriate radiological protection for workers, the coefficient should be applied considering the injection/infusion system and working practice.

Fig. 2. Hand dose distribution of different TLD positions while working with 18F (N = 5)
Conclusions:
The results of our study showed that the most exposed parts while working with open radioactive sources are fingertips of thumb, index finger and middle finger, thus, monitoring of these points would be the most expedient. Also, it was found that the maximum fingertip doses are 1.3-1.7 times higher compared with the doses from typical monitoring position (base of a middle finger of the dominant hand).

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