

Radiation Exposure to Sonographers from Fluorine-18-FDG PET Patients

Merrill Griff, Thomas Berthold, and Alfred Buck

University Hospital Zurich, Zurich, Switzerland

Objective: We estimated the amount of radiation exposure to sonographers from patients who were injected with ^{18}F -fluorodeoxyglucose (FDG) at 2 and 3 h postinjection.

Methods: We studied 8 patients who were given between 380–420 MBq ^{18}F -FDG. The patients were measured with a RADOS RDS-120 dosimeter between 2 and 3 h after FDG injection. The dosimetry measurement was taken at a distance of 0.5 m from the injected patient, a distance used by a sonographer to perform an abdominal ultrasound. Measurements were taken at the levels of the sonographer's shoulder, abdomen, and gonads.

Results: At the first measurement at 2 h, the mean exposures to the shoulder, abdomen, and gonads of the sonographer in $\mu\text{Sv/h}$ were 31.9 ± 11.3 , 37.1 ± 9.5 , and 32.8 ± 11.8 , respectively. At 3 h, the mean exposures to the shoulder, abdomen, and gonads were 21.5 ± 4.2 , 20.2 ± 5.8 , and 19.6 ± 4.9 , respectively.

Conclusion: The amount of radiation exposure to a sonographer is minimal. Radiation exposure risks should be considered, however, if the sonographer comes into daily, repeated contact with patients who have been given ^{18}F -FDG.

Key Words: fluorine-18-fluorodeoxyglucose; radiation exposure; sonographers

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In this study we looked at one group of ancillary health workers, ultrasonographers, who were exposed to PET patients at 2 and 3 h postinjection of ^{18}F -fluorodeoxyglucose (FDG). We determined the amount of radiation exposure to sonographers from these PET patients.

MATERIALS AND METHODS

We studied 8 adult patients who had whole-body ^{18}F -FDG PET scans. Intravenous ^{18}F -FDG ranged from 380–420 MBq. All patients were scanned beginning at 1 h postinjection. The whole-body PET scan acquisition times ranged from 45–60

min. After their PET scans were completed, the patients were transported to an ultrasound exam room where the abdominal ultrasound examinations were simulated and the exposure rates were measured. Each patient had 2 simulated abdominal sonograms, one at 2 h postinjection and the other at 3 h postinjection. The mean simulated sonogram time was 30 min, which is the average time needed for routine abdominal sonography. The survey instrument was a calibrated RADOS-120 dosimeter (Alnor Oy, Turku, Finland), which expresses exposure units in $\mu\text{Sv/h}$. Exposure rate measurements were collected at a clinically relevant distance of 0.5 m from the patient. These were taken at the levels of the sonographer's shoulder, abdomen, and gonads. Room background exposure rates also were measured in the absence of the patient.

RESULTS

The mean background radiation of the ultrasound examination room was $0.1 \mu\text{Sv/h}$. Background-corrected exposure rates to the sonographer are listed in Table 1 for the 2 time intervals that we recorded. The highest exposure reading at 2 h postinjection (Patient 8) was attributed to the patient's inability to void before the first sonogram.

DISCUSSION

The concept of nuclear medicine patients as a source of occupational exposure to other allied health personnel is not a new one (1). Harding et al. (2) found that the exposure rates rarely exceeded $20 \mu\text{Sv/h}$ for personnel accompanying or caring for nuclear medicine patients for periods of hours (2,3). Most of these reports, however, do not include patients who were administered PET radiotracers. The cardinal principles of radiation protection—time, distance, and shielding—must be reevaluated carefully with PET radiopharmaceuticals. Shielding requirements of 0.511-Mev photon emitters are much greater and, generally, impractical outside the nuclear medicine department (4,5). Sonographers also must perform examinations in relatively close proximity (≤ 0.5 m) to the patient. A report by Flores et al. (6,7) measured radiation exposure from renal patients who had received $^{99\text{m}}\text{Tc}$ -DTPA and took into consideration sonographers' potentially increased exposure

For correspondence or reprints contact: Merrill D. Griff, MPH, CNMT, RT(N), Nuklearmedizin, University Hospital Zurich, Ramistrasse 100, 8091 Zurich, Switzerland; Phone: 011-41-1-255-3555; E-mail: merrill.griff@dmr.usz.ch.

TABLE 1
Radiation Exposure to Sonographers from Patients Who Were Given ¹⁸F-FDG

Patient	Measurement after 2 h (All measurements are in μ Sv/h)			Measurement after 3 h (All measurements are in μ Sv/h)		
	Shoulder	Abdomen	Gonads	Shoulder	Abdomen	Gonads
1	22	25	21	20	24	20
2	28	33	28	17	19	19
3	45	46	31	23	24	24
4	19	27	23	21	14	15
5	24	35	22	19	20	17
6	27	37	43	17	10	12
7	42	40	42	28	24	26
8	48	54	53	27	27	24
Mean	31.875	37.125	32.875	21.5	20.25	19.625
SD	11.33	9.58	11.80	4.21	5.78	4.87

rates. Our study, using simulated sonographic examinations and patients who were given ¹⁸F-FDG, provides appropriate post-PET scan data.

CONCLUSION

An increased demand for ¹⁸F-FDG PET scans is anticipated. A portion of those patients will undergo additional examinations, potentially increasing the occupational radiation exposure dose to other allied health and medical personnel. The use of additional permanent or mobile shielding is impractical, for the most part. Some personnel, such as sonographers, must perform tasks at close proximity to these patients. Our study measured the exposure rates from patients having typical whole-body PET scans, who were injected with a mean dose of 400 MBq ¹⁸F-FDG. We recommend performing other examinations at least 3 h postinjection of ¹⁸F-FDG and to have the patient void before the secondary examination. As an alternative, the ancillary test can be performed before the PET examination to completely avoid radiation exposure.

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