



RESEARCH ARTICLE

ESTIMATION OF RADIATION DOSE TO STAFF FROM 18F-FLUORODEOXYGLUCOSE WHOLE BODY POSITRON EMISSION TOMOGRAPHY/COMPUTED TOMOGRAPHY INVESTIGATIONS

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ABSTRACT

Objective: The use of whole body 18F-FDG investigation is now rapidly growing. Unlike in radiology, patients in Nuclear medicine are a source of radiation themselves, since F-18 in 18F-FDG is a Positron emitter. The aim of this study is to measure the amount of radiation dose received by nuclear medicine physicians and staff during injection

Methods: As per clinical protocol, the patients are supposed to have minimum period of 4 hours prior to the study. Whole body 18F-FDG PET/CT scans were performed in 35 patients for various indications. The radiation dose from the patients was measured using the portable radiation survey meter, during injection.

Results: The maximum radiation exposure during FDG injection was 40 mR/hr to the nuclear medicine physician. The minimum radiation exposure during FDG injection was 6.63 mR/hr to the nuclear medicine physician. This was a pediatric patient and the total activity for this patient was 2.2 mCi. The average radiation exposure during FDG injection was 20.91 mR/hr to the nuclear medicine physician. The maximum radiation exposure after water push was 20 mR/hr to the nuclear medicine physician. The minimum radiation exposure after water push was 3.38 mR/hr. The average radiation exposure after water push was 7.87 mR/hr to the nuclear medicine physician.

Conclusion: The exposure rate at surface of Patients is very high of 18F-FDG injected patients. Therefore the person administering the dose to patient should avoid standing very close to the patient. Also the half life of 18F is very less i.e. 109.7 minutes; therefore, exposure rate falls rapidly with the passage of time. So the exposure to staff and Nuclear medicine Physicians are very low

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INTRODUCTION

Integrated Positron Emission Tomography (PET)/Computed Tomography (CT) is an imaging technology which provides metabolic information overlaid on the anatomic details in a single investigation (1,2). While PET provides the metabolic characterization, CT provides the cross-sectional details of the body. For metabolic characterization a number of PET radiopharmaceuticals have been developed, till date Fluorine-18 (F-18) Fluorodeoxyglucose (FDG), a glucose analogue is the workhorse agent with widespread application in Oncology, Neurology and Cardiology (3-6).

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F-18 is a positron emitter and patients injected with F-18 FDG intravenously become a source of radiation. This poses a challenge to every functioning department in terms of monitoring and controlling the radiation exposure both to the working staff as well as to the patient and his attendants (7-11).

MATERIALS AND METHODS

This study was carried out in the Department of Nuclear Medicine, All India Institute of Medical Sciences, New Delhi. The department has two PET/CT scanners-Biograph 2 and Biograph mCT having 2 slice and 64 Slice CT respectively from Siemens Limited, Germany. This study was carried out after obtaining written informed consent of the patients. The F-18 FDG was injected by Nuclear Medicine Physicians. During 18F-FDG injection radiation exposure rate to the Nuclear

Medicine Physican was monitored. The time expended by Nuclear medicine Physicians was noted with a stop watch. A portable radiation survey meter was used for this study which is a calibrated RAM GAM-1 portable gamma ray survey meter (Rotem Industries, Israel). The model number of this survey meter is 40029 and its serial number is 1908086. The calibration was done by Nuvia India.

RESULTS

We carried out this study while injecting 35 patients. Three parameters were considered- radiation exposure during injection (mR/hr), Radiation exposure after injection (mR/hr) and Time expended with patients (Seconds).

mR/hr. The average radiation exposure after injection was at 1 meter distance 4.13 mR/hr. The maximum time spent with patient by a nuclear medicine physician before injection was 15 seconds. This was the maximum time taken by a nuclear medicine physician for FDG injection. This patient was on stretcher and patient was old and sick too. The minimum time spent with patient by a nuclear medicine physician before injection was 3 seconds. The average time spent with patient by a nuclear medicine physician before injection was 7.70 seconds. The maximum time spent with patient by a nuclear medicine physician after injection was 40 seconds. This was the maximum time taken by a nuclear medicine physician after FDG injection with patients. This nuclear medicine physician was on training.

Table 1. The details of the exposure rate from the patients using the survey meters

S.No.	Radiation Exposure during injection (mR/hr)	Radiation exposure after injection (mR/hr)	Time expended with patients (Sec)	Remarks
	During FDG injection	At contact	before injection	
1.	15	33.7	4	
2.	16	34.1	4	
3.	17	40	3	
4.	12	55.7	3	
5.	40	60	3	Canula removal
6.	16.7	69.8	5	
7.	12	107	5	
8.	8.2	30	6	
9.	39	79	7	
10.	15	103	5	
11.	20	94.4	6	
12.	6.63	89.9	10	Pediatric
13.	15	91	7	Sick patient
14.	19.2	45.6	4	
15.	22.4	81	15	Sick patient
16.	14.2	46.7	5	
17.	10.61	44.6	10	Old
18.	21.8	53.6	3	
19.	15.5	27.1	5	New resident
20.	27	46	12	New resident
21.	34	61	12	
22.	31	34.2	10	
23.	37	63	14	New resident
24.	13	58.5	10	New resident
25.	27	23.9	12	New resident
26.	32	87	12	New resident
27.	25	41	10	New resident
28.	24	66	12	New resident
29.	25	21	10	New resident
30.	18	40.5	9	New resident
31.	19.2	53.4	6	
Average	20.91741	57.47419355	7.70967	

DISCUSSION

The maximum radiation exposure during FDG injection was 40 mR/hr to the nuclear medicine physician. The minimum radiation exposure during FDG injection was 6.63 mR/hr to the nuclear medicine physician. This was a pediatric patient and the total activity for this patient was 2.2 mCi. The average radiation exposure during FDG injection was 20.91 mR/hr to the nuclear medicine physician. The maximum radiation exposure after injection was at contact 107 mR/hr. The minimum radiation exposure after injection was at contact 21 mR/hr. The average radiation exposure after injection was at contact 57.47 mR/hr. The maximum radiation exposure after injection was at 1 meter distance 6.85 mR/hr. The minimum radiation exposure after injection was at 1 meter distance 2.1

This nuclear medicine physician has now decreased his time taken to injection. The minimum time spent with patient by a nuclear medicine physician after injection was 12seconds. The average time expended with patient by a nuclear medicine physician after injection was 23.09 seconds. The Exposure rate behind the nuclear medicine physician was 0.33 mR/hr (when nuclear medicine physician was standing in the front of the patient). The Exposure rate behind the nuclear medicine physician was 2.47mR/hr (when nuclear medicine physician was not standing in the front of the patient). So total absorb dose to the nuclear medicine physician was 2.14 mR/hr.

Conclusion

The exposure rate during injection is high so the Nuclear Medicine Physicians administering the dose to patient should

avoid standing very close to the patient as well as should spent the minimum time with the injected patients. If they follow the radiation safety guideline prescribed by the competent authority (AERB), The radiation dose to the staff and Nuclear Medicine physicians would be within the permissible limits.

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