Radiation protection in the management of hospitalized patients when injected with ^{99m}Tc

M.Casale[*1], *A.A.Russo*[2], *R.Delia*[3]

[1]*Hospital "S.Maria", Terni, Italy*
[2] *Institute of Biomedical Engineering, National Research Council, Rome, Italy*
[3] *Policlinico Tor Vergata, University of Rome Tor Vergata, Rome, Italy*

E-mail address: m.casale@aospterni.it

Purpose

The purpose of this paper is to evaluate the effective dose equivalent for the medical staff, caregivers and other patients, when exposed to radiation from hospitalized patients, treated with 1,11GBq ^{99m}Tc, for diagnostic examinations.

For this purpose, were made a series of measures to:
a) Provide a quantitative assessment of ambient dose equivalent rate, measured at various distances from a patient undergoing nuclear medicine diagnostic procedure with ^{99m}Tc;

b) Obtain from the measures referred to in paragraph a) a thorough evaluation of the dose, Hp (10) and then from this, the estimated effective dose .

Materials and Methods [1]

The measurement of ambient dose equivalent rate, was performed in patients undergoing bone scintigraphy with 99m Tc. This survey, for high injected activity (30 mCi), represents the worst in terms of radiation protection. For the determination were carried out a series of measures to contact the patient and at various distances (20 cm, 50 cm and 100 cm), using a dosimeter Panoramic Survey Meter Victoreen-470, equipped with appropriate certifications of calibration.

Measurements were made in different projections (AP, PA, LATdx, LATsn) after about 3 hours somministrazione1. Patients were chosen to represent a significant percentage, height, weight and age of the population.

Materials and Methods [2]

Table shows the values, ,mean and maximum, obtained on 15 patients. The measures relate only to the PA projection, based on experimental data, is one that provides maximum value.

Attività sommin. 30 mCi	100 cm	50 cm	20m	0 cm
$\langle \dot{H}^*(10) \rangle \pm \sigma$ (µSv/h)	(4±1)	(12±2)	(31±5)	(90±15)
$\dot{H}^*(10)_{max}$ (µSv/h)	7	17	42	117

Materials and Methods [3]

The following tables show the mean value and the maximum value of H*[10] at different distances [100, 50, 20 and 0 cm] from the patient, depending on the time

Attività sommin. 30 mCi	0 (h)	1 (h)	2 (h)	3 (h)	4 (h)	5 (h)	6 (h)	7 (h)
$\langle \dot{H}^*(10) \rangle$ (µSv/h)	4	3.6	3.2	2.8	2.5	2.2	2.0	1.8
$\dot{H}^*(10)_{max}$ (µSv/h)	7	6.2	5.6	5	4.4	3.9	3.5	3.1

Attività sommin. 30 mCi	0 (h)	1 (h)	2 (h)	3 (h)	4 (h)	5 (h)	6 (h)	7 (h)
$\langle \dot{H}^*(10) \rangle$ (µSv/h)	12	10.7	9.5	8.5	7.6	6.7	6.0	5.3
$\dot{H}^*(10)_{max}$ (µSv/h)	17	15.1	13.5	12	10.7	9.5	8.5	7.6

Attività sommin. 30 mCi	0 (h)	1 (h)	2 (h)	3 (h)	4 (h)	5 (h)	6 (h)	7 (h)
$\langle \dot{H}^*(10) \rangle$ (µSv/h)	31	27.6	24.6	21.9	19.5	17.4	15.5	13.8
$\dot{H}^*(10)_{max}$ (µSv/h)	42	37.4	33.3	29.7	26.5	23.6	21.0	18.7

Attività sommin. 30 mCi	0 (h)	1 (h)	2 (h)	3 (h)	4 (h)	5 (h)	6 (h)	7 (h)
$\langle \dot{H}^*(10) \rangle$ (µSv/h)	90	80.2	71.4	63.6	56.7	50.5	45.0	40.1
$\dot{H}^*(10)_{max}$ (µSv/h)	117	104.2	92.9	82.7	73.7	65.7	58.5	52.1

Results [1]

The mean value, the standard deviation and the maximum value of H*(10)˙ measured 3 hours after the radionuclide administration and at different distances from patient with the survey meter in PA position, are shown in the table below.

Injected Activity (1.11 GBq)	100 cm	50 cm	20 cm	0 cm
$\dot{H}^*(10)_{av} \pm \sigma$ (μSv/h)	(4 ± 1)	(12 ± 2)	(31 ± 5)	(90 ± 15)
$\dot{H}^*(10)_{max}$ (μSv/h)	7	17	42	117

Results [2]

From these data, it is possible to obtain the estimated value of the personal dose equivalent $H_p(10)$ and to evaluate the annual doses, received by medical staff, patients and other members of the public, who could be nearby the treated patients, during their hospitalization. The values of effective dose to the operators were obtained by measured data, taking into account the work load for health operators, the time requested, on average, for care of the patient, the distance between operator and patient.
Furthermore the worst exposure conditions were considered.

Results [3]

Evaluation of radiological risk to medical personnel [Risk to external exposure]

For the evaluation of the radiological risk to medical personnel is assumed that the department has 10 beds all occupied. It is assumed also that the hospitalitation is of 10 days and that each patient throughout the entire hospitalization, undergo a bone scan.

A reasonable estimate of the average time spent by a health professional in the vicinity of a patient undergoing a bone scan, once back in the Department can be obtained considerring a 230 working days per year and three shifts, the operator example, you find it for about 80 days a year in the situation described.

Consequently, the effect of the exposures arising from patients who underwent scintigraphy with ^{99m}Tc, you can quantify an annual environmental dose equivalent of 500 μ Sv. On the other hand, the estimator of effective dose is represented by the equivalent of deep dose Hp (10). As reported in the literature, an estimate of H*(10) is an estimate Hp.

Therefore, the estimated annual effective dose is 500 μ Sv This is lower than 1000 μ Sv / year, which is the limit value for the population provided by Italian regulation.

Conclusions

Since H*(10) is a good indicator of effective dose, the obtained results show that the operators, in every exposure conditions, do not ever exceed the dose limit value, established for not-exposed workers by Italian regulation (1000μSv/y).