INTERNAL CONTAMINATION IN NURSES ATTENDING PATIENTS, THAT RECEIVED THERAPEUTIC AMOUNTS OF RADIOIODINE-131*

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INTRODUCTION

The most frequent and often very successful used unsealed source in Nuclear Medicine and Radiotherapy is the radioiodine-131 for the treatment of thyroid carcinoma and hyperthyroidism. Always there is a great concern about the health physics of radioiodine and possible internal contamination involved in high level 131-I thyroid therapy cases, in particular to the thyroid as target and limiting organ.
This report deals with 131-I air concentrations and internal contamination in nurses attending these patients under two different conditions.
During the past three years a change took place from the old building, where we had an unventilated two-bed nursing room, to a new building where we have rooms with forced ventilation and air-conditioning (refreshment five times per hour). From both external exposure caused by radioiodine treated patients and internal contamination due to ingestion and inhalation of 131-I, we calculated the dose-equivalent to the thyroid and the effective dose-equivalent to our health care personnel.

MATERIALS AND METHODS

In our hospital radioiodine-131 is given orally as a liquid in quantities of 185-925 MBq for the treatment of hyperthyroidism (uptake range 26-89%, mean value 67%) and up to 7 GBq for the treatment of thyroidcarcinoma and metastasis. In general the patients need only low care, which results in a maximum nursing time of 10 hours/week.
After drug administration the patient is not allowed to leave the room for three days on an average, until both the acceptable level of total body activity is reached (less than 370 MBq) and the fast excretion phase is over.
In both the old and new housing about 140 patients are treated yearly with 131-I for therapy, together with 65 patients diagnosted with amounts of 37 to 185 MBq. All health care personnel involved is classified as radiological worker category A, wearing personal filmdosimeters and as a standard undergoing periodically thyroid activity measurement. In this department the job is done by 20 colleagues.
Following ICRP-30 the annual limit on intake of 131-I amounts 1 MBq by ingestion and 2 MBq by inhalation, we use an investigation level amounting to 1/10 of the ingestion value.

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MEASUREMENTS

In this study airborne 131-I contamination was measured with the Herfurth Air Sample Collector (H-1351N), intake at 2 metres above the floor of the two-bed nursing rooms.
Both volatile iodine and aerosols were measured periodically during the first 3 hours, 24 hours and patients' total residence time after drug administration. From the measurements we learned that the 131-I activity mainly consists of volatile iodine compounds or very low AMAD particles. Internal contamination control in both nursing personnel and administrators was performed with the Whole Body Counter (WBC) of the Institute for Radiopathology and Radiation Protection (J.A. Cohen Institute, Leiden, the Netherlands). This WBC consisted of four NaI-detectors Ø 4,75 x 4 inch placed in a measurement room having a wall thickness of 10 cm aged-lead. The sensitivity of the system amounts 30 Bq of 131-I for a 30 min counting time.

RESULTS

The degree of air contamination during above mentioned periods was correlated to both the administered activity and the excreted activity; in all cases the coefficient of correlation is bad ($< 0{,}750$). Table 1 deals with the 131-I concentrations in both the unventilated and the conditioned room at a mean administered activity of 3,8 GBq per patient.

Table 1. 131-I concentration in air in the therapy room.

Period	Unventilated room		Conditioned room	
	range Bq/m^3	mean value Bq/m^3	range Bq/m^3	mean value Bq/m^3
3 h	44 - 1428	400,7	2,2 - 114	43,6
24 h	3,9 - 737	236,6	0,7 - 92	24,2
total residence time	1,9 - 585	105,2	0,3 - 53	15,1

The distribution of the internal contamination of nursing personnel is given in figure 2, from which are calculated the mean and median values of this activity. From these data we learn that, in the new housing, this nursing personnel has a significant higher (although low) degree of contamination, probably due to little experience in contamination risk and unfamiliarity with this treatment.
Figure 3 shows the internal contamination in persons who dispense and administer the oral radioiodine quantity.

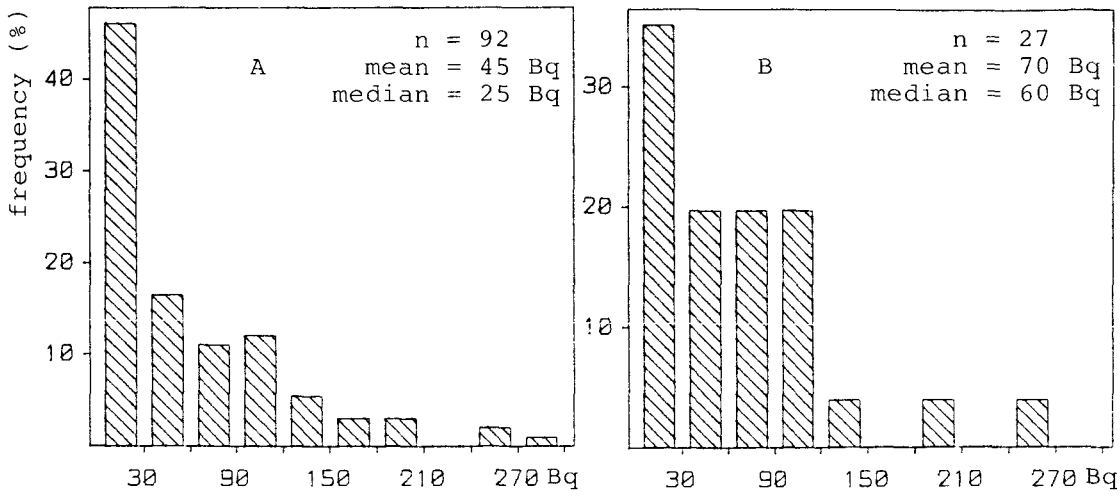

Figure 2 : Distribution of the internal contamination of nursing personnel in A: unventilated therapy room and B: the conditioned room.

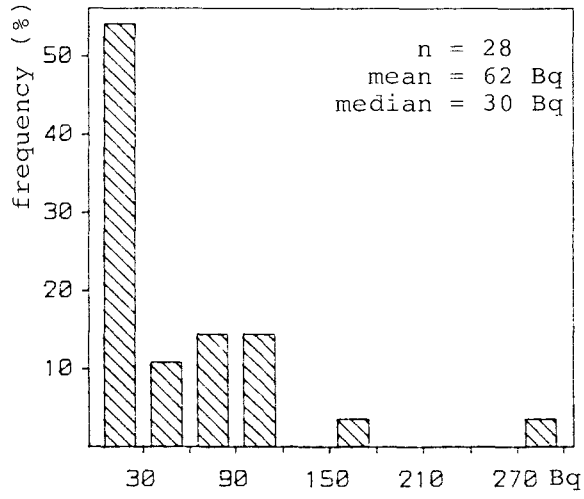

Figure 3 :

Distribution of the internal contamination in personnel dispensing and administering the liquid iodine-131 therapeutic quantities.

DISCUSSION

In case of nursing personnel we calculated, from the elapsed time between possible intake and WBC-measurements, a mean weekly intake of about 60 Bq I-131. From the airmeasurements, and the maximum total residence time of the personnel in the nursing rooms, we learned that most of the internal contamination can be ascribed to ingestion for lack of discipline; pointing out that the sanitary facilities are highly contaminated in this unit.
Following ICRP-30 the mean dose equivalent to the thyroid is 4,5 man.mSv/y, resulting in an effective dose equivalent of 135 man-μSv/y. Personal dosimeters indicate that the dose equivalent due to external radiation does not alter this figure significantly.

As can be seen from figure 3, even workers handling the therapeutic quantity are contaminated at a low level, resulting in an effective dose equivalent of 65 man.μSv/y, however this work is done by only a few men.
From the mean values of air-contamination and amount of refreshment together with the residence time of the patients and the volume of their room, can be calculated that the total airborne activity is about 10^{-3} of the administered quantity.
Besides that, no other waste is discharged directly to the environment, because we have decay-tanks and a decay-facility for solid waste.

CONCLUSION

In the present situation it is possible to nurse patients, having a low iodine uptake, treated with quantities up to 7 GBq without a significant radiation exposure to the health care personnel. However, it is necessary that the working conditions are judged by a health physicist, the discipline is near perfect and monitoring is performed on a regular basis.
Under these conditions, refering to the relative low air-contamination, even moderate care patients may be treated, mainly resulting in a higher external exposure of the personnel.

LITERATURE

1. ICRP Publication 30, Limits for intakes of radionuclides by workers. Annals of ICRP, Pergamon Press, Oxford, 1979.
2. Pollock, R.W. and Myser, R.D., Concentrations of I-131 in the air during thyroid therapies, Health Physics, vol. 36, no. 1, 1979, pp 68-69.
3. Langhorst, S.M., Morris, J.S. and Miller, W.H., Investigation of charcoal filters used in monitoring airborne radioactive I, Health Physics, vol. 48, no. 3, 1985, pp 344-347.
4. Nishizawa, K., O'hara, K., e.a., Monitoring of I excretions and used materials of patients treated with 131-I, Health Physics, vol. 38, no. 4, 1980, pp 467-481.
5. Krzésniak, J.W., Chomicki, O.A., e.a., Airborne radioiodine contamination caused by 131-I treatment, Nucl.-Med., Band XVIII/ Heft 5, 1979, pp 246-251.
6. Castronovo, F.P., Beh, R.A., Veilleux, N.M., Iodine 131 therapy patients: Radiation dose to staff, Radiation Protection Dosimetry, vol. 15, no. 1, 1986, pp 45-49.