

RADIATION EXPOSURE TO THE FAMILY OF RADIOACTIVE PATIENTS

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Eleven patients treated with ^{131}I for thyroid carcinoma or thyroid ablation and their immediate family members were monitored by film badge for radiation exposure. The results indicated that the current AEC regulation permitting a patient body burden of 30 mCi at time of hospital discharge is conservative.

AEC licensing regulations generally require that patients who receive therapeutic ^{131}I be hospitalized until the radionuclide burden falls below 30 mCi. The National Council on Radiation Protection and Measurements (NCRP) has set forth many recommendations for the behavior of visitors and relatives of temporarily radioactive patients. NCRP Report No. 37 (1) contains a detailed and complex set of conditions pertaining to patients discharged from hospital with burdens greater than 8 mCi of ^{131}I . We are frequently asked by patients, particularly those hospitalized with large doses of ^{131}I , what risks they may cause family and friends. Because we know of no report bearing practically on this subject and the AEC has considered lowering permissible burdens (2), we undertook the following study.

METHOD

Patients treated with moderate-to-large quantities of Na^{131}I for thyroid ablation or cancer were given film badges for themselves and members of their immediate family. Patients and family members were instructed to wear their badges on their waist belts at all times during the day for 8 days. They were asked to relate to the patient as normally as possible. The patients were instructed to sleep alone and to keep contact with infants at a minimum during the 8 days but no other precautions were advised.

The film badges were a commercial multiwindow, multiframe, automatic processed type used for rou-

tine personnel monitoring at our hospital. Control films from the same lots gave negative readings in all cases. Known exposure controls were not used. All badges were transported to and from the laboratory to the patients' homes in lead containers which also contained the control film.

RESULTS

Patients treated with large doses of ^{131}I for thyroid cancer (Table 1) were hospitalized until body retention was less than 30 mCi except for Patient No. 2 who lived alone with an elderly wife where a burden of 42.5 mCi was not considered a public hazard. The highest absorbed dose readings among 11 relatives was 80 mrad. Patients who underwent thyroid ablation for a variety of causes, usually intractable angina (Table 2), were given doses under 30 mCi to avoid hospitalization. These patients would excrete most of the administered activity in the first 24 hr and relatives' film readings were, therefore, generally lower. Patients were asked to judge the faithfulness with which relatives wore their badges. An attempt was made to determine the extent of contact between the patient and each family member but this was too uncertain to be reported.

Estimates of total dose (D_{∞}) to relatives was extrapolated from the known absorbed dose (D_n) received by each relative for a duration of n days according to the equation

$$D_{\infty} = D_n / (1 - e^{-n\lambda})$$

where λ is the effective decay constant, $0.693/T_{\text{eff}}$ and $T_{\text{eff}} = 7.6$ days.

Using this equation the highest exposure of 80 mrad to a family member would extrapolate to a

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TABLE 1. FAMILY EXPOSURE FROM PATIENTS TREATED FOR THYROID CARCINOMA

Patient	Total dose (mCi)	Body burden at discharge (mCi)	Exposure time (days)	Family doses (mrad)
1	210	25.2	8	80, 70, 30
2	219	42.5	2*	20
3	311	26.4	8	50, 20, 20
4	209	18.4	8	80, 40, 0, 0

* Died after 2 days from unrelated causes.

TABLE 2. FAMILY EXPOSURES FROM PATIENTS TREATED FOR THYROID ABLATION

Patient	Total dose (mCi)	24-hr uptake (%)	Exposure Time (days)	Family doses (mrad)
5	29.7	10	7	40
6	24.8	9	6	40
7	25.0	10	8	0
8	29.9	55	8	50, 30
9	36.4	4.4	7	30, 0, 0, 0
10	30.0	10	8	0
11	22.3	12	8	20

maximum of 130 mrad, well below the permissible yearly exposure of 500 mrad.

DISCUSSION

The National Council on Radiation Protection and Measurements (1) has stated that patients may be discharged with a burden of 8 mCi ^{131}I without restrictions. This burden is based on an exposure rate of 1.8 mR/hr at 1 meter, which would result in 500 mrad if exposed to infinity. Clearly the likelihood of such prolonged close proximity is remote. If no household member is under 45 years of age, the permissible discharge burden is 80 mCi which would conceivably result in 5 rads if exposed for the effective life of the radionuclide. The AEC has selected a burden between these two figures of 30 mCi, but is currently considering lowering the permissible patient burden at time of discharge from the hospital (2). On the basis of this study we feel that current AEC regulations are conservative and family members are unlikely to receive the permissible dose of 500 mrad/year as a result of association with patients discharged with currently allowed radionuclide burdens.

It may be prudent for therapists treating patients with large doses of radioiodine to monitor family members having the greatest exposure to the patient. If cumulative film-badge readings for 8-day periods approach 260 mrad (which yields $D_{\infty} = 500$ mrad), additional precautions for the patient's family may be necessary. Our findings indicate that there is insufficient reason from a public health standpoint to lower currently allowed burdens of ^{131}I at time of discharge from the hospital. Such a step would increase health care costs unnecessarily.

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