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Radiation exposure levels in relatives of patients after radioiodine therapy

***Bererhi H, Constable A R**

مستوى الأشعاعية لأقارب المرضى بعد العلاج باليود المشع

أنتوني كونستابل، هاديا البريحي

الملخص :الهدف: تقييم مستوى النشاط الاشعاعي لأقارب المرضى الذين تلقوا علاجا باليود المشـع ،وهل هو بمستوى واطئ يسمح للمرضى بمغادرة المستشفى مبكرا وبذلك يقلل فترة رقادهم. **الطريقة:** تمت مراقبة 47 من أقارب المرضى المصابين بفرط نشاط الغدة الدرقية و 23 من أقارب المرضى بسرطان الغدة الدرقية والذين عولج أقاربهم المرضى باليود المشع لمدة سبعة أيام، لقياس أشعاعيتهم بعد خروج المرضى في المستشفى على مستوى 30 MBqمن بقايا اليود المشع .**النتائج:** كانت الجرع المقاسة في الأزواج والأطفال أقل من 1 mSv ماعدا طفلاً واحداً أستلم 1ر46 mSv **الخلاصة :** بالنظر للجرعة الاشعاعية القليلة التيتعرض لها الأقارب ، فمن الممكن جعل التعليمات أقل صرامة مما يسمح بخروج المرضى مبكرا وبذلك نختزل مدة بقاء هم في المستشفى

ABSTRACT: ***Objective –*** To assess whether the level of radioactivity received by relatives of patients treated with radioiodine (^{131}I) is low enough to allow the patients leave the hospital earlier, thus reducing their hospital stay. ***Method –*** Forty seven relatives of thyrotoxic patients and 23 relatives of thyroid cancer patients treated with ^{131}I therapy were monitored for 7 days for radiation after discharging the patients at 30 MBq residual ^{131}I. ***Results*** – The doses measured in spouses and children were less than 1 mSv except for one child who received 1.46 mSv. ***Conclusion –*** In view of the low radiation doses received by the relatives, regulations could be made less stringent, thus reducing the hospital stay of the patients.

KEY WORDS: radioiodine, relatives, radiation, dosimeter

Radioiodine (^{131}I) is widely accepted as the treatment of choice for thyrotoxicosis.[1] It is also used for whole body scans and in high doses for therapy in differentiated thyroid carcinoma.[2]

In the United Kingdom, patients receiving ^{131}I therapy are nowadays treated as outpatients with some restrictions on their contact with others if they receive a dose less than 800 MBq. This corresponds to the limit for travel by private transport.[3] In the United States, an internally retained activity of 1110 MBq[4] is permitted for a patient to be discharged from hospital with timed restrictions for contact with others. Now the US Regulations are less stringent since they have been updated.[5]

For social and cultural reasons regulations in Oman require that patients remain in hospital until the radiation level at one metre from the patient drops to 2 μSv/h. This practice was derived from the UK guidance notes,[3] which allow an internal body activity limit of 30 MBq of ^{131}I for returning to radiosensitive work and contact with children. This corresponds to a radiation level at one metre from the patient of about 2 μSv/h.

Buchan and Brindle have shown that contamination[6] and radiation doses[7] to relatives of patients receiving up to 800 MBq and discharged as outpatients with appropriate instructions, are negligible.

The present study was planned to measure the radiation dose received by relatives of patients with 30 MBq of ^{131}I in the body at discharge from hospital and without imposing any restrictions on them. The study was undertaken as a first step towards relaxing our rather stringent regulations.

METHOD

Fourteen patients treated with ^{131}I for thyrotoxicosis and five treated for differentiated carcinomas of the thyroid (3 therapeutic doses and 2 whole body scans) were selected. The mean (±SD) dose administered for thyrotoxic patients was 489 (±117) MBq (range, 300–670 MBq) and for cancer patients was 2920 (±2500) MBq (range 300–5740 MBq). The duration of hospitalisation varied from 2 to 9 days (mean 5 days) for patients with cancer

Department of Clinical and Biomedical Physics, College of Medicine, Sultan Qaboos University, P O Box 35 Al-Khod, Muscat 123, Sultanate of Oman. E-mail: haddiab@omantel.net.om.

*To whom correspondence should be addressed.

FIGURE 1. *Capsules showing one mounted on a necklace.*

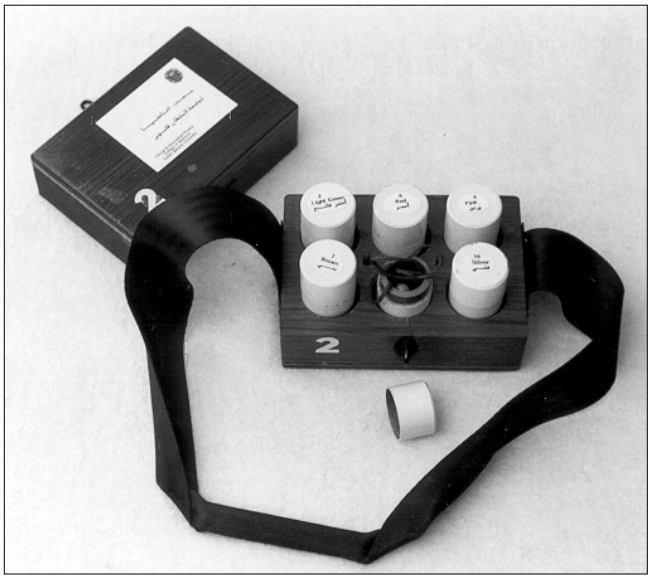

FIGURE 2. *A wooden box that houses the lead pots containing the capsules.*

and 9 to 15 days (mean 12 days) for thyrotoxic patients. The patient was discharged when the activity in the body fell below 30 MBq and this was deemed to have occurred when the radiation level at one metre from the erect patient was less than 2 μSv/h. On discharge, all patients in this study were well and self-dependent.

The main selection criteria were (a) the patient and family must consent to wearing the dosimeter at all times for 7 days, (b) the patient and relatives should live together during the whole week the dosimeter was worn. In other respects, families were to assume their normal habits and sleeping arrangements, which were recorded. The ages of the relatives monitored ranged from 6 months to 60 years.

For the dosimeters, Harshaw TLD 200 rods (6 mm x 1 mm dia) made of cadmium fluoride dysprosium were used. For every subject three rods were inserted into a flexible black tube made of silicon rubber with one sealed end. The open end was sealed with a removable plug of black rubber. The tube was then put into a watertight painted capsule with a screw-in end piece and a cord was threaded into two holes at the extremities of the capsule, designed in such a way that, once the cord was in place, the capsule could not be opened (Figure 1). The lengths of the cord were individually adjusted to bring the capsules to the level of the supra-sternal notch. The capsules were placed in individually labelled lead pots, which were then fitted into a wooden box (Figure 2) together with a dosimeter for background measurement. Patients were asked to keep the background dosimeter in a place remote from general living activities. After the capsules were returned the radiation doses were measured with a Harshaw 6600 TLD reader.

The ethical committee of our institution approved the study and, after discussion with their relatives, all patients agreed to participate.

RESULTS

The cumulative radiation dose (μSv) over 7 days received by the relatives of patients treated with ^{131}I for thyrotoxicosis and carcinoma from the time the patient arrived home are shown in Table 1 and Table 2 respectively. The results are presented as mean plus and minus one standard deviation. Statistical significance was determined by applying the Student's t-test. A p value <0.05 was considered statistically significant.

One patient was eliminated from the study because he left home for a 7-day period. Children slept in separate rooms from their parents except for one 7 year-old child who slept in the same bed as her parents. The spouse of each patient slept in the same bed in all cases.

In the families of cancer and thyrotoxicosis patients, the spouses received a higher mean dose than the rest of the relatives. In the families of the thyrotoxic patients the spouses received the maximum dose. However, among the families of the cancer patients, it was a child who received the maximum dose (1.46 μSv). The lowest dose of zero was received by a child looked after by a maid, who also received zero dose.

There was no significant difference between the means of the cumulative radiation doses received by relatives of our patients with 30 MBq over a 7 day period and the cumulative radiation dose per 30 MBq received by the relatives of Buchan and Brindles's patients over 21 days. Buchan and Brindle[7] measured the cumulative dose

TABLE 1

Cumulative radiation doses received over 7 days by relatives of patients treated with ^{131}I for thyrotoxicosis with 30 MBq body retained activity.

Relatives	No.	Radiation Dose (μSv)			
		Minimum	Maximum	Mean	SD
Spouses	13	1	728	221	246
Other	34	0 (child & maid)	253	68	60

TABLE 2.

Cumulative radiation doses received over 7 days by relatives of patients treated with ^{131}I for differentiated thyroid carcinoma with 30 MBq body retained activity

Relatives	No.	Radiation Dose (μSv)			
		Minimum	Maximum	Mean	SD
Spouses	4	8	665	195	314
Other	19	819	1460 (child)	167	347

TABLE 3

Cumulative radiation doses received by relatives of Buchan and Brindle's patients treated with ^{131}I for thyrotoxicosis[6] calculated for 30 MBq body retained radioactivity.

Relatives	Number	Radiation Dose (μSv)	
		Mean	SD
Spouses	29	168	110
Other	25	45	26

to family members for 21 days from the time the patient arrived home after administration of ^{131}I doses of 148-592 MBq on an outpatient basis and to whom no instructions were given to minimise radiation hazards. The results of Buchan and Brindle[7] were analysed by Wasserman and Klopper[8] and were found to be, on average, for 21 days, 5.6±3.7 μSv.MBq^{-1} for spouses and 1.5±0.87 μSv.MBq^{-1} for other family members. Using these figures, the radiation dose to the families if, like ours, their patients had 30 MBq of ^{131}I in their bodies at the time of discharge would be 168±110 μSv for spouses and 45±26 μSv for other family members (Table 3).

DISCUSSION

There is no evidence that radiation from patients treated with ^{131}I causes problems to other people. Moreover, a long-term study[9] did not detect any harmful effect in 103 persons, who, when children had been treated with ^{131}I for thyroid carcinoma with a mean dose of 17 GBq and a maximum dose of 26 GBq and were followed for a mean period of 22 years (maximum: 45 years). Nevertheless, precautions should be taken to avoid unnecessary radiation to others who may come into the vicinity of the patient. To achieve this, patients are usually kept in hospital until their retained activity satisfies the adopted regulations: 30 MBq in Oman, 800 MBq for England[3] and 1110 MBq for USA.[4] Since 1997, the activity retained by the patient in the USA has been unspecified provided no other individual receives a dose exceeding 5 mSv. This means that a patient, treated with more than 7000 MBq of ^{131}I, could leave the hospital subject to certain restrictions.[5] In our institution patients are kept in hospital until they are considered safe for close contact with children. Our study shows that even with this strict restriction the radiation doses to relatives of patients with thyrotoxicosis or carcinoma of the thyroid showed a measurable radiation dose. For most relatives this was lower than the ICRP recommended annual limit of 1 mSv except for a one year-old child who received a cumulative dose over 7 days of 1.46 mSv. This child was the youngest in a family we visited on the day of discharge. The entire time we were there (about one hour), the patient held the child in her lap or her shoulder. Apart from this child, spouses received the highest radiation, evidently due to the time they spent close to the patient, particularly during sleep.

The fact that the lowest dose was sustained by a child cared by a maid suggests that families with infants should preferably appoint a childminder.

This study shows that although we retained our patients until they were considered safe to be with children, the relatives still received doses comparable to the doses documented as received from outpatients,[7] in another study, even though that study recorded doses over a period approximately thrice as long as ours.

Unlike in other countries, our patients are not released immediately from hospital, mainly because of the uncertainty regarding their compliance to hospital instructions in a climate of social and cultural traditions totally different from those of Western urban communities. Traditional close physical contact between mothers and young children cannot be minimised by mere instructions.

CONCLUSION

While the restrictions practised in our study were intentionally more stringent than necessary, these enabled us to observe and measure the radiation doses to relatives

at extreme conditions. Our findings enable us to recommend significant shortening of the hospital stay of patients treated with ^{131}I.

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Radiation Doses Glossary

μSv – microSievert

mSv - milliSievert

MBq - megaBecqueral

GBq – gigaBecqueral

mCi - milliCuries

****Editor's Note:** This recent study (Ref: 10) has vindicated the leniency of the US Regulations by finding the radiation doses received by relatives of 30 outpatients treated with large doses of ^{131}I for thyroid cancer to be well below the permitted limit of 5.0 mSv. (Reference added at Editor's discretion.).