SHORT COMMUNICATION

Radiation Doses to Patient's Relatives Following Radioiodine Therapy

B T Sulaiman, MMed*, S E M Clarke, FRCP**, * Department of Radiology, Faculty of Medicine, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, ** Department of Nuclear Medicine, Guy's Hospital, St Thomas Street, London SE1 9RT

Summary

A total of 10 volunteers were monitored for radiation doses, whose spouses were given radio-iodine (^{131}I) orally. Nine of the spouses were given radio-iodine for Graves' disease and one for thyroid carcinoma. It was found that the highest radiation dose received by the volunteer was only 13.5% of the annual dose limit for individual members of the public. Hence, patients treated with radio-iodine do not pose a significant radiation hazard to the public.

Key Words: Radio-iodine (^{131}I), Radiation dose

Radio-iodine therapy for Graves' disease, Plummer's disease and thyroid malignancy has become a popular mode of treatment and it has been proven to be successful and safe. It is preferred to surgery because of its low morbidity. Patients who are given therapeutic dose of radio-iodine become a source of radiation. As the iodine-131 therapy is carried out as an outpatient, there has been concerned about the consequent radiation doses to the relatives or member of the public. Patients are worried about glowing in the dark. There are limited studies concerning this subject and from this limited data, the general conclusion is that the therapeutic procedures performed do not constitute a significant hazard to patient's relatives or the public. In this study, we specifically assess the radiation dose received by the patient's relatives following radio-iodine therapy for either Graves' or Plummers disease.

Ten volunteers were selected from the thyroid clinics. They were relatives, husbands, wives or person staying together with the patient treated with radio-iodine. The main indication for radio-iodine in this study is Graves' or Plummers thyroid disease. As the patient left the clinic, the volunteers were asked to carry a portable dosemeter at all times for the duration of one week. The dosemeter used has a digital read out in microSievert (μSv). The dosemeter used is shown in Figure 1. It is handy to be carried about. A standard dose of 400 megabecquerel (MBq) of ^{131}I was given to all patients in this study.

The I-131 present in the patient poses an external source of radiation exposure to individuals who come into close contact with the patient. The external radiation exposure can be minimized by reducing the duration of time spent in close proximity to others and by increasing the distance. Studies have been performed measuring the radiation dose received by the hospital staff and relatives following outpatients nuclear medicine investigations and it was concluded that the radiation doses were small and the radionuclides used for nuclear medicine investigations did not constitute a significant hazard to the hospital staff and patient's relatives, Harding LK *et al* 1985, 1990[1]. Buchan RCT 1971[2] suggested that the external exposures often exceed the internal thyroid dose equivalent in family members of therapy patients.

There is no evidence suggesting that small amounts

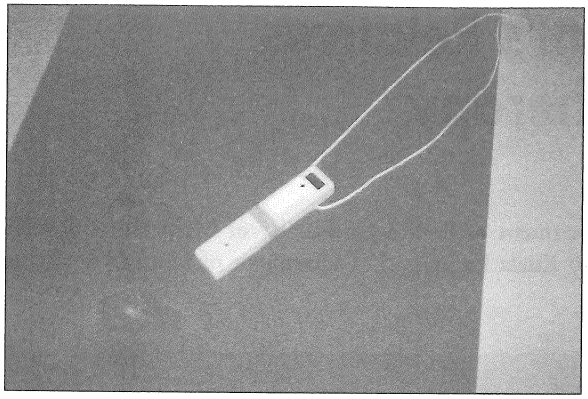

Fig. 1: Dosemeter

of radiation from I-131 treated patients cause any problem to others. However, guidelines developed from the reported data, when properly applied could reduced unnecessary radiation exposure to others. The group of people at greatest risk from the external radiation exposure to I-131 treated patients are the embryoes, fetuses, infants and children. The younger the child, the greater the sensitivity to ionizing radiation (NCRP 1983)[3].

From our study, there is no single factor that can be pointed out for the amount of radiation received by the patient's relatives. There are multiple factors that have to be considered in determining the amount of radiation doses. When we take the physical decay and urinary excretion of I-131 into account, we would expect the daily variations of radiation doses to be diminishing with time. However, there are some variation from one patient to another. This is due to the fact that there are other factors that are involved.

Even though the 20 minutes Tc-99m thyroid uptake does not reflect the exact amount of iodine uptake but it does indicates the status of iodine uptake by the thyroid gland. High thyroid uptake reflect less urinary clearance because the 24 hours urinary excretion of radio-iodine is inversely related to the 24 hour thyroid uptake. High thyroid uptake is another factor which could account for the high radiation dose to the volunteers. Hence, one is expected to receive a high radiation dose from patients having a high thyroid uptake prior to the treatment. Volunteers that live in a bigger house received low radiation dose because of the larger space area and hence less close contact.

There appears to be some correlation between the dose and age of the volunteers. The younger age group received a higher dose with some exception. This is probably related to the difference in daily activities between age groups. There is a decreasing radiation dose with duration of contact up to 40 hours, beyond which the dose appears to raise. In volunteers with shorter duration of contact, thyroid uptake plays a major role in determining the radiation dose to others. However, for the longer duration of contact, both the duration of contact as well as the thyroid uptake contribute to dose received.

The Society of Nuclear Medicine recommends that the treated patients sleep alone for the first few days after the treatment (Becker DV *et al* 1983)[4]. It is advisable for the patients to sleep separately for 7 days. Apart from sleeping separately, they are also asked not to travel in a public transport if the journey takes more than an hour on any one vehicle. From this study it is clear that sleeping together and travelling in a car expose the individual to a higher radiation dose. Volunteer that sleep on the same bed as the patient received 254μSv, which is 5.08% of the annual dose limit for the general public. Hence, sleeping together subject the spouse or relative to a higher radiation exposure and hence they are advised to sleep separately. Travelling together in a car and attending dinner or party subject the spouse or relative to a much higher radiation dose as compared to the daily contact at home. This is related to the duration of stationary contact between the treated patients and the spouse or relative are longer.

In conclusion, patients treated with 400 Mbq of I-131 do not cause a radiation hazard to others. They are considered safe to the relatives or the public. Guidelines are developed to reduce unnecessary radiation exposure. The highest radiation dose received by the spouse in this study was 674μSv, which is 13.5% of the annual dose limit for the public. The radiation dose received by the relatives depend on a number of combining factors. It is apparent that travelling in a car, attending party or dinner and sleeping in a same room subject the relatives or

spouse to a higher dose even after 5, 6 or 7 days after I- 131 drink. Thyroid uptake and the type of house also affect the radiation doses. Higher thyroid uptake causes high radiation doses while staying in a big house will reduce the duration of close contact but this is very subjective and very much dependent on every individuals.

From this point of view, even though the radiation received by the relatives is within the permissible dose limit, it is wise to advise patients treated with radio-iodine not to share the same bed with their spouse and if possible they should sleep in a separate room. Refrain from or minimise travelling in a car or public transport and attending party or dinner as this will increase the radiation dose to others. Extra care should be taken in patients having a high thyroid uptake prior to the treatment as they tend to expose a high radiation dose to others.

References

1. Harding LK, Mostafa AB and Thomson WH. Staff radiation doses associated with Nuclear Medicine Procedures. Nucl Med Commun 1990;11 : 271-7.

2. Buchan RCT, Brindle JM. Radio-iodine therapy to out-patients - the radiation hazard. Br J Radiol 1971;44 : 973-5.

3. NCRP. Protection in Nuclear Medicine and ultrasound diagnostic procedures in children. National Council on Radiation Protection and Measurements. Washington, DC, Report No. 73, Dec 31, 1983.

4. Becker DV, Siegel BA. Guidelines for patients receiving radio-iodine treatment. New York, The Society of Nuclear Medicine; 1983;5-6.