Release of Radiation Iodine Patients based on Patient-Family Member Specific Effective Dose Calculation at 0.3 Meter

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Introduction

Radioactive iodine (RAI), also known as I-131, is used following surgery for certain types of thyroid cancer; specifically, follicular and papillary and hyperthyroidism. The physical properties of iodine as well as its beta particle emission makes it an ideal agent that is specifically absorbed by the thyroidal cell and subsequently results in radiation-induced cellular apoptosis.

Most of the hospitals comply with the United States Nuclear Regulatory Commission (NRC) recommendation on the patient release criteria using a measured dose rate at 1 meter from the chest. Patients may be released when I-131 measured exposure rate is less than 7 mR/hr, which is equivalent to a body burden of less than 33 mCi.

In Malaysia, patients are allowed to be discharged if the dose rate is less than or equal to 5 mR/hr, at 1 meter distance. These current release criteria and patient effective dose calculation are based on 1 meter measurement. However, the precautions advised normally do not take into account the time spent in close proximity with a patient and the information on close proximity exposure particularly at 0.3 meter is not well defined.

Purpose

- To review the adequacy of RAI patient release criteria based on specific dose calculation at 0.3 meter.
- To establish a pattern on the exposure rate at a distance of 0.3 meter post-RAI.

Method

External exposure rate measurements at 0.3 meter were taken from 20 female patients (10 hyperthyroidism and 10 postoperative thyroid cancer patients), using a calibrated survey meter (Ludlum Model 14 C) at the following time intervals.

DAY 1 → DAY 7 → DAY 14 → DAY 21 → DAY 28

For **thyroid cancer patients** treated with 100 mCi, the exposure rates were measured at 0.3 meter **after 24 hours of I-131 administration**.
For **hyperthyroidism patients** treated with 10-15 mCi, the exposure rate was measured at 0.3 meter **immediately after I-131 administration.**

The exposure rate clearance graphs for thyroid cancer patients and hyperthyroidism patients were plotted respectively.

Results and Discussion

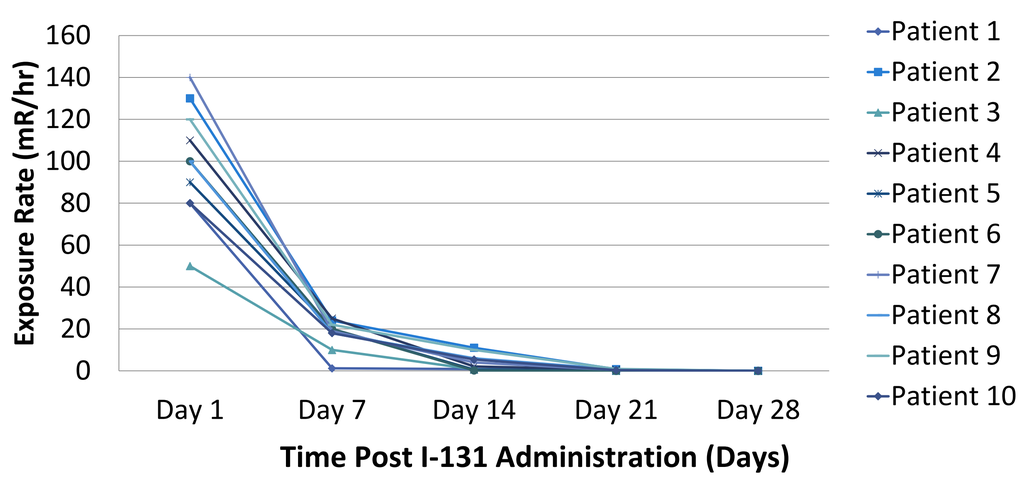

Figure 1. I-131 exposure rate clearance (mR/hr) for thyroid cancer patients

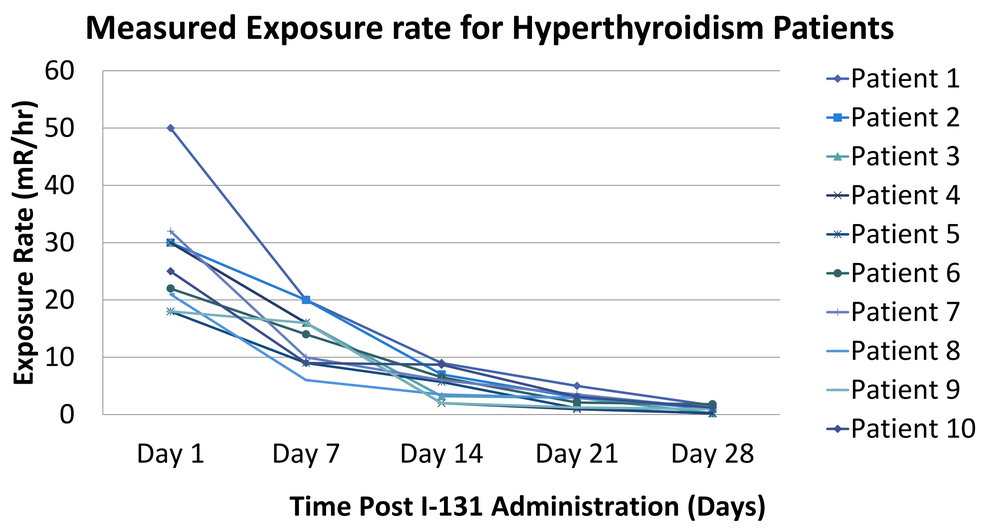

Figure 2. I-131 exposure rate clearance (mR/hr) for hyperthyroidism patients

Table 1. comparison of the total effective dose equivalent to any other individual or exposed persons

	Thyroid Cancer patients	Hyperthyroidism patients
Measured exposure rate at 0.3 meter on Day 14	0.85 mR/hr	3.00 mR/hr
Effective dose (mSv)	0.02 mSv	0.80 mSv

Assuming a patient sleeps together with partner after day 14, their sleeping partner might receive an exposure of more than 1 mSv taking the highest exposure rate of 5 mR/hr at 0.3 meter as the worst scenario. Thus, 14 days restriction is inadequate as release criteria from their sleeping partner and to hold small children for hyperthyroidism patients.

Despite postoperative thyroid cancer patients receive relative higher I-131 dose compared to hyperthyroidism patients, excretion of I-131 in thyroid cancer patients is faster. This may due to a smaller thyroid tissue mass after removal from surgery. Radioactive iodine is removed from body due to either radioactive decay or metabolic excretion. As more radioactive iodine is released back to the blood stream in the case of remnant thyroid tissue, resulting excretion, we can induce excretion of I-131 in thyroid cancer patients is faster.

The effective half life for thyroid cancer patient is between 1 day, depending on the state of disease, in the case of partial or total ablation of thyroid tissue, and 7 days for patients with euthyroid goiter. Hyperthyroid patients retain a greater percentage of radio activities with an effective half life of about 5 days.

Conclusions

Radiation exposure from hyperthyroidism patients to others take longer time to decrease to safety level than a thyroid cancer patient.

Our patient specific release criteria is based on personalized effective dose calculated from an external exposure rate measurement and tends to be more restrictive for hyperthyroidism patients

An external accumulate exposure rate of less than 1 mR/hr at 0.3 meter was accepted as our resuming contact criteria.

References

1. United States Nuclear Regulatory Commission Office of Federal and State Material and Environmental Management Programs 2009 Washington, DC, 20555-0001. NRC Information Notice 2003-22, Supplement 1. Available at www.nrc.gov/reading/doccollections/gencomm/infonotices/2003/m1090500018.pdf, assessed October 26, 2010
2. NCRP. Protection in Nuclear Medicine and Ultrasound Diagnostic Procedures in Children, National Council on Radiation Protection and Measurements, Washington, DC, Report No. 73, 1983:2
3. Radiation Safety in the Treatment of Patients with Thyroid Diseases by Radioiodine I 131; Practice Recommendations of the American Thyroid Association.
4. National Council on Radiation Protection and Measurements (NCRP), "Precautions in the Management of Patients Who Have Received Therapeutic Amounts of Radionuclides", NCRP Report No. 37, October 1, 1970
5. Radiation Protection 97. Radiation Protection following Iodine-131 therapy (exposures due to out-patients or discharged in patients)
6. Hanscheid H, Lassmann M, Luster M, Thomas SR, Pacini F,Ceccarelli C, Ladenson PW, Wahl RL, Schlumberger M, RicardM, Driedger A, Kloos RT, Sherman SI, Haugen Br, Carriere V, Corone C, Reiners C 2006 Iodine biokinetics and dosimetry in radioiodine therapy of thyroid cancer: procedures and results of a prospective international controlled study of ablation after rhTSH or hormone withdrawal. J Nucl Med 47:648–654.

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