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Radiation Safety to the Public in the Treatment of Thyroid Cancer Patients with I-131 Based on Dose Calculation and Releasing Time

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Abstract: To ensure the radiation safety for public, caregiver and family members from the patients who need high dose radioactive iodine treatment. The patients require isolation in a lead shielded room for certain period of time and released them if the radioactivity remaining in the body less than 1.2 GBq. The aim of this study was to estimate the isolation time and investigate the possibility of earlier release from hospitalization. This study was retrospective analysis of data from 136 patients who required hospitalization to treat thyroid cancer with I-131. The radiation dose rates were measured by using a radiation detector at 1.0 m from the anterior neck of patient immediately after I-131 administration and subsequent at 24, 48, 72 and 96 h respectively. The measured data were plotted using a Microsoft Excel; the effective half-life (*T*eff) was derived using a curve fit function of the spreadsheet program assuming. The mean *T*eff to all patients obtained by excel were 17.33 and 34.65 h for the initial fast and the second slower clearance phase, respectively. The dose rate from patient decreased in a bi-exponential pattern, where there is a fast clearance of radioiodine in the first day post I-131 treatment and a slower clearance after this time. The isolation time depends on the *T*eff value instead of the administered I-131 activity and this study has demonstrated that after 24 h post I-131 radiation dose rate at 1 m was less than 70 μSv/h. Based on dose rate measurement to release the patients, this suggests that a majority of the patients could be discharged from the isolation room after 24 h after I-131 treatment.

Key words: Radioiodine treatment, thyroid cancer, isolation time

1. Background

Patients treated with radioiodine are necessary to ensure the radiation safety for public, caregiver and family members. Routinely, in Thailand the patients who need high dose radioactive iodine treatment require isolation in a lead shielded room for certain period of time (usually 2-4 days) [1]. According to Nuclear Regulatory Commission (NRC) regulatory, to release patient form isolation the radioactivity should be remaining in the body less than 1.2 GBq or dose rate at 1 m less than 0.07 mSv/h [2]. Currently, thyroid cancer in Thailand has more dramatically increased but room isolation is insufficient. To fix this problem some nuclear medicine department have to treat patient as an outpatient some facilities treatment as outpatient but as we know that dose rate measured immediately after treatment more exceeded. If we can shorten the total admission time while maintaining safety regulation, more patients can be treated and several advantages may appear such as reducing therapy costs and increasing psychological benefits for the patients and their families [3]. Thus, aim of this study was to estimate the isolation time and investigate the possibility of earlier release from hospitalization by assessing the time dependent dose rate following the administration of I-131 activities and estimate the radioiodine effective half-life inside the patient's body, which would be useful for releasing patients form hospitals and guide radiation protection recommendations [1].

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2. Methods

This study was retrospective analysis of data from 136 patients (104 women and 32 men, mean age 47 ± 15.04 years) who required hospitalization to treat thyroid cancer with I-131 activity 3.7 GBq (23 patients), 5.55 GBq (103 patients) and 7.4 GBq (10 patients). The patient comprised of two groups: the ablation group (37 patients) and the follow up group (99 patients). The radiation dose rates were measured by using a radiation detector (Ludlum Model 375 Monitor with Ludlum 133-2) at 1.0 m from the anterior neck of patient immediately after I-131 administration and subsequent at 24, 48, 72 and 96 h respectively. The measured data were plotted using a Microsoft Excel; the effective half-life (T_{eff}) was derived using a curve fit function of the spreadsheet program assuming exponential decay [2].

Table 1 Dose rate (μSv/h) measured at 1.0 m from the patients (n = 136) as a function of time of post I-131 activity administration.

Time	0 h	24 h	48 h	65 h	72 h	89 h
Dose Rate A	167.68 ± 42.92	40.02 ± 11.98	14.45 ± 8.47	8.85 ± 8.47	7.72 ± 5.67	5.67 ± 4.55
Dose Rate B	173.55 ± 46.77	37.48 ± 15.84	12.8 ± 8.24	7.4 ± 5.12	5.92 ± 5.72	3.3 ± 3.14

A: the patient receiving radioiodine for the first time; B: the patients receiving second or subsequent therapeutic doses for suspected residual, recurrent or metastatic disease.

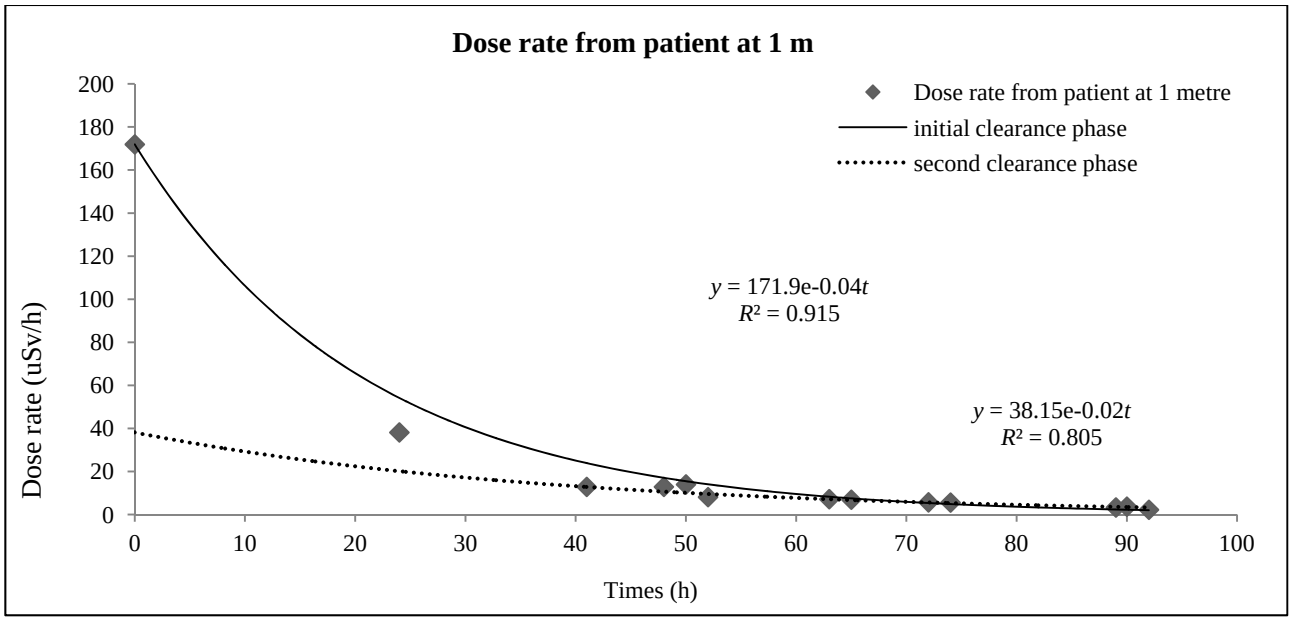

Fig. 1 The clearance pattern of administered I-131 from the body.

3. Results

The mean dose rates measured at 1 m from the patient at different times after I-131 treatment was shown in Table 1. The variation of the dose rate with time in both patient groups was decays in a bi-exponential as show in Fig. 1. The mean T_{eff} to all patients obtained by excel were 17.33 and 34.65 h for the initial fast and the second slower clearance phase, respectively.

4. Conclusions

Dose rates monitoring is important information for radiation protection purposes because they are directly linked to the risk involved in the management of thyroid cancer patients after receiving I-131 therapy [4]. In this study the dose rate from patient decreased in a bi-exponential pattern, where there is a fast clearance of radioiodine in the first day post I-131 treatment and a slower clearance after this time [5].

The isolation time depends on the T_{eff} value instead of the administered I-131 activity and this study has demonstrated that in both patients group after 24 h post I-131 radiation dose rate at 1 m was less than 70 μSv/h [6]. Based on dose rate measurement to release the patients, this suggests that a majority of the patients could be discharged from the isolation room after 24 h after I-131 treatment.

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