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Estimation of Radiation Exposure to Some Iraqi Patients with Hyperthyroidism treated with Radioactive Iodine-131 as an Outpatient Basis

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Abstract

A broadly established therapy is radioactive iodine-131 for patients with hyperthyroidism (1). The radioactive iodine-131 dose is given to the patient as a single dose, which leads to a high radiation exposure surrounding the patient's location for several days, depending on the amount of the received radiation dose, patient's isolation in a special room is necessary for a period of time until the amount of radiation exposure decreases to an acceptable limits according to the National regulations. This study aimed to obtain a measurable estimation to the amount of radiation exposure resulting from patients treated with iodine-131 and assessment of compliance of patients and their family members to radiation safety instructions (RSI). In this study, (35) Iraqi patients with hyperthyroidism (15 male and 20 female) divided in to three groups according to ¹³¹I doses received that ranging from 3.7 to 7.4 GBq (100-200 mCi), the radiation dose rate was measured at different levels of the patient's body as well as at different periods after receiving the I-131 treatment dose.

Results shows that the external dose rates decrease rapidly and as a result, the greater amount of radioactive iodine is disposed of in the urine in the first two days after therapy. Also there is no observed differences appears in the average radiation dose rate ($\mu\text{Sv/hr}$) resulting from patients after giving the dose of iodine-131 between males and females within the same group, while a significant difference was observed in the average dose rate between the divided groups, especially after an hour of giving the dose.

Conclusion this study provide an estimation to the amount of radiation exposure resulting from patients for three days post ¹³¹I therapy on outpatient basis, also these results enables us to obtain a database that can be used in determining the amount of radiation reflected from patient to family members and contacts. Oral and written radiation safety instructions (RSI) are given in an appropriate way to patients and family members before patient's discharge.

Keywords: Radiation Exposure, Iraqi Patients, Hyperthyroidism

Introduction

Hyperthyroidism is the increasing in the amount of thyroid hormones secretion in the blood while the amount of TSH is minimized, and the thyroglobulin creation is amplified ¹. The thyroid is used up of iodine because of

the hormones that are quickly secreted from the thyroid gland. The general reason for hyperthyroidism are diffuse toxic goiter, also called Graves' disease, toxic multi nodular goiter and toxic adenoma ². Radioactive Iodine-131 has been used widely for hyperthyroidism since the 1940s ³. A move towards radioactive ¹³¹I therapy hyperthyroidism treatment in western countries was listed as a result of well-known safety profile of I-131 therapy ⁴. Benefits to patients treated with radioiodine-131 must be balanced against radiation

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exposure to contacts, family members and occupational workers⁵. Each Medical center present these detailed self-protective recommendations that should be useful to minimize the exposure to radiation levels to the whole community^{6,7}. The ICRP and IAEA set a detailed strategy for all radiation employees to follow in dealing with radiation⁸. The annual limit of occupational dose to an individual adult is 20 mSv and 15 mSv for adults older than 60 years according to national regulations⁹. Whereas the U.S.NRC recommended dose base of 5 mSv per episode in all age¹⁰. Many studies in western countries confirmed that radioactive I-131 treatment on outpatient basis is an efficient and secure therapeutic method with low exposure to radiation levels to family and contacts of patients treated with I-131, and also for relatives of patients who obtained high doses of I-131^{11,12}. While, there is a few in formations regarding exposure to radiation to family members and contacts of outpatients treated with I-131 in the Arab communities¹³. A previous Saudi study noted that I-131 is very efficient in treatment of hyperthyroidism with little side effects, this mutually with its safety and minimum cost have made it a best treatment of many patients with hyperthyroidism¹⁴. To our Knowledge, this study is the first to conduct on Iraqi patients for the purpose of obtaining a quantitative estimation to the amount of radiation exposure resulting from patients treated with radioactive iodine-131 on outpatient basis and evaluation of compliance of patients and their family members to radiation safety instructions (RSI).

Material and Method

Dose Rate Measuring System Graetz X5C plus was used directly and combined with Telescopic Probe DE for measurements from a (1 m) distance to obtain a quantitative estimation of the radiation exposure rate resulting from patients treated with radioiodine-131. Therapeutic doses using radioactive iodine-131 were all taken from the Jordan Nuclear Medicine Center (Jordan).

Thirty-five self-dependent hyperthyroidism Iraqi patients all were used I-131 for treatment on an outpatient basis. They were divided into three groups according to the amount of radiation dose received for each group.

Patients were administered into isolated rooms and doses were given orally in liquid form; iodine is fast

and totally absorbed in the upper intestine, it is spread first in the body’s extra vascular fluid within the first one hour (15) and the radiation dose rate was measured and recorded after 1, 24 and 48 hours at a distance of (1m) from the patient’s body at the level of the abdomen (bladder), thyroid and knees.

Oral and written radiation safety instructions were given to patients and family members before leaving the Nuclear Medicine Center.

Results and Discussion

The current study included (35) Iraqi patients with hyperthyroidism (15 male and 20 female) aged between (27 and 63) years old, all were treated for their hyperthyroidism with I-131 doses ranging from 3.7 to 7.4 GBq (100-200 mCi) as shown in Table (1). The female patients were more influenced with thyroid diseases than male patients for all groups around (57.14% female and 42.85% male). This is in accord with a previous study by Morganti et al. 2005 (16) which reported that thyroid diseases are more common in females.

Table (1): Patients distribution according to radioactive I-131 doses received and gender

Groups	I-131 Doses	Patients Number	
		Male	Female
A	3.700 GBq (100 mCi)	8	10
B	5.550 GBq (150 mCi)	4	6
C	7.400 GBq (200 mCi)	3	4
Total no. of patients		15	20

The average of age, weight, and length for the patients included in the study, distributed by groups and gender were listed in Table (2).

Table (2): Average of age, length and weight for patients according to their groups

Groups	Average of age (years)		Average of Length (cm)		Average of Weight (kg)	
	Male	Female	Male	Female	Male	Female
A	46.23	42.67	170.9	163.12	81.55	83.86
B	60.78	52.54	173.0	166.98	79.0	78.9
C	47.94	43.63	168.9	159.0	69.44	75.0

The average dose rate ($\mu\text{Sv/hr}$) at (1 m) distance resulting from patients after giving the dose of radioactive iodine-131 and at three different levels of the body (bladder, thyroid and knee) where the radiation exposure rate was measured for each patient individually at three different periods as shown as in Table (3).

Table (3): Average dose rate ($\mu\text{Sv/hr}$) of patients after receiving radioactive iodine-131doses.

Group	Sex	Time	Average Dose Rate ($\mu\text{Sv/hr}$)		
			Thyroid	Bladder	Knee
Group A (3.700 GBq)	Female	1 hr	130.00	156.50	128.08
		24 hrs	40.56	48.30	41.00
		48hrs	20.90	22.01	18.02
	Male	1 hr	124.10	139.44	116.77
		24 hrs	30.07	41.09	33.11
		48 hrs	14.54	16.81	13.46
Group B (5.550 GBq)	Female	1 hr	184.11	225.47	211.50
		24 hrs	50.38	67.00	55.70
		48 hrs	23.4	29.20	20.30
	Male	1 hr	179.10	220.60	220.2
		24 hrs	49.80	70.40	54.00
		48 hrs	21.70	31.80	22.00
Group C (7.400 GBq)	Female	1 hr	290.00	330.00	288.00
		24 hrs	80.11	85.60	72.08
		48 hrs	36.67	40.07	32.00
	Male	1 hr	270.40	321.30	245.90
		24 hrs	84.00	91.10	77.00
		48 hrs	38.4	45.70	36.88

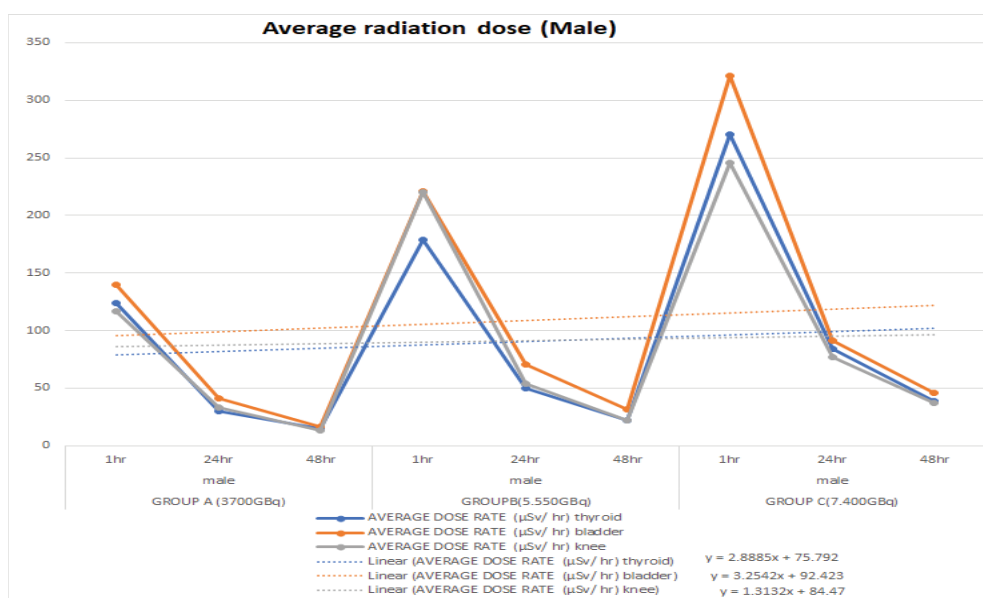


Figure (1): The average dose rate ($\mu\text{Sv/hr}$) of male patients after receiving radioactive iodine-131doses.

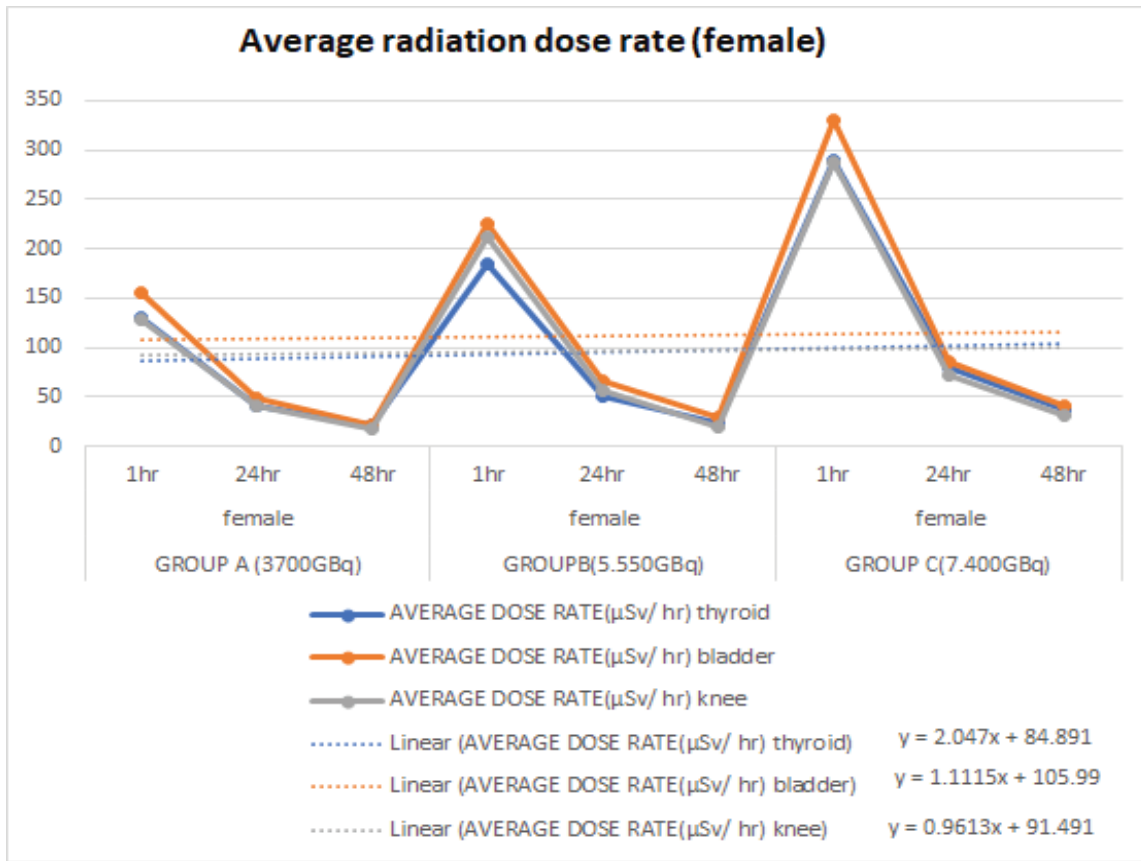


Figure (2): Average dose rate (μSv/hr) of female patients.

Figure (2): The average dose rate (μSv/hr) of female patients after receiving radioactive iodine-131 doses.

Figures (1) and (2) together with Table (3) shows that the external dose rates decrease rapidly and as a result, the greater amount of radioactive iodine is disposed of in the urine in the first two days after treatment, and the results do not indicate that there are significant differences in the average radiation dose rate (μSv/hr) resulting from patients after giving the dose of iodine-131 between males and females within the same group, while a significant difference was observed in the average dose rate between the three groups, especially after an hour of giving the dose and the reason behind may rely on a personal basis that all I-131 incur patients do not importantly have the same iodine kinetics¹⁷. A previous study by Mountford and O'Doherty¹⁸, reported that keeping a patient in hospital needs an extra financial income, and the rules when discharging the hospital may reason a real disturbance of their family and daily life. Therefore, the time spend in hospital and the regulations to pursue after discharge could be depend

on a proper radio protective evaluation and may not be so preventive. The residence factors should be rely on the patient's daily life and the patient's livelihood, also on their capability to accept a set of social restrictions for many days. Taking in to account the previous constraints and according to our results from Table (3) partners are advised to sleep apart for 3 days (1850 MBq in follow-up of patient) to 23 days in the case of 7400 MBq dose¹⁹.

Conclusion

The results of this study indicate that the external dose rates decreases and to be within the ICPR limit of 1 mSv/year only after two days from receiving I-131 treatment dose thus hyperthyroid patients can continue to be treated with radioiodine on an out-patient basis, if given appropriate radiation protection advice such as a preventive isolation of the patient with sleeping separately up to 23 days in order to strictly abide by ICPR limit of 1 mSv/year. For patients with hyperthyroidism, ¹³¹I is considered as a widely accepted therapy but the decisions of treatment is optional due to

the patient preference with taking in to consideration the balance of risks with advantages of each available treatment for hyperthyroidism as well as patient's lifestyle and health status. We believe the results of this study provide a quantitative estimation to the amount of radiation exposure resulting from patients treated with radioactive iodine-131 on outpatient basis and it could be considered as a base for further future studies.

Financial Disclosure: There is no financial disclosure.

Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the College of Health and Medical Technologies and all experiments were carried out in accordance with approved guidelines.

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