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RADIOIODINE THERAPY IN DIFFERENTIATED THYROID CARCINOMA: TRENDS IN DISCHARGE AND RADIATION DOSE RATES

Hafiz Sibtain Raza[1*,2], Saeed Ahmad Buzdar[1], Muhammad Asghar Gadhi[2], Muhammad Shahid Khan[3], Malik Younas Imran[2]

[1]Institute of Physics, The Islamia University of Bahawalpur, Bahawalpur, Pakistan
[2]Bahawalpur Institute of Nuclear-Medicine & Oncology (BINO), Bahawalpur, Pakistan
[3]Department of Physics, University of Okara, Pakistan

***Corresponding Author:** Hafiz Sibtain Raza
*Email: sibtain.raza@iub.edu.pk

ABSTRACT

The main treatment for metastatic well-differentiated thyroid carcinoma (DTC) is radioiodine therapy. Differentiated thyroid cancers (DTCs) make about 95% of thyroid cancer diagnoses, making thyroid cancer the most prevalent endocrine malignancy. Purpose of this study was to look into hospital discharge trends after radioiodine treatment and radiation dose rate emissions.

The patients with well-differentiated thyroid (DTC) were treated with I-131 from 2020-2024. At the Bahawalpur Institute of Nuclear Oncology, we retrospectively examined 124 DTC patients who had I-131 treatment (50-210 mCi). Radiation dose rates were recorded every day at a distance of one meter till discharge (≤25 µSv/hr). Comparison of dose rate emissions presented in a figure helped us to see the higher value of R1 as compared to R2 and R3. Hospital discharge patterns is displayed in table 1 showing that most of the patients were discharged after 72 hours.

No radiation dose was found to be less than 25 µSv/hr, and the majority of patients (58%) were released within 72 hours. The median age was 36 years old, and the female-to-male ratio was 2.4:1. Seventy percent of the histological subtypes were papillary carcinomas. Personalized treatment plans and enhanced radiation safety protocols are supported by our findings. The findings have consequences for clinical practice, emphasizing the necessity of customized I-131 dosing plans and uniform hospital discharge standards.

Key Words: Radioiodine Therapy. Dose administration. Dose rate. Well Differentiated Thyroid cancer. Follicular carcinoma thyroid. Endocrine Carcinoma

INTRODUCTION

The most recurrent kind of thyroid cancer is follicular cancer, that is regarded as the most common kind of endocrine system cancer, [1],[2]. Three chief forms of follicular-derived thyroid tumors include differentiated thyroid cancer (DTC), poorly differentiated thyroid cancer (PDTC), and anaplastic thyroid cancer (ATC). More than 90% of all malignancies have a good prognosis and a relatively low-risk presentation, which is attributed to DTC, [3]. Patients with DTC have a generally good prognosis, but those with distant metastases have a much worse prognosis, [4].

While making up only 5–10% of cases of follicular-derived thyroid tumors, PDTC and ATC are substantially more aggressive and more likely to be linked to distant metastases and lymph nodes, [5].

Approximately one-third of thyroid cancer-related deaths are caused by PDTC and ATC malignancies, which have median survival times of 3.2 and 0.5 years, respectively, [6]. Over the past few decades, the incidence of Differentiated Thyroid cancer has increased globally, with women experiencing a 2.5–3 times higher rate than that of men, [7],[8]. This higher incidence has not been linked to a rise in DTC mortality; rather, it is almost exclusively the result of an increase in PTC cases, [9]. The main treatment for metastatic DTC, which affects 10% of individuals, is radioiodine therapy. After receiving radioiodine therapy, half of the metastatic patients experience a long-lasting stable illness or a full or partial remission. Regrettably, the remaining patients' condition worsens despite the treatment, [10]. Radioiodine avidity in recurrent or metastatic disease must be assessed and staged using post-therapeutic radioiodine whole-body imaging. While the remaining individuals either acquire non-radioiodine-avid metastases or experience progressive disease despite radioiodine treatment, over 70% of patients with metastatic disease exhibit radioiodine uptake, [11]. A growing body of research indicates that tumor-absorbed dosages in advanced and metastatic disease are associated with treatment response, highlighting the necessity for tailored treatment. Other aspects that should be examined individually, in addition to iodine-131 (I^{-131}) uptake, are the molecular pathophysiology and processes of DTC, the features of individual individuals, and the presentation of the disease, [12]. If a patient stops responding to treatment, I^{-131} therapy should be discontinued because, regrettably, it loses its effectiveness in a small percentage of cases. Yet, early I^{-131} therapy termination (i.e., when still able to achieve disease stabilization and symptom relief) should be avoided because RAI-R DTC patients still have few therapeutic choices, [10]. Radioiodine uptake is shown in about 70% of patients with metastatic disease, while the remainder patients either have progressing disease in spite of radioiodine or have non-radioiodine-avid metastases treatment, [13].
The current study's objective was to examine measurements of radiation dose rate emissions at a distance of one meter as a function of time in order to determine the allowable radiation dose that thyroid cancer patients could receive from both single and multiple RAI therapies.

MATERIALS AND METHODS

From 2020 to 2024, this analytical study was carried out at the Bahawalpur Institute of Nuclear Oncology (BINO), located in Bahawalpur, Pakistan, in the Department of Radiation Therapy. Individuals of any gender and age who had been diagnosed with Differentiated Thyroid Carcinoma (DTC) were included. Individuals with undifferentiated thyroid cancer and a negative I^{-131} scan were not accepted. Prior to the study's commencement, moral and ethical concerns were explored, and approval from the BINO Ethical Committee was secured.
A total of 124 patients with Differentiated thyroid cancer, had been cured with dissimilar doses of I^{-131} ranging from 50 mCi to 210 mCi as an in-patient had been included in the study. Dose rate for all the patients had been calculated as R1,R2 and R3. After being placed in an isolation room, the patients underwent daily surveys using a calibrated survey meter at a distance of one meter to measure the dose rate, which was continued until it was at or below 25µSv/hr. Following their first thyroid operations, or in some cases, repeat procedures, all of the patients were evaluated in the nuclear medicine outpatient department when the postsurgical thyroid scan revealed a significant amount of residual thyroid tissue. They underwent baseline testing for thyroglobulin (Tg) and anti-thyroglobulin (ATG) antibodies. In certain cases of bone scans had also been performed.

RESULTS

The study included 124 patients with well differentiated thyroid cancer out of which 88 (71%) were females with an age range of 17-80 years. All had been treated with different doses of I^{-131} as an in-patient. One hundred and twenty-four patients had been given dose range of 50 to 210 mCi. Most of the patients 72 out of 124 (58%) were discharged after 72 hours with no further complication observed. While 46 out of 124 (37%) were discharged after 96 hours (4 days), 5 out of 124 patients were discharged after 48 hours (2 days). Radiation dose below or at 25µSv/hr had not been observed in any case of the RAI therapy.

Stay in Hospital (in hours)	Number of patients with percentage
24	0 (0%)
48	05 (4%)
72	72 (58%)
96	46 (37%)
120	01 (0.8%)

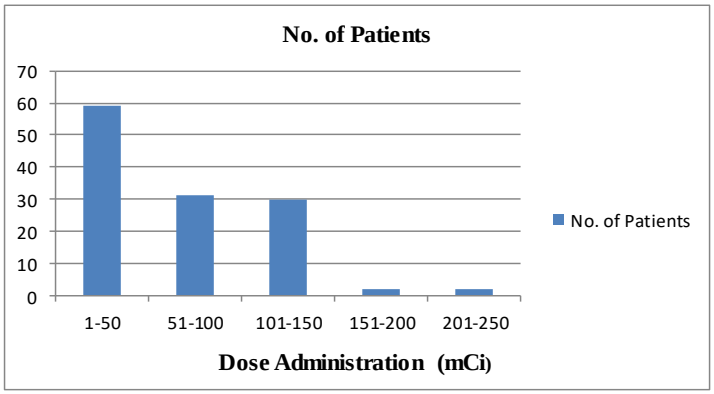

Figure 1: Histogram of Dose Adm. v/s No. of Patients

Figure 1 displays that there were 59 out of 124 patients who had received the dose upto 50 mCi, while 31 patients received the dose ranging from 50 to 100 mCi, 30 patients received dose ranging from 101 to 150 and 4 patients received the dose more than 150 mCi.

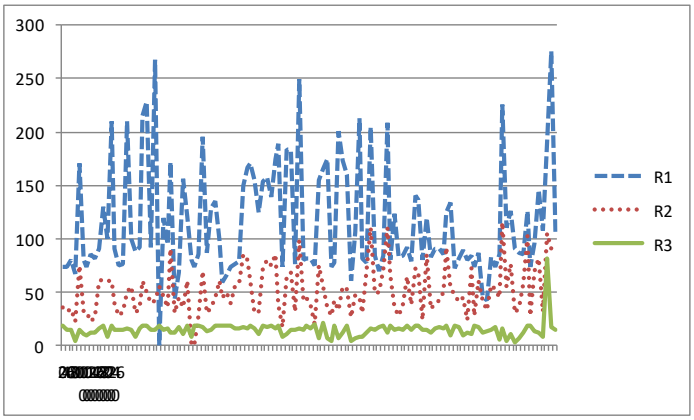

Figure 2 Comparison of R1, R2, R3

Figure 2 shows that dose rate R1 is larger as compared to the dose rate R2. And as the appropriate value is obtained in form of R3, then the patient had been discharged.

DISCUSSION

Differentiated thyroid cancers (DTCs) make about 95% of thyroid cancer diagnoses, making thyroid cancer the most prevalent endocrine malignancy,[14].The most effective treatment for distant metastatic differentiated thyroid carcinoma (TC) is still radioiodine (RAI) therapy,[15]. The malignancy of thyroid parenchymal cells is known as thyroid cancer. Thyroid follicular cells, which give rise to differentiated thyroid cancer (DTC), and parafollicular or C-cells, which give rise to medullary thyroid carcinoma (MTC), are the two main cell types that make up the thyroid parenchyma. DTC includes Hurthle cell cancer, follicular thyroid cancer, and papillary thyroid cancer (PTC), which make up 90–95% of all thyroid cancers, [16]

It is more difficult to manage advanced thyroid cancers, such as iodine-refractory disease and poorly differentiated/undifferentiated subtypes, even though the majority of follicular-derived thyroid

cancers are well differentiated and have an overall excellent prognosis after treatment with surgery and radioiodine chemotherapy,[17] . One of the major worries after RAI treatment of DTC patients is the radiation safety threat, which may be quantified by the patients' exposure rates,[18]. Regarding the criteria to be adhered to when releasing patients following therapy with unsealed radionuclides, the ICRP has not issued any guidelines. Rather, the guidelines have focused on dosage limitations for hospital employees who are exposed at work for the general public and dosage restrictions for caretakers. Patients' release criteria vary greatly as a result of variations in the models and underlying assumptions. The measured dose rate at one-meter distance that is less than 20 to 50 µSv/hr is the hospital discharge criterion, per PNRA recommendations. The majority of patients in this analysis who had RAI therapy for the first time needed at least 48 hours to be released from the hospital.

Patients with differentiated thyroid cancer are treated in clinical nuclear medicine by receiving postoperative doses of Iodine131 more than 50 mCi. There are three primary justifications for this regimen. First, this can be used to ablate any normal thyroid tissue that remains after surgery, which will aid in the later detection of a residual or recurrent tumor; second, it can be used to identify any tiny neoplastic foci inside the thyroid remnant or elsewhere in the body, which will improve the long-term result; and third, it can be used to treat known residual tumor sites, [19]. Iodine symporters in the thyroid tissue absorb the supplied radioactive iodine, which is then primarily eliminated from the urine and intestinal tracts. These patients are housed in an isolation chamber and are observed every day using a calibrated survey meter one meter away from the neck region until their activity levels fall below a reasonable range.

This study's female to male ratio of 2.4:1 is consistent with a different study conducted on the Pakistani population by Zuberi et al. that showed a ratio of 2.2:1,[20]. According to Rahbari, thyroid cancer is 2.9 times more likely in women, [21]. The thyroid cancer patients in this study were 36 years old on average. According to Zuberi et al., the Pakistani population's peak incidence of thyroid cancer occurred between the ages of 30 and 60, [20].

With 70% of patients having papillary carcinoma on histology and 19% having follicular carcinoma, papillary carcinoma was the most prevalent cancer type in our community. According to a number of further research, the most common subtype of thyroid cancer is papillary thyroid cancer, [22], [23].

In the long run it can be said that most of the patients were discharged after 72 hours which is clearly depicted in table 1. And most of the patients received the dose upto 50 mCi. No radiation dose was found to be less than 25 µSv/hr. Over time, the dose rates (R1, R2, and R3) dropped significantly.

CONCLUSION

After receiving radioiodine therapy, the majority of patients with well-differentiated thyroid carcinoma can be safely released 72 hours later, according to this study. There is support for tailored treatment plans and enhanced radiation safety protocols. Individualized I-131 dosage plans and standardized hospital discharge standards are advised.

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