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Estimating the Absorbed Dose to THYROID during Chest wall Radiotherapy

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***Abstract*—**Thyroid cancer's overall contribution to the worldwide cancer burden is relatively small, but incidence rates have increased over the last three decades throughout the world. This trend has been hypothesised to reflect a combination of technological advances enabling increased detection, but also changes in environmental factors, including population exposure to ionising radiation from fallout, diagnostic tests and treatment for benign and malignant conditions. The Thyroid dose received apparently shielded by cerrobend blocks was about 8cGy in 100cGy Expose .

***Keywords*—**Absorbed Dose, Thyroid, Radiotherapy

I. Introduction

RADIOTHERAPY for certain cancers, including head and neck, lung, lymphoma/leukaemia, breast and brain, can expose the thyroid to_0.25 Gy [1]. In the Childhood Cancer Survivor Study, the highest thyroid doses were observed among children first treated for Hodgkin lymphoma [2]. As discussed above, thyroid risk in this study increased with dose up to 20 Gy, after which point therewas a decline in the risk [2]. Thyroid cancer is one of the most common second cancers after radiotherapy for Hodgkin lymphoma during childhood and significant increased risks of thyroid cancer have been observed from 5 to more than 40 years after childhood radiotherapy (reviewed in Ref. [3]). Bhatia et al. [4] estimated the cumulative incidence of thyroid cancer to be 4.4% at 30 years after childhood treatment for Hodgkin lymphoma. (See previous reviews for a more detailed discussion of radiotherapy-related thyroid cancer [3],[5],[6]. In addition to cancer treatment, radiotherapy for the treatment of benign conditions, including (but not restricted to) Tinea capitis, hemangioma, and enlarged thymus, has been clearly associated with increased thyroid cancer risk (reviewed in Ref. [7]).

II. THYROID CANCER

According to the WHO, thyroid malignancies are classi®ed as carcinomas, which are by far the most common thyroid malignancies, sarcomas, lymphomas and even less frequent tumours including metastases to the thyroid. This review will focus on thyroid carcinomas, their aetiology, genes that seem to play a role in their pathogenesis, and clinical aspects, diagnostic and therapeutic ones as well[9].Four types of thyroid cancer comprise more than 98% of all thyroid malignancies: papillary thyroid carcinoma (PTC), follicular thyroid carcinoma (FTC), both of which may be summarised as differentiated thyroid carcinoma (DTC), undifferentiated (anaplastic) thyroid carcinoma (UTC) and medullary thyroid carcinoma (MTC)[10].

III. Radiation-Induced Cancer

Radiation effects on the thyroid gland were first reported in the 1920s in thyrotoxic patients administered radiotherapy [11]. Later, radioactive iodinewas used to reduce the basal metabolic rate in patients with cardiac diseases (congestive heart failure and angina) .The first reports on hypothyroidism following radiotherapy for head and neck cancer were published in the 1960s[12]-[14].

More recent examples of the human experience with radiation-induced cancer include the following[15]: hyroid cancer has been observed in children who received radiotherapy for what was thought to be an enlarged thymus. The thyroid was included in the treatment field, and both malignant and benign thyroid tumors have been observed. Breast cancer is also elevated in these individuals[16]-[19].

As recently as the 1950s, it was common practice to use x-rays to epilate children suffering from tinea capitis (ringworm of the scalp). An increased incidence of thyroid cancer from this practice was first reported by Modan and his colleagues in Israel, who treated a large number of immigrant children from North Africa in whom ringworm of the scalp reached epidemic proportions. There was also a significantly increased risk of brain tumors, salivary gland tumors, skin cancer, and leukemia mortality. A comparable group of children in New York for whom x-rays were used for epilation before treatment for tinea capitis show quite different results. There were only two malignant thyroid tumors in addition to some benign tumors. There is, however, an incidence of skin cancer around the face and scalp in those areas also subject to sunlight. The skin tumors arose only in white children, and there were no tumors in black children in the New York series[18]-[23].

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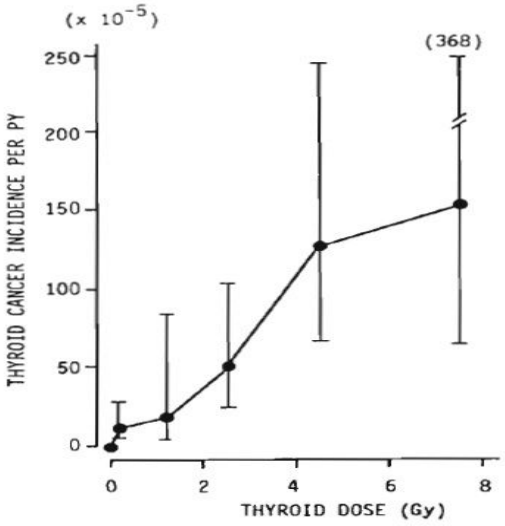

Fig. 1 cancer incidence per person-year (PY) as a function of the radiation dose in the t. Rates adjusted for gender, ethnicity, and interval after irradiation. Error bars represent 90% confidence limits. (From Shore RE, Woodard E, Hildreth N, et al.: tumors following thymus irradiation. JNCI 74:1177-1184, 1985, with permission.)

IV. MATHERIAL AND METHOD

A Primus linac (Siemens, Germany) High Energy X-ray machine of the Mahdieh Radiotherapy and Oncology, Hamadan, Iran was used in this work. The primus linac provides two low and high energy photon beams (6 and 15 MV) and a range of electron beams (5-12 MeV).

A. Dosimetry system

Absorbed dose measurements were made with thermoluminescence (TL) dosimetry. We used Lithium florid (LiF) Thermoluminescent Dosimeters (TLD-100) chips (3.7mm*3.7mrn*0.9mm, manufactured by Harshaw, Solon, USA) Pre-irradiation annealing was carried out in 400 C for 1 h, followed by cooling to room temperature. Each dosimeter was rinsed before being read out with a solution of methanol containing 12 mmol HCl/l. The dosimeters were read out in 300 C for 10 s. Each dosimeter was individually calibrated. The calibration was carried out in a PMMA phantom with 5 mm build up in a 60Co beam. The stability of the dosimeters was within ^3%. The variation in the mass energy transfer coefficient in the energy interval for 6 MV, 60Co and 192Ir is less than 3%. This value was calculated from a standard textbook of TL dosimetry [24].

B. External beam radiotherapy planning

Treatment planning is a multi-step process. The complexity of this process depends upon the treatment intent, the site of the tumour, the equipment/facilities available and the desired accuracy of treatment (including reproducibility and verification). The aim of radiotherapy in the radical setting is to deliver the maximum possible dose of radiation to the tumour to achieve local tumour control, whilst trying to spare surrounding normal tissue.

V. RESULT

During radiotherapy treatment, critical organs are shielded using lead and cerrobend blocks.

A. Transmition factor X-Ray

For transmission Factor Also common method of measuring the absorbed dose distribution and electron contamination in the build-up region of high-energy beams for radiation therapy is by means of parallel-plate Ionisation chambers.

The transmission factor is the ratio of the doses (at the depth and distance from the source corresponding to the reference condition) with and without the cerrobend in position.

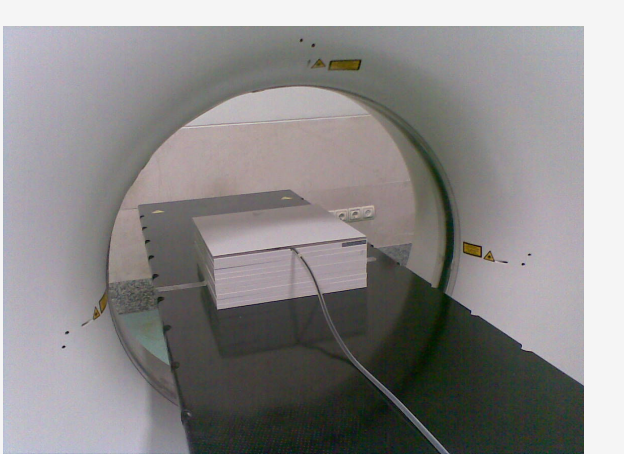

Fig. 2 phantom placed in CT scan device

Fig. 3 placement of Tissue equivalent phantom on a flat linear accelerator

B. Scater X-Ray

Thirty- four thermoluminescent dosimeter chips (TLD-100) fabricated by Harshaw Chemical Co., Solon, USA, in the form of lithium fluoride, were placed in an adult male tissue-equivalent RANDO human phantom. Three TLDs were used to measure background radiation.

The irradiation of organs outside the primary beam is mainly due to X-rays scattered within the linac head such as collimator scatter , Tray scatter and cerrobend scatter.

TABLE I
THYROID ABSORBED DOSE MEASUREMENTS PER 100 CGY, THE SCATTERED X-RAYS OF CHEST RADIOTHERAPY FIELD USING TLD

absorbed dose (cGy)	distance from Beside of Field (cm)	TLD
8.352	4	1
8.352	6	2
7.7952	8	3
7.1688	10	4
7.308	12	5
6.3336	14	6
5.0808	16	7
3.9672	18	8
2.9928	20	9
1.392	22	10
0	24	11

VI. CONCLUSION

The thyroid gland is an organ of high sensitivity for radiation carcinogenesis, at least in children; in adults, radiation is much less efficient in inducing thyroid cancer. The malignant tumors that have been produced, however, consistently have been of a histologically well-differentiated type, which develops slowly and often can be removed completely by surgery or treated successfully with radioactive iodine if metastasized; consequently, these tumors show a low mortality rate. It is estimated that about 5% of those with radiation-induced thyroid cancer die as a result.

The Thyroid dose received apparently shielded by cerrobend blocks was about 8cGy in 100cGy Expose three main contributions in the Absorbed Dose to Thyroid During Radiotherapy:

- Due to primary photon beam transmitted through the block :

  4 percent for 8 cm cerrobend blocks

- Due to scattered photons and contamination electrons : 3 up

  4.5 percent, Dependent on cerrobend block Size,These two factors collectively cause the increase with increasing field size ,energy, and block size.

The use of cerobend Block, on Thyroid show that reduced the absorbed dose to the Thyroid by 2 to 3 times.

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