Thyroid remnant volume and Radioiodine ablation in Differentiated thyroid carcinoma.

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ABSTRACT

Aims: The aims of the study were to determine the thyroid remnant volume and to see the effect of radioiodine ablation on thyroid remnant volume.

Methods: A retrospective analysis of seventy-one differentiated thyroid carcinoma patients treated with high dose radioiodine (I-131) for post surgical ablation of thyroid remnants were done in Institute of Nuclear Medicine & Allied Sciences, Comilla of Bangladesh Atomic Energy Commission. Female were 60 and male were 11 with female-male ration of 5.5:1. All patients enrolled during the period from January 2001 to December 2011. The age range of the patients was 15 years to 90 years. The thyroid remnant volumes were determined by SPECT scintigraphy. High dose radioiodine (I-131) ablations were done with doses ranged from 2.77 GBq (75mCi) to 5.55 GBq (175 mCi). A successful ablation was defined as the absence of activity in the thyroid bed on subsequent imaging studies.

Results: Fifty-nine patients (83.1%) showed complete ablation and twelve (16.9%) showed partial ablation of thyroid remnants after radioiodine therapy. The remnant thyroid volume as determined from scintigraphic images was significantly different ($p = 0.048$) between them who were completely ablated and them who were partially ablated. It was also observed that in complete ablation, 52.5% had thyroid remnant volume <1.0 gm, 40.7% had 1.1 to 2.0 gm, 5.1% had 2.1 to 3.0 gm and 1.7% had > 3.0 gm. i.e., The smaller the volume of thyroid remnant, better the response and larger the volume, the poorer the response to radioiodine.

Conclusions: Successful ablation of thyroid remnants significantly depends on their volume and the successful ablation is inversely related with thyroid remnant volume.

INTRODUCTION

Differentiated thyroid carcinoma (DTC) accounts for over 90% of all thyroid malignant tumors (1) and has an overall excellent prognosis. The therapeutic approach for a DTC usually involves total or near total thyroidectomy followed by radioiodine ablation therapy (2). Radioiodine ablation is done to ablate any remaining thyroid tissue, normal or malignant (3,4). Successful ablation depends on type of surgery, thyroid remnant volume, radioactive iodine uptake (RAIU), effective half-life (EHF) of I-131 etc (5,6). There are several studies on thyroid remnant volume and radioiodine ablation (7,8,9). Thyroid remnant can be assessed clinically or by surgeon's notes or by imaging such as ultrasonography or scintigraphy (6). Among these, clinical assumption, surgeon's notes, ultrasonography or plannar scintigraphy is found to be inadequate (6). Tc-99m pertechnitate single photon emission computed tomography (SPECT) showed superior to planar scintigraphy in determination of thyroid remnant volume (6). The aims of this study were to determine the thyroid remnant volume by SPECT scintigraphy and to see the effect of radioiodine ablation on thyroid remnant volume.

MATERIAL AND METHODS

Patient group

The medical records of 71 patients treated for differentiated thyroid carcinoma in Institute of Nuclear Medicine & Allied Sciences (INMAS), Comilla from January 2001 to December 2011 were reviewed retrospectively. All patients had undergone a total or near total thyroidectomy with radical neck resection (in case of neck lymph node metastases) prior to radioiodine treatment. The age, sex, histological type and lymph node involvement, thyroid remnant volume and pre treatment thyrotropin (TSH) levels were recorded in all patients.

Radioiodine treatment

In INMAS, Comilla radioiodine treatment in DTC was done on the basis of consensus on Therapy protocol for thyroid carcinoma (10). According to consensus, histopathologically proven DTC were considered for radioiodine treatment. Post operative pre-ablative assessment were done with thyroid scintigraphy with 111 MBq (3 mCi) ^{99m}Tc-pertechnitate, thyroid and neck ultrasonography with 7.5 MHz probe and thyroid stimulating hormone (TSH) estimation were done approximately 4-6 weeks after surgery. No exogenous TSH was used in this study group. No TSH suppression was initiated until the completion of I-131 treatment. Empirically fixed high dose of radioiodine was given**.** Treatment doses ranged from 2.77 GBq (75 mCi) to 5.55 GBq

(150 mCi). The criteria used to determine the ablative dose were based on the presence or absence of lymph node and distant metastases. A 2.77 GBq (75 mCi) dose was selected for patients free from lymph nodes or distant metastases and a 5.55 GBq (150 mCi) I-131 dose was selected for patients with cervical lymph node. All patients were hospitalized in a specially designed shielded room during treatment until exposure was less than 50 μSv/hour. During hospitalization, the patients were orally hydrated and instructed to chew a gum to stimulate the salivary glands for faster I-131 excretion. A whole body iodine scan (WBS) was performed on 5th post-ablative day using a large field-of-view gamma camera equipped with high-energy parallel-hole collimator. Any discrete uptake in the thyroid bed on the post-ablative scan was considered to be a remnant. Metastases were clearly identified as abnormal foci of uptake outside the thyroid bed.

Follow up procedures and criteria for successful ablation

All patients were followed up at 3 months, 6months and after 1 year and then 6 monthly. The first follow up scan was performed after 1 year with 185 MBq (5 mCi) of I-131 when TSH was >30 mIU/L. Raised TSH was achieved by prior withdrawal of thyroid hormone for 4-6 weeks. Radioiodine ablation was considered to be successful when there was no detectable uptake in the thyroid bed. Any focal uptake in the neck or elsewhere in the body was considered to represent treatment failure or metastases and I-131 ablation therapy was repeated until complete ablation was achieved. Palpation, ultrasound of neck, serum TSH and serum thyroglobulin were done in all patients in all follow up visit and before iodine ablation as well as during each diagnostic I-131 whole body scan.

RESULTS

Total 71 patients were studied of which 60 were female and 11 were male with female: male ratio of 5.4:1 and age ranged of the patients was 15 years to 90 years. The histopathological diagnosis was papillary carcinoma in 58 patients (81.7%) and follicular carcinoma in 13 patients (18.3%). Of 58 papillary carcinoma, 15 (25.8%) had papillary carcinoma with lymph node metastasis. Of 13 follicular carcinoma cases, 2 (15.4%) were follicular with lymph node metastasis. There was no distant metastasis case in the studied group. From the study, it was seen that 59 patients (83.1%) showed complete ablation and 12 (16.9%) showed partial ablation of thyroid remnants. The radioiodine (I-131) dose used in complete ablation and partial ablation were 88.49 ± 21.62 mCi and 87.91 ± 28.24 mCi respectively. The thyroid remnant volume in complete ablation and

partial ablation were 1.3 ± 0.7 gm and 2.0 ± 0.8 gm respectively (Table-1). It was also seen that in complete ablation, 52.5% had thyroid remnant volume <1.0 gm, 40.7% had 1.1 to 2.0 gm, 5.1% had 2.1 to 3.0 gm and 1.7% had > 3.0 gm. (Table-2).

Table-1: Clinical characteristics of patients in whom complete and partial ablation of thyroid remnants achieved with I-131.

Clinical characteristics	Complete ablation	Partial ablation
Age (Years)	34 ± 12	34 ± 13
Sex Male-11	8	3
Female-60	51	9
Histological type		
Papillary	37	6
Papillary mets	12	3
Follicular	8	3
Follicular mets	2	0
Remnant thyroid vol (gm)	1.3 ± 0.7	2.0 ± 0.8
Post-operative TSH (mIU/L)	74.65 ± 12.47	77.95 ± 9.56
I-131 dose (mCI)	88.49 ± 21.62	87.91 ± 28.24

Table-2: Thyroid remnant volume and success of radio ablation

Thyroid remnant volume gram	Complete ablation n- 59	Partial ablation n-12
< 1.0	31 (52.5%)	1 (8.3%)
1.1 - 2.0	24 (40.7%)	6 (50%)
2.1 - 3.0	3 (5.1%)	4 (33.3%)
>3.0	1 (1.7%)	1 (8.3%)

DISCUSSION

Radioiodine treatment for thyroid remnant ablation has established itself in the management of differentiated thyroid carcinoma. Thyroid remnant volume is one of the predictor of complete ablation (8,9). There are several ways to determine thyroid remnant volume (6). In this study, post-surgery thyroid scan with Single Photon Emission Computed Tomography (SPECT) employing Tc-99m-pertechnitate was used for determination of thyroid remnant volume. Regarding the dose of radioiodine for thyroid remnant ablation, no consensus has been reached as to optimal required dose of I-131 (9). Comparable results have been reported by different centres using empirical High dose and Low dose for ablation (4). In this study empirically fixed high dose radioiodine was used. From the study, it has been observed that complete thyroid remnants ablation occurred in 83.1% cases and partial thyroid remnants occurred in 16.9% cases. Mean thyroid remnant volume of complete ablation was 1.3 ± 0.7 gm and mean thyroid remnant volume of partial ablation was 2.0 ± 0.8 gm which is statistically significant ($P<0.048$). Regarding the ablative dose of radioiodine, it was seen that in complete ablation, the mean dose was 88.49 ± 21.62 mCi and in partial ablation, the mean dose was 87.91 ± 28.24 mCi which is statistically not significant. Thus thyroid remnant volume is the critical factor for achieving ablation of thyroid remnant. From the study, it was also found that of complete thyroid remnant ablation, 52.5% had thyroid remnant volume <1.0 gm, 40.7% had 1.1 to 2.0 gm, 5.1% had 2.1 to 3.0 gm and 1.7% had > 3.0 gm. i.e,. The smaller the volume of thyroid remnant, better the response and larger the volume, the poorer the response to radioiodine ablation therapy. Findings of this study are close to other researchers. Maxon et al have indicated that the greatest success of I-131 ablation occurred when less than 2 gm of thyroid tissue remained after thyroidectomy (6). Samuel AM and Rajashekharrao B found that 87.3% ablation achieved in tissues of mass less than 5 gm (8). In partial ablation cases, percentage of partial ablation does not correlate with thyroid remnant volume that may be due to very small sample size. Further study needed with large sample size to find out the relation of partial ablation with thyroid remnant volume.

CONCLUSIONS

Thyroid remnant volume is primarily responsible for successful ablation and the successful ablation is inversely related with thyroid remnant volume.

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