ORIGINAL ARTICLE

Comparison of efficiency of diagnostic and post-treatment whole body I-131 scans in well differentiated thyroid cancers

Maseeh uz Zaman, M. Rafique Gooda

Abstract

Objective: Whole body iodine-131 (^{131}I) scans with diagnostic dose and after a therapeutic dose with serum thyroglobulin levels are the current sensitive parameters to follow patients with well differentiated thyroid cancers (WDTC) after total thyroidectomy and ^{131}I therapy. In this study, we compared the efficiency of diagnostic whole body imaging with high-dose post-treatment ^{131}I scans in patients with WDTC.

Materials & Methods: 43 patients, 11 male and 32 female, age range 18-68 years, who had near total thyroidectomy for WDTC (28 papillary and 15 follicular cancers) were included. Diagnostic whole body scan (DWIS) with 2 mCi of ^{131}I followed by treatment with ^{131}I (100-150 mCi) in all patients and after 5-8 days post treatment whole body scan (TWIS) were acquired. Serum TSH, thyroglobulin level and anti-thyroglobulin antibodies levels were also measured in all cases.

Results: Thyroid bed uptake was seen in all patients on DWIS and TWIS (100% concordance) while nodal metastasis and pulmonary metastasis were found in 3 and 1 cases on DWIS and 5 and 3 cases on TWIS (60% and 30% concordance respectively). Furthermore, patient's age, pathology and serum TSH level did not have any significant correlation with detection efficiency of DWIS and TWIS.

Conclusion: We conclude that DWIS with low dose ^{131}I is not always predictive of subsequent therapeutic ^{131}I uptake, especially for lymph node and lung metastasis of WDTC. Furthermore, patient's age, pathology and serum TSH level did not have any significant correlation with detection efficiency of DWIS and TWIS.

Key words: diagnostic whole body iodine scan, post treatment scan, thyroglobulin, TSH

Karachi Institute of Radiotherapy and Nuclear Medicine (KIRAN) and Department of Radiology, The Aga Khan University Hospital, Karachi
MU Zaman

Dept of ENT and Head and Neck Surgery Hamdard College of Medicine & Dentistry and Hamdard University Hospital, Karachi
MR Gooda

Correspondence:
Dr M Rafique Gooda
Hamdard University Hospital,
Taj Medical Complex
M.A. Jinnah Road,
Karachi
Cell: 0333-2103929

Introduction

Well differentiated thyroid cancer (WDTC) is more prevalent in our part of world because of indolent course but has a worse prognosis when disease is outside the neck. WDTC is usually curable when discovered at an early stage[1,2]. The comprehensive management of DTC patients consists of surgery, radioactive Iodine-131 (^{131}I) ablation and thyroxin suppressive therapy[3,4,5,6]. Serum thyroglobulin level and whole body iodine scan are the current sensitive parameters to follow the disease. Diagnostic whole body scans (DWIS) with low doses of ^{131}I detect locally recurrent or metastatic well differentiated thyroid carcinoma in about 75% of cases[7,8]. The sensitivity of this procedure is related to the dose of radiopharmaceutical administered[9]. Whole body imaging after a therapeutic or high dose ^{131}I (TWIS) does demonstrate foci of tracer uptake that have not been visualized on DWIS in 10-30% of cases[10]. In recent years, utility of DWIS has been questioned due to its low sensitivity especially for nodal metastasis.

In this study, we compared the efficiency of diagnostic whole body imaging with high-dose post-treatment ^{131}I scans in patients with WDTC.

Materials & Methods

This study comprised 43 patients (11 male and

32 female) with age range of 18-68 ±11 years who received therapeutic doses of ^{131}I for differentiated thyroid carcinomas between March 2005 and March 2009. All patients had near total thyroidectomy (leaving less than 1gm thyroid tissue). Surgery was conducted by us in our hospitals. Histopathology revealed papillary carcinoma in 28 (65%) and follicular carcinoma in 15 (35%) patients. Two to four weeks after surgery, thyroid function tests (FT^4 and TSH), serum thyroglobulin level and anti-thyroglobulin antibodies levels were estimated.

When serum TSH level was >30 i.u/ml, a diagnostic whole body scan with 2 millicurie (mCi) of ^{131}I given orally and after 48-72 hours images were acquired at two imaging facilities using double head gamma camera with high energy collimators.

^{131}I (100-150 mCi) doses were administered within 3-5 days after the DWIS. Patients with residual tissue over thyroid bed were received 100 mCi (39 out of 43 patients) while patients with extra-thyroidal uptake (4 out of 43 patients) were given 150 mCi of ^{131}I orally. Whole body post-treatment scans (TWIS) were obtained 5-8 days after therapy using the same gamma camera. Extra-thyroidal uptake sites seen on DWIS or TWIS like cervical nodes or pulmonary metastasis were confirmed by ultrasound and CT examinations.

Statistical analysis

The chi-square test was used for analysis of factors related to diagnostic sensitivity. Data were analyzed using SPSS. P<0.05 was considered significant.

Results

DWIS showed tracer uptake over thyroid bed consistent with residual thyroid tissue in all 43 (100%) patients while nodal uptake (ipsilateral cervical chain) was noted in 3 (7%) patients. Bilateral pulmonary metastasis was seen in one (2%) patient. TWIS revealed uptake of ablative dose over thyroid bed in 43 (100%), ipsilateral nodal uptake in 5 (12%) cases and bilateral diffuse pulmonary metastasis in 3 (7%) cases (Table 1). These sites of tracer uptake on DWIS and TWIS were confirmed by ultrasound neck and CT examinations. Serum TSH and Tg on the treatment day (mean ± standard deviation) were 47.2 ± 19 ulU/ml and 29 ± 16 ng/ml, respectively. In all patients anti-thyroid antibodies were within normal range in same sample.

We also compared the sites of iodine uptake on DWIS and TWIS with patient's age, pathology and serum TSH level and statistically no significant correlation was found (Table2).

Table 1: *Concordance between diagnostic and post-treatment WB scans*

Total	Thyroid Bed	Neck/Mediastinum	Lung	Bone	Others
WBIS (n) 47	43	03	01	0	0
TWIS (n) 51	43	05	3	0	0
Concordance Rates (%)	100	60	33	0	0

Discussion

For many decades, diagnostic whole body scan with ^{131}I has remained an important tool for assessment of residual functioning thyroid tissue in patients with WDTC. However, during the last few years, its role has been questioned due to effect of stunning of functioning thyroid tissue by relatively large diagnostic dose of ^{131}I (5-10 mCi) which resulted in reduced uptake of subsequent therapeutic dose[11,12]. Most of the societies now recommend using 1-32 mCi of ^{131}I or I-123 to avoid the stunning effect[13].

In this study the concordance rate between DWIS and TWIS were high for thyroid bed and this is due to the fact that postoperative residual

Table 2: *Detection rates of metastatic sites for DWIS*

	DWIS	TWIS	Detection Rates (%)	P Value
Age				
<45 Years	02	05	40	0.201
>45 Years	02			
Pathology				
Papillary	03	05	60	0.064
Follicular	01	03	33	
TSH Level				
<40 IU/ml	02	04	50	0.052
>40 IU/ml	02	04	50	

thyroid tissue over bed was normal which maintains normal iodine trapping capacity. This is somewhat higher than a recently published study in which diagnostic scan with I-123 and post-therapy scan with ^{131}I was compared[14]. However, the concordance rates for lymph nodes and lung metastases are 60% and 33%, respectively. The reasons for this are reduced and non-homogenous expression of sodium iodide symporter in WDTC and lower photon flux of DWIS due to lower dose of ^{131}I. Better detection efficiency of TWIS is due to enhanced photon flux and good target to background ration as these studies were done 5-8 days after the therapeutic dose[15,16,17,18].

Additional metastatic foci have been reported in 4 (9%) patients (2 pulmonary and 2 nodal metastasis) on TWIS compared to DWIS. This correlates with study published by Sherman et al in 1994 who found that newly discovered disease altered the disease stage in approximately 10% of the patients, affecting clinical management in 9%–15%[19]. Patient's age, pathology and serum TSH level did not have any significant correlation detection with efficiency of DWIS and TWIS as also reported by Iwano et al[7].

Conclusion:

We conclude that DWIS with low dose ^{131}I is not always predictive of subsequent therapeutic ^{131}I uptake, especially for lymph node and lung metastasis of WDTC. Furthermore, patient's age, pathology and serum TSH level did not have any significant correlation with detection efficiency of DWIS and TWIS.

References:

1. Beierwaltes WH, Nishiyama RH, Thompson HW, Copp JE, Kubo A. Survival time and 'cure' in papillary and follicular thyroid carcinoma with distant metastases: statistics following University of Michigan therapy. J Nucl Med 1982; 23:561-568.
2. Hay ID. Papillary thyroid carcinoma. Endocrinol Metab Clin North Am 1990; 19:545-576
3. Zaman MU, Kamal S, Toor R, Maqbool M, Habib S, Niaz K. A Randomized clinical Trial Comparing 50mCi and 100mCi of Iodine-^{131} for ablation of Differentiated Thyroid Cancers. JPMA 2006; 56:353-357.
4. Young RL Mazzaferri EL, Rahe AJ, Dorfman SG. Pure follicular thyroid carcinoma: impact of therapy in 214 patients. J Nucl Med 1980; 21:733- 737
5. Schumberger M, Tubiana M, De Vathaire F, et al. Long term results of treatment of 283 patients with lung and bone metastases from differentiated thyroid carcinoma. J Clin Endocrinol Metab 1986; 63:960-967
6. Samaan NA, Schultz PN, Hickey RC, et al. 1992 The results of various modalities of treatment of well differentiated thyroid carcinoma: a retrospective review of 1599 Patients. J Clin Endocrinol Metab. 75:714-720.
7. Maxon HR, Smith HS. Radioiodine- ^{131} in the diagnosis and treatment of metastatic well differentiated thyroid cancer. Endocrinol Metab Clin North Am 1990; 19:685-718.
8. Namec J, Rohling S, Zamrazil V, Pohunkova D. Comparison of the distribution of diagnostic and thyroablative ^{131}I in the evaluation of differentiated thyroid cancers. J Nucl Med 1979; 20:92-97
9. Waxman A, Ramanna L, Chapman N , et al. The significance of ^{131}I scan dose in patients with thyroid cancer: determination of ablation : concise communication. J Nucle Med 1981; 22:861-865.
10. Preisman RA, Halpern S. Detection of metastatic thyroid carcinoma after the administration of a therapeutic dose of ^{131}-iodine. Eur J Nucl Med 1978; 3:69-70.
11. Park HM, Park YH, Zhou XH. Detection of thyroid remnant/metastasis without stunning: An ongoing dilemma. Thyroid 1997; 7:277–280.
12. Park H-M. Stunned thyroid after high dose ^{131}I imaging. Clin Nucl Med 1992; 17:501-502.
13. Cooper DS, Doherty GM, Haugen GR, Kloos RT, Lee SL, Mandel SJ et al. Management Guidelines for Patients with Thyroid Nodules and Differentiated Thyroid Cancer.The American Thyroid Association Guidelines Taskforce. Thyroid 2006; 16 (2):1-34.
14. Iwano S, Kato K, Nihashi T, Ito S, Tachi Y, Naganawa S. Comparisons of I-123 diagnostic and ^{131}I post-treatment scans for detecting residual thyroid tissue and metastases of differentiated thyroid cancer. Ann Nucl Med 2009; DOI 10.1007/s12149-009-0303-z
15. Fatourechi V, Hay ID, Mullan BP, Wiseman GA, Eghbali- Fatourechi GZ, Thorson LM, Gorman CA. Are posttherapy radioiodine scans informative and do they influence subsequent therapy of patients with differentiated thyroid cancer? Thyroid 2000; 10:573–577.
16. Souza Rosario PW, Barroso AL, Rezende LL, Padrao EL, Fagundes TA, Penna GC, Purisch S. Post ^{131}I therapy scanning in patients with thyroid carcinoma metastases: An unnecessary cost or a relevant contribution? Clin Nucl Med 2000; 29:795–798.
17. Balachandran S, Sayle BA. Value of thyroid carcinoma imaging after therapeutic doses of radioiodine. Clin Nucl Med 1981; 6:162-167.
18. Pacini F, Lippi F, Formica N. et al. Therapeutic doses of iodine-^{131} reveal undiagnosed metastases in thyroid cancer patients with detectable serum thyroglobulin levels. J Nucl Med 1987; 28:1888-1891
19. Sherman SI, Tielens ET, Sostre S, Wharam MD Jr, Ladenson PW. Clinical utility of post-treatment radioiodine scans in the management of patients with thyroid carcinoma. J Clin Endocrinol Metab 1994; 78:629–634.