ORIGINAL

Low Iodine Diet Compliance before Radioactive Iodine Treatment and Scanning

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(Received October 1, 2019)

ABSTRACT Radioactive iodine (RAI) therapy is commonly used in thyroid cancer patients after surgery to destroy residual tissue and prevent disease recurrence. A low iodine diet (LID) is prescribed two weeks before RAI and patient's compliance with LID is essentials to ensure the successful ablation rate. This study aimed to determine the level of LID compliance and effectiveness of current practice in delivering the information. There were 31 respondents been recruited and level of knowledge on LID, compliances to the diet, and sources of LID information were investigated. Advice on LID was given in two weeks before treatment and a self-answered feedback form were administered to all respondents prior to ward admission. Compliance rate towards LID advice was 93.6% whereby 48.4% had moderate knowledge on LID and 74.2% had moderate LID compliance. About 32.3% respondents admitted that they having difficulties in LID compliance within two weeks. Significant association were observed between levels of knowledge ($p < 0.01$) and occupational status ($p < 0.05$) with levels of compliances towards LID. No significant association were observed between levels of knowledge and sources of LID information. Overall, high compliances rate towards LID were achievable among patients undergo RAI treatment might be due to Malaysian's general iodine intake which is below from the recommended iodine intake. Patient's occupation and knowledge on LID had influences person's compliances towards restriction on iodine intake in food.
Keywords: Low iodine diet, radioactive iodine, compliance.

INTRODUCTION

Thyroid cancer is a disease with the appearance of abnormal cells in the thyroid gland. There are anaplastic thyroid cancers, follicular thyroid cancer, hurtle cell thyroid cancer, medullary thyroid cancer, and papillary thyroid cancer (*1)*. According to Malaysian National Cancer Registry Report 2007-2011, thyroid cancer had been ranked 17th in Malaysian males and 9th in females; the incidence rate was the highest among Malay population in both sexes (*2*). Radioactive iodine therapy (RAI) post thyroidectomy is one of the treatments for thyroid cancer to destroy residual tissue and prevent disease recurrence (*1*). There are several factors that might influence the likelihood of successful ablation and subsequently alter the effectiveness of the dose. The influence factors include the severity of the initial disease, the amount of residual thyroid tissue left after surgery (*3*), the radiation dose delivered by I-131, initial dose rate and the radioiodine uptake in the neck (*4- 6*).

Studies showed that there was a positive relationship between radioiodine uptake and dietary iodine consumption (*7*). As part of the RAI treatment, a low-iodine diet (LID) is generally recommended to patients before RAI treatment *(8)*. The LID aims to deplete whole-body iodine and then optimize RAI uptake in thyroid cells. An optimal radioactive iodine update might increase the effectiveness of the RAI treatment (*5*). Currently, there are several LID guidelines available which include recommendation of LID defined by an intake <50 µg/day for two weeks before I-131 ablation by American Thyroid Association, two-week LID before I-131 ablation by the British Thyroid Association, a three-week LID before I-131 administration by the European Thyroid

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Cancer Taskforce and LID for 2-4 weeks before radioiodine scanning by the American Association of Clinical Endocrinologists (*5, 9, 10*). Sohn et al. (2013), included 295 post-surgical papillary thyroid carcinoma patients, showed that excessive iodine intake (UIE >250 µg/g Cr) before RAI treatment was associated with poor RAI outcomes (*11*). Yoo and colleagues (2012) demonstrated that the success rate of RAI for patients undergoing less strict LID and very strict LID was 80.3% and 75.6% respectively and concluded that very strict LID may not improve the success rate of initial RAI ablation therapy (*12*). However, the extent of patients' compliance with LID was remained unclear. Previous studies reported that there was patients' feedback regarding the palatability and facility of LID whereby they claimed that it was hard to comply with LID before RAI and subsequently they withdrew from medications (*5, 6*). Reasons for non-compliance to LID included unpalatable and difficult to comply with LID (*10*). Moreover, studies demonstrated that misconceptions, which caused by a lack of proper counseling, would reduce the compliance of LID (*8, 13*).

In the current setting, there are two methods to convey of LID information to patients who were scheduled for RAI which were a phone call or face-to-face interview and at least two weeks before ward admission. The level of compliance toward LID among these patients was undetermined. Hence, the current study aimed to determine patients' compliances with LID before RAI treatment and scanning as well as the effectiveness of current practice in delivering the information on LID towards patients' compliances.

METHODS

Selection of respondents

A cross sectional study was conducted among patients two weeks before radioiodine scanning and treatment in National Cancer Institute. Patients who undergoing RAI treatments or scanning and able to communicate verbally were approached. Consented subjects were recruited in this study. Respondents with communication problem and those who chose not to provide informed consent were excluded from this study. According to Browne RH (1995) (*14*), recommendation of a minimum sample size of 30 samples per group as a rule of thumb and justifies based on rationale about feasibility and precision about the mean and variance. Ethical approval was obtained from Medical Research and Ethical Committee (MREC), Ministry of Health with reference number NMRR 17-2206-37811.

Data Collection

All consented respondents involved in this study were educated on the preparation and management of LID before the radioiodine scanning and treatment session. During the session, a healthcare staff will inform respondents regarding food to avoid such as fish, seafood and others. Then the respondents maintained the LID for two weeks before RAI. Data collection was conducted via feedback forms that were given to all consented respondents before the admission to the nuclear medicine ward and be filled up by respondents themselves. The feedback form was divided into four main sections as follow; Section A (Socio-demographic), Section B (Knowledge on LID Intake), Section C (Compliances towards LID) and Section D (Sources of LID information). Section A was regarding the information on age, weight, height, education level, marital status, ethnic, religion and employment status were obtained from the respondents. Height and weight were measured by staff nurse during admission using *Detecto* scale.

In section B, the knowledge of LID was evaluated through five items including the type of food allowed and not allowed to eat (scale: yes, no). Meanwhile, in section C, evaluations on respondents' compliance were done based on twelve questions on a high iodine food item checklist (scale: yes, no, not sure). Patients were then classified as having high, moderate and low knowledge if answered 5 "No", 3-4 "No" and 2 and below the question "No", respectively. Then, patients were classified as high compliance, if answered 17 "No answer". Moderate and low compliance was indicated if patients answered 9-16 "No" answer and 8 and below "No" answer, respectively.

Data Analysis

All data were analysed using the IBM SPSS Statistic version 22.0 (Armonk, NY: IBM Corp). Continuous data such as age, weight and height were presented in means, standard deviation while categorical data such as educational level, marital status, ethnic, religion and occupation were presented in frequency and percentage. Categorical data was analysed using Chi-square or Fisher's exact test. A value of $p < 0.05$ is considered statistically significant.

RESULTS

A total of 31 respondents who received radioiodine scanning and treatment, were recruited. Socio-demographic characteristic of study group is given in Table 1. The result shows that 48.4% and 74.2% respondents had moderate knowledge on LID and moderate compliance towards LID respectively as in Table 2. As shown in Table 3, Fisher's exact test indicated that there was a significant association between levels of knowledge and levels of compliances towards LID ($p<0.05$). However, there

was no significant association between levels of knowledge and type of information media, ethnic group and occupation. As shown in Table 4, Fisher's exact test indicated that there was no significant association between levels of knowledge with a person of delivery information (p>0.001). In Table 5, several questions were asked to determine the source of LID information that is given to respondents. There were 96.8% of respondents admitted that they were informed on LID and 93.6% of respondents were compliance with LID advice.

Table 1. Socio-demographic characteristic of respondents

Characteristics	**n (%)**
Ethnics	
Malay	21 (67.7)
Chinese	4 (12.9)
Indian	5 (16.1)
Others	1 (3.2)
Religion	
Islam	22 (71)
Buddha	2 (6.4)
Hindu	4 (12.9)
Christian	3 (19.7)
Occupation	
Employed	14 (45.1)
Unemployed	17 (54.8)
Marital Status	
Single	5 (16.1)
Married	23 (74.2)
Divorced	3 (9.7)
Education Level	
Primary	4 (12.9)
Secondary	19 (65.5)
Tertiary	8 (27.5)

Table 2. Respondents' knowledge and compliances towards Low Iodine Diet (LID)

Characteristic	**n (%)**		
	Low	**Moderate**	**High**
Level of knowledge	6 (19.4)	15 (48.4)	10 (32.3)
Level of Compliances	2 (6.5)	23 (74.2)	6 (19.4)

Table 3. Association between ethnic, occupation, media of delivery information, respondents' level of knowledge and compliances towards LID

Variable	***n***	**Compliances, n (%)**			***p value*** [a]
		Low	**Moderate**	**High**	
Knowledge					<0.01*
Low	6	1 (6.7)	5 (83.3)	0 (0)	
Moderate	15	1 (6.7)	14 (93.3)	0 (0)	
High	10	0 (0)	4 (40.0)	6 (60.0)	
Ethnic					0.136
Malay	21	2 (9.5)	16 (76.2)	3 (14.3)	
Chinese	4	0 (0.0)	1 (25.0)	3 (75.0)	
Indian	5	0 (0.0)	5 (100.0)	0 (0.0)	
Others	1	0 (0.0)	1 (100.0)	0 (0.0)	
Occupation					0.027*
Employed	14	1 (7.1)	10 (71.4)	3 (21.4)	
Unemployed	17	1 (58.8)	13 (76.5)	3 (17.6)	
Media of Delivery Information					
Phone	13	2 (15.4)	9 (69.2)	2 (15.4)	0.316
Interview	18	0 (0.0)	14 (77.8)	4 (22.2)	

[a]*Fisher's exact test; n = frequencies; *p<0.05*

Table 4. Association between levels of knowledge with person of delivery information

Variable	***n***	**Knowledge, n (%)**			***p value*** [a]
		Low	**Moderate**	**High**	
Person of deliver information					0.359
Staff nurse	23	5 (21.7)	11 (47.8)	7 (30.4)	
Doctor	8	1 (12.5)	4 (50)	3 (37.5)	

[a]*Fisher's exact test; n = frequencies*
**p<0.05*

Table 5. Source of information on low-iodine diet (LID)

Statement (Answer)	**Yes (%)**
Have you been advised on low iodine diet prior to Radioactive Iodine (RAI) treatment?	96.8
Do you practice diet low in iodine before Radioactive (RAI) treatment?	93.6
Who inform you regarding a low iodine diet prior to treatment Radioactive Iodine (RAI) treatment?	
Staff nurse	74.2
Doctor	25.8
When were you informed on the diet low in iodine?	
One-month prior treatment	67.7
2 weeks' prior treatment	9.7
Others	22.6
Where do you get information on low-iodine diet?	
Phone	41.9
Interview	58.1
Do you have difficulty to follow low-iodine diet for 2 weeks?	
Yes	32.3
No	67.7

DISCUSSION

Low iodine diet (LID) was defined by an intake less than 50µg per day for two weeks by American, British and European Thyroid Association (*15*) while Korean Thyroid Association defined LID by an intake less than 100µg per day (*16*). LID was always prescribed to patients undergoing RAI treatment to increase the radio-iodide accumulation in thyroid remnants. In thyroid carcinoma, decrease uptake and shorter effective half-life of radio-iodide cause negative effect towards the dose of radiation in tumor tissue when compared to normal tissue (*4*). One method used to enhance uptake is to deplete the plasma inorganic iodide pool before the administration of radio-iodide[6]. A study by Lee *et al*. (2014) in Korea shows that a strict LID for one week is sufficient to achieve an adequate decreased of the body iodine pool before RAI (*4*). In theory, low plasma iodide concentration will increase the expression of sodium iodide symporter and leads to a higher specific activity of radio-iodide (*15*). Prescription of LID will limit iodide intake in achieving depletion of iodide in the body and enhances the uptake of radioactive iodine by remaining thyroid cells, increasing the effectiveness of radioactive iodine treatment (*17*).

The iodine content of foods varies with geographic location ranging from 30µg/100g to 800µg/100g based on the World Health Organisation (WHO)/Food and Agriculture Organization of the United Nations (FAO) (*18, 19*). The coastal regions of the world are much richer in iodine content than the soils further inland. Population living near the sea and consuming seaweeds and reef fish, such as the Korean population have 'more than adequate' iodine intake in their diet *(16).* Present findings showed high compliances with LID is due to the normal eating habits of Malaysian whereby there was moderate to low intake of iodine in their daily food intake (*11*). Urinary iodine excretion, thyroid size using ultrasonography, thyroid-stimulating hormone (TSH) and thyroglobulin are the indicators recommended by the WHO/United Nations Children's Fund (UNICEF)/International Council for Control of Iodine Deficiency Disorders (ICCIDD) (2007) for assessing iodine nutrition iodine nutrition worldwide (*19, 20*). A urinary iodine on centration of above 100µg/L corresponds to a dietary iodine intake of 150µg/day (*21).*

The present finding resulted in higher knowledge improved LID compliance and consistent with study finding by Moon (2012) where patients were confident in avoiding food with high iodine content and selecting food with low iodine content and did not view these items as barriers (*21*). Chung et al. (2013) suggested that if the respondents adequately educated, and if their compliance was regularly monitored, one week of LID may be sufficient before RAI therapy (*22*). Choi et al. (2008) also reported that most of the respondents could achieve iodine level below recommendations, after two weeks of stringent LID and advice from a specialized dietitian (*21, 23*). The compliances towards LID were associated with employment status which was supported by Galobardes B. (2001) whereby food availability in the workplace environment or social network and peer-groups does influence compliance towards dietary advice (*24*). Food intake and food habit among employed patients might be influenced by peers and social environment. However, other factors such as cultural, religious beliefs and food costs were not measured which may influence dietary intake (*24).*

CONCLUSION: High compliances rate towards LID were achievable among patients undergo RAI treatment might be due to Malaysian's general iodine intake is lower than the recommended iodine intake. Proper nutrition education for thyroid patients is effective to enhance compliance and to reduce perceived barriers on the low iodine diet.

Acknowledgement

We would like to thank the Director General of Health Malaysia for his permission to publish this article.

Funding Statement

This study is not funded by any organization.

Conflict of Interest

This study has no conflict of interest.

REFERENCES

1) Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, Pacini F, Randolph GW, Sawka AM, Schlumberger M, Schuff KG. 2015 American Thyroid Association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer: the American Thyroid Association guidelines task force on thyroid nodules and differentiated thyroid cancer. Thyroid. 2016 Jan 1;26(1):1-33
2) Azizah AM, Nor Saleha IT, Noor Hashimah A, Asmah ZA, Mastulu W. Malaysian national cancer registry report 2007–2011. Malaysia cancer statistics, data and figure. Putrajaya: National Cancer Institute, Ministry of Health. 2016.
3) Beierwaltes WH, Rabbani R, Dmuchowski C, Lloyd RV, Eyre P, Mallette S. An analysis of" ablation of thyroid remnants" with I-131 in 511 patients from 1947-1984: experience at University of Michigan. Journal of nuclear medicine: official publication, Society of Nuclear Medicine. 1984 Dec;25(12):1287-93.
4) Lee M, Lee YK, Jeon TJ, Chang HS, Kim BW, Lee YS, Park CS, Ryu YH. Low iodine diet for one week is sufficient for adequate preparation of high dose radioactive iodine ablation therapy of differentiated thyroid cancer patients in iodine-rich areas. Thyroid. 2014 Aug 1;24(8):1289-96.
5) Morris LF, Wilder MS, Waxman AD, Braunstein GD. Reevaluation of the impact of a stringent low-iodine diet on ablation rates in radioiodine treatment of thyroid carcinoma. Thyroid. 2001 Aug 1;11(8):749-55.
6) Yang DU, Gao YH, Feng ZY, Meng FG, Fan LJ, Sun DJ. Serum Thyroglobulin—A Sensitive Biomarker of Iodine Nutrition Status and Affected by Thyroid Abnormalities and Disease in Adult Populations. Biomedical and environmental sciences. 2017 Jul 1;30(7):508-16.
7) Pittman Jr JA, Dailey III GE, Beschi RJ. Changing normal values for thyroidal radioiodine uptake. New England Journal of Medicine. 1969 Jun 26;280(26):1431-4.
8) Sawka AM, Ibrahim-Zada I, Galacgac P, Tsang RW, Brierley JD, Ezzat S, Goldstein DP. Dietary iodine restriction in preparation for radioactive iodine treatment or scanning in well-differentiated thyroid cancer: a systematic review. Thyroid. 2010 Oct 1;20(10):1129-38.
9) Maxon HR, Thomas SR, Boehringer A, Drilling J, Sperling MI, Sparks JC, Chen IW. Low iodine diet in I-131 ablation of thyroid remnants. Clinical nuclear medicine. 1983 Mar;8(3):123-6.
10) Maxon HR, Thomas SR, Hertzberg VS, Kereiakes JG, Chen IW, Sperling MI, Saenger EL. Relation between effective radiation dose and outcome of radioiodine therapy for thyroid cancer. New England Journal of Medicine. 1983 Oct 20;309(16):937-41.
11) Sohn SY, Choi JY, Jang HW, Kim HJ, Jin SM, Kim SW, Suh S, Hur KY, Kim JH, Chung JH, Kim SW. Association between excessive urinary iodine excretion and failure of radioactive iodine thyroid ablation in patients with papillary thyroid cancer. Thyroid. 2013 Jun 1;23(6):741-7.
12) Yoo ID, Kim SH, Seo YY, Oh JK, Chung SK. The success rate of initial 131 i ablation in differentiated thyroid cancer: comparison

between less strict and very strict low iodine diets. Nuclear medicine and molecular imaging. 2012 Mar 1;46(1):34-40.

13) Rosenthal MS. Patient misconceptions and ethical challenges in radioactive iodine scanning and therapy. Journal of nuclear medicine technology. 2006 Sep 1;34(3):143-50
14) Browne RH. On the use of a pilot sample for sample size determination. Stat Med 1995;14: 1933–1940.
15) Selamat R, Mohamud WN, Zainuddin AA, Rahim NS, Ghaffar SA, Aris T. Iodine deficiency status and iodised salt consumption in Malaysia: findings from a national iodine deficiency disorders survey. Asia Pacific journal of clinical nutrition. 2010 Dec 1;19(4):578-85.
16) Ju DL, Park YJ, Paik HY, Kim MJ, Park S, Jung KY, Kim TH, Choi HS, Song YJ. Dietary evaluation of a low-iodine diet in Korean thyroid cancer patients preparing for radioactive iodine
21) Moon JA, Yoo CH, Kim MH, Lee SM, Oh YJ, Ryu YH, Lee YS, Chang HS, Park CS, Lee KE. Knowledge, self-efficacy, and perceived barriers on the low-iodine diet among thyroid cancer patients preparing for radioactive iodine therapy. Clinical nutrition research. 2012 Jul 1;1(1):13-22.
22) Chung JH. Low iodine diet for preparation for radioactive iodine therapy in differentiated thyroid carcinoma in Korea. Endocrinology and Metabolism. 2013 Sep 1;28(3):157-63.

therapy in an iodine-rich region. Nutrition research and practice. 2016 Apr 1;10(2):167-74.

17) Perros P, Boelaert K, Colley S, Evans C, Evans RM, Gerrard BA G, Gilbert J, Harrison B, Johnson SJ, Giles TE, Moss L. Guidelines for the management of thyroid cancer. Clinical endocrinology. 2014 Jul;81:1-22.
18) WHO/FAO. Iodine. In: Vitamin and mineral requirements in human nutrition. 2nd Edition. Report of a Joint FAO/WHO Expert Consultation. FAO. 2004 pp 303-317
19) World Health Organization. Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers. 2007.
20) Ma ZF, Venn BJ, Manning PJ, Cameron CM, Skeaff SA. The sensitivity and specificity of thyroglobulin concentration using repeated measures of urinary iodine excretion. European journal of nutrition. 2018 Jun 1;57(4):1313-20.
23) Choi JH, Kim HI, Park JW, Song EH, Ko BJ, Cheon GJ, Kim BI. Analysis of urine iodine excretion decrease by two-week stringent low iodine diet for remnt thyroid ablation with radioactive iodine in Korean patients with thyroid cancer; prospective study. Nucl Med Mol Imaging. 2008 Oct 1;42(5):375.
24) Galobardes B, Morabia A, Bernstein MS. Diet and socioeconomic position: does the use of different indicators matter?. International journal of epidemiology. 2001 Apr 1;30(2):334-40