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Reevaluation of Stringent Low Iodine Diet in Outpatient Preparation for Radioiodine Examination and Therapy

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Abstract. To decrease total body iodine is a key point in preparation for radioiodine study and therapy. We introduced a stringent self-managed low iodine diet (LID) and compared the outcome to that of the conventional restricted iodine diet (RID) for outpatients. We measured urine iodine to creatinine ratios (I/Cr) in patients prepared with RID for one week, LID for one week, or LID for two weeks. Mean urinary iodine excretion after RID for one week (n = 210) was 182.2 μg/gCr (range, 13–986 μg/gCr; standard deviation (SD) = 158.5) not reaching below the recommended level (I/Cr<100 μg/gCr). Urinary iodine excretion after LID for one week (n = 15) showed a lower mean urinary iodine level (I/Cr 119.4 μg/gCr; range, 23–218 μg/gCr; SD = 55.9) than RID for one-week, and two-week LID (n = 17) showed an even lower mean level (I/Cr 63.1 μg/gCr; range, 7–134 μg/gCr; SD = 38.7). The one-week LID period adequately (recommended level of I/Cr being less than 100 μg/gCr) prepared 26% of the patients, while two-weeks on the diet adequately prepared 70% of the patients. Furthermore, none of the two-week LID patients had I/Cr>150 μg/gCr, although a significantly greater number of one-week LID patients (19%) did. Our self-managed, outpatient LID successfully induced iodine deficiency, and two-week LID may be recommended for preparation in radioiodine study and therapy for thyroid cancer.

Key words: Low iodine diet, Radioiodine study, Radioiodine therapy, Outpatient

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TO maximize uptake of radioiodine in the thyroid remnant and metastatic lesions after thyroidectomy for thyroid cancer, nonradioactive iodine in serum needs to be reduced and serum TSH level should be elevated. Low iodine diets (LID) to prepare patients for radioiodine imaging and therapy have been described. The use of such diets results in increasing the ^{131}I tumor dose (per 100 mCi) in patients with differentiated thyroid cancer by 2.3-fold [1]. Japanese popular diet customarily contains large quantities of food rich in iodine [2–4], so it is difficult to restrict iodine in daily diet. It has been reported that the mean urinary iodine excretion from subjects on an iodine-restricted diet (RID) was 240–420 μg/gCr [2]. In 2004, Park and Hennessey suggested that the desired goal was an iodine to creatinine ratio (I/Cr) of less than 50 μg/gCr and a ratio of between 50 and 100 μg/gCr, though suboptimal, was considered adequate preparation for radioiodine uptake and scanning [5]. The urinary iodine levels in the previous reports in Japan were higher than the adequate level. We questioned the traditional standard one-week protocol for RID.

For the estimation of iodine in urine, the Sandell-Kolthoff reaction with choloric acid digestion or non-hazardous persulfate digestion has been used extensively as a simple and sensitive method [6–8]. However, these methods were not completely suitable for testing because it is time-consuming and produces a non-neglible amount of toxic waste. In 2000, Ohashi *et al.* reported a simple and rapid method for determination of urinary iodine [9]. This new method, incorporating the whole process into a microplate format, is readily applicable and allows rapid monitoring of urinary iodine.

In this study, we evaluated the stringent and longer-

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term LID to clarify the optimized standardized protocol for patient preparation for radioiodine scans and therapy in an out-patient setting by using the Ohashi method.

Materials and Methods

For over 15 years, a restricted iodine diet menu (RID: Table 1) has been recommended to patients with thyroid cancer in preparation for ^{131}I uptake scans and therapy in Kuma Hospital. Traditionally, the standard preparation at our institution has been a one-week period of dietary restriction prior to radioiodine studies and therapy. Two hundred twenty patients (179 women, 41 men) treated between January 2001 and March 2004 were prepared for radioiodine scans with a one-week self-managed RID (Table1). In this study, we introduced stringent limitations on dietary iodine, low iodine diet (LID: Table 2). A total of 32 thyroid cancer patients underwent the initial ^{131}I total body scan post-thyroidectomy between May 2004 and August 2004. Of these, 15 (10 women, 5 men) and 17 (14 women, 3 men) patients were prepared with a one-week or a two-week self-managed LID, respectively. The mean ages of the three groups of 220 patients on one-week RID, 15 patients on one-week LID and 17 patients on two-week LID were 47.1 ± 16 (Mean ± SD), 44.6 ± 15 and 47.8 ± 16 years old, respectively. There were no significant differences in age and gender distributions among the three groups.

Table 1. Restricted Iodine Diet (RID)

Avoid the following foods
1. Seaweed
2. Seaweed soup (which is made with Laminaria japonica and used as a base for Japanse cooking)
3. Iodinated eggs
4. Restaurant foods

Table 2. Low Iodine Diet (LID)

Avoid the following foods
1. Seaweed
2. Seaweed soup (which is made with Laminaria japonica and used as a base for Japanese cooking)
3. Iodinated eggs
4. All seafood, including fish and shellfish
5. Chicken, viscera of animals
6. Foods and medications containing red food dyes
7. Convenience foods
8. Restaurant foods

After thyroidectomy, the diets were explained to the patients. The patients were then sent home with a simple, one-page list of dietary recommendations (Table 1 or Table 2). After receiving an outline of diet recommendation, the diet was started one or two weeks prior to the radioiodine scans. Urinary iodine concentration was measured by a microplate method using Sandell-Kolthoff reaction [9]. Since the urinary concentration in morning specimens reflected dairy urinary iodine excretion [10], single voided urinary specimens were obtained from every patient in those undergoing radioiodine scans. The iodine concentrations was expressed as μg iodine per gram of creatinine (I/Cr: μg/gCr). Clinical categories for urinary iodine content are defined as ideal, adequate, inadequate for I/Cr of <50 μg/gCr, 51–100 μg/gCr and >100 μg/gCr, respectively. Statistical analysis was performed by the Mann-Whitney U test and a p value less than 0.05 was considered significant.

Result

Table 3 shows the median and range of urinary iodine excretion. One-week LID patients showed a lower mean urinary iodine level (119.4 μg/gCr) than the one-week RID patients (mean: 182.2 μg/gCr). Urinary iodine levels for patients following the two-week LID (mean: 63.1 μg/gCr) were about a half of those for patients following the one-week LID. Difference in the reduction of urinary iodine levels between the one-week LID and the two-week LID were significant ($p<0.01$).

Distribution of I/Cr among patients following LID for one or two weeks is shown in Fig. 1. Patients following LID for one week and two weeks attained the ideal goal of an iodine state (I/Cr<50 μg/gCr) in 13% of cases and 35% of cases, respectively. Although 70%

Table 3. Urinary Iodine/Creatinine after Restricted Iodine diet (RID) or Low Iodine Diet (LID) Preparation

	one-week RID	one-week LID	two-week LID
Median	125	130	66
Range	13–986	23–218	7–134
No. examined	210	15	17

Values indicate μg/gCr.

of patients with two-week LID period attained the adequate iodine state (I/Cr<100 μg/gCr), only 26% of patients with one-week LID period achieved this state (Fig. 1). Furthermore, none of the two-week LID patients had a poor iodine state (I/Cr>150 μg/gCr), while a significant number of one-week LID patients (19%) did.

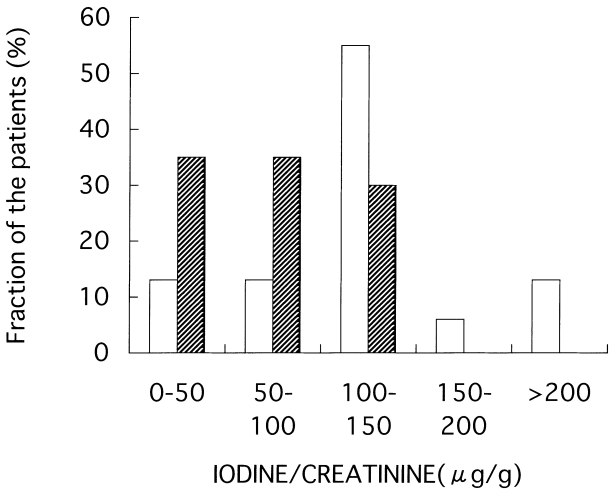

Fig. 1. Distribution of urinary iodine/creatinine values at 50 μg/g intervals among patients following a one-week versus two-week low iodine diet (LID) period. Open column indicates one-week LID and shaded column indicates two-week LID.

Discussion

Most centers that routinely perform radioiodine therapy recommend a low iodine diet to increase the radioiodide accumulation in thyroid cancers. Many reports [5, 11–13] suggested that LID, typically 30–50 μg per day, produces better outcomes. Park and Hennessy suggested that an I/Cr of <100 μg/gCr was considered adequate, though suboptimal, in preparation for radioiodine uptake and scanning [5]. However, in Japan, it is difficult to achieve an iodine deficient state. It has been reported that the daily diet customarily includes large quantities of food rich in iodine and the median urinary iodine excretion rate was 321 μg/gCr in a Japanese population [2]. Many countries around the world showed iodine deficiencies in their population in 1990 [14]. WHO-UNICEF-ICCIDD recommended universal salt iodization as the main strategy to eliminate iodine-deficiency disorders [15]. However, in Japan, salt and milk are not iodinated and many vitamin preparations are not supplemented with iodine. An exchange protocol about restricted food and term for low iodine diet would be necessary to compare with other countries.

For over 15 years, one-week RID has been prescribed for thyroid cancer patients treated at Kuma Hospital in preparation for radioiodine uptake, scan and therapy. The median urinary iodine excretion rate of a one-week RID period was 182.2 μg/gCr and ranged from 13 to 986 μg/gCr. This is not only higher than the target for iodine ideal state, <50 μg/gCr but also above that considered adequate iodine state (<100 μg/gCr). Therefore, it is necessary to introduce a new protocol for a stringent low iodine diet. In this study, we showed the effectiveness of a self-managed two-week LID in our outpatient clinic. All patients adhering to a two-week LID were able to reduce their total iodine and achieved urinary iodine levels below the mean urinary iodine level achieved with one-week RID (182.2 μg/gCr). Seventy percent of patients with two-week LID period achieved the adequate low iodine state.

Radioiodine study is performed periodically to detect possible metastases in patients with thyroid cancer. Excess iodine intake might cause a false negative radioiodine study. If a diagnostic whole-body scan is negative, we must clarify whether it is a false-negative scan due to iodine contamination and/or inadequate TSH elevation, or a true negative scan because metastases of thyroid cancer cannot accumulate iodine. We suggest that urinary iodine should be measured prior to radioiodine study because total iodine levels vary over a wide range, even if patients were prepared with two-week self-managed LID.

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