Original Article

Impact of sweating on equivalent dose of patients treated with ^{131}Iiodine

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ABSTRACT

Background: Radioiodine therapy is used for the treatment of patients with differentiated thyroid cancer (DTC) who undergo total thyroidectomy. After radioiodine administration, regulations require to quarantine these patients until their retained activity reduces to <33 mCi. Some of the injected radioiodine is excreted by perspiration which helps dose reduction so that performing the activities which stimulate sweating such as exercise may shorten the time of dose reduction. To the best of our knowledge, this is the first study in the literature that has evaluated the impact of specific exercise program on the ambient equivalent dose of ^{131}I gamma rays. **Materials and Methods:** Patients with DTC without metastasis who had undergone total thyroidectomy and were treated with radioiodine were included in this study. 30 patients were chosen among patients who were able to exercise, did not have renal failure, and did not use diuretics. Patients were divided into two control and intervention groups. Intervention group members walked on treadmills under a specific program, in 3 time intervals. The control group did not have any specific activity. Immediately after each exercise process, both groups took a shower, and their doses were measured by a survey dosimeter. **Results:** It was revealed that there was a significant difference between mean values before and after each exercise time. The calculated *P* value which evaluates the overall impact was 0.939 which revealed that there was no significant difference between total ambient equivalent dose reductions of both groups. **Conclusion:** According to the study, it may conclude that sweating is an effective alternative way for radioiodine excretion, and if sweating is accompanied with well-hydrated status they may have synergism effect to shorten quarantine period. This could be an important consideration in patients which over-hydration is intolerable especially those with cardiac, liver, or renal problems.

Keywords: ^{131}Iiodine, differentiated thyroid cancer, equivalent dose, exercise, sweating

INTRODUCTION

Treatment of differentiated thyroid cancer (DTC) is usually a dual step procedure which consists of thyroidectomy and radioactive iodine treatment.[1,2] The main purpose of ^{131}I administration is the destruction of thyroid remnant tissue. The other purposes are evaluating the disease regression by measuring the level of serum thyroglobulin and imaging of physiologic and pathologic radioiodine uptakes with gamma camera.[3-7] There are two important issues about ^{131}I application. The first and the most important consideration is its side effects which can occur immediately, few days or even months after the treatment, such as nausea, fatigue, metallic taste in the mouth, dry mouth, swollen salivary glands, bone marrow suppression, fertility problems, and even secondary cancers.[8-10] Because the most absorption of ^{131}I is in thyroid tissue,[11] it destroys the remaining thyroid cells by β particles.[12] Besides of destroying the cancer cells, ^{131}I can also enters to the other body organs such as salivary glands and affect them by its radiation,[13] so some methods should be applied to extract the radioiodine from other body organs immediately after the administration to reduce its side effects. The second issue

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is that after radioiodine administration patients will be a mobile source of radiation and thus radiation safety after radioiodine therapy is important for patients, their families, and the public.[14] Due to the excretion of radioiodine, not only the patient's body but also their body fluids such as urine, saliva and sweat are radioactive.[3,4,11,12] According to the NRC guidelines, patients must be quarantined until their retained activity reduces to <33 mCi.[12] They are recommended drinking more fluid to have more urination and so more radioiodine activity reduction.[13-16] Some of the administered radioiodine are excreted by perspiration which helps dose reduction, so performing the activities which stimulate the perspiration such as exercise may shorten the time of dose reduction. As during the hospitalization, patients have enough time to exercise we designed this study to evaluate the impact of a specific exercise program on the ambient equivalent dose of ^{131}I gamma rays in patients who were able to run on the treadmill. To the best of our knowledge, this is the first study in the literature that has evaluated the impact of specific exercise program and its subsequent sweating on ambient equivalent dose of ^{131}I gamma rays.

MATERIALS AND METHODS

Patients with DTC without metastasis who had undergone total thyroidectomy and were treated with Radioiodine at Nuclear Medicine Department of Shiraz Namazi hospital in May and June of 2015 were included in this study. Thirty patients were chosen among patients who did not have renal failure, did not administer diuretics and were able to exercise. They randomly divided into two intervention and control groups. The intervention group was consisted of 6 male and 9 female with age range of 23–48 and mean age of 33-year-old. The control group was consisted of 1 male and 14 female with an age range of 21–76 and the mean age of 53-year-old. Both groups had a same diet especially liquid intake (equal according to the estimated amount for each gender)[17] and they were in a same environmental situation during hospitalization. Intervention group members walked on treadmills 3 times, with 27 min durations which were 6, 24 and 30 h after radioiodine administration. Treadmill program was according to the modified standard Bruce protocol[18] which is shown in Table 1. The control group did not have any specific activity. All patients were asked to take a shower immediately after each exercise. Before and after each exercise and after taking a shower, the ambient equivalent dose of gamma rays was measured by a gamma-ray dosimeter (radiation alert, monitor 5) at the distance of 1 m from patients. This was used as a factor for discharge deciding. All statistical analyses were performed using a commercially available software program (Statistical Package for the Social Sciences, version 21; SPSS, Chicago, Illinois, USA). The normality distribution of differences was assessed separately in each group, using the Kolmogorov–Smirnov test in which the $P > 0.05$ represented the normal distribution. To have a better comparison, independent *t*-test were used. To assess the effect of each exercise periods, the average differences between the measurements which were performed before and after each exercise were calculated in the intervention group and compared with together. To evaluate the overall impact, the average differences between the first measurements and the last measurements (in the intervention group before the first exercise and after the last exercise and taking a shower) were calculated in both groups and compared with together.

RESULTS

The calculated *P* value which can assess the effect of each exercise process was <0.05. It was revealed that there was a significant difference between mean values before and after each exercise time. Table 2 and Figure 1 represent the average differences between the measurements which were performed before and after each exercise in the intervention group. Table 3 and Figure 2 demonstrate the average differences between the first and the last measurements in both groups. The calculated *P* value which evaluates the overall impact was 0.939 which revealed that there was no significant difference between total ambient equivalent dose reductions of both groups.

DISCUSSION

There is no doubt that radionuclides can produce many hazards, particularly when high doses are administrated to the patients (e.g., radioiodine therapy).[19] For this reason, the radiation dose should be reduced quickly to a reasonable level to decrease the radiation-induced side effects such as secondary malignancies. One of the methods which can be helpful in dose

Table 1: Modified standard Bruce protocol

Stage	Speed (mph)	Grade (%)	Duration (min)
0	1.7	0	3
0.5	1.7	5	3
1	1.7	10	3
2	2.5	12	3
3	3.4	14	3
4	4.2	16	3
5	5.0	18	3
6	5.5	20	3
7	6.0	22	3

Table 2: Mean differences before and after each exercise period in intervention group

Exercise	Mean difference before and after exercise (μSV/h)	SD	95% CI	*P*
Exercise 1	9.00	9.49	3.75	0.003
Exercise 2	4.07	4.33	1.67	0.003
Exercise 3	3.87	3.87	1.72	0.002

SD: Standard deviation, CI: Confidence interval

Table 3: Mean differences between the first and the last measurements in both groups (in the intervention group before the first and after the last exercise)

Group	Mean difference (μSV/h)	SD	*P*
Intervention	72.40	18.52	0.939
Control	73.00	23.57	

SD: Standard deviation

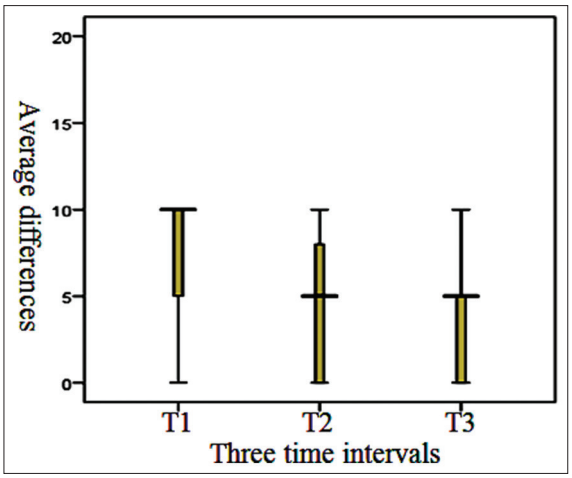

Figure 1: Average differences between the measurements which were performed before and after each exercise in intervention group

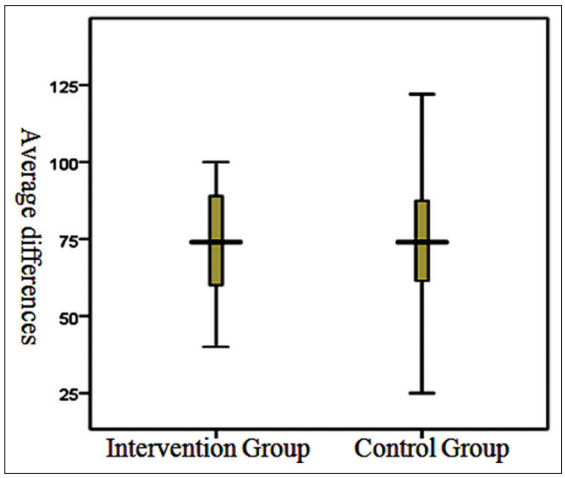

Figure 2: Mean differences between the first measurements and the last measurements

reduction is decreasing the biological half-life of radionuclide by increasing the excretion rate. Radioiodine is mainly excreted by micturition and perspiration. In this study, we tried to present and evaluate a solution to shorten the dose reduction time in the patients who had undergone radioiodine therapy. As perspiration is one of the methods in which ^{131}I can be excreted from the body, exercise which stimulates sweating was used immediately after radionuclide administration to decrease the radiation dose. According to Table 2 and Figure 1, there was a significant difference between mean values of ambient equivalent dose reduction before and after each exercise time which means exercise can reduce the dose due to perspiration in each patient, but considering Table 3 and Figure 2 in general, there was no significant difference between intervention and control group in dose reduction which can be due to patient's physiological characteristics (The amount of perspiration, urination and the other factors which affect the biological half-life of ^{131}I), amount of thyroid remnant tissue etc. Patients with different amount of remnant thyroid tissue have different radioiodine absorption in their thyroid, which is in direct relationship with the measured value of the ambient equivalent dose. There are also some other factors which may affect the amount of perspiration and consequently the result of the study, such as age, sex and also the exercise habits.

The results showed that there was a significant dose reduction after each exercise period in the intervention group, but the overall results revealed that there was no significant reduction in ambient equivalent dose values between the two groups. It should be noticed that although the intervention group had an increased demand for hydration due to sweating subsequent exercise, the liquid intake was definite (equal according to the estimated amount for each gender),[17] thus they had a lower urinary output. Consequently, we may be able to conclude that the nonsignificant result is due to lower urinary output in the intervention group. Hence, we may conclude that sweating is an effective alternative way for radioiodine excretion. This could be an important consideration in patients which over-hydration is intolerable especially those with cardiac, liver, or renal problems. On the other hand, if sweating is accompanied with well hydrated status they may have synergism effect to shorten quarantine period. For future studies it is recommended to consider the effect of harder exercise programs, age, sex, physiological characteristics, the amount of the thyroid remnant tissue and other physiologic and pathologic iodine uptakes.[6,7]

CONCLUSION

According to the study it may conclude that sweating is an effective alternative way for radioiodine excretion, and if sweating is accompanied with the well hydrated status, they may have synergism effect to shorten quarantine period. This could be an important consideration in patients which over-hydration is intolerable especially those with cardiac, liver, or renal problems.

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Conflicts of interest

There are no conflicts of interest.

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