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The effect of methimazole on thyroid gland uptake of technetium in hyperthyroid patients

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Abstract

Introduction: The aim of this study was to investigate the effect of methimazole on Technetium-99m reabsorbing by thyroid gland, it may be possible to perform thyroid scan when the patients are on the methimazole, this can be time saving and decrease the adverse effects of discontinuing methimazole

Patients and Methods: Among all the patients with hyperthyroidism who referred to nuclear medicine ward of Shiraz University of medical sciences, 50 patients were randomly selected. we asked the patients who were on Methimazole, to discontinue the usage of all drugs (not Methimazole) and foods which are effective on thyroid gland for 1 week, after that thyroid scan was performed for these patients. In The other episode, we asked them to discontinue the usage of all drugs (also Methimazole) and foods which are effective on thyroid gland for 1 week and then thyroid scan was performed again. Revealed data was analyzed under supervision of statistical specialist with descriptive methods on SPSS. **Results:** 34 patients were males (68%) and other was females. Mean age of the patients was 53.5 years. (Min: 39 years and max: 75 years) Although The ROI (Region of Interest) of thyroid was increased in the patients who used methimazole before scan 398.72(SD: 191.73) than the patients who discontinued for one week 380.15 (SD: 112.49), but the difference wasn't statistically significant. The ROI of peripheral tissue of the thyroid was decreased in the patients who used methimazole before scan 26.44(SD: 5.42) than the patients who discontinued for one week 27.0414 (SD: 5.57), but the difference wasn't statistically significant.

Discussion: In conclusion, we demonstrated that methimazole pretreatment does not interfere with either the efficacy of ROI and reabsorbing of Technetium-99m in thyroid gland and peripheral tissues. A possible limitation of this study is the number of patients in the sample. So it seems that it may be possible to perform thyroid scan when the patients are on the methimazole, this can be time saving and decrease the adverse effects of discontinuing methimazole. [GMJ. 2012;1(1):8-12]

Keywords: methimazole - Technetium-99m - thyroid gland uptake - hyperthyroid

Introduction

A thyroid nuclear medicine scan is a diagnostic method for evaluation of the thyroid gland, which is located in the front of the neck and controls the body's metabolism. A radioactive substance that concentrates in

the thyroid is taken orally or injected into a vein or both. Thyroid scanning contributes to the management of many thyroid abnormalities as a readily available, accurate and inexpensive means of documenting the location

and functional characteristics of a suspected abnormality.

The most frequently performed type of thyroid imaging is the Technetium-99m pertechnetate scan ($^{99m}\text{TcO}_4^-$). (1).

Since the introduction of ^{99m}Tc -depreotide into clinical practice, scintigraphy with this compound has been proven to have high diagnostic efficacy in the evaluation of thoracic nodules (2).

^{99m}Tc -depreotide takes advantage of the greater availability of gamma camera imaging and ^{99m}Tc from generators, as well as of the low cost of this radionuclide. Moreover, ^{99m}Tc -depreotide scintigraphy delivers information regarding the SSTR status of tumors, which may contribute to decision making regarding individual therapy. (3)

$^{99m}\text{TcO}_4^-$ plays as an analog of iodide and is trapped by thyroid cells but without any aspects of organification. In the condition which the patients use thyroid hormone, antithyroid drugs, amiodarone, iodinated radiographic contrast and vitamin or mineral supplements containing iodine will decrease tracer uptake by the thyroid.

In all conditions for facilitate interpretation of scan and uptake Results of laboratory thyroid function tests should be available. (4)

During a thyroid scan, the shape, size and location of the thyroid gland as well as the parts of the gland that are under active or overactive could be found out. Pictures of the gland are taken from three different angles and the tracer in the test is either technetium or iodine. A whole-body thyroid scan mostly done for the patients with thyroid cancer and when the cancer has been treated for follow up. This scan can be done to find out if the cancer has been arrested or if it has been metastasized to other parts of the body. (5)

Hyperthyroidism is the term for overactive tissue within the thyroid gland causing an overproduction of thyroid hormones (thyroxine or "T₄" and/or triiodothyronine or "T₃"). Hyperthyroidism is thus a cause of thyrotoxicosis. (6)

Thyroid hormones, thyroxine (T₄) and 3,3',5-triiodo-L-thyronine (T₃) are major regulators of development, differentiation, and metabolism and are essential for the proper

function of nearly all tissues. In the adult, the main function of thyroid hormones is the regulation of the basal metabolic rate, i.e., the rate of energy metabolism required to maintain cellular function at rest (7). Thyroid hormones exert their multiple effects via genomic and nongenomic modes of action (8).

Methimazole is a drug that inhibits the synthesis of thyroid hormone and is used to treat hyperthyroidism. It inhibits synthesis of thyroid hormones by decreasing iodine use in manufacture of thyroglobulin and iodothyronine. Methimazole is actively concentrated in the thyroid gland and interferes with hormonal synthesis by inhibition of the enzyme thyroid peroxidase (9).

Methimazole does not affect the transport of iodide through the iodide pump or the release of "preformed" hormones (9).

Following oral administration, the bioavailability of methimazole varies from 27% to 100%, with an average of 80%, and the drug achieves a peak serum level in 4 to 6 h after administration (10, 11).

Methimazole has been recommended in hyperthyroid patients prior to surgical ablation of the gland in order to produce a euthyroid state, thus reducing surgical risk by counteracting the deleterious systemic effects of hyperthyroidism.

Medical treatment is also useful to assess the impact of a return to a euthyroid state on kidney function, prior to permanent therapy (12). Finally, methimazole is used for long-term management of patients which are not candidates for surgical ablation or radioactive iodine therapy, such as patients with a high anesthetic risk, patients in renal failure, or when access to radioiodine is limited. (9, 10).

Side effects of methimazole treatment are frequent and usually occur within the first 3 months of therapy (9, 10). Vomiting, anorexia, and lethargy, as well as hematologic changes, can be observed in 15% of treated patients (10). Vomiting and anorexia are often caused by the bitter taste of the product (9). Facial excoriations and hepatopathy have been reported in 2% of cases (9, 10).

Other less common side effects that have been noted in cats are positive antinuclear antibody and myasthenia gravis (10).

In this study we try to investigate the effect of methimazole on Technetium-99m reabsorption by thyroid gland, it may be possible to perform thyroid scan when the patients are on the methimazole, this can be time saving and decrease the adverse effects of discontinuing methimazole.

Patients and methods

Among all the patients with hyperthyroidism who referred to nuclear medicine ward of Shiraz University of medical sciences, 50 patients were randomly selected.

All the patients who had any other underlying diseases more than hyperthyroidism or the patients who used other drugs more than Methimazole or the patients who didn't accept to involve in the study were excluded.

At the first episode of the study we asked the patients who were on Methimazole, to discontinue the usage of all drugs (not Methimazole) and foods which are effective on thyroid gland for 1 week, after that thyroid scan was performed for these patients.

In The other episode, we asked them to discontinue the usage of all drugs (also Methimazole) and foods which are effective on thyroid gland for 1 week and then thyroid scan was performed again.

Thyroid scan was performed from thyroid and peripheral tissues after 20-25 min of 2 mc Technetium-99m injection to the patients. The ROI (Region of Interest), which was directly related with Technetium-99m absorption, was measured, the results of these two scan was compared. Revealed data was collected in the questionnaire.

Paired T test and Chi-square test were used to determine the strength of the relationship existing among various parameters. The data were analyzed, using the statistical package for social science series (SPSS 15.0) and $p \leq 0.05$ was considered as significant.

Results

34 patients were males (68%) and other was females. Mean age of the patients was 53.5 years. (Min: 39 years and max: 75 years)

Although The ROI (Region of Interest) of thyroid was increased in the patients who used methimazole before scan 398.72(SD: 191.73) than the patients who discontinued for one week 380.15 (SD: 112.49), but the difference wasn't statistically significant. (Table 1)

The ROI of peripheral tissue of the thyroid was decreased in the patients who used methimazole before scan 26.44(SD: 5.42) than the patients who discontinued for one week

Table 1. The ROI (Region of Interest) of thyroid in patients

The ROI (Region of Interest) of thyroid	Mean	Count	Std. Deviation
patients who discontinued methimazole for one week	380.15	50	112.49
patients who used methimazole before scan	398.72	50	191.73

Table 2. The ROI (Region of Interest) of peripheral tissues in patients

The ROI (Region of Interest) of thyroid	Mean	Count	Std. Deviation
patients who discontinued methimazole for one week	27.04	50	5.57
patients who used methimazole before scan	26.44	50	5.42

27.0414 (SD: 5.57), but the difference wasn't statistically significant. (Table 2)

Discussion

In the present study it was shown that ROI and reabsorption of Technetium-99m was not influenced by methimazole not in the thyroid tissue nor in the peripheral parts. However, there was some changes with wasn't statistically significant.

In our study such as Fischetti AJ et al study, methimazole administration didn't have a significant effect on reabsorption of Technetium-99m.

Similarly, Chun R et al study showed no difference in response to radioiodine based upon when methimazole was discontinued, these results are the same to ours in the present study.

Methimazole is taken up by the thyroid gland as other anions similar to iodide (perchlorate, thiocyanate, and pertechnetate). Its target is the thyroid peroxidase. It blocks the iodination of tyrosine residues and the coupling of iodotyrosines into iodothyronines.

Methimazole inhibits organification and the addition of iodine to thyroglobulin by the enzyme thyroperoxidase, a necessary step in the synthesis of thyroxin (T4). (16)

On the other hand $^{99m}\text{TcO}_4^-$ plays as an analog of iodide and is trapped by thyroid cells but without any aspects of organified. (4)

So it could be considered as a reason, as mentioned Methimazole and $^{99m}\text{TcO}_4^-$ had different effects on the thyroid gland cells, and administration of methimazole may haven't a direct effect on $^{99m}\text{TcO}_4^-$ reabsorbing.

On the other hand, In Nieckarz JA et al study the effect of the ant thyroid drug, methimazole, on thyroid uptake of $^{99m}\text{TcO}_4^-$ and ^{123}I were significantly increased and peaked at 4 days post methimazole withdrawal, these results was different from what we obtained in this study.

As mentioned in introduction Methimazole is A drug that inhibits the synthesis of thyroid hormone and is used to treat hyperthyroidism, It inhibits synthesis of thyroid hormones by decreasing iodine use in manufacture of thyroglobulin and iodothyronine. Methimazole is actively concentrated in the thyroid gland and interferes with hormonal synthesis by inhibition of the enzyme thyroid peroxidase; it causes an increase in TSH.

Increased TSH causes activation in membrane pumps of thyroid cells. This may causes increases in $^{99m}\text{TcO}_4^-$ reabsorption (9). So this mechanism is considerable as a reason of the results of Nieckarz JA et al study.

Conclusions

In conclusion, we demonstrated that methimazole pretreatment does not interfere with either the efficacy of ROI and reabsorbing of Technetium-99m in thyroid gland and peripheral tissues. A possible limitation of this study is the number of patients in the sample.

So it seems that it may be possible to perform thyroid scan when the patients are on the methimazole, this can be time saving and decrease the adverse effects of discontinuing methimazole.

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