

A woman with Pituitary Microadenoma: May Thyroid Hormone Resistance be a Cause? A case report and Review of the Literature

Pitüiter Mikroadenomlu Kadın Hasta: Tiroid Hormone Direnci Bir Neden Olabilir mi? Literatür ile Desteklenmiş Olgu Sunumu

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Abstract

Resistance to thyroid hormone (RTH) is an inherited syndrome characterized by reduced responsiveness of target tissues to thyroid hormone. It is usually first suspected due to findings of high serum free thyroxine (T4) and free triiodothyronine (T3) concentrations and normal or slightly high serum thyroid-stimulating hormone (TSH) concentrations. Herein, we report a 37-year-old woman presented with anxiety and sleeplessness. She was found to have elevated free T3 and T4 plasma concentrations without goiter, unsuppressed TSH and pituitary microadenoma. Thus, we performed tests for differential diagnosis between TSH-secreting pituitary adenoma (TSHoma) and RTH. The patients with inappropriate TSH secretion caused by RTH or TSHomas are misdiagnosed and incorrectly treated. Current diagnostic strategies suggest that RTH patients are distinguishable from patients with TSH-secreting pituitary tumors by the use of standard laboratory tests and imaging. Here, we present a woman in whom the standard evaluation for inappropriate TSH secretion was insufficient to distinguish these entities. *Türk Jem 2011; 15: 130-4*

Key words: Thyroid hormone receptor, thyroid hormone resistance, thyroid-stimulating hormone, pituitary adenoma

Özet

Tiroid hormon direnci, hedef dokuların tiroid hormonuna azalmış yanıtı ile karakterize kalıtsal bir sendromdur. Genellikle, yüksek serum serbest tiroksin (T4) ve serbest triiyodotironin (T3) ile normal ya da hafif yüksek serum TSH konsantrasyonları ilk olarak şüphe uyandıran bulgulardır. Burada 37 yaşında anksiyete ve uykusuzluk yakınması olan bir kadın hasta sunuldu. Hastada guatrın eşlik etmediği yüksek plazma serbest T3 ve T4 düzeyleri ve baskılanmayan serum TSH konsantrasyonları ile pitüiter mikroadenom mevcuttu. Bu nedenle, TSHoma ve tiroid hormon direnci arasında ayırıcı tanı amaçlı testler uygulandı. Tiroid hormon direnci ya da TSHoma'nın neden olduğu uygunsuz TSH sekresyonu olan hastalar yanlış tanı alıp doğru olmayan tedaviler görmekteydiler. Güncel tanılacak yaklaşımlar, tiroid hormon direnci olan hastaları, TSH-salgılayan pitüiter tümörlerden standart laboratuvar testleri ve görüntüleme yöntemleri ile ayırmayı önermektedir. Burada, uygunsuz TSH salınımını araştırmak için kullanılan standart testlerin yetersiz olduğu kadın hasta değerlendirildi. *Türk Jem 2011; 15: 130-4*

Anahtar kelimeler: Tiroid hormon reseptörü, tiroid hormon direnci, tiroid uyarıcı hormon, pitüiter adenom

Introduction

Resistance to thyroid hormone (RTH) is a rare autosomal dominantly inherited disorder characterized by reduced target

tissue responsiveness to thyroid hormones. The majority of patients with RTH are eumetabolic and classified as having generalized resistance to thyroid hormone (GRTH) with elevated serum levels of free triiodothyronine (FT3) and free thyroxine (FT4)

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in association with unsuppressed thyroid-stimulating hormone (TSH) secretion (1,2). Several general mechanisms have been identified. Impaired biologic activity of the hormone is caused by mutations that result in synthesis of abnormal hormone molecules. Since response to the authentic hormone is normal, this circumstance is a "pseudo-resistance". Abnormal hormone receptor is caused by mutations in the receptor protein that reduce its ability to bind cognate ligand or protein co-factors or to bind to DNA. Nuclear hormone receptors form a complex with regulatory proteins via ligand and they bring about the hormone effects. Cofactors mediate the stabilization of hormone-receptor complex and they regulate functional activities. If defects occur in the structure of cofactors, this situation can be responsible for hormone resistance.

Some hormones activate second messengers, and defective postreceptor signaling pathways damage the hormonal functions. (1). Before gene defects in the thyroid hormone receptor (TR) were recognized, patients with RTH were classified on clinical grounds alone into either generalized resistance (GRTH), pituitary resistance (PPTH) or combined. In GRTH, all thyroid responsive tissues are affected to various degrees. These patients tend to have high circulating concentrations of thyroid hormones with near normal TSH, but they do not exhibit signs of hyperthyroidism (3,4). In PPTH, pituitary resistance to circulating thyroid hormone is usually observed and some patients may present with symptoms of hyperthyroidism. A third category called isolated peripheral tissue RTH (PTRTH) has only been seen in a single patient (5).

The prevalence of RTH is approximately 1:50,000. It is higher than the prevalence of a TSH-secreting pituitary adenoma, which is another cause for inappropriate TSH secretion (1). TSHomas are rare and account for 1% of pituitary adenomas (6,7). Misdiagnosis and mistreatment are often encountered in patients with inappropriate TSH secretion due to RTH or TSHomas. In such cases, biochemical testing and magnetic resonance imaging of the pituitary can be beneficial in the establishment of the differential diagnosis. (6-10).

Case Report

A 37-year-old woman complaining of emotional disturbances was suspected to have endocrinopathy because of elevated free serum thyroid hormone levels. Her medical history was otherwise unremarkable. Her blood pressure was normal. An electrocardiogram showed a normal sinus rhythm with 85 beats per minute. On physical examination, no signs or symptoms suggestive of hypothyroidism were detected, but she had emotional disturbances that can indicate signs of hyperthyroidism. Laboratory investigation showed elevated free serum thyroid hormone levels in the presence of inappropriately normal TSH ((Roche Diagnostics GmbH D-68298 Mannheim, Germany). Anti-thyroid antibodies directed to thyroglobulin, thyroperoxidase were negative (Immulate 2000 systems, Siemens, 2009). TSH receptor antibody was negative (Immunotech, Beckman Coulter Company, France, 2008) (Table 1).

The thyroid evaluated by ultrasound was measures 61 x 17 x 15 mm in size for the right lobe and, 55 x 14 x 17 mm for the left lobe.

The parenchyma was diffusely heterogeneous. There was a cystic nodule 3 mm in diameter in the right lobe and an isoechoic nodule with a hypoechoic halo 7 mm in diameter in the left lobe (Figure 1). Similar thyroid function tests (TSH normal, FT3 elevated, FT4 elevated) were detected in the blood samples of the patient's mother and son. Thus, we suspected thyroid hormone resistance in this patient and performed a thyrotropin-releasing hormone stimulation test. Primary TSH was 3.14 mIU/mL (range: 0.34-5.6), at the 30th minute - 16.11 mIU/mL, at the 60th minute - 13.63 mIU/mL, and at the 90th minute was 9.86 mIU/mL.

Magnetic resonance imaging (MRI) of pituitary gland was performed for excluding the possibility of a thyrotropin-secreting pituitary adenoma which usually presents as macroadenoma. A microadenoma 6 mm in diameter was detected in the right side of pituitary gland (Figure 2).

Since endogenous production of antibodies directed against these hormones is a rare cause of elevated serum T4 and T3 level,

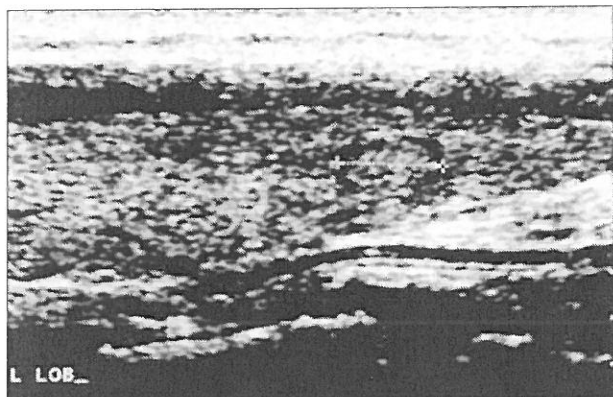


Figure 1. Ultrasonography demonstrates isoechoic nodule with a hypoechoic halo 7 mm in diameter in the left lobe of the thyroid gland

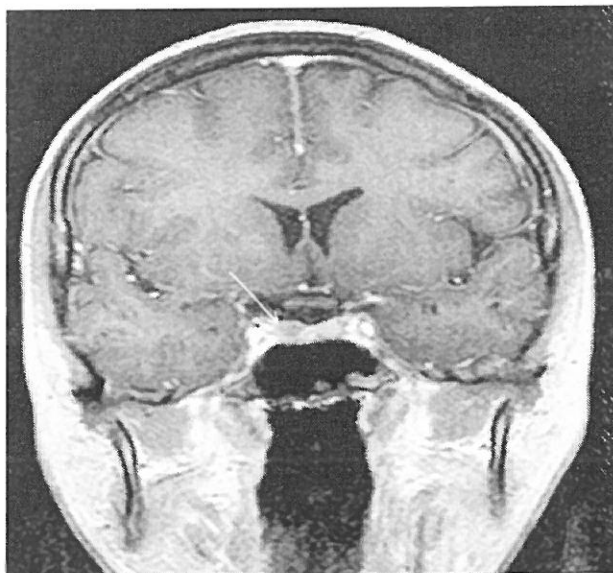


Figure 2. Microadenoma was seen on right side of pituitary gland in postcontrast T1 weighted image

we examined antibodies directed to triiodothyronine and thyroxine with radioimmunoassay (RIA) (Pasteur Cerba Lab., France). These antibodies were negative (Table 2). Although clinical presentation is compatible with RTH, we investigated serum alpha-subunit concentrations of glycoprotein hormones using IRMA kit (Pasteur Cerba Lab., France), because the patient had pituitary microadenoma. The result was normal (Table 2).

Informed consent was obtained from the patient and her family members. The blood samples of the family members were sent to Chicago University, USA to search for possible genetic mutations in thyroid hormone beta receptors, since the laboratory findings in family members was compatible with PTHR

Discussion

RTH is an inherited syndrome characterized by reduced responsiveness of target tissues to thyroid hormone. It is usually first suspected due to findings of high serum FT4 and FT3)

	Patient	Normal range
December 2008	TSH: 2.58 μ U/mL FT3: 4.07 pg/mL FT4: 1.27 pg/mL	0.34-5.6 2.5-3.9 0.56-1.12
April 2009	TSH: 4.16 μ U/mL FT3: 4.15 pg/mL FT4: 1.44 ng/dL	0.34-5.6 2.3-3.9 0.61-1.29
TG Ab IU/mL	10	0-40
TPO Ab IU/mL	20	0-35
TSHR Ab	0.2	<1.5

	Patient	Normal range
Thyroxine Ab (%)	<1	<10
Triiodothyronine Ab (%)	5	<15
Alpha subunit of pituitary glycoprotein hormones (IU/ml)	0.56	0.05-0.90 (before menopause) 0.05-1.60 (after menopause)

Biochemical test	RTH	TSHoma
Serum TSH levels	Usually <10	Usually >10
Normal TSH circadian rhythm	Preserved	Absent
TSH response to supraphysiologic TH doses	Suppressed	Not suppressed
TSH response to TRH test	Normal or exaggerated	Absent
Free α subunit/TSH molar ratio	Normal	Disproportionate increase
Serum SHBG	Normal	Usually increased

concentrations and normal or slightly high serum TSH concentrations (1,11). Several general mechanisms have been identified (impaired biologic activity of the hormone, abnormal hormone receptor, abnormal cofactors or interfering substances, postreceptor abnormalities) (1). The clinical features can be variable. Goiter is frequently observed, but the symptoms of hyperthyroidism may not be present. In terms of clinical features, RTH is divided into three groups such as GRTH, PPTH and combined. The TR β gene mutations can cause RTH. 122 different mutations are detected among 300 families. TSHoma and the presence of T4, T3 antibodies can be considered in the differential diagnoses. Failure to differentiate RTH from primary thyrotoxicosis has resulted in inappropriate treatment of nearly one-third of patients. There is no specific treatment for RTH, but genetic counselling is suggested in these patients. (12).

In our case, the absence of autoimmune thyroid anticorps and the presence of elevated FT3 and FT4 levels versus normal TSH levels directed us to consider the differential diagnosis for TSHoma and PTHR. GRTH should be considered in patients presenting with elevated free thyroid hormone levels and normal or increased TSH concentrations, especially if these patients appear clinically euthyroid (13). Furthermore, high serum T4 and T3 concentrations and normal or high serum TSH concentrations, in the presence of anatomic evidence of a pituitary tumor identified by MRI or CT, are very strong evidence that the patient has a TSH-secreting pituitary adenoma. However, the tumor may be an incidentaloma, which can be detected by MRI in up to 10 percent of normal subjects (14). Patients with TSH-secreting adenomas (TSHoma) and hyperthyroidism must be distinguished from those with the syndrome of RTH. The main differential diagnosis to be excluded is inappropriate TSH secretion from a pituitary tumour and this distinction may be difficult as there are no significant differences in age, gender, FT3, FT4 and TSH concentrations in both conditions (15). A typical finding in patients with TSHoma is a disproportionate abundance of serum glycoprotein hormone free α subunit but this level is normal in RTH (16). Dynamic testing of the pituitary-thyroid axis can be helpful (Table 3).

Due to the clinical, laboratory and radiological findings, we performed "TSH response to thyrotropin-releasing hormone (TRH) stimulation test" and also evaluated the serum concentrations of alpha subunits of glycoprotein hormones for the differential diagnosis of TSHoma and RTH. We found normal TSH response to TRH test and normal serum concentrations of alpha subunits of glycoprotein hormones. Thus, we excluded TSHoma. Other conditions to be distinguished from TSHoma are those in which serum total T4 and T3 concentrations are increased because

of increased protein binding of the hormones in serum. These conditions include elevations in serum thyroxine-binding globulin concentrations, familial dysalbuminemic hyperthyroxinemia, in which an abnormal albumin with increased affinity for T4 is produced, and the presence of anti-T4 antibodies. Patients with these conditions are euthyroid, have normal serum TSH concentrations, and usually, normal serum FT4 and FT3 concentrations when measured by appropriate methods. Anticorps presence against T4 and T3 hormones of the patient were investigated. The anticorps levels were within normal range. The presence of elevated FT3 and FT4 levels versus normal TSH levels and hyperthyroidism symptoms (anxiety, insomnia, palpitation) guided us to the diagnosis of pituitary RTH.

Patients with RTH have variable tissue hyporesponsiveness to thyroid hormone due to a defect in the TR beta gene (1). Some variations of the RTH phenotype have been shown to have a clear molecular basis. Subject heterozygous for a TR β gene deletion have a normal clinical phenotype, presumably because the expression of a single TR β allele is sufficient for normal function. RTH manifests in homozygotes completely lacking the TR β gene and in heterozygotes that express a mutant TR β with dominant negative effect. The most severe form of RTH, with extremely high FT4 and FT3 concentrations and signs of both hypothyroidism and thyrotoxicosis, occurred in a homozygous individual expressing only mutant Trs (17,18).

We investigated the blood samples for PTHR prediagnosis. There was not a gene mutation in thyroid hormone beta receptors. However, it is a fact that, in the literature, there was a research performed in the same laboratory and that research has been unsuccessful in 15% of the families, who were thought to have thyroid hormone resistance. Subsequent mutation analysis of the TR β gene should be conducted for identifying family members. In some patients, mutations in the TR β gene cannot be identified and raise the possibility of mosaicism. Comparing amplification patterns of mutant and wild-type alleles may prove to be helpful in this situation (19)

In the literature, there are some cases stating that thyroid hormone resistance may exist without mutations in thyroid hormone receptors (13,20-23).

Here in, we presented a patient who had THR with pituitary microadenoma. There was a similar case in literature but a R438H mutation was found in the TR-beta gene (24).

The main principle in treating PTHR is the use of TSH suppressive drugs. Glucocorticoids, dopaminergic drugs, octreotide and thyroid hormone analogues with low metabolic effects are not ideal choices but they may also be tested. D-thyroxine (D-T4) and triiodothyroacetic acid (TRIAc) are thyroxine analogues and have a stronger effect on hypophysis than on peripheral tissue. TRIAC is a thyroid hormone analogue that has been found useful in the treatment of RTH (25). Co-transfection studies have shown that TRIAC has similar affinities for both wild type TR β 1 and TR β 1 mutations while T3 has less affinity for TR β 1 mutations. TRIAC is able to inhibit the secretion and biological activity of TSH with very little thyromimetic effects at the level of peripheral tissues (26-28). Patients, who have previously been misdiagnosed and treated with ablative therapy resulting in a reduced thyroid reserve and thyroid dysfunction, may need very high doses of thyroid hormone

replacement in future. The increased level of TSH may potentiate the risk of thyrotroph hyperplasia and possible adenoma formation (29-32).

Finally, mutations in the TR β gene cannot be identified in some patients and raise the possibility of mosaicism. Therefore, it raises the question of whether RTH predisposes to pituitary hyperplasia and adenoma development.

References

1. Refetoff S, Weiss RE, Usala SJ. The syndromes of resistance to thyroid hormone. *Endocr Rev* 1993;14:348-99.
2. Beck-Peccoz P, Mannavola D, Persani L. Syndromes of thyroid hormone resistance. *Ann Endocrinol* 2005;66:264-69.
3. Refetoff S. Resistance to thyroid hormone. In: Braverman LE, Utiger RE, eds. *Werner and Ingbar's The Thyroid: A fundamental and clinical Text*, 9th edn. Philadelphia, PA: Lippincott, Williams and Wilkins, 2005;1109-29.
4. Chatterjee VK, Gurnell M. Thyroid hormone resistance syndrome. In: Wass JAH, Shalet SM, eds. *Oxford Textbook of Endocrinology*. London: Oxford University Press, 2002;339-49.
5. Kaplan MM, Swartz SL, Larsen PR. Partial peripheral resistance to thyroid hormone. *Am J Med* 1981;70:1115-21.
6. Beck-Peccoz P, Persani L. TSH-induced hyperthyroidism caused by a pituitary tumor. *Nat Clin Pract Endocrinol Metab* 2006;2:524-8.
7. Beck-Peccoz P, Brucker-Davis F, Persani L, Smallridge RC, Weintraub BD. Thyrotropin-secreting pituitary tumors. *Endocr Rev* 1996;17:610-38.
8. Brucker-Davis F, Skarulis MC, Grace MB, et al: Genetic and clinical features of 42 kindreds with resistance to thyroid hormone. the national institutes of health prospective study. *Ann Intern Med* 1995;123:572-83.
9. Weiss RE, Refetoff S. Resistance to thyroid hormone. *Rev Endocr Metab Disord* 2000;1:97-108.
10. Sarlis NJ, Gourgoulis L, Koch CA, et al: MR imaging features of thyrotropin – secreting pituitary adenomas at initial presentation. *AJR Am J Roentgenol* 2003;181:577-82.
11. Kopp P, Kitajima K, Jameson JL. Syndrome of resistance to thyroid hormone: Insights into thyroid hormone action. *Proc Soc Exp Biol Med* 1996;21:49-61.
12. Olateju TO, Vanderpump MP. Thyroid hormone resistance. *Ann Clin Biochem* 2006;43:431-40.
13. Boltcher Y, Paufler T, Stehr T, et al. Thyroid hormone resistance without mutations in thyroid hormone receptor beta. *Med Sci Monit* 2007;13:CS67-70.
14. Molitch ME, Russell EJ. The pituitary incidentaloma. *Ann Intern Med* 1990;112:925-31.
15. Beck-Peccoz P, Chatterjee VK. The variable clinical phenotype in thyroid hormone resistance syndrome. *Thyroid* 1994;4:225-32.
16. Beck-Peccoz P, Persani L, Faglia G. Glycoprotein hormone α -subunit in pituitary adenomas. *Trends Endocrinol Metab* 1992;3:41-5.
17. Ono S, Schwartz ID, Muller OT, et al. Homozygosity for a "dominant negative" thyroid hormone receptor gene responsible for generalized resistance to thyroid hormone. *J Clin Endocrinol Metab* 1991;73:990-4.
18. Usala SJ, Menke JB, Watson TL, et al. A homozygous deletion in the c-erb-B2 thyroid hormone receptor gene in a patient with generalized thyroid hormone resistance: isolation and characterization of the mutant receptor. *Mol Endocrinol* 1991;5:327-35.
19. Mamasasiri S, Yesil S, Dumitrescu AM, et al. Mosaicism of a thyroid hormone receptor-beta gene mutation in resistance to thyroid hormone. *J Clin Endocrinol Metab* 2006;91:3471-7.
20. Hamon B, Hamon P, Bovier-Lapierre M, et al. A child with resistance to thyroid hormone without thyroid hormone receptor gene mutation: A 20-year follow-up. *Thyroid* 2008;18:35-44.
21. McDermott JH, Agha A, McMahan M, et al. A case of Resistance to Thyroid Hormone without mutation in the thyroid hormone receptor beta. *Ir J Med Sci* 2005;174:60-4.
22. Boltcher Y, Paufler T, Stehr T, et al. Thyroid hormone resistance without mutations in thyroid hormone receptor beta. *Med Sci Monit* 2007;13:CS67-70.
23. Parikh S, Ando S, Schneider A, Skarulis MC, Sarlis NJ, Yen PM. Resistance to thyroid hormone in a patient without thyroid hormone receptor mutations. *Thyroid* 2002;12:81-6.

24. Safer JD, Colan SD, Fraser LM, Wondisford FE. A pituitary tumor in a patient with thyroid hormone resistance: a diagnostic dilemma. *Thyroid* 2001;11:281-91.
25. Takeda T, Suzuki S, Rue-Tsuan L, DeGroot LJ. Triiodothyroacetic acid has unique potential for therapy of resistance to thyroid hormone. *J Clin Endocrinol Metab* 1995;80:2033-40.
26. Gosling B, Schwartz HL, Dillmann W, Surks MI, Oppenheimer JH. Comparison of the metabolism and distribution of L-T3 and Triac in the rat: a possible explanation of differential hormone potency. *Endocrinology* 1976;98:666-75.
27. Beck-Peccoz P, Piscitelli G, Cattaneo MG, Faglia G. Successful treatment of hyperthyroidism due to nonneoplastic pituitary TSH hypersecretion with TRIAC. *J Endocrinol Invest* 1983;6:217-23.
28. Orgiazzi J, Ducottet X, Barbier Y, Jordan D, Pugeat M, Marin MH. Inappropriate TSH hypersecretion: opposite effect of T4 and T3 on the thyrotrophs? *Ann Endocrinol (Paris)* 1985;45:86A.
29. Salmela PI, Wide L, Juustila H, Ruokonen A. Effects of thyroid hormones (T4, T3), bromocriptine and TRIAC on inappropriate TSH hypersecretion. *Clin Endocrinol (Oxford)* 1988;28:497-507.
30. Sriwatanakul K, Mc Cormick K, Woolf P. Thyrotropin (TSH) induced hyperthyroidism: response of TSH to dopamine and its agonist. *J Clin Endocrinol Metab* 1984;58:255-61.
31. Samaan NA, Osborne BM, Mackay B, et al. Endocrine and morphologic studies of pituitary adenomas secondary to primary hypothyroidism. *J Clin Endocrinol Metab* 1977;45:903-11.
32. Ertörer ME, Bakiner O, Bozkırlı E, Tütüncü NB, Demirağ NG. The syndrome of Resistance to Thyroid Hormone: Disappearance of a Pituitary Adenoma following cessation of Antithyroid drug treatment: Case Report. *Türkiye Klinikleri J Endocrin* 2008;3:77-80.



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