Peer reviewed article

A report of ten patients with thyroid hemiagenesis: ultrasound screening in patients with thyroid disease

Dilek Berker, Ufuk Ozuguz, Serhat Isik, Yusuf Aydin, Yasemin Ates Tutuncu, Gulhan Akbaba, Serdar Guler

Ankara Numune Training and Research Hospital, Endocrinology and Metabolism Clinic, Ankara, Turkey

Summary

Background: Thyroid hemiagenesis (TH) is a rare congenital abnormality of the thyroid gland, characterised by the absence of one lobe. The true prevalence of this congenital abnormality is not known because the absence of one thyroid lobe usually does not cause clinical symptoms by itself. This study aims to identify the frequency of TH and associated diseases in outpatients referred to our clinic for the first time.

Subjects and methods: 6242 outpatients, who were referred to our thyroid clinic between January 2008 and March 2009 and underwent thyroid ultrasonography, were retrospectively analysed. For patients with TH, demographic data, family history of thyroid disorders, drugs administered, thyroid function parameters, thyroid autoantibodies were examined and thyroid sonography was carried out. Tc99m pertechnetate scintigraphy was performed to confirm the diagnosis of hemiagenesis and to rule out coexisting ectopic thyroid tissue.

Results: We identified 10 cases of TH in 6242 outpatients with various thyroid disorders, 8 women and 2 men (ratio 4:1), age 21–63 years, indicating a prevalence of 0.16%. Associated thyroid disease in these patients included: 1 patient with nodular Graves' disease, 1 with Hashimoto's thyroiditis, 4 with euthyroid nodular goiters and 2 with euthyroid multinodular goiters. Nine patients were clinically asymptomatic. However, the patient with nodular Graves' disease presented thyrotoxicosis.

Conclusions: TH is a rare congenital anomaly and prevalence of TH in thyroid patients is 0.16%. In our study, the most frequently seen thyroid disease accompanying thyroid hemiagenesis was nodular goiter.

Key words: thyroid hemiagenesis; Hashimoto's thyroiditis; Graves' disease; nodular goiter

Introduction

Thyroid hemiagenesis (TH) is a rare congenital abnormality of the thyroid gland, characterised by the absence of one lobe. The first case of TH was described in 1866 by Handsfield-Jones [1]. Since the first report of TH, many case reports have been published. Etiology of TH still remains unclear. The true prevalence of this congenital abnormality is not known because the absence of one thyroid lobe usually does not cause clinical symptoms by itself. However, several studies show that the prevalence of this anomaly was estimated as 0.05–0.2% [2–4]. Although hemiagenesis of the thyroid gland is a benign condition, most of the patients reported as having TH had several thyroid disorders [5–10]. Therefore, lack of awareness of its existence may lead to an incorrect diagnosis. This study aims to identify the frequency of TH and associated diseases in outpatients referred to our clinic for the first time.

Material and methods

Study design and patients

6242 outpatients, who were referred to our thyroid clinic between January 2008 and March 2009 and underwent thyroid ultrasonography, were retrospectively analysed. The study was approved by the Ethics Committee of Ankara Numune Training and Research Hospital. TH was defined as either a total absence or severe hypoplasia of one thyroid lobe (<1/10th of the normal thyroid lobe volume).

No conflict of interest to declare.

For patients with TH, demographic data, family history of thyroid disorders, drugs administered, thyroid function parameters [thyroid-stimulating hormone (TSH), free triiodothyronine (FT_3) and free thyroxine (FT_4)], thyroid autoantibodies [anti-thyroperoxidase antibody (TPO-Ab) and anti-thyroglobulin antibody (Tg-Ab)] were examined and thyroid sonography (US) was carried out. Tc99m pertechnetate scintigraphy was performed to confirm the diagnosis of hemiagenesis and to rule out coexisting ectopic thyroid. Fine-needle aspiration biopsy (FNAB), anti-TSH receptor antibody (TR-Ab) and I-131 radioiodine uptake were also performed. Thyroid ultrasonography was performed in first-degree relatives of ten patients with TH.

Laboratory assay

After an overnight fast, blood samples were collected from all the study subjects for the determination of serum TSH, FT_3, FT_4, TR-Ab, TPO-Ab and Tg-Ab levels. Serum TSH, FT_3 and FT_4 levels were evaluated using an Abbott Architect 2000 device and the Chemiluminescence Microparticle Immunoassay (CMIA) method. Serum Tg-Ab and TPO-Ab values were evaluated by immunoradiometric assay (IRMA) methods (ICN Pharmaceuticals, USA). TR-Ab auto-antibodies were measured in patients with the use of a radioreceptor assay (Radim, Italy). Normal ranges in our laboratory are as follows: TSH 0.35–4.94 μIU/ml; FT_3 1.71–3.71 pg/ml; FT_4 0.70–1.48 pg/ml; Tg-Ab <50 IU/ml; TPO-Ab <10 IU/ml and TR-Ab <9 U/l (9–14 U/l bordeline, >14 U/l positive).

Thyroid ultrasonography

Thyroid ultrasonography was performed and interpreted by the same experienced physician, using the same equipment with a 11 MHz linear transducer (Logiq 3 Pro, GE Medical Systems, WI, USA). The subjects were examined in the supine position with hyperextended neck. Images were obtained in the transverse and longitudinal planes. The length, width, and depth of each lobe were measured, and the volume was calculated by the mean of the elliptical shape volume formula ($\pi/6 \times$ length $\times$ width $\times$ depth).

Thyroid scintigraphy

Thyroid scintigraphy was carried out with ^{99m}Tc, 10–15 min after administration of 37–90 mBq sodium pertechnetate.

Results

We identified 10 cases [8 women and 2 men (ratio 4:1), age 21–63 years] of TH in 6242 outpatients with various thyroid disorders, indicating a prevalence of 0.16%. Associated thyroid disease in these patients included 1 nodular Graves' disease, 1 Hashimoto's thyroiditis, 4 euthyroid nodular goiters and 2 euthyroid multinodular goiters. Two patients had no underlying thyroid disease. Family screening of patients with TH were negative. The general features and accompanying thyroid disorder of patients with TH are summarised in table 1.

Seven patients had no lobe on the left (70%) and 3 had no right lobe (30%). The isthmus was present in only 3 patients (30%). Parenchymal echogenicity indicated that 3 patients were homogeneous and 7 patients were heterogeneous (5 patients mild heterogeneous, 1 patient moderate and 1 patient severe heterogeneous) (table 2).

Nine patients were clinically asymptomatic. However, the patient with nodular Graves' disease (patient no. 9) presented thyrotoxicosis. A 63-year-old male patient complained about palpitations, heat intolerance and weight loss. Thyroid functions were thyrotoxic. Anti-TSH receptor antibody, TPO-Ab, and Tg-Ab were positive (laboratory and ultrasonographic features of this patient are presented in table 1–2). High-resolution US revealed a diffuse nodular enlarged right lobe whereas no isthmus and left lobe were detected (fig. 1A and 1B). Tc99m pertechnetate scintigraphy showed homogenous uptake of the radioisotope only in the right lobe (fig. 2). I-131 radioio-

Table 1

General features of patients with thyroid hemiagenesis.

Patients no.	Sex	Age	Thyroid functions	Thyroid antibodies	Accompanying thyroid disorder	Current treatment
1	F	41	Euthyroid	Negative	EMNG	None
2	F	28	Euthyroid	Negative	None	None
3	F	21	Subclinic hypothyroid	Positive	Hashimoto's thyroiditis	L-thyroxine 50 mcg/day
4	F	24	Euthyroid	Negative	ENG	None
5	F	45	Euthyroid	Negative	ENG	None
6	F	38	Euthyroid	Negative	EMNG	None
7	F	33	Euthyroid	Negative	None	None
8	F	62	Euthyroid	Negative	ENG	None
9	M	63	Hyperthyroid	Positive	TDNG	Propylthiouracil 300 mg/day
10	M	44	Euthyroid	Negative	ENG	None

EMNG: Euthyroid multinodular goiter, ENG: Euthyroid nodular goiter, TDNG: Toxic diffuse nodular goiter.

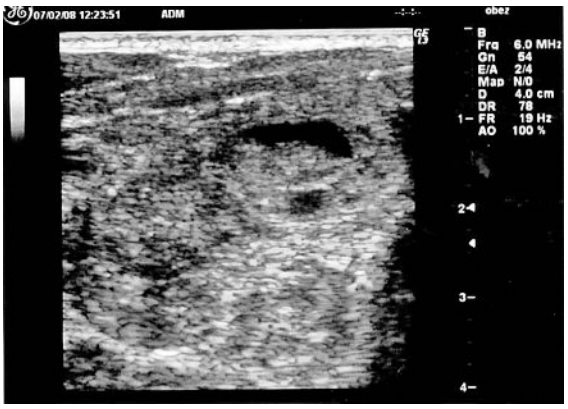
Table 2

Ultrasonographic features of patients with thyroid hemiagenesis.

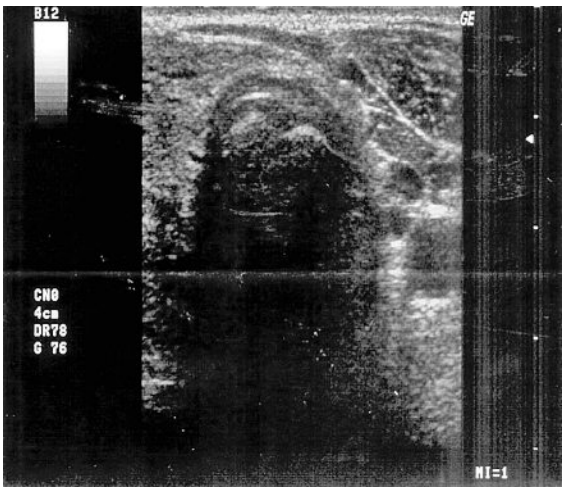
Patients no.	Right lobe (mm)	Left lobe (mm)	Isthmus (mm)	Parenchymal echogenicity	Thyroid volume (ml)
1	13 × 20 × 53	Absent	3.4	Homogeneous	7.16
2	16 × 17 × 52	Absent	3.8	Mild heterogeneous	7.35
3	Absent	16 × 24 × 40	Absent	Mild heterogeneous	7.98
4	19 × 19 × 49	Absent	Absent	Homogeneous	9.19
5	18 × 26 × 50	Absent	Absent	Mild heterogeneous	12.16
6	Absent	15 × 29 × 45	Absent	Mild heterogeneous	10.17
7	12 × 19 × 44	Absent	Absent	Mild heterogeneous	5.21
8	Absent	28 × 37 × 53	Absent	Homogeneous	28.55
9	28 × 46 × 80	Absent	Absent	Severe heterogeneous	53.58
10	23 × 26 × 61	Absent	3	Moderate heterogeneous	18.96

Figure 1

Thyroid ultrasound of patient no. 9 (transverse and longitudinal planes).



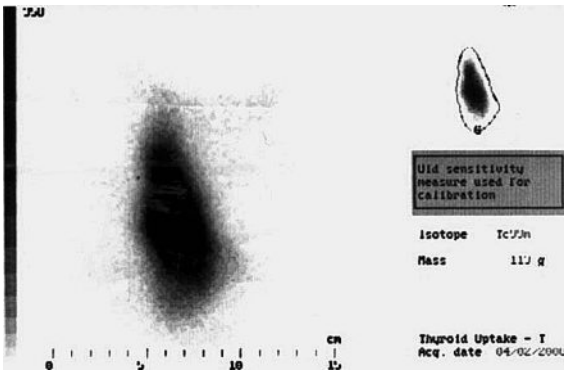
A



B

Figure 2

^{99m}Tc scintigraphy of patient no. 9.



dine uptake was 16–31.7% (4th–24th hours). After treatment with propylthiouracil (PTU) 300 mg/day for 12 weeks, euthyroid state was achieved. The patient with Hashimoto's thyroiditis (patient no. 3) was clinically asymptomatic whereas her TSH level was 10.32 μIU/ml. She received levothyroxine 50 mcg/day and euthyroid state was achieved.

Discussion

TH is a rare congenital anomaly with absence of a lobe and the isthmus. The accurate incidence is unknown as the patients are clinically asymptomatic. Several studies show that the prevalence rate of the TH in the normal population is 0.05–0.2% [2–4]. Gursoy et al. have indicated the prevalence of TH as 0.025% in the normal population and 0.25% in patients with thyroid disorders [11]. However, the incidence of hemiagenesis in the normal population was expected to increase with the widespread use of thyroid ultrasound. In our study, we observed TH prevalence as 0.16% in an outpatient referral population with thyroid disorders.

Etiology of TH still remains unclear. However, different theories have been established to explain TH; several genetic mechanisms, a descent defect from the floor of primitive pharynx to trachea or, a lobulation defect. It is unknown whether disturbance of the lobulation process is due to the interference of environmental factors or to some genetic abnormality. Several genes are known to control thyroid development and morphogenesis [12–13] and one of those genes is PAX8. In a study performed in 2007, 6 TH patients were examined indicating no mutation in the PAX gene [14]. A genetic component is suggested by the occurrence of TH among monozygotic twins [15] and mem-

bers of the same family [16]. In our study, family screening of patients with TH was negative.

According to our results, 8 out of 10 patients were women (80%), and 2 out of 10 were men (20%). Seven of the 10 patients (70%) had left hemiagenesis and isthmus was present only in 3 patients (30%). Confirming our results, most investigators have indicated that TH affects the left lobe more frequently than the right (4:1). Agenesis of the isthmus was seen in about 50% of the patients [17]. The female/male ratio is approximately 3–4:1 [17–19]. Similar to our study, higher estimated prevalence of TH in female subjects may be due to the higher prevalence of thyroid disorders in women than men.

Several thyroid diseases are associated with TH. There are reports of simple and nodular goiter [5], Graves' disease [6], thyroiditis [7], and hypothyroidism [10], toxic adenoma [8], papillary carcinoma [9]. In our study, we reported 1 patient with nodular Graves' disease, 1 with Hashimoto's thyroiditis, 2 with euthyroid multinodular goiters and 4 with euthyroid nodular goiters. Fine-needle aspiration biopsies for all patients with nodular goiters were benign. Hyperthyroidism has been reported as the major reason for patients' complaints. There have been about 30 patients with Graves' disease associated with TH reported [20]. The possibility of Graves' disease with TH should be considered in the differential diagnosis of toxic adenoma. Although RAI and surgical treatment are commonly used in toxic adenoma, they are not first choice in Graves' disease. In our study, 2 patients had multinodular goiters and 4 patients had nodular goiters. Simple and nodular goiter may be explained by environmental factors such as iodine deficiency and the TSH-dependent stimulation of the existent thyroid tissue.

TH is commonly diagnosed on thyroid scintigraphy but there are some confusing conditions. The reasons for nonvisualisation of one thyroid lobe include a neoplasm, contralateral autonomous solitary thyroid nodule that is suppressing normal extranodular tissue, inflammations and infiltrative diseases such as amyloidosis [5, 16, 18, 21]. Therefore, it is reasonable to make a confirmation of thyroid scans with ultrasound, CT or MRI. However, ultrasonography is the best diagnostic tool as it can be performed easily everywhere, cost effectively, with no radiation exposure to the patient.

In conclusion, TH is a rare congenital anomaly. Its prevalence among other thyroid diseases is 0.16% and left lobe agenesis is more frequent. In our study, the most frequently seen thyroid disease accompanying TH was nodular goiter.

Correspondence:
Ufuk Ozuguz, MD
Ankara Numune Training and Research Hospital
Endocrinology and Metabolism Clinic
06100, Ankara, Turkey
E-Mail: uozoguz@yahoo.com.tr

References

1 Handfield-Jones (1896) Handbuch der Systematischen Anatomie des Menschen. Friedrich Vleiwig und Braunschweig, Sohn.
2 Shabana W, Delange F, Freson M, Osteaux M, de Schepper J. Prevalence of thyroid hemiagenesis: ultrasound screening in normal children. Eur J Pediatr. 2000;159:456–8.
3 Maiorana R, Carta A, Floriddia G, et al. Thyroid hemiagenesis: prevalence in normal children and effect on thyroid function. J Clin Endocrinol Metab. 2003;88:1534–6.
4 Korpal-Szczyrska M, Kosiak W, Swieton D. Prevalence of thyroid hemiagenesis in an asymptomatic schoolchildren population. Thyroid. 2008;18:637–9.
5 Karabay N, Comlekci A, Canda MS, Bayraktar F, Degirmenci B. Thyroid Hemiagenesis with Multinodular Goiter: A Case Report and Review of the Literature. Endocr J. 2003;50: 409–13.
6 Ozgen AG, Saygili F, Kabalak T. Thyroid hemiagenesis associated with Graves' disease and Graves' ophthalmopathy: Case report. Thyroid. 2004;14:75–7.
7 Sharma R, Mondal A, Popli M, Sahoo M, Malhotra N, Soni S. Hemiagenesis of the Thyroid Associated with Chronic Lymphocytic Thyroiditis. Clin Nucl Med. 2001;26:506–8.
8 Mortimer PS, Tomlinson IW, Rosenthal FD. Hemiaplasia of the thyroid with thyrotoxicosis. J Clin Endocrinol Metab. 1981;52:152.
9 Pizzini AM, Papi G, Corrado S, Carani C, Roti E. Thyroid hemiagenesis and incidentally discovered papillary thyroid cancer: Case report and review of the literature. J. Endocrinol Invest. 2005;28:66–71.
10 Burman KD, Adler RA, Wartofsky L. Hemiagenesis of the thyroid gland. Am J Med. 1975;58:143–6.
11 Gursoy A, Anil C, Unal AD, Demirer AN, Tutuncu NB, Erdogan MF. Clinical and epidemiological characteristics of thyroid hemiagenesis: ultrasound screening in patients with thyroid disease and normal population. Endocrine. 2008;18.
12 Fabbro D, Pelizari L, Teli G, Damante G. Pax-8 protein levels regulate thyroglobulin gene expressions. J Mol Endocrinol. 1998;12:1100–5.
13 Macchia PE, Mattei MG, Lapi P, Fenzi G, Di Lauro R. Cloning chromosomal localization and identification of polymorphism's in the human thyroid transcription factor 2 gene TTF2. Biochemie. 1999;81:433–40.
14 Tonacchera M, Banco ME, Montanelli L, Di Cosmo C, Agretti P, De Marco, et al. Genetic analysis of the PAX8 gene in children with congenital hypothyroidism and dysgenetic or eutopic thyroid glands: identification of a novel sequence variant. Clin Endocrinol. (Oxf) 2007;67(1):34–40.
15 McLean R, Howard N, Murray IP. Thyroid dysgenesis in monozygotic twins: variants identified by scintigraphy. Eur J Nucl Med. 1985;10:346–8.
16 Rajmil Ho, Rodriguez-Espinosa J, Soldevila J, Ordonez-Lıanos J. Thyroid hemiagenesis in two sisters. J Endocrinol Invest. 1984;7:393–4.
17 Melnick JC, Stemkowski PE. Thyroid hemiagenesis (hockey stick sign): a review of the world literature and a report of four cases. J Clin Endocrinol Metab. 1981;52:247–51.
18 Mıkosch P, Gallowıtsch HJ, Kresnık E, Molnar M, Gomez I, Lınd P. Thyroid hemiagenesis in an endemic goiter area diagnosed by ultrasonography: Report of sixteen patients. Thyroid. 1999;9:1075–84.
19 Marwaha RK, Khanna CM, Gupta RK, Sharma R. Hemiagenesis associated with chronic lymphocytic thyroiditis. J Assoc Physicians. India 1990;38:507–8.
20 Nebesio TD, Eugster EA. Unusual thyroid constellation in Down syndrome: congenital hypothyroidism, Graves' disease, and hemiagenesis in the same child. J Pediatr Endocrinol Metab. 2009;22(3):263–8.
21 Matsumura LK, Russo EM, Dib SA, Maciel RM, Chacra AR. Hemiagenesis of the thyroid gland and T3 hyperthyroidism. Postgrad Med J. 1982;58:244–6.