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Original Article / Özgün Araştırma

Spectrum and Prevalence of Thyroid Disorders in Patients Admitted to the Anaesthesiology Outpatient Clinic for Surgery

Anestezi Polikliniğine Ameliyat İçin Başvuran Hastalardaki Tiroid Bozukluklarının Spektrumu ve Prevalansı

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Abstract / Özet

Objective: An anaesthetic approach and surgery are important treatment strategies in patients with thyroid dysfunction due to potential complications. We investigated the prevalence of thyroid disorders, the significance of thyroid function tests (TFTs) with respect to anaesthesia in the preoperative period and the need for routine examinations.

Methods: A total of 10,600 patients who were admitted to the anaesthesiology outpatient clinic for surgery were retrospectively screened and enrolled between 2011 and 2013. Evident hypothyroidism was defined as free tetra-iodothyronine (fT4) <0.7 ng dL^{-1} and thyroid-stimulating hormone (TSH) >4 mIU mL^{-1}, and subclinical hypothyroidism was defined as TSH >4 mIU mL^{-1} with normal free hormone levels. Evident hyperthyroidism was defined as fT4 >1.7 ng dL^{-1} and TSH <0.1 mIU mL^{-1}, and subclinical hyperthyroidism was defined as TSH <0.1 mIU mL^{-1} with normal free hormone levels. Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 17.0. Independent samples t-test and one-way analysis of variance were used to compare the difference between groups.

Results: Of the participants, 8.5% were found to have hypothyroidism, 2.5% had hyperthyroidism, 3.5% received treatment and 2.5% had their treatment postponed. The likelihood of hypothyroidism was greater among females, and no difference was found between genders with respect to hyperthyroidism.

Conclusion: We believe that TFTs are important because of regional factors. However, given the high cost of TFTs and because thyroid dysfunction risk increases with age, we concluded that routine TFTs in young patients with normal physical examination findings are not mandatory.

Keywords: Thyroid function tests, hypothyroidism, hyperthyroidism, iodine

Amaç: Gelişebilecek komplikasyonlar nedeniyle tiroid disfonksiyonu olan hastaların anestezi yaklaşımı ve ameliyatı önemlidir. Çalışmada tiroid bozukluk prevalansını, tiroid fonksiyon testlerinin peroperatif dönemde anestezi bakımından öneminin belirlenmesini ve rutin olarak çalışılmasının gerekliliğini değerlendirmeyi amaçladık.

Yöntemler: 2011-2013 yılları arasında ameliyat için başvuran 10.600 hasta taranarak kayıt edildi. Aşikâr hipotiroidi serbest tiroksin (sT4) <0,7 ng dL^{-1} ve tiroid stimulant hormon (TSH) >4 mIU mL^{-1} olarak, subklinik hipotiroidi ise serbest hormon düzeyleri normal iken TSH>4 mIU mL^{-1} olarak tanımlandı. Aşikar hipertiroidi sT4>1,7 ng dL^{-1} ve TSH<0,1 mIU mL^{-1} olarak, subklinik hipertiroidi ise serbest hormon düzeyleri normalken TSH<0,1 mIU mL^{-1} olarak tanımlandı. Verilerin analizi SPSS (Statistical Package for Social Sciences) 17,0 istatistik paket programı kullanılarak yapıldı. Gruplar arasında fark olup olmadığını karşılaştırmak için Independent Samples t testi (bağımsız gruplarda t testi) ve One-Way ANOVA (Varyans Analizi) Testi kullanıldı.

Bulgular: Araştırmaya katılanların; %8,5'inde hipotiroidi, %2,5'inde hipertiroidi olduğu, %3,5'ine tedavi uygulandığı ve %2,5'inin ertelendiği bulundu. Kadın hastaların hipotiroidi olma oranlarının istatistiksel olarak erkeklerden daha yüksek olduğu fakat hipertiroidi bakımından fark olmadığı saptandı.

Sonuç: Bölgesel faktörlerden dolayı tiroid fonksiyon testlerinin (TFT) çalışılmasının önemli olduğu düşüncesindeyiz. Fakat maliyetler göz önünde bulundurulduğunda, yaş arttıkça tiroid disfonksiyon riskinin artması nedeniyle, muayane bulguları normal olan genç hastalar için TFT'nin rutin olarak çalışılmasının mutlak gereksinim olmadığı kanısına vardık.

Anahtar Kelimeler: Tiroid fonksiyon testi, hipotirodi, hipertiroidi, iyot

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Introduction

Diseases of the thyroid gland are among the most common endocrinologic diseases. The size of the thyroid gland has been reported to increase with age, and the prevalence of goitre has reached 70% in populations with iodine deficiency (1, 2).

Evident hypothyroidism is observed in approximately 1%–7% of the general population, where the rate for subclinical hypothyroidism is approximately 14%–18% (3).

Although a euthyroid state in patients is ideal, mild to moderate hypothyroidism and hyperthyroidism are not definite contraindications for surgery. Elective surgery should not be performed in patients with severe hypothyroidism and hyperthyroidism; they should be treated before surgical intervention is required. Close monitoring is required for subsequent responses to aggressive supportive therapy, and thyroid therapy as mortality risk is high in urgent surgery (4, 5).

The iodine intake ratio is the most important factor affecting thyroid diseases and prevalence in a population. Therefore, thyroid disease prevalence changes according to region and age (6). Food and drinking water are poor sources of iodine in the Black Sea Region. Our study was conducted in a province, which is located in this region.

We evaluated the prevalence of thyroid disorders, number of postponed surgeries, age and gender distribution, importance of thyroid function tests (TFTs) with respect to anaesthesia during the postoperative period and necessity of routine examination for hormone tests in patients admitted to the Anaesthesiology Outpatient Clinic for surgery between 2011 and 2013.

Methods

The present study was approved by the Ethics Committee of the Karadeniz Technical University Faculty of Medicine Ethics Council (2013, nr: 143). A total of 10,600 patients aged 18 years and older were retrospectively screened and enrolled in the study according to the consent received after admission to the hospital. TFTs of all patients who were 18 years and older were evaluated.

TFTs were conducted at our clinical laboratory on admission. TFT parameters were measured using the automated luminescent immunoassay (Cobas E610; Roche, Nutley, NJ, USA). The normal ranges of the TFTs at our hospital were as follows: free tri-iodothyronine (fT3): 1.71–3.71 pg mL^{-1}; free tetra-iodothyronine (fT4): 0.93–1.7 ng dL^{-1} and thyroid stimulating hormone (TSH): 0.27–4.4 mIU mL^{-1}.

Evident hypothyroidism was defined as fT4 <0.7 ng dL^{-1} and TSH >4 mIU mL^{-1}, and subclinical hypothyroidism was defined as TSH >4 mIU mL^{-1} with normal free hormone levels. Evident hyperthyroidism was defined as fT4 >1.70 ng dL^{-1} and TSH <0.1 mIU mL^{-1}, and subclinical hyperthyroidism was defined as TSH <0.1 mIU mL^{-1} with normal free hormone levels. Patients with fT3 >6 ng dL^{-1} with normal fT4 values were defined as having T3 toxicosis. Patients who underwent thyroid surgery within the recent month and who were admitted to our outpatient clinic again were not included in the study.

Age, gender, fT3 value, fT4 value, TSH value and the number of postponed and performed surgeries were retrospectively screened and recorded.

Statistical analysis

Data analyses were performed using the Statistical Package for the Social Sciences (SPPS Inc. 2006, Chicago, IL, USA) program version 15 for windows. G* Power version 3.0.10 (Kiel, Germany) statistical program was used to calculate the sample size [Effect size=0.08, α=0.05, power (1–β)=0.95 and allocation ratio (n1/n2)=1]. Frequency distributions, mean, standard deviation, percent values and crosstabs were used to assess data. Independent samples *t*-test and one-way analysis of variance (ANOVA) were used to compare the difference between groups. In multiple comparisons, Tukey's honest significant difference test was applied to identify differences among groups. The chi-squared test was used to compare quantitative data. The ≤30 years age group was used as the reference, and the odds ratio (OR) and 95% confidence interval (CI) were calculated. A p value less than 0.05 indicated a statistically significant difference between groups.

Results

With respect to demographic data, 46.3% of patients were female and 53.7% were male, and the mean age was 53.5±17.8 years. No statistically significant difference was noted in age between genders (female: 53.39±16.89 years; male: 53.6±18.6 years; p>0.05).

Evident hypothyroidism was found in 1.9% of the patients, subclinical hypothyroidism was found in 6.7% of the patients, total hypothyroidism was found in 8.6% of the patients, evident hyperthyroidism was found in 0.7% of the patients, subclinical hyperthyroidism was found in 1.8% of the patients, total hyperthyroidism was found in 2.5% of the patients, 3.5% of the patients were treated and 2.5% of the patients had their treatment postponed. The mean TSH was 2.1±4.3 mIU mL^{-1}, the mean fT4 was 1.2±0.2 ng dL^{-1} and the mean fT3 was 3.2±0.7 pg mL^{-1} (Table 1).

When patients were evaluated according to gender, the likelihood of hypothyroidism was significantly greater among females. In addition, no difference was found between genders with respect to hyperthyroidism, and a statistically significant difference was not detected between groups (Table 2).

When the ratios of performing and delaying treatment were compared with respect to gender, the ratios were higher among females, and the difference was statistically significant (p<0.05) (Table 3).

Of the 10,600 participants, 196 of 198 patients with evident hypothyroidism (99.0%) were given treatment, and the treatment of 195 (98.5%) patients was postponed; 37 of 707 patients with subclinical hypothyroidism (5.2%) were treated and, among them, the treatment of two patients was postponed; 233 of 905 patients with total hypothyroidism (25.7%) were treated, and the treatment of 197 (21.8%) was postponed; 68 of 70 patients with evident hyperthyroidism (97.1%) were given treatment, and the treatment was postponed in 67 (95.7%) patients; 72 of 194 patients with subclinical hyperthyroidism (37.1%) were treated, and the treatment was postponed in four (2.1%) patients and 140 of 264 patients with total hyperthyroidism (53.0%) were given treatment, and the treatment was postponed in 71 (26.9%) patients.

Table 1. Prevalence of thyroid dysfunction

	Nonexistent		Existent	
	n	%	n	%
Evident hypothyroidism	10,402	98.1	198	1.9
Subclinical hypothyroidism	9,893	93.3	707	6.6
Total hypothyroidism	9,695	91.5	905	8.5
Evident hyperthyroidism	10,530	99.3	70	0.7
Subclinical hyperthyroidism	10,406	98.2	194	1.8
Total hyperthyroidism	10,336	97.5	264	2.5
T3 toxicosis	10,580	99.82	20	0.18
Treatment	10,227	96.5	373	3.5
Delay	10,332	97.5	268	2.5

A statistically significant difference was found between the TSH, fT3 and fT4 values according to the age groups ($p<0.05$). Post-hoc analysis was applied to identify from which age group(s) the difference arose. The TSH values in ≥71 years age group were significantly lower than those in other age groups; the fT4 values in the ≤30 years age group were significantly higher than those in the other age groups and the fT3 values were significantly different in all of the age groups and decreased with increasing age (Table 4).

With respect to evident hypothyroidism, the >30 years age group had a three-fold greater risk than the <30 years age group. However, a significant difference was not found between the risk ratios of total hypothyroidism according to the age group (Table 5).

With respect to evident hyperthyroidism, the 31–50 years age group had a 1.49-fold greater risk, the 51–70 years age group had a 2.44-fold greater risk and the ≥71 years age group had a 4.06-fold greater risk than the ≤30 years age group; the risk was found to increase as age increased (Table 6).

Discussion

Thyroid dysfunction is a severe accompanying health problem during the perianaesthetic period. Hypothyroidism, which varies in severity along a spectrum between a subclinical form and myxoedema, is a clinical disease that develops because of a deficiency of thyroid hormones (4). Hypothyroidism may lead to many problems because of cardiac con-

Table 2. Comparison of hypo-hyperthyroidism according to gender

	Female (n=4,903)		Male (n=5,697)			
	n	%	n	%	χ^2	P
Evident hypothyroidism	119	2.4	79	1.4	14.998	0.001
Subclinical hypothyroidism	408	8.3	299	5.2	39.485	0.001
Total hypothyroidism	527	10.7	378	6.6	56.574	0.001
Evident hyperthyroidism	33	0.7	37	0.6	0.001	0.977
Subclinical hyperthyroidism	97	2.0	97	1.7	0.967	0.325
Total hyperthyroidism	130	2.7	134	2.3	0.853	0.356

Table 3. Comparison of administration or delay of treatment according to gender

		Female (n=4,903)		Male (n=5,697)			
		n	%	n	%	χ^2	P
Treatment	Nonexistent	4,698	95.8	5,529	97.1	11.424	0.001
	Existent	205	4.2	168	2.9		
Delay	Nonexistent	4,754	97.0	5,578	97.9	9.271	0.002
	Existent	149	3.0	119	2.1		

Table 4. Comparison of TSH, fT3 and fT4 values according to the age groups (mean±SD)

	Age[1]=<30	Age[2] 31–50	Age[3] 51–70	Age[4]=>71	F	p	Difference
TSH	2.2±3.0	2.3±5.3	2.1±4.6	1.7±2.3	8.574	0.001	4 with 1, 2, 3
fT4	1.24±0.18	1.20±0.21	1.20±0.24	1.21±0.24	12.205	0.001	1 with 2, 3, 4
fT3	3.5±0.5	3.3±0.9	3.1±0.7	3.0±0.6	199.952	0.001	All

SD: standard deviation; TSH: thyroid stimulating hormone; fT4: free tetra-iodothyronine; fT3: free tri-iodothyronine
[1]: Age=<30, [2]: Age 31–50, [3]: Age 51–70, [4]: Age=>71

Table 5. Hypothyroidism status according to the age groups

	Evident hypothyroidism				Subclinical hypothyroidism				Total hypothyroidism			
	n (198)	%	OR	(95% CI)	n (707)	%	OR	(95% CI)	n (905)	%	OR	(95% CI)
Age =<30	8	0.1	1		103	1.0	1		111	1.0	1	
Age 31–50	64	0.6	3.72	(1.78–7.78)	220	2.1	0.98	(0.77–1.24)	284	2.7	1.19	(0.94–1.49)
Age 51–70	85	0.8	3.75	(1.81–7.77)	268	2.5	0.90	(0.71–1.14)	353	3.3	1.12	(0.89–1.39)
Age=>71	41	0.4	3.34	(1.56–7.15)	116	1.1	0.71	(0.54–0.93)	157	1.5	0.90	(0.70–1.16)

OR: odds ratio; CI: confidence interval

Table 6. Hyperthyroidism status according to the age groups

	Evident hyperthyroidism				Subclinical hyperthyroidism				Total hyperthyroidism			
	n (70)	%	OR	(95% CI)	n (194)	%	OR	(95% CI)	n (264)	%	OR	(95% CI)
Age=<30	4	0.0	1		4	0.0	1		8	0.1	1	
Age 31–50	13	0.1	1.49	(0.48–4.6)	26	0.2	2.99	(1.04–8.6)	39	0.4	2.25	1.05–4.82
Age 51–70	28	0.3	2.44	(0.86–6.9)	79	0.7	6.99	(2.5–19.1)	107	1.0	4.75	2.31–9.77
Age >71	25	0.2	4.06	(1.4–11.7)	85	0.8	14.19	(5.2–38.7)	110	1.0	9.26	4.51–19.05

OR: odds ratio; CI: confidence interval

tractility arising from a reduction in cardiac output, increased peripheral vascular resistance, arrhythmia, delayed gastric emptying, increased susceptibility to a hypotensive effect of anaesthetic agents and loosening of oropharyngeal tissues or difficult intubation due to a large tongue (7–9). As a cause of hypothermia and delayed recovery, Kumar et al. (10) highlights the importance of subclinical hypothyroidism. Hyperthyroidism occurs with an increase in thyroid hormone secretion due to an increase in thyroid gland function (9). Many problems such as high output heart failure, congestive heart failure along with peripheral oedema, ventricular tachycardia, arrhythmias such as atrial fibrillation and atrial flutter, hypertension and slow induction with volatile anaesthetics due to increased cardiac output may be encountered in patients with hyperthyroidism (5, 8). Therefore, anaesthetic approach and surgery are important in patients with thyroid dysfunction.

Measurements of the levels of TSH, fT3 and fT4 are among the most commonly used tests in the diagnosis of thyroid dysfunction. TSH level measurement is recommended as the most reliable test in all forms of hypothyroidism and hyperthyroidism in most guidelines (11).

The area in which we conducted the present study has endemic iodine deficiency but also high levels of nuclear radiation, which is another environmental factor that may affect the thyroid. Our region was significantly affected by the Chernobyl nuclear accident that occurred in 1986.

Yakar et al. (12) detected hypothyroidism in 13.1% of patients and hyperthyroidism in 8.75% of patients. Erdoğan et al. (13) found evident hypothyroidism in 1.55% of patients, subclinical hypothyroidism in 2.65% of patients (total hypothyroidism in 4.2%), evident hyperthyroidism in 3.75% of patients, subclinical hyperthyroidism in 6.18% (total hyperthyroidism as 9.93%) of patients and T3 toxicosis in 0.8% of patients in an area that has a moderate iodine deficiency. The T3 toxicosis ratio reported in that study was four-fold greater than ours.

Wanj et al. (14) found the hypothyroidism ratio to be 8.11% and the hyperthyroidism to be 2.89%. Hollowell et al. (15) detected subclinical hypothyroidism in 4.3% of patients, clinical hypothyroidism in 0.1% of patients, subclinical hyperthyroidism in 0.7% of patients and clinical hyperthyroidism in 0.5% of patients in the National Health and Nutrition

Examination Survey III study. In the Colorado thyroid disease prevalence study (16), subclinical hypothyroidism was found in 9% of patients, total hypothyroidism was found in 9.4%, subclinical hyperthyroidism was found in 2.1% and total hyperthyroidism was found in 2.2%. The prevalence of subclinical hypothyroidism among people in India was 9.4% (17), a higher rate than what we found. We detected 6.7% subclinical hypothyroidism, 8.5% total hypothyroidism, 1.8% subclinical hyperthyroidism and 2.5% total hyperthyroidism in our study.

The hypothyroidism and hyperthyroidism ratios found in our study are lower than the study of Yakar et al. (12), although our area is an iodine-poor area. However, the rates for each type of thyroidism are more similar than reported for other countries. Although hyperthyroidism was more prevalent in Erdoğan et al. (13), evident hypothyroidism was more prevalent in our study. Contrary to our study, another study conducted in our country (18) reported hyperthyroidism ratios that were greater than hypothyroidism ratios, suggesting that this condition arose from mild subclinical hypothyroidism symptoms, and patients were being referred to the clinic less frequently. Considering that all of the patients included in the present study were evaluated regardless of whether they underwent surgery, we suggest that hypothyroidism ratios are greater than hyperthyroidism ratios. We believe that our results could better reflect real values. Similar to that in the present study, thyroid dysfunction has often been observed to be more prevalent among women (12, 13, 16, 18, 19). Okamura et al. (20) found the prevalence of thyroid dysfunction to be greater than expected and, similarly, greater among females than males. Other studies with greater female ratios were suggested to arise from environmental factors, genetic factors, education levels and nutritional problems.

In the present study, the risk for evident, subclinical and total hyperthyroidism was found to increase with age, and no difference was noted between the risk ratios according to the age group for subclinical and total hypothyroidism; however, the risk increased with age for evident hypothyroidism. The risk increased at every decade, particularly >30 years. Similarly, a study conducted in Colorado (16), USA, reported that the hypothyroidism ratio increased at every decade, particularly >34 years.

Surgery was postponed because of thyroid dysfunction in 2.5% of the patients referred to our clinic for surgery. We consider this an important rate because severe thyroid dysfunction may lead to life-threatening complications.

Thyroid function tests increase costs at hospitals (10). Some studies have indicated that TSH should be tested first for the follow up and the treatment of thyroid dysfunction; further tests are not required for those with normal TSH. In addition, testing for fT3 and fT4 in patients with abnormal TSH levels would decrease costs (21, 22).

Conclusion

Testing for TSH is important because it leads to postponed surgery in 2.5% of patients. In addition, given the high cost of TFTs, we believe that routine TFTs are not absolutely necessary in young patients with normal physical examination findings because the risk of thyroid dysfunction increases with age, a finding that is consistent with other studies.

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Informed Consent: Written informed consent was obtained from patients who participated in this study.

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