VERSITA

Cent. Eur. J. Med. • 6(2) • 2011 • 152-157
DOI: 10.2478/s11536-010-0064-z

Central European Journal of **Medicine**

# Prognosis of thyroid function after hemithyroidectomy

**Research Article**

V. Beiša, D. Kazanavičius*, A. Skrebūnas, G. Simutis, A. Šileikis, K. Strupas

*Vilnius University Hospital Santariškių Klinikos, Center of Abdominal surgery, LT-08661 Vilnius, Lithuani*

**Received 26 November 2009; Accepted 20 October 2010**

**Abstract:** Identify criteria and create a risk scoring system to predict hypothyroidism after hemithyroidectomy. We have retrospectively studied 216 cases of patients with goiter who had undergone hemithyroidectomy from January 2002 to December 2007 at Vilnius University Hospital Santariškių Klinikos. Patients were divided into two groups according to their thyroid function after hemithyroidectomy: 168 (77.8%) patients' thyroid function was normal (group A), 48 (22.2%) patients had symptoms of hypothyroidism (group B). The relationship between groups and parameters such as patients` sex, age, patient's weight, preoperative serum thyroid-stimulating hormone (TSH) level, weight of the remnant gland, ratio of the remaining thyroid gland weight to patient`s weight was statistically analysed. The patients' mean age was 41.6 ± 14.1 years in group A and 52.9 ± 13.9 years in group B (p=0.0002). The mean preoperative TSH level was 0.79 ± 0.5 mU/L in group A, compared with 1.42 ± 1.00 mU/L in group B (p= 0.005). The mean ratio of the remaining thyroid gland weight to patient`s weight was 0.102 ± 0.053 g/kg in group A and 0.063 ± 0.027 g/kg in group B (p=0.04). The groups did not establish a significant difference between patients' sex, patient's weight or weight of the remaining gland. Patient's age, preoperative serum TSH level, ratio of the remaining thyroid gland weight to patient's weight is the main factors of hypothyroidism after hemithyroidectomy. A risk scoring system was created to predict hypothyroidism after hemithyroidectomy before the operation.

**Keywords:** *Hypothyroidism • Hemithyroidectomy*



## 1. Introduction

Thyroid nodules are a common clinical problem [1,2]. The main concern with the newly found thyroid nodules is the possibility of malignancy. Fine-needle aspiration (FNA) is the standard diagnostic method for evaluating thyroid nodules. Unfortunately, even FNA, currently the most effective diagnostic method, yields indeterminate results in up to 20% of all aspirations, which bear a 20% risk of malignancy. These indeterminate cases often lead to thyroid surgery (usually hemithyroidectomy) for diagnostic purposes [3,4].

In the past, most patients received thyroid-stimulating hormone (TSH) suppression therapy with levothyroxine after hemithyroidectomy to prevent the recurrence of thyroid nodules [5]. In more recent years, physicians stopped administering thyroid suppression therapy during the immediate postoperative period [6]. The emergence of the new trend was based on two developments: the publication of data that put into question the efficacy of levothyroxine therapy and heightened awareness of the morbidity associated with levothyroxine [7,8].

So, TSH-suppression therapy has fallen out of favour leaving hypothyroidism as the most common complication after hemithyroidectomy. The reported incidence of hypothyroidism after hemithyroidectomy ranges from 7.4 to 36.6% [6,9,10]. An early diagnosis of the subclinical state, followed by myxoedema, is very important. Otherwise the treatment of this postoperative complication is delayed and high cholesterol levels in the serum may give atherosclerosis with all its complications [8,11].

However, until now, we have not known who should be carefully followed up for higher risk of hypothyroidism. Therefore, the aim of this study was to evaluate the risk factors of hypothyroidism, divide patients in to different risk groups, and help to predict hypothyroidism before operation. This prediction helps make a decision choosing a type of operation: hemithyroidectomy or thyroidectomy.

* *E-mail: dkazanavicius@gmail.com*

**Figure 1a.** Scatter diagram of the patient's age (years) versus the post-hemithyroidectomy TSH level (2 months after the surgery).

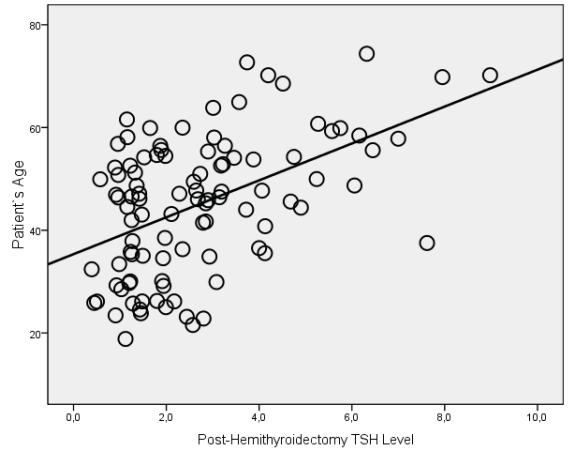
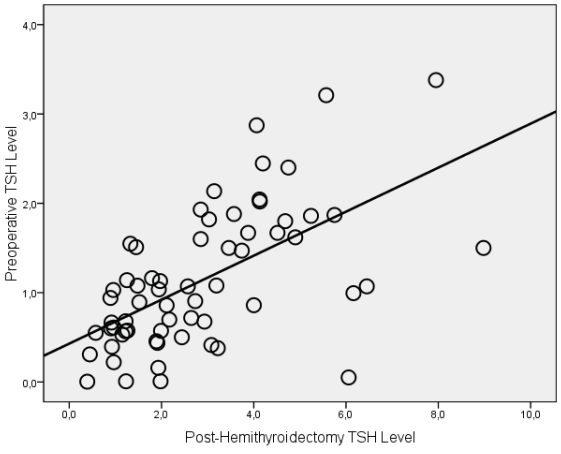



**Figure 1b.** Scatter diagram of the preoperative thyroid stimulating hormone (TSH) level (*mU/l*) versus the post-hemithyroidectomy TSH level (2 months after the surgery).




## 2. Material and Methods

We conducted a retrospective review of medical records of all patients undergoing hemithyroidectomy from January 2002 to December 2007. Patients were excluded from the study if they: (1) were preoperatively on thyroid hormone for pre-existing hypothyroidism or/and to prevent nodule growth; (2) pathologic diagnosis of malignancy; (3) later underwent completion thyroidectomy; (4) were on medications known to alter thyroid hormone or serum TSH level (5) had immunological features of thyroiditis. All patients were euthyroid state preoperatively.

Patients' medical records were reviewed for sex, age, body weight, preoperative serum TSH level and weights of the resected and remaining gland.

### 2.1. Statistical methods and Experimental Procedures

A normal range for TSH in our institution was from 0.4 to 4.0 mU/l. The weight (M) of the remnant lobe was calculated using the measurements from ultrasonography in the following equation according to the Žeromskas ellipsoid method [12]:

M *(g)* = 0.508 x (lobe length *(mm)*) x (lobe width *(mm)*) x (lobe depth *(mm)*)

We calculated ratio (A) of the remaining thyroid weight to patient's weight:

A *(g/kg)* = M *(g)* / patient's body weight *(kg)*

Patients were divided into two groups (A and B) according to the TSH level after hemithyroidectomy. Group A - patients with TSH level < 4.0 mU/l, group B – patients with hypothyroidism (TTH > 4.0 mU/l). A postoperative TSH test was performed 2, 6 and 20 months after the surgery.

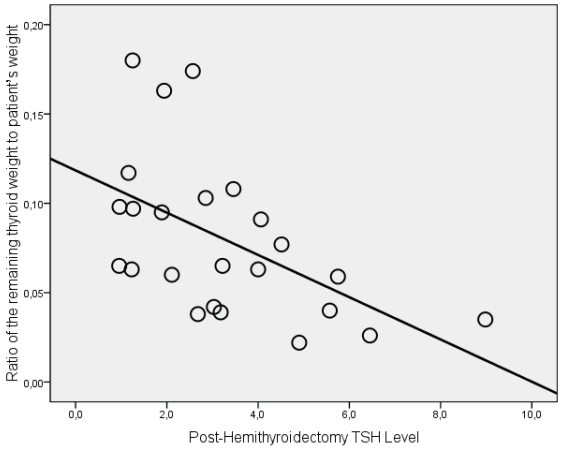
The statistical significance of the difference between A (euthyroid) and B (hypothyroid) group was analyzed using Student's *t*-test for continuous variables and the chi-squared test for nominal variables. According to our results a risk scoring system to predict postoperative hypothyroidism was created. It was tested with Fisher's formula. Values of $p<0.05$ were considered statistically significant.

## 3. Results

From January 2002 to December 2007, a total of 482 patients underwent hemithyroidectomy in our institution. After excluding patients based on the abovementioned criteria, 216 patients were included in the analysis. The most common reason for exclusion was being preoperatively on thyroid hormone.

Of these 216 patients, 48 (22.2%) became hypothyroid (group B) after surgery. In 37 cases (77.1%) postoperative hypothyroidism were detected 2 months postoperatively. After 6 and 20 months postoperatively it developed in 8 (16.7%) and 3 (6.2%) patients respectively. The remaining 168 patients were euthyroid. The patients' mean age was 41.6 ± 14.1 years in group A and 52.9 ± 13.9 years in group B (*p=0.0002*) (Figure 1a). The mean preoperative serum TSH level was 0.79 ±0.5 mU/L in group A, compared with 1.42 ± 1.00 mU/L in

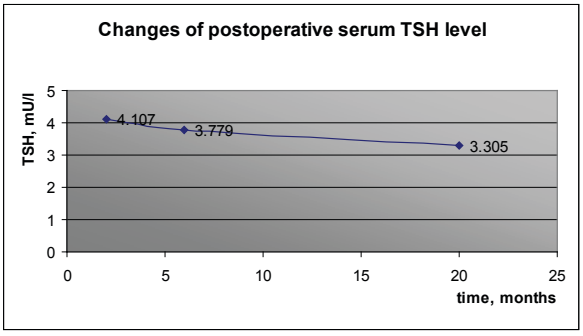
**Figure 1c.** Scatter diagram of the ratio of the remaining thyroid weight to patient's weight (g/kg) versus the post-hemithyroidectomy TSH level (postoperative TSH levels were measured 2 months after the surgery).




group B (*p=0.005*) (Figure 1b). The mean ratio of the remaining thyroid weight to patient's weight was 0.102 ± 0.053 g/kg in group A and 0.063 ± 0.027 g/kg in group B (*p=0.04*) (Figure 1c). The groups did not establish a significant difference between patients' sex (194 patients (89.8%) were women), patient's weight (mean weight was 79.10 ± 19.21 kg in group A and 80.03 ± 11.78 kg in group B (*p=0.859*)) or weight of the remaining gland (the mean weight of the remaining gland was 7.662 ± 4.342 g in group A and 5.425 ± 3.916 g in group B (*p=0.095*)) (Table 1). We observed a compensatory glands` growth response effect in post-operative spontaneous recovery of hypothyroidism (meanly +1,98g). Also we have taken notice of the patients who, according to the high postoperative serum TSH level, were numbered among hypothyroidism group (group B), but didn't take thyroid hormone postoperatively. Serum TSH level of those patients was decreasing progressively 0.8 mU/L per 20 months (Figure 2). 4,107 mU/L was the highest TSH value of the patients returned to normal in post-op hypothyroid group.

The analysis showed that patient's age, preoperative serum TSH level, ratio of the remaining thyroid weight to patient's weight were independent predictors of

**Figure 2.** Changes of postoperative serum TSH level: it is decreasing in patients who didn't take thyroid hormone postoperatively; TSH: thyroid-stimulating hormone.




postsurgical hypothyroidism after hemithyroidectomy. A risk scoring system to predict postoperative hypothyroidism using the abovementioned predictors was created. According to the percentiles of the patients, means of the predictors and standard deviations, cut-off values of each variable were determined. Variables of the preoperative TSH level (cut-off value 0.6 and 1.4 mU/l) and patients` age (cutoff values 40 and 60 years) were divided into three groups. Variable of the ratio of the remaining thyroid weight to patient's weight was divided into two groups (cut-off value 0.1 g/kg). Considering the probability of the postoperative hypothyroidism development in each variable's group we assigned a highest score of 2 to preoperative TSH level and patient's age. The highest score of 1 was assigned to the ratio of the remaining thyroid weight to patient's weight (Table 2). The sum of scores was estimated. Patients with sum of scores of 0-1, 2-3 and 4-5 developed hypothyroidism with the incidence of 14.2%, 49.4% and 81.2% (*p=0.01*). The risk scoring system showed significant association with the development of postoperative hypothyroidism.

## 4. Discussion

Hypothyroidism has been mentioned as potentially debilitating sequelae of hemithyroidectomy in many previous studies [9,13,14]. The usual indication for

**Table 1.** Comparative analysis between post-hemithyroidectomy euthyroid and hypothyroid patients.

| Predictor | Number of patients | Euthyroid (group A) | Hypothyroid (group B) | p |
|---|---|---|---|---|
| Sex | 216 | W=153; M=15 | W=41; M=7 | >0.05 |
| Age, years | 216 | 41.6 ± 14.1 n=106 | 52.9 ± 13.9n=110 | 0.0002 |
| Patient's weight, kg | 59 | 79.10 ± 19.21 n=32 | 80.03 ± 11.78 n=27 | 0.859 |
| Preoperative serum TSH level, mU/l | 82 | 0.79 ±0.5 n=40 | 1.42 ± 1.00 n=42 | 0.005 |
| Weight of the remaining gland, g | 57 | 7.662 ± 4.342 n=27 | 5.425 ± 3.916 n=30 | 0.095 |
| Ratio of the remaining thyroid weight to patient's weight, g/kg | 27 | 0.102 ± 0.053 n=15 | 0.063 ± 0.027 n=12 | 0.04 |

*W: women; M: men; TSH: thyroid-stimulating hormone; n: number of patients*

**Table 2.** Risk scoring system to predict hypothyroidism after hemithyroidectomy.

| Parameter | Cut-off value | Risk score |
|---|---|---|
| Preoperative TSH level, mU/l | ≤0.6 | 0 |
| | >0.6 and ≤1.4 | 1 |
| | >1.4 | 2 |
| Patient's age, years | ≤40 | 0 |
| | >40 and ≤60 | 1 |
| | >60 | 2 |
| Ratio of the remaining thyroid weight to patient's weight, g/kg | ≥0.1 | 0 |
| | <0.1 | 1 |

**Table 3.** Previous studies regarding the predictors of postsurgical hypothyroidism after hemithyroidectomy.

| Study | Hypothyroidism | Predictors of hypothyroidism | Predictors without significant association |
|---|---|---|---|
| Moon H.G. et al. [6] | 36.6% (37/101) | Preoperative serum TSH levelRemnant thyroid volume | Sex<br>Age |
| McHenry and Slusarczyk [9] | 35% (25/71) | Preoperative serum TSH level | Lymphocytic infiltration within the thyroid gland<br>Weight of resected gland |
| Miller et al. [18] | 27% (24/90) | Preoperative serum TSH levelAge | Sex |
| Buchanan and Lee [17] | 24.1% (38/158) | Lymphocytic infiltration within the thyroid glandPresence of thyroid antibody | |
| Piper et al. [13] | 18% (12/66) | Preoperative serum TSH levelLymphocytic infiltration within the thyroid gland | |
| Our study | 22.2% (48/216) | Preoperative serum TSH levelAgeRatio of the remaining thyroid weight to patient's weight | SexPatient's weightWeight of the remaining gland |

*TSH: thyroid-stimulating hormone*

hemithyroidectomy is the presence of a single dominant thyroid nodule in a patient whose fine-needle aspiration findings are suspicious or indeterminate. The rationale for performing thyroid resection for indeterminate nodules is that these nodules harbor thyroid carcinoma up to 20% cases [4,15]. Hemithyroidectomy is also performed on patients with unilateral or bilateral thyroid enlargement, toxic or nontoxic nodular thyroid disease, and diffuse or multinodular goitre. Because only one lobe of the thyroid gland is removed, hemithyroidectomy is associated with a lower incidence of postoperative hypocalcemia and recurrent and superior laryngeal nerve injury than in total thyroidectomy. However, hypothyroidism may develop in 7.4 – 36.6% cases after thyroid hemithyroidectomy [6,9,10]. It is very important not only to select the patients at risk of developing the hypothyroidism but also to help a patient and a doctor make a decision choosing a type of operation: hemithyroidectomy or thyroidectomy, if there are minimal alterations of structure (less than 1 cm in diameter) in the remaining gland. Therefore, how can we predict hypothyroidism after hemithyroidectomy?

It is necessary to wait for at least four to five half-lives of TSH before measuring a serum TSH level postoperatively to get an accurate assessment of the thyroid hormone being produced by the residual thyroid lobe because serum TSH has a half-life of about 7 days [16]. To monitor TSH level after hemithyroidectomy serum TSH was assessed at the first 2 months and again at 6 months and 20 postoperatively in our study. In our study, 22.2% (48/216) had postsurgical hypothyroidism. Most of postoperative hypothyroidism (77.1%) was detected in 2 months postoperatively. After 6 and 20 months it developed in 16.7% and 6.2% cases respectively.

Our finding that 22.2% of patients developed hypothyroidism after undergoing hemithyroidectomy for benign thyroid disease is consistent with others reported in the literature. In fact, Buchanan and Lee (2001) reported 24.1% incidence [17]. They concluded that an elevated thyroid autoantibody level is an independent risk factor for hypothyroidism. It must be admitted that thyroid autoantibody level plays in the development of postoperative hypothyroidism. Therefore, we did not include this variable into our analysis. Our aim was to identify and evaluate other factors of hypothyroidism after hemithyroidectomy.

Several studies have looked into the risk factors of developing posthemithyroidectomy hypothyroidism (Table 3) [6,9,13,17,18]. They noted that some of the proposed risk factors can be determined only after surgery, whereas others can be detected during the

preoperative period. Among them, the preoperative TSH level was commonly noted to have a significant relation with postoperative hypothyroidism. We found that the incidence of postoperative hypothyroidism significantly correlated with higher preoperative serum TSH levels. In addition to the preoperative TSH level, our results show that patients who developed postsurgical hypothyroidism were older and had lower ratio of the remaining thyroid weight to patient's weight compared to those who remained in the euthyroid state.

It is already known that the lymphocytic infiltration within the thyroid gland, at the time of surgery, is a possible predictor of hypothyroidism [10,18-21] and we therefore did not factor this variable into our analysis. Regarding other potential risk factors, we did not find any significant difference between our two groups with respect to sex, patient's weight and weight of the remaining gland.

We have demonstrated that patient's age, a high preoperative serum TSH level and ratio of the remaining thyroid weight to patient's weight are independent predictors of postsurgical hypothyroidism after hemithyroidectomy. Our study shows that the most important predictors in developing hypothyroidism are preoperative serum TSH level and patient's age, less important – ratio of the remaining thyroid weight to patient's weight. To our knowledge, this is the first study that shows the relation between ratio of the remaining thyroid weight to patient's weight and postsurgical hypothyroidism and the decrease of serum TSH level in patients who had high postoperative serum TSH level after hemithyroidectomy, but didn't take thyroid hormone postoperatively.

## 5. Conclusion

The risk scoring system proposed in our study showed promising predictability of developing hypothyroidism after hemithyroidectomy. Being able to predict the individual patient's probability of developing postsurgical hypothyroidism is of value when making diagnostic and therapeutic plans for patients with thyroid nodules. Our findings have confirmed the identity of the key risk factors for the development of hypothyroidism during the postoperative period following hemithyroidectomy. Therefore, in a modern thyroid surgery practice this scoring system helps a patient and a doctor make a decision choosing a type of operation if there are minimal alterations of structure in the remaining gland. We intend to conduct future research in this area by means of a prospective study.

## References

[1] Hegedus L. Clinical practice: the thyroid nodule, N Engl J Med. – 2004, vol. 351, no. 17, p. 1764-1771
[2] Ross D.S. Nonpalpable thyroid nodules: managing an epidemic, J Clin Endocrinol Metab. – 2002, vol. 87, no. 5, p. 1938-1940
[3] Cooper D.S., Doherty G.M., Haugen B.R. et al. Management guidelines for patients with thyroid nodules and differentiated thyroid cancer, Thyroid. – 2006, vol. 16, no. 2, p.109-142
[4] Gharib H., Papini E., Valcavi R. … et al. American Assosiation of Clinical Endocrinologists and Associazione Medici Endocrinologi medical guidelines for clinical practice for the diagnosis and management of thyroid nodules, Endocr Pract. – 2006, vol. 12, no. 1, p. 63-102
[5] Gharib H., Mazzaferri E.L. Thyroxine suppressive therapy in patients with nodular thyroid disease, Ann Intern Med. – 1998, vol. 128, no. 5, p. 386-394
[6] Moon H.G., Jung E.J., Park S.T. et al. Thyrotropin level and thyroid volume for prediction of hypothyroidism following hemithyroidectomy in an Asian patient cohort, World J Surg. – 2008, vol. 32, no. 11, p. 2503-2508
[7] Sawin C.T. Subclinical hyperthyroidism and atrial fibrillation, Thyroid. – 2002, vol. 12, no. 6, p. 501-503
[8] Al-Abadi A.C. Subclinical thyrotoxicosis, Postgrad Med J. – 2001, vol. 77, no. 903, p. 29-32
[9] McHenry C.R., Slusarczyk S.J. Hypothyroidisim following hemithyroidectomy: incidence, risk factors, and management, Surgery. – 2000, vol. 128, no. 6, p. 994–998
[10] Berglund J., Bondeson L., Christensen S.B., Tibblin S. The influence of different degrees of chronic lymphocytic thyroiditis on thyroid function after surgery for benign, non-toxic goitre, Eur J Surg. – 1991, vol. 157, no. 4, p. 257-260
[11] Koh Y.W., Lee S.W., Choi E.C. et al. Prediction of hypothyroidism after hemithyroidectomy: a biochemical and pathological analysis, Eur Arch Otorhinolaryngol. – 2008, vol. 265, no. 4, p. 453-457
[12] Žeromskas P. Skydliaukės dydžio ir jos likučio po operacijos nustatymas: daktaro disertacija. - Vilnius, 2000. – 102 p

[13] Piper H.G., Bugis S.P., Wilkins G.E. et al. Detecting and defining hypothyroidism after hemithyroidectomy, Am J Surg. – 2005, vol. 189, no. 5, p. 587–591. (discussion 591)
[14] Hedman I., Jansson S., Lindberg S. Need for thyroxine in patients lobectomised for benign thyroid disease as assessed by follow- up on average 15 years after surgery, Acta Chir Scand. – 1986, vol. 152, p. 481–486
[15] Mandel S.J. A 64-year-old woman with a thyroid nodule, JAMA. – 2004, vol. 292, no. 21, p. 2632-2642
[16] Lombardi G., Panza N., Lupoli G. et al. Study of the pituitary–thyroid axis in euthyroid goiter after partial thyroidectomy, J Endocrinol Invest. – 1983, vol. 6, no. 6, p. 485–487
[17] Buchanan M.A., Lee D. Thyroid auto-antibodies, lymphocytic infiltration and the development of post-operative hypothyroidism following hemithyroidectomy for non-toxic nodular goitre, J R Coll Surg Edinb. – 2001, vol. 46, no. 2, p. 86-90
[18] Miller F.R., Paulson D., Prihoda T.J., Otto R.A. Risk factors for the development of hypothyroidism after hemithyroidectomy, Arch Otolaryngol Head Neck Surg. – 2006, vol. 132, no. 1, p. 36–38
[19] Bang U., Blichert-Toft M., Petersen P.H. et al. Thyroid function after resection for nontoxic goitre with special reference to thyroid lymphocytic aggregation and circulating thyroid autoantibodies, Acta Endocrinol (Copenh). – 1985, vol. 109, p. 214–219
[20] Seiberling K.A., Dutra J.C., Bajaramovic S. Hypothyroidism following hemithyroidectomy for benign nontoxic thyroid disease, Ear Nose Throat J. – 2007, vol. 86, no. 5, p. 295–299
[21] Su S.Y., Serpell J. Es16p hypothyroidism following hemithyroidectomy, ANZ J Surg. – 2007, vol. 77, suppl. 1, p. A24