



## Short-stay thyroid surgery for older patients: is it safe?

### Operacija tireoidne žlezde sa kratkotrajnim boravkom u bolnici kod starijih bolesnika: da li je bezbedna?

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#### Abstract

**Background/Aim.** The incidence of nodular thyroid disease increases significantly with age as well as the incidence and aggressiveness of thyroid cancers. The aim of the study was to determine whether thyroid surgery for geriatric patients is safe in a short hospital stay surgery setting. **Methods.** In this retrospective study, medical histories of all operated geriatric patients (65 years and older), in whom a total thyroidectomy (TT) or hemithyroidectomy (HT) was performed from January 2012 to December 2018, were analyzed. A total of 976 patients were operated on for thyroid diseases in the mentioned period, out of which 247 geriatric patients fulfilled the inclusion criteria. Patients with thyroid reoperations and simultaneous neck lymph node dissections were excluded from the study. The geriatric patients were divided into two groups: the HT group (33 patients) and the TT group (214 patients). Each of these two geriatric groups, HT and TT, had two additional paired control groups. Control group I consisted of younger subjects from 20–44 years, and control group II included middle-aged subjects from 45–64 years. **Results.** All three TT groups – geriatric, control I, and control II,

had 214 patients each, and all three HT groups had 33 patients each. In all three HT groups, the average hospital stay was 24 hrs, while in the TT geriatric group, 150 (70.1%) of 214 patients spent 24 hrs at the hospital. In the geriatric population, the incidence of neck swelling and increased drainage output were higher compared to both control groups, and thus the need for longer hospitalizations. When the age was compared, it was shown that subjects with each subsequent year of intervention had a 22% lower chance of developing complications, and regarding the pathohistological finding, benign thyroid hyperplasia was less likely to develop complications compared to malignant hyperplasia. **Conclusion.** According to the study, TT can be safely performed within the concept of a short hospital stay in patients under 65 years, while in the elderly, hospitalization days may be extended due to more frequent surgical and nonsurgical complications. Speaking of HT, the short hospital stay is safe for all age groups.

#### Key words:

aged; length of stay; minor surgical procedures; postoperative complications; risk factors; thyroidectomy; thyroid gland.

#### Apstrakt

**Uvod/Cilj.** Incidenca nodularnih bolesti štitaste žlezde značajno raste sa starenjem, kao i incidenca i agresivnost karcinoma štitaste žlezde. Cilj rada bio je da se utvrdi da li je operacija štitaste žlezde bezbedna kod starijih bolesnika u okviru koncepta kratkotrajnog postoperativnog boravka u bolnici. **Metode.** U studiji retrospektivnog tipa, analizirane su istorije bolesti svih operisanih bolesnika starijih od 65 godina kojim je urađena totalna tireoidektomija (TT) ili hemitireoidektomija (HT) u periodu od januara 2012. do decembra 2018. godine. U navedenom periodu ukupno je

operisano 976 bolesnika zbog bolesti štitaste žlezde, od kojih je 247 gerijatrijskih bolesnika ispunilo kriterijume da budu uključeni u studiju. Bolesnici kod kojih je bila rađena reoperacija štitaste žlezde, kao i bolesnici kod kojih je istovremeno bila urađena tireoidektomija i disekcija limfnih čvorova vrata, bili su isključeni iz studije. Gerijatrijski bolesnici bili su podeljeni u dve grupe – u prvoj grupi bili su bolesnici kod kojih je izvršena HT (33 bolesnika) a u drugoj su bili bolesnici kod kojih je izvršena TT (214 bolesnika). Svaka od ove dve gerijatrijske grupe, HT i TT, imala je po dve uparene kontrolne grupe. Prvu (I) kontrolnu grupu činili su mlađi bolesnici, od 20–44 godina, a drugu (II) kontrolnu

grupu činili su bolesnici srednjih godina, od 45–64 godina. **Rezultati.** Sve tri grupe kod kojih je bila izvršena TT – gerijatrijska grupa i I i II kontrolna grupa, imale su po 214 bolesnika i svaka od tri grupe kod kojih je bila urađena HT imala je po 33 bolesnika. Kod bolesnika iz sve tri grupe kod kojih je bila izvršena HT, prosečan boravak u bolnici bio je 24 časa, dok je u gerijatrijskoj grupi bolesnika kojima je bila urađena TT, 150 (70,1%) od 214 bolesnika provelo 24 sata u bolnici. U gerijatrijskoj populaciji dolazilo je češće do pojave otoka u predelu vrata i povećane drenaže u odnosu na obe kontrolne grupe, pa je samim tim i postojala potreba za dužom hospitalizacijom. Poređenjem godina starosti, pokazano je da ispitanici sa svakom kasnijom godinom intervencije imaju za 22% manje šanse za nastanak

komplikacija, kao i da kod benignih bolesti štitaste žlezde postoje manje šanse za nastanak komplikacija u odnosu na maligne bolesti. **Zaključak.** Prema rezultatima dobijenim u ovoj studiji, TT se može bezbedno sprovesti u okviru koncepta kratkog boravka u bolnici kod bolesnika mlađih od 65 godina, dok se kod starijih bolesnika dani hospitalizacije mogu produžiti zbog češćih hirurških i nehirurških komplikacija. Kod HT, kratkotrajni postoperativni boravak u bolnici je bezbedan za sve starosne grupe.

#### **Ključne reči:**

**stare osobe; hospitalizacija, dužina ; hirurgija, mala; postoperativne komplikacije; faktori rizika; tireoidektomija; tireoidna žlezda.**

## **Introduction**

The incidence of nodular thyroid disease increases significantly with age as well as the incidence and aggressiveness of thyroid cancers<sup>1,2</sup>. Since global and regional population aging trends are on the rise, including thyroid diseases, it is essential to establish adequate guidelines and protocols to provide optimal care for these patients<sup>3</sup>.

Short-stay surgery represents a modern, safe, and effective approach to surgical treatment with numerous benefits for patients, their relatives, hospitals, and the healthcare system in general. This concept is less stressful for patients, especially when it comes to the youngest and oldest age groups, which are heavily dependent on their loved ones in daily life<sup>4,5</sup>. Despite numerous evaluations on this topic, there is still a concern that thyroid surgery in the elderly may lead to more frequent complications than in the younger population, which led some authors to favor multi-day thyroid surgery for adequate preoperative preparation and longer postoperative follow-up<sup>6,7</sup>. The higher percentage of comorbidities in the geriatric population could be one of the factors affecting the incidence of intra- and postoperative complications and, therefore, the period of inpatient stay. Although most authors consider geriatric thyroidectomy a safe procedure that fits into the concept of short-stay surgery<sup>8,9</sup>, there is still insufficient literature data regarding the safety of this approach.

The aim of this study was to determine if thyroid surgery for geriatric patients is safe in a short hospital stay surgery setting.

## **Methods**

In this retrospective study, medical histories of all operated geriatric patients (65 years and older), in whom a total thyroidectomy (TT) or hemithyroidectomy (HT) was performed from January 2012 to December 2018 in our hospital, were analyzed. In the aforementioned period, 976 patients were operated on for thyroid diseases within the short-stay surgery setting, out of which 247 geriatric patients fulfilled the inclusion criteria. In 214 geriatric patients, a TT was performed, while HT was conducted in 33 geriatric patients.

The analyzed geriatric patients were divided into the HT and TT group; each of these groups was paired with two control age groups, control I (20–44 years) and control II (45–64 years), in a numerical ratio of 1: 1: 1. For TT, each group had 214 patients, and for HT, each group had 33 patients.

Patients with thyroid reoperation, as well as patients who underwent thyroidectomy and neck lymph node dissection at the same time, were excluded from the study. All patients were prepared for short-stay thyroid surgery as outpatients in a standard manner and were admitted to the surgery department on the day of surgery. Standard preoperative preparation has implied anamnesis, clinical examination, blood analyses, biochemical analysis, laboratory analysis for thyroid hormones, anti-thyroid autoantibodies (anti-thyroid peroxidase and anti-thyroglobulin antibodies), thyroglobulin, and calcitonin, ultrasound imaging of the neck, electrocardiogram, lung X-ray, cardiologic examination, and an ear, nose, and throat specialist examination. In certain cases, a part of the preoperative workup also included an X-ray of the neck for tracheal positioning, thyroid scintigraphy, percutaneous biopsy, and appropriate specialist findings for other conditions patients might have.

Discharge was planned 24 hrs after the operation, with an overnight stay, with the possibility of an extension of stay in case of complications. All operations were performed by a single surgeon through a neck-based incision using ultrasound scissors.

According to the short-stay protocol, patients were prepared completely before arrival and admission to the hospital<sup>10,11</sup>. After that, patients were admitted on the day of planned surgical treatment and discharged the same day or 24 hrs after the surgery (short-stay concept).

Protocols within the modern one-day surgery provide a contemporary, safe, and effective approach to surgical treatment with numerous benefits for both the patients and their relatives, hospitals, and the health system in general. Treatment within one-day surgery gives greater benefits and comfort to the patient, to whom the entire treatment and care are subordinated, unlike standard hospital care, where there are much more serious patients for treatment. Patients who are operated on in well-organized day hospital wards receive treatment that is better adapted to their needs, which allows

them to be discharged on the same day and return to home surroundings for easier recovery.

Data were collected from medical histories, operating protocols, histopathological findings, laboratory findings, and outpatient examinations. The following data were processed: demographic (age and gender), hospital stay, postoperative laboratory findings [parathyroid hormone (PTH) – in the first hour postoperatively, serum calcium – 24 hrs postoperatively], clinical findings, pathological findings [American Society of Anaesthesiologists (ASA) score, pathohistological finding, postoperative indirect laryngoscopy], surgical complications (neck swelling, drainage output > 100 mL/24 hrs, bleeding of the operative wound requiring reoperation) and nonsurgical complications (hypertensive crisis, exacerbation of the chronic obstructive pulmonary disease, etc.). The serum calcium levels were measured 24 hrs after the operation, whereby hypocalcemia was defined as a value less than < 2.0 mmol/L.

Descriptive statistical methods, methods for testing statistical hypotheses, and methods for analyzing the relationship between outcomes and potential predictors were used to analyze the primary data. Descriptive statistical methods were measures of central tendency, measures of variability, and relative numbers. The methods used to test the statistical hypotheses were the  $\chi^2$  test, Fisher's exact probability test, analysis of variance, Kruskal-Wallis test, and Mann-Whitney *U* test. Logistic regression was used to analyze the relationship between binary outcomes and potential predictors. Predictors of hospitalization days were analyzed by univariate and multivariate ordinal logistic regression. Statistical hypotheses were tested at a level of statistical significance (alpha level) of 0.05. The model of multivariate logistic regression included those predictors of complications that were statistically significant in the models of univariate logistic regressions at the level of significance of 0.1 and those that, based on previous research, are considered significant for complications. All data were processed in IBM SPSS Statis-

tics version 22 (SPSS Inc., Chicago, IL, USA) software package.

This retrospective observational cohort study was done in accordance with current Good Clinical Practice guidelines, the Declaration of Helsinki, and the Ethics Committee approval of the Clinical Center "Dr. Dragiša Mišović – Dedinje", Belgrade, Serbia (No. 01-2905/1 from 21 March, 2022).

## Results

Out of the total 976 patients that were operated on for thyroid disease within the short-stay surgery setting, 247 geriatric patients fulfilled the inclusion criteria. In 214 geriatric patients, a TT was performed, while HT was conducted in 33 geriatric patients.

In all investigated groups of patients, women appeared more frequently than men, with no statistically significant difference between the groups ( $p = 0.114$ ;  $p = 0.109$ , respectively). According to the ASA classification system, the eldest group with HT (Table 1) had a statistically significant higher percentage of patients with the ASA III category compared to the controls ( $p < 0.001$ ). The same appeared in the eldest TT group ( $p < 0.001$ ).

As shown in Table 2, in the geriatric HT group, the most frequent histopathological diagnosis was benign goiter (including incidentally found differentiated microcarcinoma) with no statistically significant difference compared to the controls ( $p = 0.222$ ). In the TT groups, benign goiter was also the most frequent pathohistological diagnosis in all three groups (78.5%, 67.3%, and 61.2%, respectively). Diffuse thyroid hyperplasia (Graves' disease) appeared most frequently (14%) in the younger control group, as expected (compared to the medium age control group, 4.2%, and the geriatric group, 0%). A statistically significant difference was found between the TT age groups with regard to the histopathological findings ( $p < 0.001$ ).

In all three HT groups, the average hospital stay was one day ( $p = 0.133$ ), without surgical complications needing

**Table 1**

### American Society of Anaesthesiologists (ASA) classification system in relation to age and type of surgery

ASA score	Hemithyroidectomy			Total thyroidectomy		
	65+	45–64	65+	45–64	65+	45–64
I	0 (0.0)	4 (12.1)	10 (30.3)	3 (1.4)	5 (2.3)	37 (17.3)
II	20 (60.6)	26 (78.8)	23 (69.7)	154 (72.0)	188 (87.8)	173 (80.8)
III	13 (39.4)	3 (9.1)	0 (0.0)	57 (26.6)	21 (9.8)	4 (1.9)
Total	33 (100)	33 (100)	33 (100)	214 (100)	214 (100)	214 (100)

65+ – patients older than 65 years; 45–64 – middle-aged group of patients; 20–44 – younger group of patients. Results are presented as numbers (percentages) of patients.

**Table 2**

### Pathohistological (PH) findings in relation to age and type of surgery

PH finding	Hemithyroidectomy			Total thyroidectomy		
	65+	45–64	65+	45–64	65+	45–64
Benign goiter	28 (84.8)	30 (90.9)	32 (96.9)	168 (78.5)	144 (67.3)	131 (61.2)
Chronic thyroiditis	2 (6.1)	3 (9.1)	1 (3.1)	17 (7.9)	29 (13.6)	24 (11.2)
Graves' disease	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	9 (4.2)	30 (14.0)
Thyroid carcinoma	3 (9.1)	0 (0.0)	0 (0.0)	29 (13.6)	32 (14.9)	29 (13.6)
Total	33 (100)	33 (100)	33 (100)	214 (100)	214 (100)	214 (100)

65+ – patients older than 65 years; 45–64 – middle-aged group of patients; 20–44 – younger group of patients. Results are presented as numbers (percentages) of patients.

reoperation or nonsurgical complications and without mortality. Two patients out of the middle-aged control group ( $p = 0.327$ ) had neck swelling caused by subcutaneous seromas, which were solved by needle puncture in an ambulatory setting.

In the TT geriatric group, 150 (70.1%) of 214 patients spent 24 hrs in the hospital, while 176 (82.2%) patients of the middle-aged control group and 178 (83.2%) of the younger control group spent a similar time in the surgical ward. The arithmetic mean of the hospital stay was 1.5 days (range 1 to 7) for the geriatric group, while it was 1.3 (range 1 to 7) and 1.4 days (range 1 to 6) for the control groups, respectively. A significant statistical difference was found in terms of hospital stay between the geriatric and the middle-aged group ( $p = 0.011$ ) as well as between the geriatric and the younger control group ( $p = 0.010$ ).

There was no statistical difference between the age groups in the case of postoperative serum calcium ( $p = 0.107$ ) and PTH levels ( $p = 0.756$ ).

In the TT groups, the number of postoperative complications showed a statistically significant difference between the age groups (Table 3) in terms of neck swelling (10.3%,

4.7%, 2.3%, respectively;  $p = 0.001$ ), drainage output (6.1%, 2.3%, 0.5%, respectively;  $p = 0.002$ ), while nonsurgical complications (1.9%, 0%, 0%, respectively;  $p = 0.036$ ) occurred more frequently in the geriatric group. Four geriatric patients had nonsurgical complications which prolonged the hospital stay (hypertensive crisis in three patients and exacerbation of chronic obstructive pulmonary disease in one patient). Neck swelling implied subcutaneous seroma or hematoma, which did not require reoperation. In two patients within the middle-aged control group (45–64 years), postoperative bleeding required surgical revision of hemostasis.

For overall 642 patients combined, complications appeared more frequently in patients with thyroid carcinoma (Table 4) ( $p = 0.001$ ). We also found that complications, in general, occurred less frequently as the team acquired more understanding of this surgical concept (Table 5) ( $p < 0.001$ ).

The model contains five predictors for potential complications, listed in Table 6, which were compared for 642 respondents (of which 164 had an outcome of interest). The whole model (with all predictors) was statistically significant ( $p < 0.001$ ). There is no significant multicollinearity between predictors.

Table 3

Type of complication in relation to age for total thyroidectomy groups

Type of complication	Age			p-value
	65+	45–64	20–44	
Neck swelling	22 (10.3)	10 (4.7)	5 (2.3)	0.001
Drainage output > 100 mL/24 hrs	13 (6.1)	5 (2.3)	1 (0.5)	0.002
Hypocalcaemia < 2.0 mmol/L	21 (9.8)	20 (9.3)	28 (13.1)	0.396
iPTH < 3 pg/mL	28 (13.1)	22 (10.3)	23 (10.7)	0.619
Unilateral vocal cord palsy	2 (0.9)	1 (0.5)	2 (0.9)	1.000
Bilateral vocal cord palsy	0 (0.0)	0 (0.0)	0 (0.0)	1.000
Bleeding into the operative wound requiring reoperation	0 (0.0)	2 (0.9)	0 (0.0)	1.000
Nonsurgical complications	4 (1.9)	0 (0.0)	0 (0.0)	0.036

iPTH – intact parathyroid hormone; 65+ – patients older than 65 years; 45–64 – middle-aged group of patients; 20–44 – younger group of patients. Results are presented as numbers (percentages) of patients.

Table 4

Pathohistological (PH) findings in relation to complications

PH finding	With complications	Without complications	Total
Benign goiter	106 (23.9)	337 (76.1)	443 (100)
Chronic thyroiditis	15 (21.4)	55 (78.6)	70 (100)
Graves' disease	5 (12.8)	34 (87.2)	39 (100)
Thyroid carcinoma	38 (42.2)	52 (57.8)	90 (100)
Total	164 (25.5)	478 (74.5)	642 (100)

Results are presented as numbers (percentages) of patients.

Table 5

Year of operation in relation to complication rates

Year of operation	With complications	Without complications	Total
2012	48 (41.1)	69 (58.9)	117 (100)
2013	25 (39.7)	38 (60.3)	63 (100)
2014	19 (19.2)	80 (80.8)	99 (100)
2015	27 (34.6)	51 (65.4)	78 (100)
2016	12 (13.8)	75 (86.2)	87 (100)
2017	24 (20.5)	93 (79.5)	117 (100)
2018	9 (11.1)	72 (88.9)	81 (100)
Total	164 (25.5)	478 (74.5)	642 (100)

Results are presented as numbers (percentages) of patients.

**Table 6****Multivariate logistic regression of complication occurrence as a dependent variable**

Independent variable	RC	<i>p</i> -value	OR (95%CI)
Age categories	-0.325	<b>0.012</b>	0.72 (0.56–0.93)
Gender	0.646	0.054	1.91 (0.99–3.67)
Year of operation	-0.247	< <b>0.001</b>	0.78 (0.71–0.86)
Patohistological finding			
Benign goiter	-0.700	<b>0.005</b>	0.50 (0.31–0.82)
Chronic thyroiditis	-0.871	<b>0.020</b>	0.42 (0.20–0.87)
Graves' disease	-0.828	0.131	0.44 (0.15–1.28)
Thyroid carcinoma			reference category
ASA	0.328	0.171	1.39 (0.87–2.22)

ASA – American Society of Anaesthesiologists; RC – regression coefficient; OR – odds ratio; CI – confidence interval.

**Bolded values are statistically significant.**

**Table 7****Ordinal logistic regression of the number of hospitalization days as a dependent variable**

Independent variable	Ordinal logistic regression			
	univariate		multivariate	
	OR (95%CI)	<i>p</i> -value	OR (95%CI)	<i>p</i> -value
Age categories	0.70 (0.56–0.89)	<b>0.003</b>	0.77 (0.59–1.01)	0.060
Gender	0.73 (0.39–1.37)	0.329		
Year of operation	0.77 (0.70–0.85)	< <b>0.001</b>	0.77 (0.70–0.85)	< <b>0.001</b>
Patohistological finding				
Benign goiter	0.48 (0.30–0.78)	<b>0.003</b>	0.58 (0.35–0.95)	<b>0.031</b>
Chronic thyroiditis	0.30 (0.14–0.67)	<b>0.003</b>	0.37 (0.16–0.83)	<b>0.016</b>
Graves' disease	0.22 (0.07–0.66)	<b>0.007</b>	0.50 (0.16–1.58)	0.239
Thyroid carcinoma			reference category	reference category
ASA	1.48 (0.97–2.25)	0.068	1.54 (0.94–2.52)	0.087

ASA – American Society of Anaesthesiologists; OR – odds ratio; CI – confidence interval.

**Bolded values are statistically significant.**

In the multiple logistic regression model, the following are statistically significant predictors of complications: older patients ( $p=0.012$ ) with the odds ratio (OR) of = 0.72, which shows that patients in the younger age category have a 28% lower chance for the occurrence of complications, with control of all other factors in the model; earlier year of operation ( $p < 0.001$ ), with OR = 0.78, which shows that respondents with each subsequent year of operation have a 22% lower chance of complications, with control of all other factors in the model; histopathological finding of benign goiter ( $p = 0.003$ ), with OR = 0.50, which shows that patients with benign goiter have a 50% lower chance of complications; chronic thyroiditis ( $p = 0.020$ ), with OR = 0.42, which shows that subjects with chronic thyroiditis have a 58% lower chance of developing complications, both compared to thyroid carcinoma as a reference category.

The multivariate ordinal logistic regression model includes those predictors of hospital length that were statistically significant in the univariate logistic regression models at a significance level of 0.1 and which, based on previous research, are considered significant for hospitalization length (Table 7). Due to multicollinearity, the complication variable was not included in the models.

In the multivariate ordinal logistic regression model with the number of days of hospitalization as a dependent variable, statistically significant predictors of longer hospitalization

are earlier years of operation ( $p < 0.001$ ) and histopathological finding, where benign goiter ( $p = 0.031$ ) and chronic thyroiditis ( $p = 0.016$ ) have a significantly lower chance of longer hospitalization compared to thyroid carcinoma as a reference category.

### Discussion

The main obstacle for short-stay thyroid surgery is the possibility of postoperative bleeding in the thyroid lodge and in the closed paratracheal space with consequent compression on the cervical trachea, which can lead to asphyxia. In about 50 to 75% of cases, this complication occurs in the first six to eight hours after surgery<sup>12</sup>, even though there are cases described in which this complication occurred several days after thyroidectomy<sup>12–15</sup>. In our study, this complication occurred in two patients of the middle-aged group with TT, where one of these patients needed a reoperation two days after surgery (the bleeding site was the anterior jugular vein). In general, in about 80 to 97% of patients, postoperative bleeding occurs in the first 24 hrs after surgery<sup>13, 15–19</sup>. Godballe et al.<sup>18</sup> claimed that the relative risk of bleeding in patients aged 50 and over is 1.5 times higher than in those younger than 50. Bergenfelz et al.<sup>20</sup> showed in their work that the group of patients with postoperative bleeding had an average age of 60 years, which, compared to the average age

of 48 years of the group of patients without postoperative bleeding, proved to be statistically significant. Patients on anticoagulant or antiplatelet therapy (which appears more often in the elderly) tend to have late postoperative bleeding, according to a larger number of authors<sup>21–23</sup>.

Another limiting factor for the implementation of a short-stay surgery approach in thyroid surgery is hypocalcemia, which occurs in 5% to 35% of cases and is usually clinically manifested 12 to 72 hrs after surgery<sup>24–26</sup>; fortunately, in the majority of cases, it is temporary. Hypocalcemia 24 hrs after TT operation occurred in all three age groups, with similar percentages and no statistically significant difference. Given this fact, hypocalcemia is the most common complication after TT, which was the case in our series as well (10.8%). Postoperative hypocalcemia, as a complication after HT, does not occur since there are always parathyroid glands on the contralateral side of the thyroid gland, whose function is not compromised by surgery.

In order to predict which patient will develop hypocalcemia after TT, for the timely initiation of replacement therapy with calcium and vitamin D preparations, as well as discharge from the ward, we decided to determine early postoperative PTH as a predictor of hypocalcemia. In our study, early postoperative PTH values lower than 3 pg/mL appeared in 11.4% of patients after TT, with no significant difference between the age groups. In a multicenter study, Noordzij et al.<sup>27</sup> concluded that postoperative PTH with values lower than 10 pg/mL predicted hypocalcemia. In the case of normal values of postoperative PTH, the probability of severe hypocalcemia is minimal, which can accelerate the discharge of these patients from the ward.

The rarest complication after thyroid surgery, which could be a limiting factor for a short stay, is bilateral paralysis of the vocal cords, with a frequency of about 0.2% to 0.6%<sup>20, 28</sup>. This complication is potentially life-threatening and is obvious immediately after the operation; it requires an adequate assessment of airway patency and airway sufficiency and, quite often, placement of a temporary tracheostomy. Fortunately, we had no case of bilateral paralysis of the vocal cords in our study. The most common cause of poor vocal cord mobility after thyroidectomy is recurrent nerve neurapraxia, which in most cases is a temporary complication with complete recovery expected after a few weeks. However, the frequency of permanent recurrent nerve injury should not exceed 1%<sup>29</sup>. We had no case of recurrent nerve injury in the HT groups, while in the TT groups, we had no significant difference between the age groups in unilateral paralysis of the vocal cords, with an overall rate of 0.78%. Unilateral injury to the recurrent

nerve results in hoarseness of the voice, which does not require an extended hospital stay.

While the average hospital stays for all HT groups in our study was one day with no significant complications in all patients, the oldest TT age group showed a statistically significant longer hospital stay in comparison to the younger age groups as a result of a higher rate of surgical and nonsurgical complications. Schwartz et al.<sup>30</sup> and Tartaglia et al.<sup>31</sup> showed in their works that complications occur more often in the elderly, while Canonico et al.<sup>6</sup> and Seybt et al.<sup>32</sup> claim that there is no significant difference between the age groups. In the study of Gervasi et al.<sup>2</sup>, age over 70 is an independent factor for complications after each surgical procedure under general anesthesia. Mekel et al.<sup>33</sup> claim that postoperative complications increase significantly with the patient's age, from 9% in the control group (mean age 50.1 years) to over 24% in octogenarians.

According to our first logistic regression model, statistically significant predictors of complications, except age, are pathohistological findings and the surgeon's experience. In numerous studies, it is stated that a higher percentage of complications is associated with a higher percentage of thyroid malignancy in the elderly<sup>34–37</sup>, which corresponds to the results of our study. This fact we also confirmed in our second multivariate ordinal logistic regression model with the number of days of hospitalization as a dependent variable, where thyroid malignancy manifested as a significant predictor of longer hospital stay.

The admission of patients for thyroidectomy into the short-stay surgery protocol should be kept for experienced endocrine surgeons and teams, i.e., those who operate on more than 100 thyroidectomies per year<sup>38, 39</sup>. In our study, all operations were performed by one surgeon and their team, and the complication rate was lower as more experience was gained each year. This fact we also confirmed in our second multivariate ordinal logistic regression model with the number of days of hospitalization as a dependent variable, where an earlier year of operation showed as a significant predictor of longer hospital stay.

## Conclusion

According to our study, TT can be safely performed within the concept of a short hospital stay in patients under 65, while in the elderly, hospitalization days may be extended due to more frequent surgical and nonsurgical complications. On the other hand, HT is safe for all age groups. Short-stay thyroid surgery, especially for geriatric patients, should be carried out by endocrine surgeons with experience with this kind of surgical setting in order to lower the length of hospitalization.

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