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RESULTS THE USE OF VARIOUS SURGICAL METHODS FOR THE TREATMENT OF PATIENTS WITH DIFFUSE TOXIC GOITER

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Abstract

This article discusses the problems of surgical tactics in diffuse - toxic goiter and its complications, both in the early postoperative period and in the long term. The above complications require surgeons to search for the most optimal method of surgical treatment.

Aim: Evaluation of immediate, long-term results and hormonal status with various methods of surgical treatment of diffuse-toxic goiter.

Materials and research methods. The article presents the experience of treating 149 patients. The analysis of immediate and long-term results of surgical interventions in relation to thyroid status is given. In 90 patients, subtotal resection of the thyroid gland was performed, in 31 - thyroidectomy, in 28 cases - embolization of the thyroid artery. Thyroid status was analyzed 1, 6, 12, 24 months after surgery. The patients were divided into subgroups depending on the initial volume of the thyroid gland (less than 45 cm³ and more than 45 cm³). Statistical analysis of numerical series was carried out using the Mann-Whitney method, relative values - using Fisher's two-sided exact test.

Research results. A moderate number of postoperative complications was revealed, with a predominance of extirpation of the gland in the group and no extirpation in patients undergoing arterial embolization.

On the contrary, a higher incidence of recurrence of the hyperthyroid state was characteristic for the latter group, where it was 28.6% over a follow-up period of 24 months. With subtotal resection, the corresponding indicator was 14.4%; after extirpation, no cases of relapse were observed. Extirpation led to the development of total hypothyroidism in all patients, in other groups this condition was observed in about half of the cases.

An excess of the initial gland volume of 45 cm³ was characterized by a sharp increase in the incidence of postoperative hypothyroidism.

Conclusions: The use of different approaches to the surgical treatment of diffuse-toxic goiter gives differences in the frequency of perioperative complications (excess during extirpation of the thyroid gland) and late complications. Among the late complications, hypothyroidism dominates, which is subject to compensation with the help of substitution therapy.

The frequency of recurrence of thyrotoxicosis has a double dependence on the approach to treatment and the initial volume of the thyroid gland. In order to prevent relapse for surgical treatment of DTG with a gland volume of more than 45 cm³, the most rational is extirpation.

Key words: Diffuse toxic goiter; thyroidectomy; resection of the thyroid gland; embolization; relapse.

Резюме

РЕЗУЛЬТАТЫ ПРИМЕНЕНИЯ РАЗЛИЧНЫХ ХИРУРГИЧЕСКИХ МЕТОДОВ ЛЕЧЕНИЯ БОЛЬНЫХ С ДИФФУЗНО-ТОКСИЧЕСКИМ ЗОБОМ

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В данной статье рассматривается проблемы хирургической тактики при диффузно - токсическом зобе и ее осложнениях, как в раннем послеоперационном периоде, так и в отдаленном периоде. Вышеуказанные осложнения требуют от хирургов поиска наиболее оптимального метода хирургического лечения.

Цель работы: Оценка непосредственных, отдаленных результатов и гормонального статуса при различных методах хирургического лечения диффузно-токсического зоба.

Материалы и методы исследования: В статье представлен опыт лечения 149 пациентов. Дан анализ непосредственных и отдаленных результатов хирургических вмешательств в отношении тиреоидного статуса. У 90 больных проведена субтотальная резекция щитовидной железы, у 31 – тироедэктомия, в 28 случаях – эмболизация артерии щитовидной железы. Тиреоидный статус анализировался через 1, 6, 12, 24 месяца после операции.

Пациенты были распределены на подгруппы в зависимости от исходного объема щитовидной железы (менее 45 см³ и более 45 см³). Статистический анализ числовых рядов проведен по методу Манна-Уитни, относительных значений – с применением двустороннего точного критерия Фишера.

Результаты исследования. Выявлено умеренное число послеоперационных осложнений с преобладанием в группе экстирпации железы и отсутствием у пациентов, подвергавшихся эмболизации артерии.

Напротив, более высокая частота развития рецидива гипертиреозного состояния была характерна для последней группы, где она составила 28,6% за период наблюдения 24 месяца. При субтотальной резекции соответствующий показатель составил 14,4%, после экстирпации случаев рецидива не наблюдалось. Экстирпация привела к развитию тотального гипотиреоза у всех пациентов, в остальных группах это состояние наблюдалось примерно в половине случаев.

Превышение исходного объема железы 45 см³ характеризовалось резким ростом частоты развития послеоперационного гипотиреоза.

Выводы: Применение различных подходов к оперативному лечению диффузно-токсического зоба дает отличия в частоте периоперационных осложнений (превышение при экстирпации щитовидной железы) и поздних осложнений. Среди поздних осложнений доминирует гипотиреоз, подлежащий компенсации с помощью заместительной терапии.

Частота рецидивов тиреотоксикоза имеет двойную зависимость от подхода к лечению и исходного объема щитовидной железы. С целью предотвращения рецидива для оперативного лечения ДТЗ при объеме железы более 45 см³ наиболее рациональной является экстирпация.

Ключевые слова: Диффузно-токсический зоб; тиреоидэктомия; резекция щитовидной железы; эмболизация; рецидив.

Түйіндеме

ДИФФУЗДЫ-УТОКСИКАЛЫҚ ЖЕМСАУЫ БАР НАУҚАСТАРДЫҢ ӘРТҮРЛІ ХИРУРГИЯЛЫҚ ЕМДЕУДІҢ ӘДІСТЕРІН ҚОЛДАНУ НӘТИЖЕЛЕРІ

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Бұл мақалада диффузды - токсикалық зоб кезіндегі хирургиялық тактиканың мәселелері және оның операциядан кейінгі ерте кезеңдегі және ұзақ мерзімді асқынулары туралы айтылады. Жоғарыда аталған асқынулар хирургтардан хирургиялық емдеудің оңтайлы әдісін іздеуді талап етеді.

Жұмыстың мақсаты: Диффузиялық-токсикалық зобты хирургиялық емдеудің әртүрлі әдістерімен жедел, ұзақ мерзімді нәтижелерді және гормоналды статусты бағалау.

Зерттеу материалдар және әдістері. Мақалада 149 науқасты емдеу тәжірибесі көрсетілген. Қалқанша безінің статусына байланысты хирургиялық араласудың жедел және ұзақ мерзімді нәтижелерін талдау берілген. 90 науқасқа қалқанша безінің субтотальды резекциясы, 31-де - тиреоидэктомия, 28 жағдайда - қалқанша артерия эмболизациясы жасалды. Қалқанша безінің гормоны операциядан 1, 6, 12, 24 ай өткен соң талданды. Қалқанша безінің бастапқы көлеміне байланысты науқастар кіші топтарға бөлінді (45 см³ аз және 45 см³ артық). Сандық қатарлардың статистикалық талдауы Манн-Уитни әдісі бойынша, салыстырмалы мәндер - Фишердің екі жақты дәл тесті арқылы жүргізілді.

Зерттеу нәтижелері. Операциядан кейінгі асқынулардың орташа саны анықталды, топта без экстирпациясы басым болды және артерия эмболизациясына ұшыраған науқастарда экстирпация болмайды.

Керісінше, гипертиреоздық жағдайдың қайталануының жиілігі соңғы топқа тән болды, мұнда ол 24 айлық бақылау кезеңінде 28,6% құрады. Субтотальды резекция кезінде тиісті көрсеткіш 14,4% құрады, экстирпациядан кейін рецидив жағдайлары байқалмады. Экстирпация барлық науқастарда жалпы гипотиреоздың дамуына әкелді, басқа топтарда бұл жағдай жағдайлардың жартысында байқалды.

Бездің бастапқы көлемінің 45 см³ артық болуы операциядан кейінгі гипотиреоз ауруының күрт өсуімен сипатталды.

Қорытынды: Диффузиялық-токсикалық зобты хирургиялық емдеудің әртүрлі тәсілдерін қолдану периоперациялық асқынулардың (қалқанша безінің экстирпациясы кезіндегі артық) және кеш асқынулардың айырмашылықтарын береді. Кеш асқынулардың ішінде гипотиреоз басым, ол ауыстыру терапиясымен өтелуге жатады.

Тиреотоксикоздың қайталану жиілігі емдеу тәсіліне және Қалқанша безінің бастапқы көлеміне екі есе тәуелді болады. ДТЖ безінің көлемі 45 см³-ден жоғары хирургиялық емдеу кезінде рецидивтің алдын алу үшін ең ұтымдысы - экстирпация.

Түйінді сөздер: Диффузды-токсикалық зоб; тиреоидэктомия; қалқанша безінің резекциясы; эмболизация; рецидив.

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Introduction

Diffuse toxic goiter (DTG) is one of the most common diseases of the endocrine system. The frequency of new cases of DTG varies from 30 (0.03%) to 200 (0.2%) per 100 thousand population per year. In regions with normal iodine supply, DTG is the most common cause of persistent thyrotoxic conditions, and in iodine-deficient regions in the etiological structure of toxic goiter, DTG competes with the functional autonomy of the thyroid gland (TG). DTG, the most common cause of hyperthyroidism [1,3], is an autoimmune disease in which autoantibodies targeting thyroid stimulating hormone (TSH) receptors stimulate receptors, resulting in an excessive increase in thyroid hormone [2].

The disease is characterized by hyperthyroidism and, in some cases, ophthalmopathy. There are currently three established treatments for this disease: surgery, radioactive iodine, and antithyroid drugs. However, all three of these treatments have some limitations and disadvantages. Medicines consisting of antithyroid drugs for 12–18 months have a serious drawback in the high relapse rate from 20% to 75% [4,5]. The use of radioactive iodine is associated with a delayed onset and a high cumulative incidence of hypothyroidism over 10 years, exceeding 70% [6]. Although surgery offers the advantage of rapid control of hyperthyroidism and has an extremely low morbidity in experienced hands, it can be complicated by re-injury of the laryngeal nerve or persistent hypoparathyroidism after nearly total thyroidectomy [7-9]. Most surgeons adhere to the tactics of performing a subtotal resection of the thyroid gland. Abroad, on the contrary, most authors advocate thyroidectomy [10]. Currently, this issue remains relevant and debatable. Postoperative hypothyroidism is observed in 10-80% of cases, which is regarded as a natural outcome of surgical treatment. Recurrence of thyrotoxicosis occurs in 10-15%.

According to most researchers, the thyroid status of operated patients depends on the functional activity of the thyroid gland, the autoimmune process and the volume of the thyroid residue after resection [11,12]. Insufficient attention has been paid to the study of the relationship between morphological changes occurring in the thyroid tissue in patients with DTG, the duration of thyrostatic therapy, the age of the patients, and the volume of the thyroid residue.

According to S.N. Styazhkina, A.V. Ledneva, E.I. Poryvaev in 2019, a retrospective analysis of 70 case histories of operated patients with diffuse toxic goiter for the

period from 2008 to 2014 was carried out. The percentage of patients with postoperative hypothyroidism: varying degrees of severity ranged from 5% to 66%. relapses of DTG are not noted. The authors note that their patients presented the following complaints: weight gain, chilliness of the limbs, interruptions in the work of the heart, edema, drowsiness, lethargy, impaired appetite, pallor of the skin, brittle nails, hair loss, joint pain. As a result of the thyroidectomy, all patients developed hypothyroidism, which required constant hormone replacement therapy with L-thyroxine preparations. In the case of constant intake of drugs, individually selected dosage, the quality of life did not suffer.

According to N.A. Maistrenko, P.N. Romashchenko, D.S. Krivolapov, A.P. Prishvin, G.V. Mikhilchenko in thyroid gland (TG) surgery, minimally invasive interventions using endoscopic and robotic technologies are widely used. The prerequisites for their use are due to an increase in the number of patients with surgical pathology of the thyroid gland, improvement of diagnostic capabilities and early detection of malignant neoplasms, the development of endovideosurgical technologies and the development of criteria for choosing minimally invasive interventions, the desire to improve the quality of life of patients, and to accelerate their labor and social rehabilitation. They operated on 155 patients with surgical thyroid diseases using various minimally invasive techniques. The examination of patients was carried out in accordance with the clinical guidelines concerning not only the list of laboratory and instrumental examination, but also the interpretation of the results obtained according to the generally accepted classifications - TIRADS and Bethesda (Horvath E. et al., 2009; Kwak JY et al., 2011; Cibas ES et al., 2009). The selection criteria for patients corresponded to generally accepted ones and took into account the main factors: the size of the nodules, the volume of the thyroid gland. This technique of surgical treatment of DTG was used in 36 patients. The results of the study will allow a reasonable and differentiated approach to the selection of patients with surgical thyroid diseases for minimally invasive surgical interventions. Ensuring the methodical and safe performance of techniques with the obligatory use of intraoperative neuromonitoring and visualization of the parathyroid glands will help to reduce the incidence of specific complications, minimize surgical trauma and the length of stay of those operated on in the hospital, improve cosmetic results and the quality of life of patients. A detailed study of the condition of patients after subtotal resection of

the thyroid gland, performed for thyroid gland disease, will allow developing the optimal tactics of surgical treatment, correcting postoperative complications, and developing a set of measures for the prevention and treatment of dysfunctions of the thyroid residue. Due to the significant progress achieved in endovascular technologies in recent years, the therapy of diffuse-toxic goiter through embolization of the arteries of the thyroid gland has appeared [6].

The East Kazakhstan region is endemic in terms of iodine deficiency and thyroid gland diseases. Despite the measures taken to prevent it, the frequency of pathology of this organ remains higher than the national average. [7].

X-ray endovascular embolization of the thyroid arteries reduces the incidence of intraoperative complications by eliminating the flow of arterial blood to the thyroid gland with a subsequent decrease in its volume, which leads to a decrease in the trauma of the operation and intraoperative blood loss. This technique is especially relevant for large volumes of the gland, as well as for the retrosternal location of the goiter, in which there is a high likelihood of trauma to the lower thyroid artery. In addition, this approach is also used as an independent method of treatment, because allows you to reduce the production of thyroid hormones without surgery. [8,13,14].

Aim: Evaluation of immediate, long-term results and hormonal status with various methods of surgical treatment of diffuse-toxic goiter.

Materials and research methods

This study was designed as a prospective, controlled clinical study. The sample size was calculated using the PASS 2000 program, version 12.0.4.

General characteristics of the examined patients

In the surgical department of the University Hospital Non-profit Joint Stock Company «SMU» from 2013 to September 2020, 149 patients with diffuse toxic goiter were operated on, of which 19 were men and 130 women (ratio - 1: 7) aged 17 to 74 years (average age - 41.5 ± 2.6 years), the largest number of patients 86 (57.7%) fell on the age group 30-49 years.

Study inclusion criteria:

1. Patients with DTG from 18 to 60 years old.
2. Surgical treatment.
3. Patients who signed an informed consent for surgical treatment with the proposed method and the use of the obtained data in a scientific study.

Criteria for exclusion from the study:

1. Patients with DTG under 18 and over 60 years of age.
2. The presence of an acute condition (ACA, ACS), stage IV cancer patients, recurrence of chronic diseases.
3. Patients who refused the proposed method of treatment and participation in the study.

All patients were admitted for surgical intervention for DTG initially.

Patients, depending on the volume of the thyroid gland and the level of thyroid hormones, underwent the following surgical interventions: subtotal subfascial resection of the thyroid gland according to O.N. Nikolaev ($n = 90$), total thyroidectomy ($n = 31$), embolization of the thyroid artery ($n = 28$). In the long-term period, all patients included in the study were registered with an endocrinologist at the family

dispensary at their place of residence. Control studies of the content of thyroid hormones in the blood were carried out after 1, 6, 12, 24 months.

The diagnosis of DTG was made taking into account the history, the presence of a characteristic clinical picture and was confirmed by the data of hormonal blood tests. The patients had moderate thyrotoxicosis - 106 (71.1%) or severe - 43 (28.9%) degree. Goiter III degree according to the classification of O.V. Nikolaev was observed in 89 patients (59.7%), IV - in 51 (34.3%), V - in 9 (6.0%). Eye symptoms (Grefe, Kocher, Moebius, Rosenbach, Stelvag) were observed in 109 patients (73.2%); endocrine ophthalmopathy of varying severity was diagnosed in 72 patients (48.3%).

The duration of the disease before surgery varied from 3 months to 15 years (average 7.2 ± 0.6 years). In half of the patients, DTG was diagnosed more than 2 years before inclusion in the study. The duration of thyrostatic therapy ranged from several months to 10 years (on average 2.1 ± 0.4 years) and did not always coincide with the duration of the disease due to late initiation of treatment or interruptions between courses of conservative therapy. It should be noted that 42 patients (30.7%) took thyreostatics for more than 2 years.

The indication for surgical treatment in 101 patients (73.7%) was the ineffectiveness of conservative therapy. In 12 patients (8.8%) with grade IV-V goiter and in one patient with retrosternal goiter, surgical intervention was performed due to the development of compression of the neck organs. In 4 patients (2.9%), the ineffectiveness of thyreostatic therapy was combined with the presence of a large goiter, in 9 (6.6%) - with a relapse of the disease after surgical treatment. In 5 cases (3.6%) the indication for surgery was the need to quickly eliminate severe thyrotoxicosis, in 4 (2.9%) cases - contraindications to the use of thyrostatics, in 1 (0.7%) - the patient's categorical refusal from long-term conservative therapy.

A prerequisite for performing surgery to prevent the development of a thyrotoxic crisis was the achievement of the euthyroid state.

Subtotal resection of the thyroid gland (SRTG) was performed in 90 patients (60.4%), thyroidectomy for various indications was performed in 31 patients (20.8%), embolization of the thyroid artery in 28 patients (18.8%).

Biochemical and hormonal studies.

The hormonal status was determined in all patients, thyroid hormones were examined before admission, after surgery and after 1,3,6 months. For the reference value were taken: TSH - 0.4-4.0 mIU / ml; free T4 - 9-19.1 pmol / l; free T3 - 2.63-5.7 pmol / l; Antibodies to rTTG - 0-1.75 IU / L; Antibodies to TPO - 0-35 U / ml.

Instrumental research methods

Assessment of the size and echographic characteristics of the thyroid gland in patients before the operation and in the postoperative period was carried out in the department of functional diagnostics of the University Hospital Non-profit Joint Stock Company «SMU» on the "LOGIQ 3 expert" apparatus with a linear transducer with a frequency of 8-10 MHz. Based on the ultrasound data, the volume of the thyroid gland was calculated, blood flow and the presence of nodules were assessed. The total thyroid volume was calculated by multiplying the length, thickness,

width of each lobe, the result was multiplied by a factor of 0.479 (WHO recommendations, 1994). The normal values were taken for the thyroid volume in women up to 18 cm³, and in men - up to 25 cm³.

Statistical analysis

Intergroup comparison of quantitative trait values was performed using the Mann-Whitney U-test. Comparison of frequency indicators in independent samples was carried out using Fisher's exact test [15]. Differences were considered statistically significant at p <0.05.

Results

The initial parameters of the thyroid gland were analyzed taking into account the previous operations: subtotal subfascial resection of the thyroid gland according to O.N. Nikolaev (n = 90), total thyroidectomy (n = 31), embolization of the thyroid artery (n = 28), which are shown in Table 1.

Table 1 summarizes the data on the baseline indicators of the morphofunctional state of the thyroid gland.

Table 1.

Baseline clinical, instrumental and biochemical indicators depending on the type of surgery.

Indicator	Subtotal resection of the thyroid gland (n = 90)	Extirpation of the thyroid gland (n = 31)	Thyroid artery embolization (n = 28)	P
Average age at the time of surgery, years	46,9±1,33	50,2±1,9	42,3±1,9	0,152
Duration of the disease, months	69,7±7,2	66,1±10,0	62,7±4,2	0,687
Initial mean volume of the thyroid gland, ml ³	43,4±3,2	48,6±7,1	47,5±3,1	0,579
TSH mIU	1,99±0,63	1,18±0,27	1,54±0,23	0,836
free.T ₄ , pmol / l	34,46±1,63	40,18±3,50	37,81±5,40	0,224
free.T ₃ , pmol / l	5,32±0,51	6,17±1,94	6,43±0,48	0,111
Antibodies to TPO	468,2	207,3	356,7	0,107
Antibodies to rTTG	38,18	16,79	17,25	0,037
Ophthalmopathy, %	29,7	48,6	32,4%	0,042

Table 1 shows that significant differences were revealed only in the values of one indicator, namely, in the content of antibodies to rTTG in the group of patients who underwent subtotal resection of the thyroid gland over the other groups. In clinical terms, these differences could be of interest in relation to the continuation of conservative

treatment, but did not have a significant value in the case of surgery.

Depending on the surgical treatment performed in patients with DTG in the early postoperative period, the following complications developed, which are presented in Table 2.

Table 2.

Frequency and structure of complications of the perioperative period in patients with DTG.

Complication	Group					
	STR TG, n=90		extirpation of the TG, n=31		Thyroid artery embolization, n=28	
	abs.	%	abs.	%	abs.	%
Intraoperative bleeding	67	74,4	25	80,6	-	-
Postoperative bleeding	6	6,7	2	6,5	-	-
Vocal cord paresis	2	2,2	2	6,5	-	-
Thyrotoxic crisis	3	3,3	0	0,0	-	-

During the operation, patients who underwent subtotal, subfascial resection of the thyroid gland and thyroidectomy in 92 cases (76.0%) were accompanied by bleeding during the operation.

In the early postoperative period, the following complications were revealed in patients undergoing subfascial, subtotal resection of the thyroid gland or thyroidectomy: paresis of the vocal cords in 4 (3.3%) patients, bleeding in 8 (6.6%) patients, thyrotoxic crisis in 3 (2.5%).

Together with an endocrinologist, an anesthesiologist-resuscitator, an ENT doctor, these complications were arrested. There were no lethal outcomes.

In the long-term period, all patients included in the study were registered with an endocrinologist at the family dispensary at their place of residence. Control studies of the content of thyroid hormones in the blood were carried out after 1, 6, 12, 24 months. The frequency of detecting thyroid status disorders at the indicated time, depending on the group of examined patients, is presented in table 3.

Table 3.

Distribution of patients depending on the thyroid status in the dynamics of prospective follow-up.

Group	Thyroid status	Examination period							
		1 month		6 month		12 month		24 month	
		number of patients	%						
Subtotal resection of the thyroid gland, n=90	hypothyroidism	34	37,8	46	51,1	36	40,0	37	41,1
	euthyroidism	56	62,2	42	46,7	49	54,4	45	50,0
	hyperthyroidism	0	0,0	2	2,2	5	5,6	8	8,9
Extirpation of the thyroid gland	hypothyroidism	24	77,4	31	100	30	96,8	30	96,8
	euthyroidism	7	22,6	0	0,0	1	3,2	1	3,2
	hyperthyroidism	0	0,0	0	0,0	0	0,0	0	0,0
Thyroid artery embolization, n=28	hypothyroidism	8	28,6	10	35,7	10	35,7	12	42,9
	euthyroidism	18	64,3	14	50,0	15	53,6	11	39,3
	hyperthyroidism	2	7,1	4	14,3	3	10,7	5	17,9

Note - over the period of 6-24 months, 7 repeated surgical interventions were performed for recurrent thyrotoxicosis, thus, the total number of relapse cases reached 21

The incidence of thyroid disorders in the examined patients depended on the type of surgery performed and the follow-up period, and it increased moderately and insignificantly in the relatively long term.

Discussion

The main approach used in clinical practice - subtotal resection of the gland - in the early and more distant follow-up periods was more associated with the development of hypothyroidism, the frequency of which increased from 37.8% 1 month after the intervention to 41.1% - 2 years later. ... In addition, by the end of the prospective observation period, 13 cases of recurrence of thyrotoxicosis (14.4%) associated with repeated hyperplasia of preserved glandular tissue or with recurrence of the disease in the retrosternal localization (1 case) were detected. Of these, during the follow-up period, repeated surgery, which led to the suppression of hyperproduction of thyroid hormones, was performed in 5 cases.

Extirpation of the thyroid gland was not associated with the presence of recurrence in any case. But almost all

patients had total hypothyroidism, compensated by the intake of thyroid hormones.

A high recurrence rate was observed during gland artery embolization. In total, 8 out of 28 (28.6%) were identified during the observation period. Three patients were reoperated within 24 months from the initial intervention. The incidence of hypothyroidism in this group at different periods of observation was minimal among the compared approaches.

In general, the number of relapses reached 21 (14.1%). We analyzed the influence of the preoperative status and the type of surgical intervention on the development of this complication.

When assessing the volume of the thyroid gland, we identified patients in whom this indicator before surgery was 45 cm³ or less and patients with a thyroid volume of more than 45 cm³. The volume of 45 cm³ was chosen as a dividing one, based on the fact that it turned out to be a whole value closest to the average indicator (44.8 cm³) for all examined patients (Table 4).

Table 4.

Influence of preoperative thyroid volume on the outcomes of subtotal resection.

Functional outcome of the intervention	Volume of the thyroid gland ≤45cm ³ , n=48		Volume of the thyroid gland >45 cm ³ , n=42	
	abs.	%	abs.	%
Hypothyroidism, n=37	22	45,8	15	35,7
Euthyroidism, n=40	23	47,9	17	40,5
Recurrence of thyrotoxicosis, n = 13	3	6,3	10	23,8*

Note: * - differences are of statistical significance

The analysis revealed that among patients with recurrent thyrotoxicosis in this group (n = 13) 76.9% of patients had a gland volume of more than 45 cm³, in the

remaining 23.1% the volume of the gland did not exceed 45 cm³ (p = 0.020). Table 5 shows the results of a similar analysis for thyroid artery embolization.

Table 5.

Influence of preoperative thyroid volume on the outcomes of subtotal resection.

Functional outcome of the intervention	Volume of the thyroid gland ≤45cm ³ , n=16		Volume of the thyroid gland >45 cm ³ , n=12	
	abs.	%	abs.	%
Hypothyroidism, n=10	7	41,7	3	25,0
Euthyroidism, n=10	7	41,7	3	25,0
Recurrence of thyrotoxicosis, n=8	2	12,5	6	50,0*

Note: * - differences are of statistical significance

The preoperative volume of the thyroid gland also influenced the frequency of recurrence of thyrotoxicosis during embolization of the thyroid artery. With a large volume, the relative recurrence rate exceeded the compared group by 4 times ($p = 0.040$).

Therefore, we carried out a comparative assessment of the risks of long-term complications depending on the initial gland volume and intervention options (Figure 1).

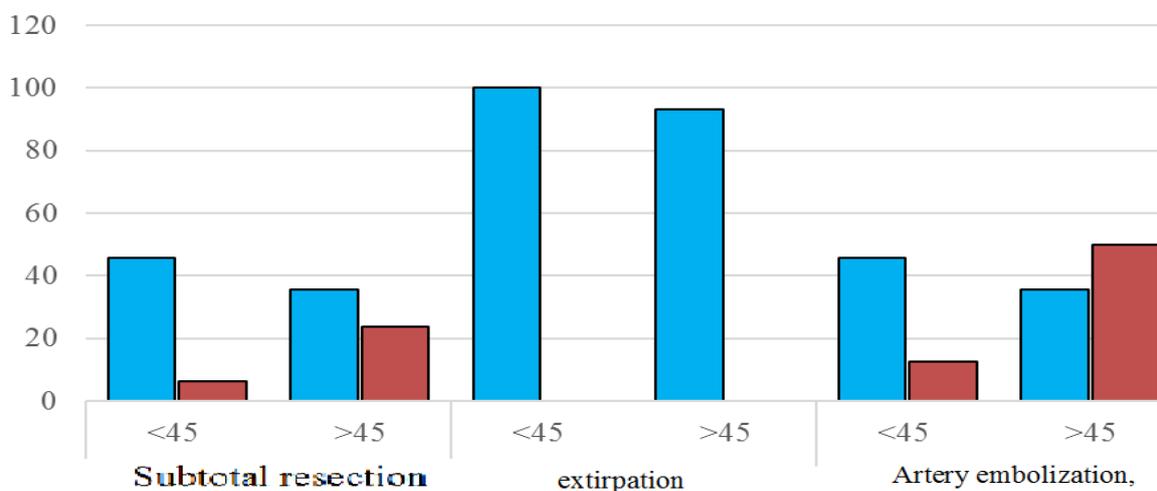


Figure 1. Risks of long-term complications during various methods of surgical treatment of diffusely toxic goiter.

During extirpation of the gland, the only risk associated with the functional activity of the organ is the development of total hypothyroidism, and it turns out to be almost absolute. In the other two groups, there is a significant excess of the risk of recurrence of thyrotoxicosis with an initially larger volume of the gland. Moreover, for artery embolization, it exceeds the index of the subtotal resection group by more than two times.

Achieving the best functional results in the surgical treatment of any disease is one of the main tasks.

Surgical treatment of patients with diffuse-toxic goiter is the main direction in this pathology. At the present stage, adequate methods of preoperative diagnostics and surgical interventions have been developed, which make it possible to visualize all thyroid tissues and ensure high safety of the intervention. However, there are literature data on the significant frequency of early and late complications in the surgical treatment of DTG [16]. One of the reasons may be the wrong choice of approach to cytoreduction, which does not sufficiently take into account the characteristics of the organ and its pathology [17].

There are also different approaches to assessing the results of treatment. A number of authors believe that a chronic hypothyroid state is quite adequate, since it determines at least a sufficient level of cytoreduction and is easily compensated for through replacement therapy [18, 19]. However, in other works, this condition is considered as the most frequent complication [20].

On the contrary, the attitude towards the development of hyperthyroidism in the period after the intervention is unequivocal. This is a complication that often requires repeated surgery [21].

Our work is devoted to a comparative assessment of the effectiveness of surgical treatment of diffuse toxic goiter using three options of intervention - subtotal resection of the gland, extirpation or embolization of the artery.

Each of these methods has its own supporters, for each it is indicated the presence of advantages and

disadvantages. Artery embolization is characterized by minimal invasiveness, however, due to the peculiarities of the arterial bed and the presence of collateral circulation, it may not be as effective as direct cytoreduction [22,23].

Subtotal resection is associated with a lower operational risk and presupposes the preservation of part of the gland tissue, having hormone-producing activity. There is an opinion that this approach is more adequate in terms of maintaining an adequate biological status of the gland, which cannot be fully compensated by the intake of thyroid hormones inside [24].

Extirpation of the thyroid gland is the most radical operation, but it also poses the greatest risk of intraoperative complications and requires lifelong thyroid hormone replacement therapy.

The study identified the features of the results and risks depending on the initial volume of the gland. A sharp increase in the frequency of the main long-term complication - hyperthyroidism - in artery embolization was revealed, but the degree of its dependence on the initial volume of the gland was also the highest.

Conclusion

The use of various approaches to the surgical treatment of diffuse-toxic goiter gives differences in the frequency of perioperative complications (excess during extirpation of the thyroid gland) and late complications. Among late complications, hypothyroidism dominates, subject to compensation with using substitution therapy in our case.

The frequency of recurrence of thyrotoxicosis has a double dependence on the approach to treatment and the initial volume of the thyroid gland. In order to prevent relapse, extirpation is the most rational for the surgical treatment of DTG when the volume of the gland is more than 45 cm³

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