

# The Significance of Local Intraoperative Hemostasis and Laser Influence in the Prevention and Treatment of Complications During Thyroid Surgery

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**Summary:** The article presents the results of clinical studies on the development of a method for local intraoperative hemostasis and improvement of reparative processes during operations on the thyroid gland. For clinical evaluation of the effectiveness of the proposed method, two study groups were formed for 237 patients with mixed, nodular and diffuse toxic goiter. The main group consisted of 98 patients, and the comparison group - 139. In the main group of operated patients, hemostasis was carried out according to the method developed by us, and in the comparison group, by traditional methods. Surgery included thyroidectomy, hemithyroidectomy, and subtotal thyroidectomy. In the main group of patients, for the purpose of hemostasis, Hemoben powder crystals with a size of 25-50 microns were used at the rate of 200 mg per area of 8-9 cm<sup>2</sup>, which was applied over the wound with a thin layer until a thin translucent film was formed, followed by irradiation of the wound with low-energy laser radiation (Sogdiana apparatus) with a wavelength of 0.89 microns, a frequency of 500 Hz for 2 minutes at a distance of 5 cm from the wound; then, for 5-7 days, percutaneous irradiation sessions with the same laser at a frequency of 80 Hz were performed daily in the projection of the surgical wound. The study showed that the use of the domestic hemostatic agent Hemoben provides complete hemostasis, and the addition of the technique by treating the surgical field with low-intensity laser radiation enhances the reparative properties of the drug. The proposed method for local hemostasis and improvement of reparative processes during thyroid surgery is characterized by a quick, effective and stable stop of bleeding, prevents the development of lympho-hemorrhagic complications, and also reduces the frequency of early postoperative complications due to intra- and postoperative laser exposure.

**Key words:** goiter, thyroidectomy, subtotal thyroidectomy, hemithyroidectomy, bipolar coagulation, local hemostasis, chemogenic, laser irradiation.

## Introduction

Thyroid (thyroid) surgery has evolved over three centuries: since the 19th century, when it was born, thyroid surgery has gone through a phase of stabilization and a phase of tremendous innovation due to continuous technological improvements [3,4]. In the first two historical phases, major advances were made through improvements in anesthesia protocols, infection prevention, and basic hemostatic procedures. Bleeding is a potentially life-threatening complication after thyroid surgery. The prevalence of bleeding is 0.36–4.3% [1,5]. The frequency of postoperative neck hematoma during thyroid surgery requiring reoperation ranges from 0 to 9.1% and is the most common reason for returning to the operating room. Mortality from bleeding after thyroidectomy ranges from 1.19% [6].

For many years, the most common method of transection of the major thyroid pedicles has been the clamp and ligation technique. As an alternative, bipolar electrocoagulation began to be used, but only for very small vessels [7,8]. This method of hemostasis is still considered the most appropriate in thyroid surgery. Other hemostatic methods introduced in the last decade have proved to be potentially very useful in neck surgery and in particular in thyroid surgery. This new class of instruments is usually better known as "energy devices" because they all use different forms of energy such as radio frequency or ultrasound [2,9,10].

But it must be taken into account that we are talking not only about bleeding from sufficiently large vessels that can be ligated or using high-energy devices and ultrasound and thereby stop bleeding, but also about excessive diffuse bleeding, characteristic of diffuse toxic goiter, which can also lead to

postoperative complications, but the causes of its development and possible methods of correction are not sufficiently described in the literature.

The issue of clear indications for the use of local hemostasis during operations on the thyroid gland also remains unresolved. In this connection, the development and use of highly effective domestic hemostatic agents of local importance is an urgent task of modern experimental and clinical medicine.

**The aim of the study is** to improve the results of surgical interventions on the thyroid gland by reducing the risk of early postoperative complications by improving the method of achieving hemostasis and enhancing reparative activity.

### Materials And Methods

For clinical evaluation of the effectiveness of the proposed method of supplementing the hemostatic and anti-inflammatory effect of various operations on the thyroid gland, two study groups were formed from 237 patients with thyroid pathology requiring surgical treatment. All patients were operated on at the clinic of the Andijan State Medical Institute and at the Endocrine Surgery Department of the Andijan Regional Endocrinological Dispensary for the period from 2020 to March 2023. All patients were divided into two groups. The main group included 98 patients operated on from 2022 to March 2023. using the proposed method of operation. The comparison group consisted of 139 patients who were operated on in 2020-2021. according to the traditional scheme of operations. Taking into account the fact that this study is aimed at evaluating the effectiveness of the intraoperative use of the domestic drug "Hemoben" in interventions on the thyroid gland, the criterion for inclusion in the analysis was only the presence of a benign pathology with the need for resection or total removal of the organ. Patients with diseases such as mixed goiter, nodular goiter and diffuse toxic goiter are included.

Our experimental studies on laboratory animals - white b / p male rats weighing 320-350 g in the amount of 24 individuals made it possible to identify the main advantages of the intraoperative use of the domestic hemostatic agent Hemoben. To assess the effect of hemostasis, an extended resection was performed not only of the left lobe of the thyroid gland, but also of the left and lower submandibular lymphatic and salivary glands. This contributed to causing profuse bleeding, and also created the possibility of assessing the inflammatory and adhesive process in this area in the experiment. In the control group of animals, intraoperative hemostasis was carried out by bipolar electrocoagulation, and in the experimental group, for the purpose of hemostasis, the hemostatic agent Hemoben was used in combination with laser irradiation. Hemoben hemostatic powder retains its hemostatic properties for a long time when incisions are made in the experimental area of the neck. This, in turn, allows for the management and prevention of bleeding during operations on organs and tissues with a high risk of bleeding in the neck. It has been proven that this drug contributes to the achievement of stable hemostasis. At the same time, the addition of the operation with low-energy laser irradiation of the intervention area enhances local reparative processes. In turn, the combined action of these two agents, namely chemical - Hemoben powder and physical - laser exposure, against the background of accelerated regeneration processes, reduces the risk of a rough adhesive process. These factors made it possible to determine directions for the development of a method for use in clinical practice.

### Results And Its Discussion

Surgical interventions included total thyroidectomy (TTE), hemithyroidectomy (TTE), and subtotal thyroidectomy (STTE) (Table 1).

**Table 1**

**Distribution of patients into groups for research, depending on the pathology of the thyroid gland and the type of operation**

The volume of surgical interventions	Mixed goiter		Nodular goiter		DTG		Total	
	Абс.	%	Абс.	%	Абс.	%	Абс.	%
Группа сравнения								
Thyroidectomy	59	42,4%	34	24,5%	15	10,8%	108	77,7%

Hemithyroidectomy	0	0,0%	17	12,2%	0	0,0%	17	12,2%
Subtotal thyroidectomy	12	8,6%	0	0,0%	2	1,4%	14	10,1%
Total	71	51,1%	51	36,7%	17	12,2%	139	100,0%
<b>Main group</b>								
Thyroidectomy	41	41,8%	24	24,5%	11	11,2%	76	77,6%
Hemithyroidectomy	0	0,0%	12	12,2%	0	0,0%	12	12,2%
Subtotal thyroidectomy	9	9,2%	0	0,0%	1	1,0%	10	10,2%
Total	50	51,0%	36	36,7%	12	12,2%	98	100,0%
<b>All patients</b>								
Thyroidectomy	100	42,2%	58	24,5%	26	11,0%	184	77,6%
Hemithyroidectomy	0	0,0%	29	12,2%	0	0,0%	29	12,2%
Subtotal thyroidectomy	21	8,9%	0	0,0%	3	1,3%	24	10,1%
Total	121	51,1%	87	36,7%	29	12,2%	237	100,0%

The task is to develop a method of local hemostasis, which involves achieving effective hemostasis, reducing the inflammatory process and preventing the development of adhesions.

In the comparison group, during operations on the thyroid gland, intraoperative hemostasis was carried out by traditional methods, and in the main group, according to the method of local intraoperative hemostasis developed by us.

#### The method of local intraoperative hemostasis

The method is distinguished by the following technical points after performing the main stages of the operation on the thyroid gland:

- for intraoperative hemostasis to stop bleeding, crystals of domestic hemostatic powder Hemoben 25-50 microns in size were used at the rate of 200 mg per area of 8-9 cm<sup>2</sup>, which is applied over the wound in a thin layer until a thin translucent film is formed;
- further, the wound was irradiated with low-energy laser radiation (domestic apparatus "Sogdiana") with a wavelength of 0.89 microns, a frequency of 500 Hz for 2 minutes at a distance of 5 cm from the wound;

then, for 3-7 days (depending on the volume of the surgical intervention), daily sessions of irradiation with the same laser at a frequency of 80 Hz were performed percutaneously over the projection of the surgical field.

- The following advantages of using this method are highlighted:

- fast, effective and stable hemostasis;
- minimal damage to the tissues of the parenchyma of the gland, including electrocoagulation;
- prevention of lymphorrhea and accumulation of seroma in the wound;
- no need to remove excess hemostatic Hemoben from the wound;
- reduction of the inflammatory process during laser exposure with a frequency of 500 Hz;

prevention of connective tissue growth and scar formation under laser exposure with a frequency of 80 Hz.

- In the course of clinical trials, we analyzed the frequency of early postoperative complications after TTE, STTE and GTTE, the results of which are presented in Table 2.

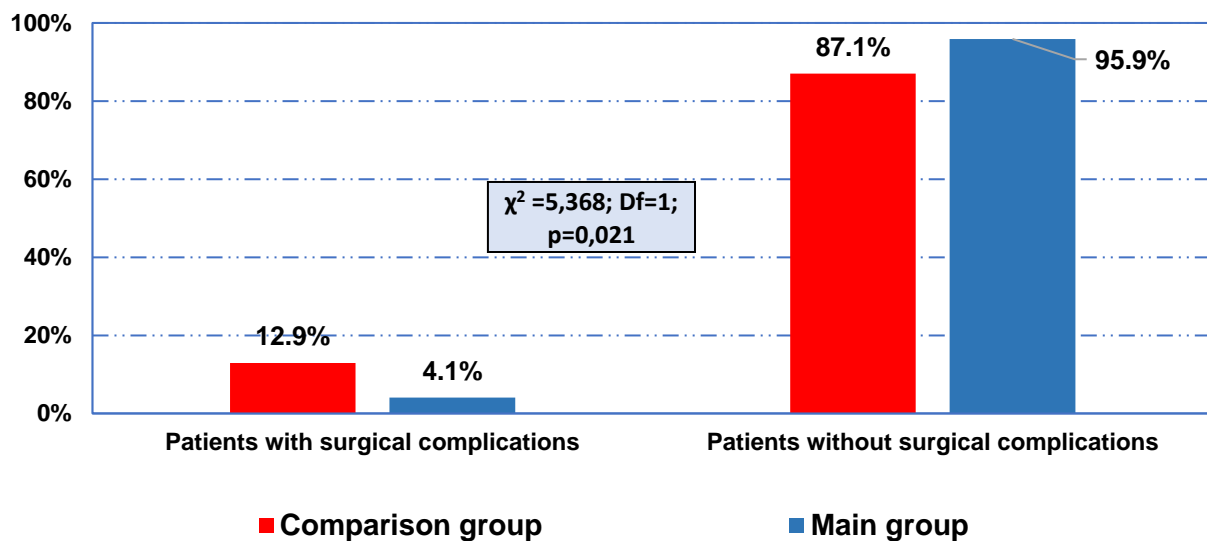
**Table 2**

#### The frequency of early postoperative complications in general by groups

Complications	Comparison group (n=139)		Main group (n=98)	
	Quantity	%	Quantity	%
Bleeding	4	2,9%	0	0,0%

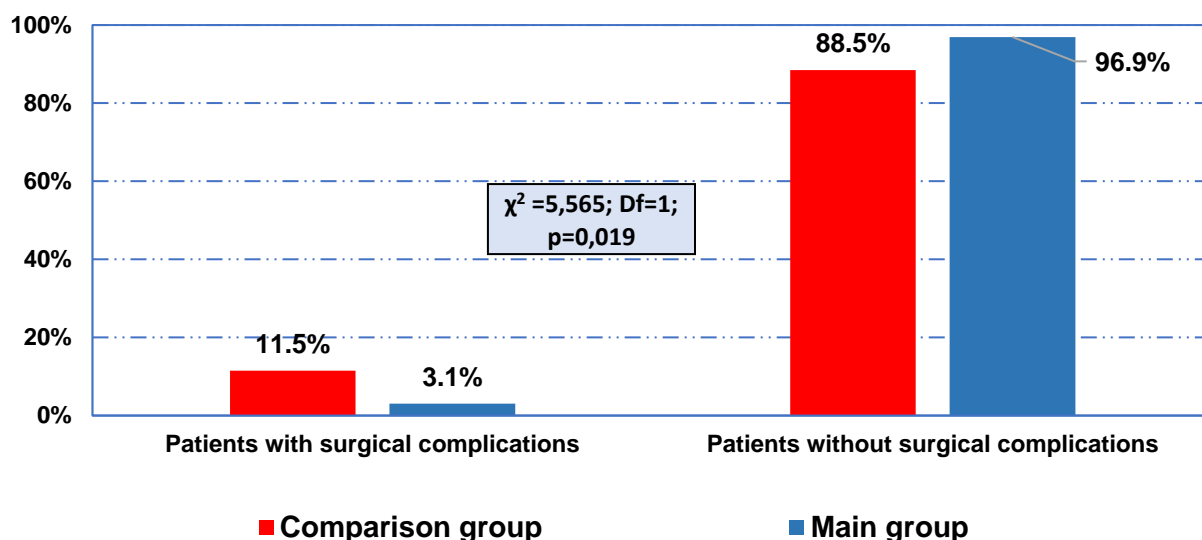
Hematoma in the area of operation	8	5,8%	1	1,0%
Lymphorrhoea	3	2,2%	1	1,0%
Limited fluid collections in the surgical area	3	2,2%	1	1,0%
Tracheomalacia	1	0,7%	0	0,0%
Paralysis of the vocal cords	24	17,3%	7	7,1%
Persistent (permanent) paresis of the larynx	3	2,2%	1	1,0%
Hypoparathyroidism (transient)	8	5,8%	2	2,0%
Suppuration of the wound	3	2,2%	1	1,0%
Patients with complications	41	29,5%	10	10,2%
$\chi^2$	12,667; Df=1; p<0,001			

In general, vocal cord paralysis in the comparison group was noted in 24 (17.3%) cases. In the main group, the same complication was noted 2.5 times less often - 7 (7.1%). In the main group, there were several times less persistent paresis of the larynx, hypoparathyroidism. But the most significant difference was noted in a sharp decrease in lympho-hemorrhagic complications (12.667; Df=1; p<0.001). In total, 41 (29.5%) complications were noted in the comparison group, while only 10 (10.2%) in the main group.



**Pic. 1. Percentage of surgical postoperative complications**

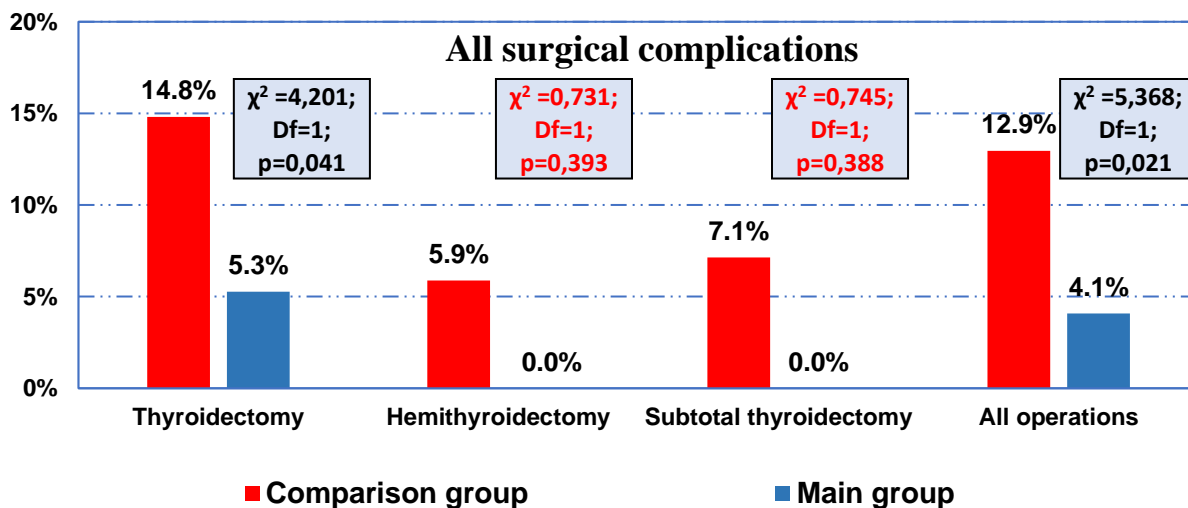
If we single out surgical postoperative complications (Fig. 1), it becomes obvious that in the comparison group there were 3 times more patients with such complications - 12.9% than in the main group - 4.1%. Accordingly, the proportion of patients without surgical complications increased from 87.1% to 95.9% (5.368; Df=1; p=0.021).

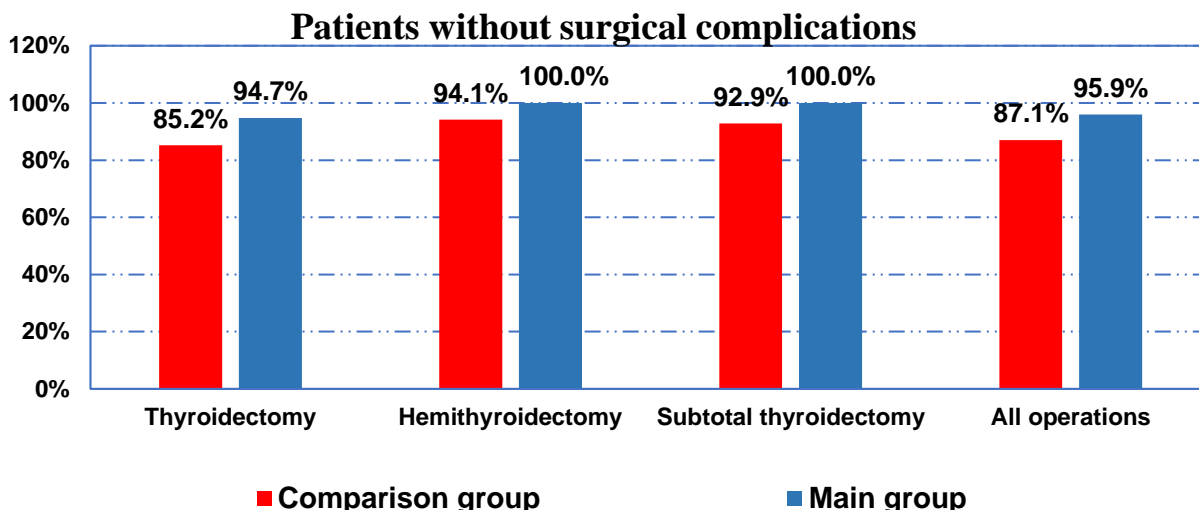


**Pic. 2. Percentage of surgical lympho-hemorrhagic postoperative complications**

Приблизительно схожая картина при анализе только лимфо-геморрагических послеоперационных осложнений (рис. 2). В группе сравнения осложнения развились у 16 (11,5%), в основной у 3 (3,1%). Благодаря чему доля больных без осложнений увеличена с 88,5% до 96,9% ( $\chi^2 = 5,565$ ; Df=1; p=0,019).

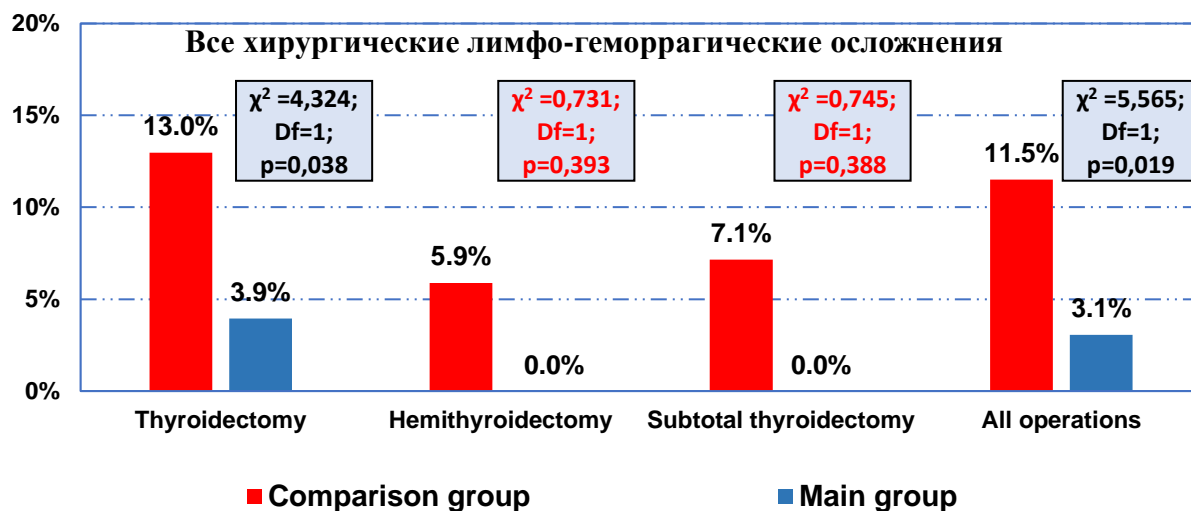
Следующий график хорошо демонстрирует долю всех хирургических осложнений независимо от типа вмешательства (рис. 3). Верхние и нижние столбцы обратно пропорционально демонстрируют по типу «симптома ножниц» снижение послеоперационных осложнений с ростом доли больных без осложнений в основной группе. Если обобщить, то получается, что в группе сравнения было 18 (12,9%) больных с осложнениями против 4 (4,1%) в основной группе ( $\chi^2 = 5,368$ ; Df=1; p=0,021). Соответственно, доля больных без осложнений повысилась с 87,1% в группе сравнения до 95,9% в основной группе.

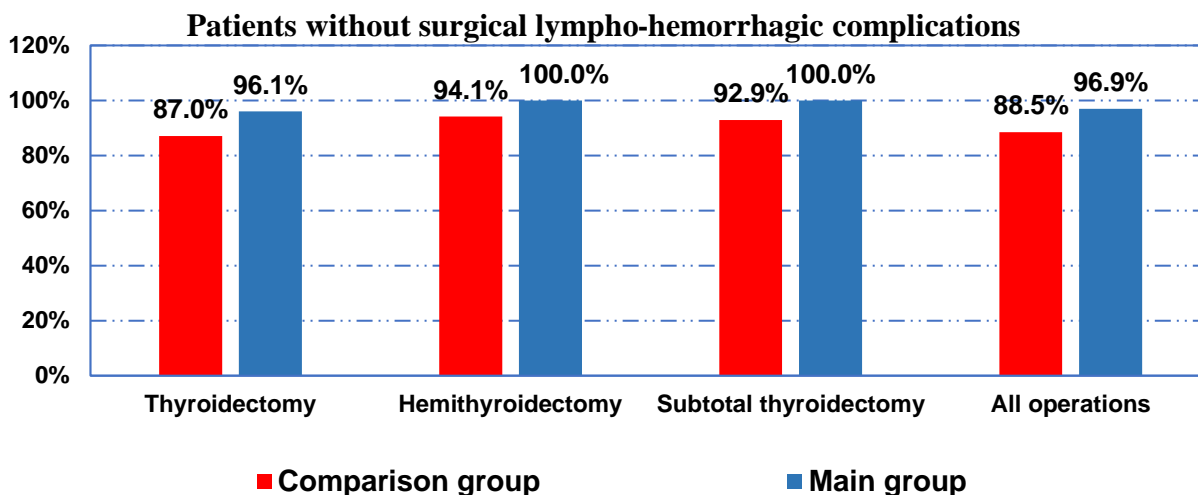




**Pic. 3. The proportion of all surgical postoperative complications after various interventions**

When analyzing the proportion of lympho-hemorrhagic surgery (Fig. 4), the picture is similar. There were 14 (13.0%) complications in TTE in the comparison group, 3 (3.9%) in the main group, which is 3 times less ( $\chi^2 = 4.324$ ;  $Df=1$ ;  $p=0.038$ ). With GTE and STTE, no complications were noted in the main group. Summing up all operations, 16 (11.5%) patients with complications were registered in the comparison group versus 3 (3.1%) in the main group ( $\chi^2 = 5.565$ ;  $Df=1$ ;  $p=0.019$ ). Accordingly, the proportion of patients without complications increased from 88.5% in the comparison group to 96.9% in the main group.



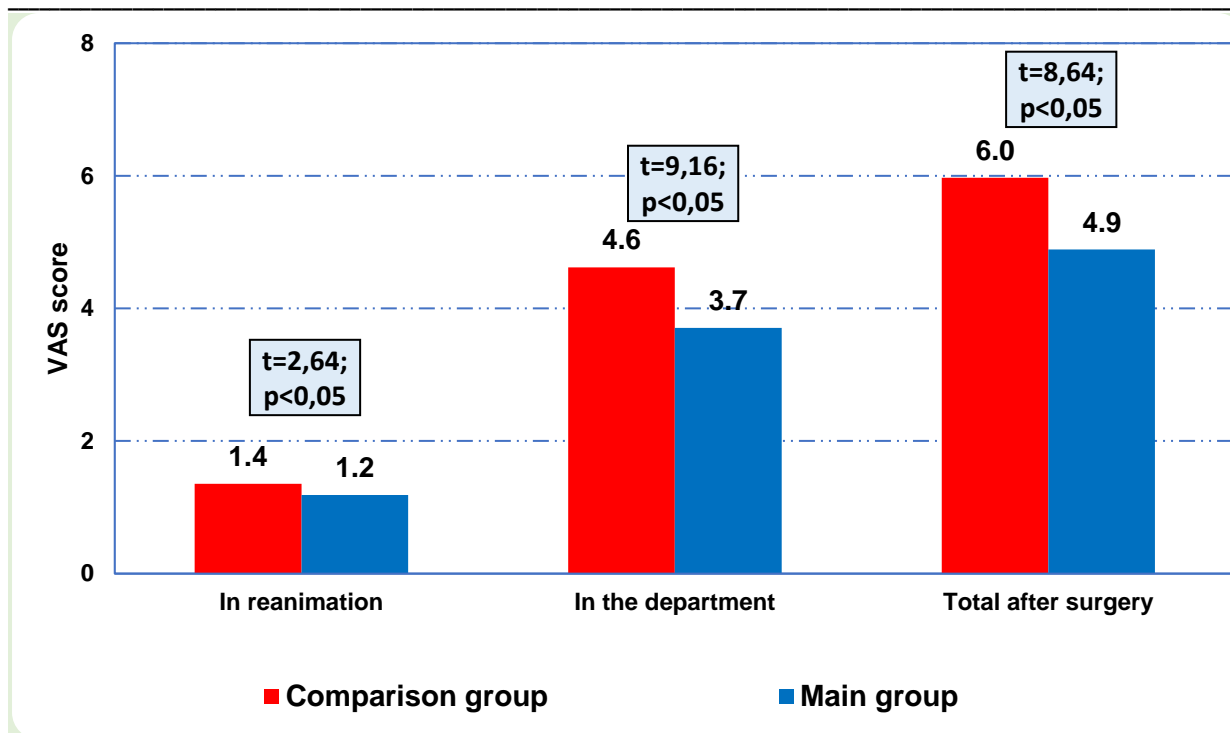


**Pic. 4. Share of all surgical lympho-hemorrhagic postoperative complications after various interventions**

The number and severity of complications primarily affect the duration of treatment. For all types of operations, the time spent by patients in the intensive care unit and in the department was significantly less in the main group (Table 3). The next graph shows the decrease in the number of bed-days in the main group due to the reduction in complications in the early postoperative period (Fig. 5). The average number of bed-days in intensive care in the comparison group was  $1.4 \pm 0.6$  versus  $1.2 \pm 0.4$  in the comparison group ( $t=2.64$ ;  $p<0.05$ ); in the department in the comparison group was  $4.6 \pm 0.9$  versus  $3.7 \pm 0.7$  in the comparison group ( $t=9.16$ ;  $p<0.05$ ); the total after surgery in the comparison group was  $6.0 \pm 1.1$  versus  $4.9 \pm 0.8$  in the comparison group ( $t=8.64$ ;  $p<0.05$ ).

**Table 3**  
**Number of bed-days after various surgeries (days:  $M \pm \delta$ )**

Index	Comparison group		Main group		Reliability	
	M	$\delta$	M	$\delta$	t	P
<b>TTE</b>						
<b>In reanimation</b>	1,4	0,6	1,2	0,4	2,11	<0,05
<b>In the department</b>	4,7	0,8	3,8	0,7	8,54	<0,05
<b>Total after surgery</b>	6,1	1,1	5,0	0,9	7,68	<0,05
<b>GTE</b>						
<b>In reanimation</b>	1,2	0,4	1,1	0,3	1,08	<0,05
<b>In the department</b>	4,3	0,8	3,5	0,7	2,75	<0,05
<b>Total after surgery</b>	5,5	1,0	4,6	0,8	2,75	<0,05
<b>STTE</b>						
<b>In reanimation</b>	1,4	0,7	1,1	0,4	1,17	<0,05
<b>In the department</b>	4,4	0,9	3,6	0,5	2,75	<0,05
<b>Total after surgery</b>	5,8	1,0	4,7	0,5	3,40	<0,05



**Pic. 5. Number of bed-days after all surgeries (days:  $M \pm \delta$ )**

Thus, a comparative analysis of the results of operations on the thyroid gland showed that the proposed method is characterized by a good hemostatic and anti-inflammatory effect, which manifested itself in a decrease in the overall incidence of complications from 29.5% (41 out of 139 patients in the comparison group) to 10.2% (10 of 98 patients in the main group;  $\chi^2=12.667$ ;  $df=1$ ;  $p<0.001$ ). At the same time, the proportion of surgical complications decreased from 12.9% (18 patients in the comparison group) to 4.1% (4 patients in the main group;  $\chi^2=5.368$ ;  $df=1$ ;  $p=0.021$ ), in turn, the frequency of lympho-hemorrhagic complications decreased from 11.5% (16 patients in the comparison group) to 3.1% (3 patients in the main group;  $\chi^2=5.565$ ;  $df=1$ ;  $p=0.019$ ). Improving the quality of postoperative rehabilitation made it possible to reduce the observation period in the intensive care unit from  $1.4 \pm 0.6$  to  $1.2 \pm 0.4$  days ( $t=2.64$ ;  $p<0.05$ ), in the department from  $4.6 \pm 0.9$  to  $3.7 \pm 0.7$  days ( $t=9.16$ ;  $p<0.05$ ) and in general the entire postoperative period from  $6.0 \pm 1.1$  to  $4.9 \pm 0.8$  days ( $t= 8.64$ ;  $p<0.05$ ).

### Conclusions:

1. The proposed method of local hemostasis and improvement of reparative processes during operations on the thyroid gland is characterized by a quick, effective and stable stop of parenchymal bleeding, prevents the development of lymphorrhea, and also, due to intra- and postoperative laser exposure, reduces the intensity of the inflammatory process (frequency 500 Hz) and the risk formation of cicatricial changes (frequency 80 Hz).

2. A comparative analysis of the results of operations on the thyroid gland showed that the proposed method is characterized not only by a good hemostatic, but also by an anti-inflammatory effect, which manifested itself in a decrease in the overall complication rate from 29.5% to 10.2% ( $p<0.001$ ), while the proportion of surgical of lympho-hemorrhagic complications decreased from 11.5% to 3.1% ( $p=0.019$ ), and the improvement in the quality of postoperative rehabilitation made it possible to reduce the postoperative observation period from  $6.0 \pm 1.1$  to  $4.9 \pm 0.8$  days ( $p < 0.05$ ).

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