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ROLE OF MODERN DIAGNOSTIC METHODS IN DETERMINING OF SURGICAL TACTICS IN PATIENTS WITH RETROSTERNAL GOITER

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Abstract. *Introduction.* Retrosternal goiter is called the location of the thyroid gland partially or completely below the level of the jugular notch of the sternum. Its frequency is in the range 10–15% in the structure of thyroid pathology. *The aim of the study* is to search for factors that can affect the course and volume of surgical intervention in patients with retrosternal goiter. *Material and methods.* The study was performed in a clinic of the Center of Endocrine Surgery, where 1156 operations for various thyroid diseases were performed in 2011–2019. Cervicothoracic goiter was detected in 227 (19.6%) patients. *Results and discussion.* The retrosternal goiter had clinical symptoms depended on the degree of compression of mediastinal and neck organs. Persistent compression contributed to relative compensation and the asymptomatic course in 78 (34.4%) patients. Computed tomography had the leading role in diagnostic. It makes possible to clarify the localization, determine the degree of compression of the neck organs, especially the trachea, and assess the deformation of the mediastinum. The most significant factors for surgical tactics and the likelihood of expanding the volume of the operation were: size of goiter retrosternal part and its relationship with the upper thoracic aperture, localization of the goiter in the anterior or posterior mediastinum, the relations of thyroid tissue with vital organs, large vessels and nerve trunks. Supplementation of cervical access with longitudinal transverse sternotomy was planned in 18 cases, but the real need for it arose only in 2 (0.9%) cases. *Conclusion.* 1. Computed tomography with three-dimensional reconstruction is the most informative diagnostic method for the choice of surgical tactics in patients with retrosternal goiter. 2. Modern software allows qualitative and quantitative analysis of tomograms with the identification of possible risk factors for changes in the volume of intervention. 3. Most patients with retrosternal goiter can be operated on through cervical access. 4. Quantitative spirometry assessment could be used to determine the urgency of the intervention.

Key words: thyroid gland; retrosternal goiter; mediastinum; recurrent goiter; sternotomy; computed tomography

РОЛЬ СОВРЕМЕННЫХ МЕТОДОВ ДИАГНОСТИКИ В ОПРЕДЕЛЕНИИ ХИРУРГИЧЕСКОЙ ТАКТИКИ У БОЛЬНЫХ ШЕЙНО-ЗАГРУДИННЫМ ЗОБОМ

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Резюме. Введение. Шейно-загрудинным зобом называют расположение щитовидной железы частично или полностью ниже уровня яремной вырезки грудины. Его частота в структуре тиреоидной патологии составляет 10–15%. Актуальность работы обоснована потребностью в точном определении порядка обследования и тактики хирургического лечения. Цель исследования: поиск факторов, способных повлиять на ход и объем хирургического вмешательства у больных загрудинным зобом. Материалы и методы. Исследование выполнено в клинике Центра эндокринной хирургии, где в 2011–2019 гг. выполнено 1156 операций по поводу различных заболеваний щитовидной железы. Шейно-загрудинный зоб выявлен у 227 (19,6%) пациентов. Результаты и обсуждение. Загрудинный зоб имел клиническую симптоматику, определявшуюся степенью сдавления того или иного органа. Ведущую роль в диагностике играла компьютерная томография, дававшая возможность уточнить локализацию, определить степень компрессии органов шеи, особенно трахеи, оценить деформацию средостения. Наиболее значимыми в определении хирургической тактики и вероятности расширения объема операции оказались: размер загрудинной части зоба и его соотношение с наиболее узким местом — верхней грудной апертурой, локализация зоба в переднем или заднем средостении, взаимоотношение тиреоидной ткани с жизненно важными органами, крупными сосудами и нервными стволами. Дополнение шейного доступа с продольно-поперечной стернотомией планировалось в 18 случаях, однако реальная потребность в нем возникла лишь в 2 (0,9%) наблюдениях. Выводы. 1. Наиболее информативным методом диагностики, определяющим вероятный объем и тактику хирургического лечения у больных загрудинным зобом, является компьютерная томография с трехмерной реконструкцией. 2. Современное программное обеспечение позволяет производить качественный и количественный анализ томограмм с определением возможных факторов риска изменения объема вмешательства. 3. Большинство больных загрудинным зобом может быть оперировано через шейный доступ. 4. Для определения срочности вмешательства можно использовать количественную оценку функции внешнего дыхания.

Ключевые слова: щитовидная железа; загрудинный зоб; средостение; рецидивный зоб; стернотомия; компьютерная томография

INTRODUCTION

Cervical sternal localisation refers to the location of the thyroid gland partially or completely below the level notch. In this case, most often a goitrous thyroid tissue, initially located in a typical place, under the influence of gravity and suction action of the thorax is gradually displaced down into the anterior or, less often, posterior mediastinum. Nodular transformation can also be subjected to dystopian thyroid tissue.

There is a steady increase in patients with nodular formations of the thyroid according to WHO data [1, 2]. The frequency of cervicothoracic goiter (CTG) varies widely — from 2.6 to 30.4% and averages 10–15% of all thyroid pathology. This percentage is particularly high in regions endemic for thyroid disease. Primary intrathoracic goitre is much less common and accounts for no more than 1% of all goitres [3]. The share of intrathoracic goiter in the group of mediastinal tumours and cysts is more than 30%, occupying the first place among benign masses of this localisation. Often CTG is a finding in women of the older age group (average age 65 years), and it is extremely rare in young age. The process of thyroid tissue prolapse is facilitated by the absence of fascial partitions, which would limit its movement into the mediastinal space. Another factor causing the anterior spread of goitre is the re-

sistance of the muscles and fascia of the anterior surface of the neck [1, 2, 4–6], which restrain the anterior growth of goitre.

Surgery is the main accepted method of treatment of CTG. Surgical interventions in this category of patients are technically more complicated, as pathologically altered thyroid tissue may extend deep into the mediastinum. The large size of the goiter and the impossibility to mobilise its lower poles without extraction in the cervical access increase the difficulty of visualisation of the recurrent laryngeal nerve and the risk of its trauma, both surgical and traction. Due to the high risk of injury of the inferior thyroid artery with subsequent development of difficultly controlled bleeding into the mediastinum when pulling the lower pole of the thyroid, it is sometimes necessary to perform a combined access: cervical access with longitudinal-transverse sternotomy [1, 3, 7]. Some authors, however, state that all retroperitoneal goitres can be safely removed via cervical access, with the exception of primary intrathoracic goitre and recurrent thyroid cancer [6]. The role of endovideosurgical and video-assisted surgical techniques in patients with tonsillar goiter is limited due to the difficulty in achieving optimal angulation of the instrument [8]. Nevertheless, there are reports on thoracoscopic assisted interventions [9].

AIM

A searching for factors that may influence the choice of access and operative technique in patients with an intrathoracic goiter.

MATERIALS AND METHODS

The study was performed in the clinic of the St. Petersburg Centre for Endocrine Surgery and Oncology on the basis of the St. Petersburg State Budgetary Institution "City Hospital No. 26". 1156 operations for various thyroid diseases were performed here in 2011–2019. Goiter of cervicothoracic localisation was detected in 227 (19.6%) patients. There were 34 (15.0%) men, 193 (85.0%) women. The age of patients in the study group ranged from 18 to 86 years and averaged 61.0 ± 12.8 years, which is about 6 years more than for the general group of patients with thyroid diseases. All patients were hospitalised and operated in euthyroidism. The degree of cervicothoracic location of goiter was determined according to the classification of A.F. Romanchishen (1992) [6]:

I degree — the lower poles of the thyroid lobes tend to extend behind the sternum;

II degree — the lower poles of the thyroid lobes are located retrosternally, but they are brought to the neck at palpation at the moment of swallowing;

III degree — the lower parts of the thyroid located in the sternum are not displayed on the neck during palpation at the moment of swallowing;

IV degree — only the tops of thyroid lobes are palpatorily detected on the neck;

V degree — the whole goitre-altered gland is located in the mediastinum (intrathoracic goiter).

The study included patients with II degree or more of cervicothoracic spread of thyroid tissue, because it has the greatest influence on the tactics and technique of surgical intervention. The number of patients with II degree of cervicothoracic spread of goiter was 30 (13.3%), with III — 156 (68.7%), IV — 38 (16.7%), V degree (intrathoracic location) was revealed in 3 (1.3%) patients. There were no statistically significant differences in the mean age depending on the degree of intrathoracic spread, although the mean age of patients with V degree of retroperitoneal spread was the highest (65.03 ± 5.3 years). All patients underwent a complex pre-operative examination, which included analysis of clinical symptoms, ultrasound of the neck, multispiral computed tomography (MSCT), and the neck scintigraphy if differential diagnostics was necessary.

The primary diagnosis of a hypogastric goiter was based on the analysis of complaints and clinical

data. The anterior goitre had clinical symptomatology determined by the degree of compression of organs. Prolonged compression of neck and mediastinal organs contributed to relative compensation and asymptomatic course of the disease, which was masked by concomitant pathology. The most frequent somatic diseases were cardiopulmonary diseases such as bronchial asthma, chronic obstructive pulmonary disease, obesity, atherosclerotic cardiosclerosis. However, decompensation with the manifestation of a visible clinical picture occurred with time. An asymptomatic course of the disease was observed in 78 (34.4%) cases. In these cases, preliminary diagnosis was performed by palpation.

The purpose of in-depth examination, which included an ultrasound and a MSCT, was to search for indications for surgery, to select the surgical access, and to plan the main stage of surgery. The main aim was to clarify the probability of expanding the access to sternotomy.

Taking into account the possibility of asymptomatic course of slowly developing laryngeal paresis, all patients were examined by an otorhinolaryngologist in the preoperative period. Hoarseness of voice can be a sign of compression or sprouting of the recurrent laryngeal nerve by a malignant tumour. The presence of proven laryngeal paresis influences the choice of surgical tactics.

Statistical processing of the obtained data was performed using the Student's criterion.

RESULTS

In our study, the most frequent (17.6%) and clinically significant symptomatology was dyspnoea at the lowest physical load and at the rest, as well as in the supine position, with characteristic stridor (Table 1). As a result, the patients had to sleep on the elevated bed, in a half-sitting position, on the stomach or on the side of the sternal node in case of unilateral thyroid enlargement. The presence of dyspnoea in most cases (87.5%) was combined with cervicothoracic goiter of III–V degree. Patients complained to headache due to impaired venous outflow. Characteristic symptoms were also: the coughing attacks, the signs of dysphagia, the swelling of superficial jugular veins, and, as a consequence, the compression of mediastinal vessels with the development of superior vena cava syndrome.

The majority of patients at the outpatient stage were long-term observed by endocrinologists, pulmonologists, therapists, cardiologists. The follow-up period ranged from 1 to 59 years, on average 10.8 ± 7.2 years. It was maximal in patients with

Table 1. Main complaints in cervicothoracic goitres

Таблица 1. Основные жалобы при шейно-загрудинных зобах

Complaints / Жалобы	A number of patients / Количество пациентов	A frequency of symp- toms, % / Частота симптомов, %
Dyspnoea at rest and a feeling of suffocation in a horizontal position / Одышка в покое и чувство удушья в горизонтальном положении	40	17,62
Neck deformation / Деформация шеи	50	22,02
Dysphagia / Дисфагия	14	6,16
Feeling of tightness in the neck / Чувство сдавления в области шеи	72	31,71
Swelling of the neck veins / Набухание шейных вен	19	8,37
Voice changes / Изменение голоса	6	2,64
Coughing fits that get worse in a horizontal position / Приступообразный кашель, усиливающийся в горизонтальном положении	11	4,84
Heart rhythm disorders / Нарушения сердечного ритма	1	0,44
Lack of complaints / Отсутствие жалоб	78	34,36

III–IV degree of goiter — $11,3 \pm 5,2$ years. Excessive concentration of specialists on profile pathology, narrowing of examination spectrum, underestimation of imaging techniques data contributed to diagnostic and tactical mistakes. Unfortunately, as practice has shown, the retroperitoneal goitre, noticeable as an enlargement of the upper mediastinum shadow, was often not described by radiologists in the fluorographic examination conclusions, which led to diagnostic mistakes and unreasonable prolonged observation. Differential diagnosis was complicated by the presence of concomitant severe pathology of the respiratory system in 4 patients.

All patients with suspected compression syndrome underwent a study of external respiratory function (spirometry), which made it possible to

determine the nature of airway patency disorder and the degree of respiratory insufficiency. These data influenced the tactics of preoperative and postoperative period treatment and allowed to determine the indications for urgent interventions in emergency patients [10]. Incorrect interpretation of clinical data and the contribution of thyroid disease can lead to the aggravation of respiratory disorders in the postoperative period. In complicated cases, the repeated investigations of external respiratory function, ECG and Echocardiography are necessary with further involvement of appropriate specialists.

Ultrasound in cervicothoracic goitre had limited informativeness due to the impossibility to assess the size and structure of the thyroid part located in the mediastinum. It was possible to examine the gland only in patients with II and III degree of subclavian location. Fine-needle aspiration biopsy was performed in all patients with thyroid nodular tumours. The colloid goiter was detected in 85 (55,9%) patients, the follicular tumour in 58 (38,2%) cases, the Hashimoto thyroiditis in 5 (3,3%) patients and the papillary carcinoma in 4 (2,63%) observations. The presence of compression syndrome was an indication for surgical treatment in cases of benign thyroid pathology.

The main method to diagnose cervicothoracic goiter was the X-ray. A MSCT of the chest with contrasting of the vascular system was used for topical diagnosis, determination of the degree of compression and evaluation of the neck and mediastinal organs deformation and clarification of anatomical relationships. The indications were: a cervicothoracic goiter of IV–V degree, a presence of compression syndrome, a suspicion of malignant growth. Magnetic resonance tomography was not used because of less clear visualisation of the sternal goiter.

MSCT helped to answer the main question of preoperative preparation of patients with cervicothoracic goiter about planning of surgery and choice of surgical access. In patients with large retroperitoneal neoplasms there is a risk of supplementing the cervical access with longitudinal-transverse sternotomy. Such interventions required additional preparation not only on the part of the patient, but also on the part of the operating theatre, which consisted in additional coordination of the surgical plan and preparation of instrument sets and consumables.

Based on the conducted survey, all patients were divided into 3 groups depending on the probability of sternotomy access and the features of performing the main stage.

In our experience, the most significant in determining the probability of sternotomy at the preoperative stage were the following features: the size of the anterior part of the goiter and its relationship to the narrowest place — the upper thoracic aperture, localisation of the goiter in the anterior or posterior mediastinum, the relationship of thyroid tissue with vital organs and large vessels and nerve trunks. Combined cervical access with longitudinal-transverse sternotomy was planned in 18 (7.9%) cases, but the real need for it occurred only in 2 (0.9%) observations.

Modern software for DICOM-images analysis allowed easy visualisation of the goitre-altered thyroid in the main projections and performing cross-sections according to the specified parameters. Availability of such programs allowed to widely use a 3D modelling in the course of planning surgical interventions in the last 5 years. The transverse, sagittal and longitudinal dimensions of the sternal part of the goiter were measured and its volume was calculated. The obtained data were compared with the transverse and sagittal dimensions of the bony ring of the upper thoracic aperture. Sternotomy was considered probable if at least one of the maximum dimensions of the goiter in the transverse plane exceeded 2/3 of the corresponding size of the upper thoracic aperture. Additional risk factors were considered to be goitre extension into the posterior mediastinum, deeper than the aortic arch, thyroid tissue dystopia into the mediastinum, recurrent and malignant nature of the disease. The probability of access extension progressively increased when two or more factors were combined.

In one of the two cases in which sternotomy was performed, there was a combination of large size and recurrent goitre with ectopy of the tissue into the mediastinum. In the second case, the patient was operated on for cervicothoracic location of papillary thyroid cancer with metastases to mediastinal lymph nodes.

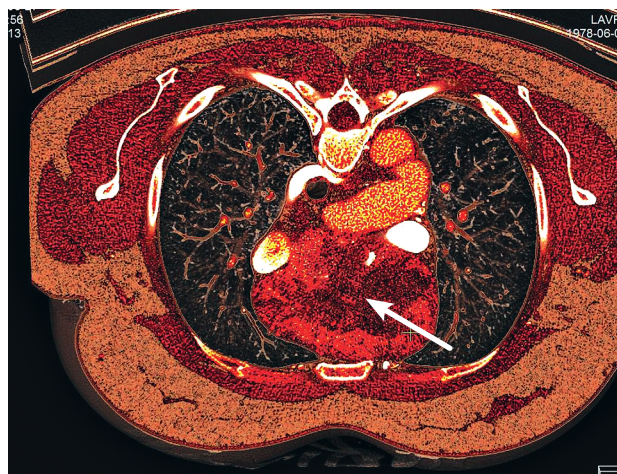
The following clinical observation demonstrates the risk assessment of sternotomy and surgical tactics. Patient L., 41 years old, was urgently admitted to Hospital No. 26 on 03rd April of 2019. She was transferred from a non-specialised regional clinic, where she was examined for a mediastinal mass detected on the fluorogram in January 2019, the mediastinoscopy with biopsy and the lymph node removal was performed. Fragments of macro-microfollicular goiter, follicular adenoma were found in all micropreparations during histological examination.

The patient knew about the thyroid disease since the age of 16. She was operated in 1994

(the volume is unknown, medical records have been lost). She was not observed by an endocrinologist and was not examined. On admission, she complained of dyspnoea with minimal physical exertion, impaired swallowing of solid food. Examination revealed dilated saphenous veins in the neck. The thyroid gland was inhomogeneous due to dense-elastic nodules, enlarged due to both lobes, partially located in the sternum, it did not protrude to the neck when swallowing. The patient was in euthyroid state. MSCT revealed a picture of a hypervascular volumetric mass of the upper and anterior mediastinum with the presence of a vascular pedicle coming from the posterior-lower edge of the left thyroid lobe (the size was 95×06×149 mm). There were signs of compression, displacement of elements of the vascular bundle and heart. There was the deviation of the trachea and oesophagus to the right (Fig. 1).

The diagnosis was recurrent polynodosis euthyroid goiter of cervical and sternum localisation of the IV degree, with compression and deviation of the neck and mediastinal organs. In the spirogram, the forced expiratory volume in 1 second and peak volume velocity were within normal limits (98 and 95%, respectively). No indications for emergency surgery were found. A decision on urgent surgery was made because of the risk of progression of respiratory disorders. The risk of sternotomy was considered to be extremely high (there was a combination of three factors: size ratio, depth of location, recurrent goitre).

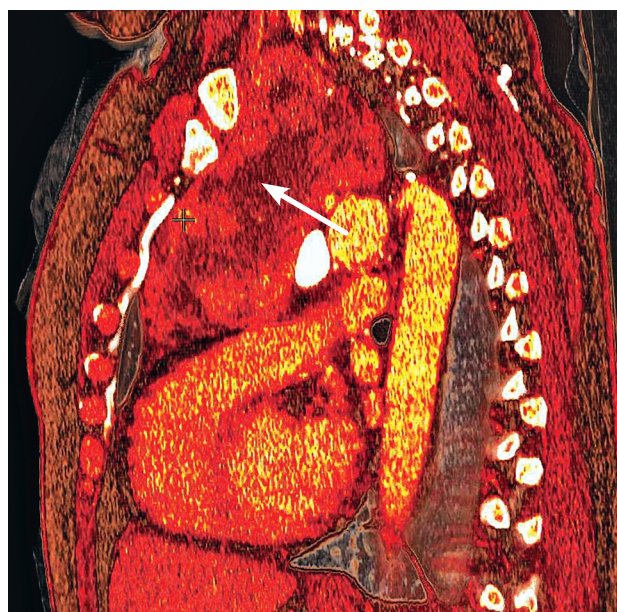
Under endotracheal anaesthesia the patient underwent an access on the anterior surface of the neck with excision of the old postoperative scar. In the course of revision, the right lobe of the thyroid with the size of 5×4×3 cm and the left lobe with the size of 4×4×3 cm were identified from the scars. The tissue was diffusely changed. From the lower pole of the left lobe there was a neoplasm spreading to the anterior mediastinum. The isthmus was absent. The right lobe of the thyroid was mobilised and removed under the control of the recurrent nerve on the right side. The left lobe was partially mobilised, the upper pole of the sternal mass was isolated. The latter was wedged into the upper thoracic aperture, surrounded by large vessels, squeezed and displaced the trachea backwards and to the right. It was impossible to remove the mass through the cervical access, a partial longitudinal-transverse sternotomy up to the third intercostal space was performed. The anterior superior mediastinum was occupied by a large nodular neoplasm 18×15×16 cm connected by a thin cord with the lower pole of the left thy-



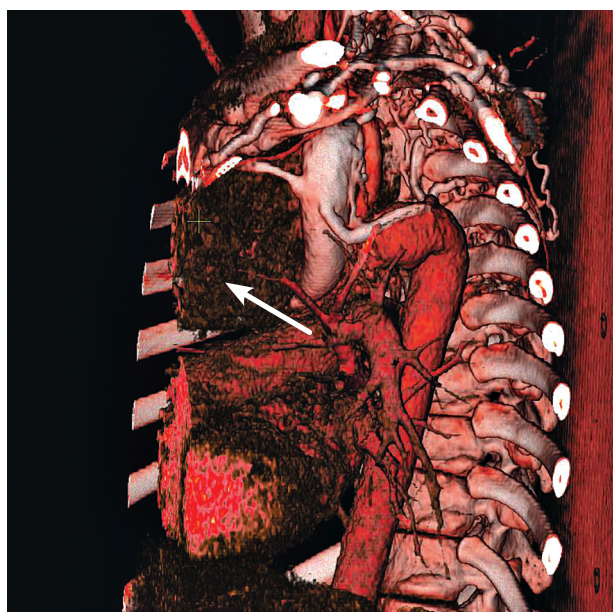
A/A



Б/Б



В/В



Г/Г

Fig. 1. Multispiral computed tomography of the neck with intravenous contrast enhancement (mediastinal tumor is indicated by an arrow): A – transverse projection; B – frontal projection; C – sagittal projection; D – three-dimensional reconstruction

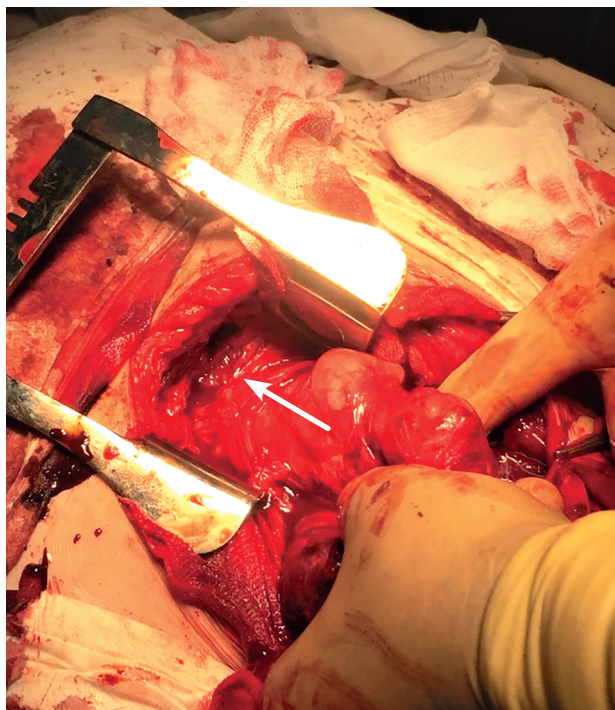
Рис. 1. Мультиспиральная компьютерная томография шеи с внутривенным контрастным усилением (образование средостения указано стрелкой): А – поперечная проекция; Б – фронтальная проекция; В – сагиттальная проекция; Г – трехмерная реконструкция

roid lobe. The neoplasm was mobilised with preservation of the main mediastinal structures and removed (Fig. 2). The postoperative period was smooth, the patient was discharged on the 10th day in satisfactory condition under the supervision of the endocrinologist of the polyclinic. The substitution therapy was prescribed.

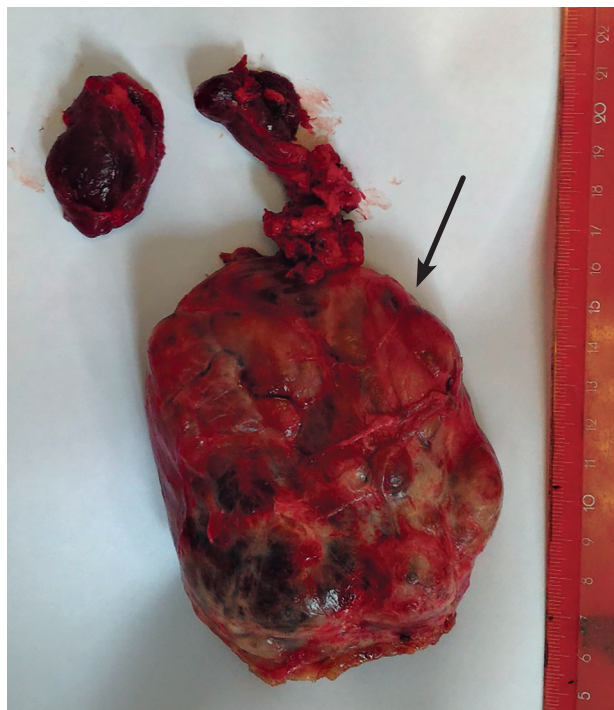
Esophagoscopy and fibrobronchoscopy were necessary for patients with large retroperitoneal goitres, especially in case of suspected malignant growth. In patients with compression syndrome, it is advisable to perform them during operation because of the possible risk of progression of respiratory disorders. Intubation of such patients is

also performed under bronchoscopy control due to significant displacement and narrowing of the laryngeal and tracheal lumen, which should be warned to the anaesthesiologist in advance.

There were patients who were admitted to the hospital for emergency indications with signs of the respiratory failure and the threat of asphyxia in the group of operated patients. The main task of the surgeon on duty in such a situation was to perform differential diagnosis and determine the role of cervicothoracic goiter in the clinical picture. On the degree of tracheal compression, the need for surgery was based on the urgent or emergency procedure. The study of external respiratory func-



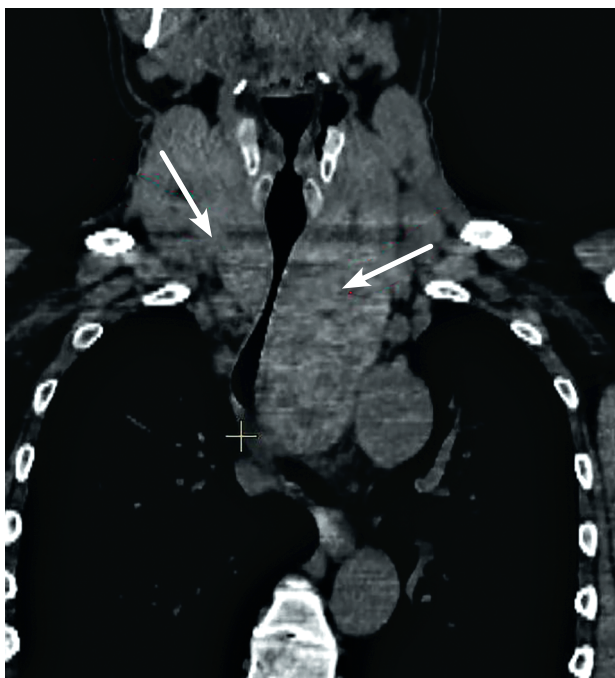
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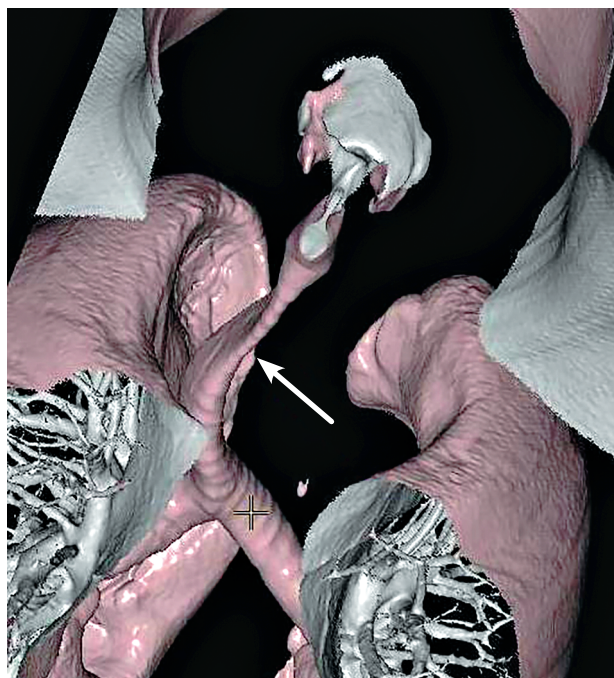
Б/В

Fig. 2. Sternotomy with retrosternal goiter: A – mobilization of mediastinal goiter; B – macroreparation (the mediastinal part is marked by an arrow)

Рис. 2. Стернотомия при за грудином зобе: А – выделение за грудином зоба; Б – макропрепарат (за грудином часть маркирована стрелкой)



A/A



Б/В

Fig. 3. Computed tomogram in direct projection (A); three-dimensional reconstruction of the tracheobronchial tree (B) (stenosed trachea is marked with an arrow)

Рис. 3. Компьютерная томограмма в прямой проекции (А); трехмерная реконструкция трахеобронхиального дерева (Б) (стрелкой отмечена стенозированная трахея)

tion and MSCT took the leading place in determining the indications for emergency intervention. In modern conditions against the background of the COVID 19 pandemic, the computer tomography is also indispensable for detecting signs of specific pneumonia, because the clinical manifestations in the form of dyspnoea are the same, and combined variants may occur, presenting serious problems in the tactical plan.

A variant of surgical tactics is illustrated by the following clinical observation. Patient S., 49 years old, was admitted on emergency indications with the diagnosis of "acute respiratory infection, respiratory failure". On admission he noted pain in the throat, dyspnoea at minimal physical activity. Examination revealed a sharp neck deformity of a significantly enlarged thyroid. A surgeon was summoned. From the anamnesis it is known that the patient knew about the thyroid disease for about 5 years. He had not been observed by doctors and had not previously asked for medical help. The dyspnoea on physical load started to be noted a year ago. Recently the progressive decrease of tolerance to physical load was noted. Deterioration occurred against the background of catarrhal symptoms. On observation: the neck area was sharply enlarged and deformed due to both lobes of the thyroid, extending up to the hyoid bone and down behind the sternum, there was a dilation of the subcutaneous vein network in the neck area. Acrocyanosis appeared only during physical exertion. The trachea was displaced to the right in the lower neck. Cervical lymph nodes were not palpatorily enlarged.

The patient was examined in the hospital emergency room, the MSCT of the chest with neck involvement was performed. The goiter of cervico-sagittal localisation of IV degree with compression and deviation of neck and mediastinal organs, the subcompensated tracheal stenosis, the left-sided maxillary sinusitis were detected. A mass with clear irregular contours, 8.3×8.6×10.4 cm in size, originating from the left lobe, spreading into the posterior mediastinum, around and beyond the tracheal bifurcation was visualised. The tracheal lumen is narrowed to 4×27 mm. There was compression of mediastinal vessels. The length of the stenosis was 8.7 cm. The structure of the mass was heterogeneous due to the presence of small calcinates (Fig. 3).

In the left lobe there were multiple nodules up to 22 mm, in the right lobe — the lower pole was represented by a nodule 43×33 mm. The study of external respiratory function revealed a significant decrease in forced expiratory volume in 1 second

(45% of the norm), Tiffno index (65% of the norm), peak expiratory volume velocity (26% of the norm).

Taking into account the spirometry data (the forced expiratory volume was 45%), the tactical approach patented by our collective [10], the absence of dyspnoea at rest, it was decided to prepare the patient for urgent surgery. The patient was given oxygen through nasal catheters. The treatment of maxillary sinusitis was started with the help of otorhinolaryngologist. There was V according to the results of thyroid function study. After inflammatory phenomena control on the 4th day the patient underwent surgical treatment to eliminate compression of neck organs and mediastinum. Taking into account the spread of the goiter to the level of the main bronchi, despite the fact that its transverse size did not exceed 2/3 of the size of the upper thoracic aperture, the probability of sternotomy access was taken into account at the stage of planning the operation.

The patient's thyroid was exposed layer by layer using the Kocher access under an endotracheal anaesthesia (an intubation with a bronchoscope). Subcutaneous veins are considerably dilated. At revision both thyroid lobes were sharply enlarged (right 12×6×5 cm, left 18×8×6 cm). Their lower poles went behind the sternum into the posterior mediastinum, annularly covered and squeezed the trachea and oesophagus, the tissue was diffusely changed due to multiple nodules of colloid structure. After ligation of the upper and lower thyroid vessels, the thyroid tissue decreased in size, which allowed its removal from the sternum to the cervical access. Thyroidectomy was performed under the control of the recurrent laryngeal nerves and perithyroid glands.

The postoperative period was normal. The patient was discharged for outpatient treatment on the 5th day after surgery. Histological conclusion was diffuse nodular macro-microfollicular colloid goiter. At the control check-up in a month the patient felt well, respiratory insufficiency was eliminated, he was physically active and had no complaints. Control spirometry in 6 months showed the recovery of respiratory function.

It was possible to stabilise the condition of all emergency patients and to perform interventions after preparation with the intensive therapy. 19 (8.4%) patients were operated on urgently, the remaining 208 (91.6%) were admitted as planned. In 13 (5.7%) out of 227 patients goitre was recurrent. The operation of choice in patients with cervicothoracic goiter was thyroidectomy performed in 183 (80.6%) patients. Hemithyroidectomy was performed in 28 (12.3%) patients, and subtotal re-

section was performed only in 3 (1,3%) cases. The operation of choice in case of retroperitoneal recurrent goitre was repeated resection in the volume of thyroidectomy. One (0.45%) patient underwent decompressive resection of the thyroid tumour and in 1 (0.4%) patient palliative removal of the mediastinal tumour was performed.

Intraoperative signs of compression syndrome were detected in 112 (49.3%) patients. Instrumentally its presence was proved only in 41 (18.1%) patients. Tracheal compression and deviation were the most frequent — 103 (92.0%) cases, oesophagus was compressed less frequently — 32 (28.5%) cases, neck and mediastinal vessels — 19 (16.9%) cases. Compression usually occurred at the level of the upper thoracic aperture, which is associated with the presence of a dense bony ring.

Most often (204 (89.9%) observations) the anterior part of the thyroid was located in the anterior mediastinum and only in 23 (10.13%) cases in the posterior mediastinum. Devascularisation of the thyroid tissue during surgical interventions resulted in its volume reduction due to decreased blood flow. This helped to remove it from the sternum to the cervical access, which was achieved in 225 (99.1%) cases. It is necessary to avoid rough traction of thyroid tissue in the cranial direction, as it can lead to rupture of venous plexuses and even tear off the anterior part of the thyroid with the development of massive bleeding into the mediastinum. This will inevitably lead to the need for sternotomy in order to haemostasis. It is also necessary to remember that the introduction of thyroid tissue into the tracheo-oesophageal furrow, displacement of the trachea and oesophagus change anatomical relationships in the area of surgery, and the recurrent laryngeal nerves may appear in a completely unexpected place, even on the anterolateral surface of the tumour nodule.

The analysis of immediate results of surgical treatment of 227 patients operated on for cervicothoracic goiter showed that one- and bilateral laryngeal paresis of accidental or forced (in case of nerve sprouting by the tumour) character was present in 2 (0,9%) observations. Postoperative haemorrhages requiring repeated intervention in the early postoperative period developed in 4 (1.8%) patients. These figures are comparable with those in the general group and the literature data [11].

CONCLUSIONS

1. Computed tomography with 3D reconstruction is the most informative diagnostic method determining the probable volume and tactics of surgical treatment in patients with retroperitoneal goitre.

2. Modern software allows to perform qualitative and quantitative analysis of tomograms with determination of possible risk factors for changing the volume of intervention.

3. The majority of patients with a sternal goitre can be operated through the cervical access. A combination of risk factors increases the probability of widening the access: an exceeding at least one of the maximum goitre size in the transverse plane 2/3 of the corresponding size of the upper thoracic aperture, goitre spread to the posterior mediastinum, deeper than the aortic arch, thyroid tissue dystopiated in the mediastinum, recurrent and malignant nature of the disease. The surgeon should anticipate the possibility of sternotomy and has to be prepared to perform it if necessary.

4. Quantitative assessment of external respiratory function can be used to determine the urgency of intervention. If the forced expiratory volume is less than 35% of normal, urgent intervention is indicated.

ADDITIONAL INFORMATION

Author contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

Competing interests. The authors declare that they have no competing interests.

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ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования.

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REFERENCES

1. Nakaya M., Akiko I., Mori A. et al. Surgical treatment of substernal goiter: An analysis of 44 cases. *Auris Nasus Larynx*. 2017; 44(1): 111–5. DOI: 10.1016/j.anl.2016.02.016.
2. Cichoń S., Anielski R., Konturek A. et al. Surgical management of mediastinal goiter: risk factors for sternotomy. *Langenbecks Arch. Surg.* 2008; 393: 751–7. <https://doi.org/10.1007/s00423-008-0338-y>.
3. Raffaelli M., Crea C.D., Ronti S. et al. Substernal goiters: incidence, surgical approach, and complications in a tertiary care referral center. *Head Neck*. 2011; 10: 1420–5.
4. Di Crescenzo G.V., Vitale M., Valvano L. et al. Surgical management of cervico-mediastinal goiters: our experience and review of the literature. *International journal of surgery*. 2016; 28(Suppl. 1): 47–53.
5. Moon J.H., Hyun M.K., Lee J.Y. et al. Prevalence of thyroid nodules and their associated clinical parameters: a large-scale, multicenter-based health checkup study. *The Korean Journal of Internal Medicine*. 2018; 33(4): 753–62. DOI: 10.3904/kjim.2015.273.
6. Romanchishen A.F., Romanchishen F.A., Karpatskiy I.V., Vabalayte K.V. Urgentnyye khirurgicheskiye vmeshatel'stva pri zabolevaniyakh shchitovidnoy zhelezy i oslozhneniyakh rannego posleoperatsionnogo perioda [Urgent surgical interventions for thyroid diseases and complications of the early postoperative period]. *Pediatr.* 2013; 4(4): 103–15. (in Russian).
7. Oueriachi F.E., Hammoumi M.M., Arsalane A. et al. Primary mediastinal goiters. *Springerplus*. 2014; 3: 503. <http://dx.doi.org/10.1186/2193-1801-3-503>.
8. Maystrenko N.A., Romashchenko P.N., Krivolapov D.S. Obosnovaniye minimal'no-invazivnykh operativnykh vmeshatel'stv na shchitovidnoy zheleze [Substantiation of minimally invasive surgical interventions on the thyroid gland]. *Vestnik khirurgii im. I.I. Grekova*. 2017; 176(5): 21–8. <https://doi.org/10.24884/0042-4625-2017-176-5-21-28>. (in Russian).
9. Gupta P., Lau K.K., Rizvi I. et al. Video assisted thoracoscopic thyroidectomy for retrosternal goitre. *Ann. R. Coll. Surg. Engl.* 2014; 96(8): 606–8.
10. Gostimskiy A.V., Romanchishen A.F., Selikhanov B.A. Sposob opredeleniya srokov operatsii pri zabolevaniyakh shchitovidnoy zhelezy, oslozhnennykh kompressiyey trakhei [A method for determining the timing of surgery for thyroid diseases complicated by tracheal compression]. Patent na izobretenie RU 2533049 C1, 20.11.2014. (in Russian).
11. Romanchishen A.F., Nakatis YA.A., Vabalayte K.V., Gotovyakhina T.V. Prichiny rasstroystv golosovoy

funktsii posle operatsiy na shchitovidnoy zheleze [Causes of voice disorders after thyroid surgery]. Sankt-Peterburg: SpetsLit Publ.; 2017. (in Russian).

ЛИТЕРАТУРА

1. Nakaya M., Akiko I., Mori A. et al. Surgical treatment of substernal goiter: An analysis of 44 cases. *Auris Nasus Larynx*. 2017; 44(1): 111–5. DOI: 10.1016/j.anl.2016.02.016.
2. Cichoń S., Anielski R., Konturek A. et al. Surgical management of mediastinal goiter: risk factors for sternotomy. *Langenbecks Arch. Surg.* 2008; 393: 751–7. <https://doi.org/10.1007/s00423-008-0338-y>.
3. Raffaelli M., Crea C.D., Ronti S. et al. Substernal goiters: incidence, surgical approach, and complications in a tertiary care referral center. *Head Neck*. 2011; 10: 1420–5.
4. Di Crescenzo G.V., Vitale M., Valvano L. et al. Surgical management of cervico-mediastinal goiters: our experience and review of the literature. *International journal of surgery*. 2016; 28(Suppl. 1): 47–53.
5. Moon J.H., Hyun M.K., Lee J.Y. et al. Prevalence of thyroid nodules and their associated clinical parameters: a large-scale, multicenter-based health checkup study. *The Korean Journal of Internal Medicine*. 2018; 33(4): 753–62. DOI: 10.3904/kjim.2015.273.
6. Романчишен А.Ф., Романчишен Ф.А., Карпатский И.В., Вабалайте К.В. Ургентные хирургические вмешательства при заболеваниях щитовидной железы и осложнениях раннего послеоперационного периода. *Педиатр.* 2013; 4(4): 103–15.
7. Oueriachi F.E., Hammoumi M.M., Arsalane A. et al. Primary mediastinal goiters. *Springerplus*. 2014; 3: 503. <http://dx.doi.org/10.1186/2193-1801-3-503>.
8. Майстренко Н.А., Ромащенко П.Н., Криволапов Д.С. Обоснование минимально-инвазивных оперативных вмешательств на щитовидной железе. *Вестник хирургии им. И.И. Грекова*. 2017; 176(5): 21–8. <https://doi.org/10.24884/0042-4625-2017-176-5-21-28>.
9. Gupta P., Lau K.K., Rizvi I. et al. Video assisted thoracoscopic thyroidectomy for retrosternal goitre. *Ann. R. Coll. Surg. Engl.* 2014; 96(8): 606–8.
10. Гостимский А.В., Романчишен А.Ф., Селиханов Б.А. Способ определения сроков операции при заболеваниях щитовидной железы, осложненных компрессией трахеи. Патент на изобретение RU 2533049 C1, 20.11.2014.
11. Романчишен А.Ф., Накатис Я.А., Вабалайте К.В., Готовяхина Т.В. Причины расстройств голосовой функции после операций на щитовидной железе. СПб.: СпецЛит; 2017.