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Improving the Method of Surgical Treatment of Complicated Echinococcosis of the Lungs

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SUMMARY

The article discusses the technical aspects of an improved method of surgical treatment of giant and complicated echinococcosis of the lungs, which is characterized by anatomical resection with suturing of the bronchial stump with eight-shaped sutures, as well as local laser exposure and application of hemostatic Hemoben powder to the wound surface of the lung and bronchial stump with local laser exposure to the wound surface after lung resection, which provides additional sealing of the stump bronchus, as well as hemo- and lymphostasis, helps accelerate wound healing, it also has an antimicrobial effect.

The relevance of the problem. Echinococcal infection is a zoonotic infection caused mainly by the tapeworm parasite Echinococcus granulosus. Khalili N., et al. (2023) consider it an endemic disease in the Mediterranean region. In about 90% of cases, echinococcal cysts are found in the liver and lungs; however, any other organ in the body can be affected, especially in endemic areas. When detecting cystic lesions in these areas, the doctor should always remember about echinococcosis as a possible diagnosis. In order to avoid life-threatening conditions such as anaphylactic shock or exposure to pressure on vital organs, timely diagnosis and proper treatment are crucial. If a rare localization is affected, echinococcal disease should be diagnosed using a combination of serological analyses and imaging methods, such as ultrasound, computed tomography and magnetic resonance imaging to determine the degree of the disease and assess possible complications. [1]. the real burden of CE remains unclear due to the specific characteristics of the disease and the heterogeneity and incompleteness of the registration of clinical cases. In addition, official notification systems do not collect key clinical information that would allow comparing different treatment outcomes and thus circumvent the difficulties of conducting clinical trials. The Italian CE (RIEC) Registry was launched in 2012 and expanded in 2014 to the European CE (ERCE). Registry. The main purpose of the ERCE was to highlight the extent of underreporting of CE by recording cases that were not reflected in official reports. 44 centers from 15 countries (7 non-European) joined ERCE. A total of 2,097 patients were registered, 19.9% of whom were immigrants. It is planned to expand ERCE to the International CE Registry (IRCE) and restructure in order to overcome its current problems and achieve these goals [2]. CE is a chronic, complex and neglected zoonotic disease that has a significant socio-economic impact on the affected population. Despite the fact that Mongolia is included in the list of countries with a high risk of cystic echinococcosis, there are very few studies and data on the

prevalence or prevention of cystic echinococcosis. Dorjsuren T, et al. (2020) conducted a field cross-sectional study to study the prevalence of cystic echinococcosis and its potential risk factors in Mongolia. A total of 1993 people were examined using ultrasound in five provinces of Mongolia. All positive cases of cystic echinococcosis were classified in accordance with the recommendations of WHO-IWGE experts. The prevalence of cystic echinococcosis varied greatly in different provinces and ranged from 2.0% to 13.1%. Children, the elderly and people with a lower level of education had a higher chance of contracting cystic echinococcosis. The assessment of potential risk factors associated with cystic echinococcosis showed the high importance of the following factors: demographic (age under 18 and the elderly), social status (level of education) and hygiene practices (removal of dog feces and the use of gloves). [3]. Chaari Z, et al. (2022) it is believed that echinococcosis of the lungs (EL) is still an endemic pathology. Different numbers of patients have been reported in different published surgical series, but only a few have studied the risk factors associated with morbidity and mortality. From 1987 to 2021, the authors performed operations in 1,169 patients, a total of 1,288 interventions were performed and the average age was 20 years. There were a total of 1951 cysts, the average size was 60 mm, 40% were complicated. The majority of patients underwent conservative operations, anatomical resection was required in 23 patients (1.8%). The average number of bronchial fistulas was 3. Decortication was required in 94 patients (7.3%). The morbidity rate was 25%, the mortality rate was 0.4%. Fever, pleurisy and associated decortication were correlating risk factors for morbidity and mortality. Other morbidity factors were identified, including insecurity of the surgical field, cyst size ≥55 mm, and ≥3 bronchial fistulas. Mortality factors were determined, such as the postoperative occurrence of septic shock, hemorrhage and respiratory failure. The authors concluded that the earlier the operation is performed (before complications occur) and various concomitant risk factors are identified, the better the prognosis of radical surgery [4]. Onal O, et al. the relationship between localization and frequency of perforations of EL cysts in children was studied. Retrospectively examined 197 patients under the age of 16 years, operated in the period from January 2000 to December 2016 for EL cysts. Patients with giant echinococcal cysts (n=27), bilateral echinococcal cysts (n=24) and more than one cyst in one lung (n=12) were excluded to create a more homogeneous group so that the relationship between the location and frequency of perforation of echinococcal cysts could be investigated. Finally, 134 patients who had only one echinococcal cyst were divided into two groups: group 1 with perforated cysts and group 2 with intact echinococcal cysts. 70.9% of the patients were men. A total of 134 cysts were identified, of which 41% were perforated. The highest frequency of perforations was found in the right medial lobe (70%) and the uvula (66.7%). There was a statistically significant difference between the location of cysts and the frequency of perforations (p=0.018). Also, echinococcal cysts located in the right middle lobe and uvula had a higher incidence of postoperative complications than echinococcal cysts located in the upper and lower lobes (p=0.018) [5]. Aqqad A, et al claim that giant echinococcosis in children is a special clinical form. This requires extensive surgery with parenchymal resection, and therefore early diagnosis and therapeutic treatment are justified [6]. Khalfallah I. also believes that complicated and giant cysts cause lung damage, leading to extensive parenchymal resection, which are more associated with postoperative complications that prolong hospital stay and increase costs [7]. A slightly different opinion is Usluer O., based on the experience of treating 537 patients with echinococcosis, he states that regardless of the size of the cyst, it was usually possible to treat surgically without resection of the lung, and the size does not seem to affect short-term perioperative results [8]. Also, the author did not reveal significant differences in morbidity between the groups.

The analysis of the literature shows that, despite significant progress in the treatment of EL, there are still controversial issues of choosing a method of surgical intervention for complicated and giant cysts. Also important are the issues of assessing lung damage, determining the optimal

surgical tactics for ruptured echinococcal cysts in the bronchus or pleural cavity, treatment strategies taking into account the critical analysis of complications of the early and late postoperative periods and the quality of life of patients.

The purpose of this study was to develop a method of surgical treatment of complicated EL.

Materials and methods of research. The objective of these studies was to develop an experimental model of lung lobe resection against the background of microbial contamination. Further, on the tested model, comparative studies of the healing process after resection of the lobe of the lung without the use of a coating (control) and also using a composite hemostatic coating "HEMOBEN" with laser stimulation should be carried out. The obtained results will allow us to develop a new method of resection intervention in complicated EL.

Experimental studies were carried out in the laboratory of experimental surgery of the State Institution "RSSPMCS named after Academician V. Vakhidov" from 2021 to 2022.

The experimental model was performed on mongrel white rats of both sexes weighing 210-270 y. The conditions of detention, intake of water and feed, animal care, as well as euthanasia were carried out in accordance with the requirements of the European Convention for the Protection of Vertebrates Used for Experimental and Other Scientific Purposes (Strasbourg, 1986).

The tasks of experimental research included:

- to establish the technique of tracheal intubation through natural pathways in experimental rats;
- to establish optimal parameters of artificial lung ventilation in rats and methods of anesthesia;
- to develop a technique of lobectomy in rats;
- to develop a model of microbial contamination of the lung resection zone;
- to develop a technique for laser stimulation of lung wound healing in case of contamination with pathogenic microflora;
- to study in an ex vivo experiment the ability of the hemostatic drug Hemoden in sealing the sutures of the bronchial stump.

Contamination of microbes in the control and experimental group of animals was carried out as follows: From the contents of the rat colon obtained by laparotomy and opening of the intestinal lumen, in an amount of 100 micrograms, a solution was prepared immediately before injection into the pleural cavity by dilution in 50 ml of saline solution. After mixing the contents in a closed container, 1 ml of suspension was collected into the syringe and injected into the pleural cavity, which is more than 5 million microbes. 2 minutes after administration, the pleural cavity was washed with 5 ml of saline solution. In the experimental group of animals, HEMOBEN powder was applied to the wound surface and, after polymerization, it was irradiated with a laser in the spectrum of 365-400 nm for 2 minutes with a power density of 3 MW/cm2.

Results and discussion. When performing lung resection by the type of lobectomy, almost all rats received a small amount of air through the puncture sites of the lungs, even with the use of atraumatic needles 4/o and the use of U-shaped sutures.

In the control group of animals in the postoperative period, hypoxia phenomena were observed, which was manifested by a delayed recovery of physical activity. During the studies, the accumulation of blood in the right pleural cavity and partial lung collapse were noted in dynamics, the healing process was delayed up to 14-21 days.

In the experimental group of animals, respiration began to be carried out immediately after surgery due to hemo- and aerostasis after the use of Hemoben. Laser stimulation promoted rapid healing of wounds without signs of infection. During euthanasia, the lungs are completely straightened out within the prescribed time. There was no effusion and accumulated hematoma in the right pleural cavity.

Thus, the use of the domestic Hemoben wound coating contributes to the rapid and final stop of bleeding, as well as persistent aerostasis from the area of the sutured lung and bronchial tissue. The technique of using Hemoben powder has shown that as a result of polymerization, this agent seals the area of the bronchial stump and punctures of lung tissue. The use of laser radiation makes it possible to have a stimulating wound healing effect even in the presence of contaminated pathogenic microflora (Fig. 1).

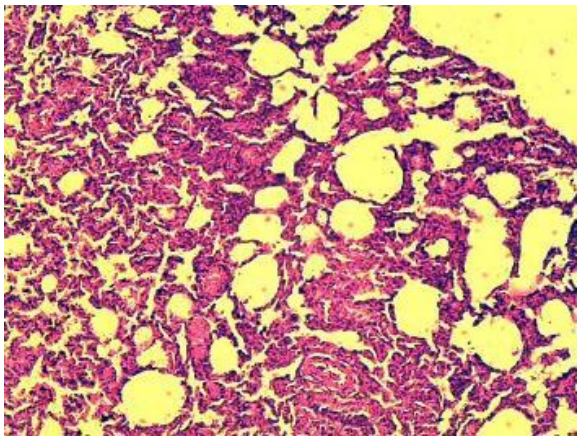

Fig. 1. Lung resection zone. Complete regeneration of damaged alveoli. Normalization of the structure of the alveoli. An experienced group. 21 days. CM. Mr. 10x10.

In ex vivo experiments using isolated sheep lung with the usual method of suturing the bronchial stump with nodular sutures, the use of wound coating also provided convincing short-term aerostasis for 15-30 minutes under the condition of pressure in the bronchial system up to 15 cm of water column. At higher pressure, the duration of full aerostasis decreased. In an experimental group of studies with the formation of bronchial stump sutures using a new technique, the use of Hemoben wound coating provided hermeticism for 1 hour after surgery at a pressure of 15 cm of water column. It should be noted that without the use of wound coating, air intake was noted through needle punctures immediately after the start of the test tests.

The conducted experimental and morphological studies have convincingly demonstrated all the advantages of the proposed method, which allowed it to be introduced into clinical practice and actively used in EL surgery.

The choice of a treatment strategy for patients with echinococcosis of the lungs depends on many factors, among which it is necessary to distinguish such as the severity of the course of the disease (the nature of the lesion, the number of cysts, the size of cysts, the presence of complications in the form of a breakthrough into the pleural cavity or bronchus, suppuration), as well as the individual experience of the surgeon, which may be limited only organ-sparing operations. It is these two factors that often cause the need to seek surgical help in specialized departments. Often, our center receives patients after operations performed in any regional or district clinics with various complications, the development of which is associated with tactical shortcomings, in particular, with the chosen minimally aggressive surgical tactics. Performing organ–sparing operations - echinococcectomy from the lung with or without suturing the residual cavity (RC) with complicated EL can lead to severe postoperative complications, including failure of the sutures of the capitonage with the development of suppuration of the RC, bronchial

stump fistula, pleural empyema, obstructed pleurisy, etc. In most such cases, only additional minimally invasive or open interventions allow to resolve the complication. In turn, the complicated nature of the course of EL can cause the development of complications after resection interventions. Therefore, for practical thoracic surgery, it is necessary to continue developments in the aspect of improving the results of operations with complicated EL.

The closest analogue to the proposed method is the surgical method of treating patients with bronchial lung cysts, which consists in opening the cyst, resection of the cyst walls protruding above the surface of the lung, after which the inner walls of the cyst are treated with a laser beam with an output power of 25-30 watts. With this technique, the authors sought to sterilize the cavity, as well as eliminate the bronchial lining of the inner walls of the cyst. Next, the cyst itself is sutured with separate wrapping sutures. Then, according to the indications, lobectomy, or bilobectomy, or pneumonectomy, or marginal lung resection is performed. Bronchial stump suturing, hemostasis, aerostasis, drainage and wound suturing are performed [13].

The disadvantages of this method are that the surface effect of laser photocoagulation is not enough for good hemostasis, which is necessary for the prevention of hematomas in the sutured cyst bed, radiation in this spectrum causes destruction of lung tissue, which can aggravate the healing process of the bronchi. The laser power used in the prototype is aimed at destroying the parasite and does not prevent the development of microbial infection.

Thus, the task is to improve the results of lung resection in giant EL or echinococcosis complicated by a breakthrough into the bronchus, pleural cavity and suppuration, with the prevention of the development of suture failure by additional sealing of the bronchial sutures, as well as stimulation of healing of the wound surface of the lungs.

The task is solved by the fact that the method of surgical treatment of giant infected echinococcal lung cysts includes opening the fibrous capsule and removing the chitinous shell of the echinococcal cyst, treating the residual cavity of the echinococcal cyst with a germicidal agent, performing lobectomy (or bilobectomy, or pneumonectomy, or marginal lung resection), suturing the bronchial stump, laser exposure and wound suturing. At the same time, the bronchial stump is sutured manually, for which separate octagonal nodular sutures are applied to the membranous and cartilaginous edges of the bronchial stump with atraumatic monofilament absorbable suture material 3/0 in the following order: one suture loop is applied to the side wall of the bronchial stump, and the second to the upper edges of the bronchial stump, 2-3 octagonal nodular sutures are applied between these sutures with a similar suture material the seam at a distance of 4-5 mm between the seams, laser exposure includes the treatment of the bronchial stump with a Matrix laser radiation with a wavelength of 365-400 nm at a power density of 3 MW / cm^2 for 1 minute, after which a powdered Hemoben composition in the amount of 60 mg per 4 cm^2 is applied to the lung wound and bronchial stump, then the operation is completed in the usual manner.

Justification of suturing the stump of the bronchus according to the claimed method. It should be taken into account that in the method of surgical treatment of giant, complicated EL, in which it is necessary to perform resection of the affected lobe of the lung, very often the lobar bronchus turns out to be short and wide.

To overcome this obstacle, the stump of the bronchus is sutured manually, by applying separate octagonal nodular sutures to the membranous and cartilaginous edges of the bronchus stump with atraumatic monofilament absorbable suture material 3/0, one loop of which is superimposed on the side wall, and the second on the upper edges of the bronchus stump, 2-3 octagonal nodular sutures are superimposed between these sutures with a similar suture material at a distance of up to 4-5 mm between the seams (Fig. 2-4). Next, the wound surface of the lung is treated with Matrix laser radiation with a wavelength of 365-400 nm at a power density of 3 MW / cm2 for 1

minute, after which Hemoben powder in the amount of 60 mg per 4 cm2 is applied to the lung wound and bronchus stump, which completely polymerizes and turns into a translucent sealed film.

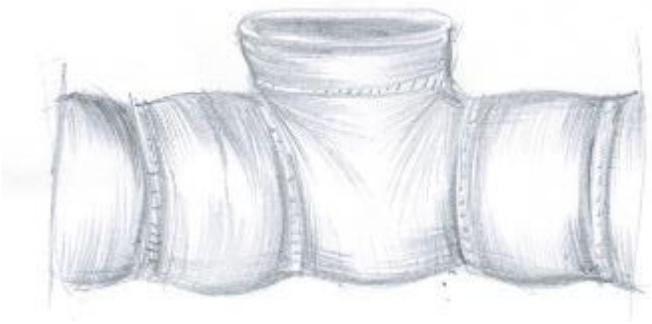

Fig. 2. View of the bronchial stump after resection

Fig. 3. The imposition of separate octagonal nodular sutures on the membranous and cartilaginous edges of the bronchus stump

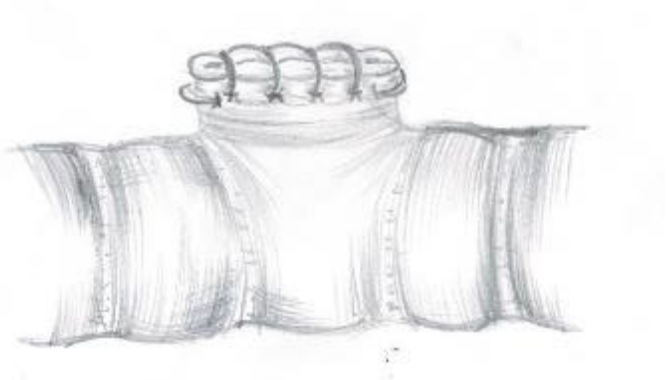

Fig. 4. The final view of the sutured stump of the bronchus

To implement the described method, a domestic bioabsorbable surgical hemostatic agent was used from a composite polymer material made of cotton cellulose derivatives "HEMOBEN", developed at the State Institution "RSSPMCS named after Academician V.Vakhidov", for which

the patent "Bioabsorbable surgical hemostatic agent" of the Intellectual Property Agency of the Republic of Uzbekistan was obtained (IAP 05906 of 23.03.2015). Local production and low price of the drug ensures its availability for medical and preventive institutions and for a wide segment of the population.

Hemostatic agent "HEMOBEN" has the ability to quickly stop bleeding, high biocompatibility, easily decomposes and has a positive effect on wound healing, speeding up the healing process and mucosal repair, improves the regenerative and drainage functions of the tracheobronchial tree.

The domestic bioabsorbable agent "HEMOBEN" is a composition containing Na-carboxymethyl cellulose, oxidized viscose, oxidized cellulose, calcium chloride in the ratio, wt%, respectively: 46,5%, 10,5%, 19,0%, 24,0%.

Viscose is an artificial polymer of cellulose, characterized in that it has the ability of biodegradation, whereas cellulose is practically not destroyed in the body. This ensures a prolonged effect of the wound coating.

Na-CMC is a hydrophilic component, has increased adhesion to tissues. It dissolves quickly in water and physiological fluids. Bio-dissolution within 1 day.

Oxidized cellulose is a hydrophilic component of the drug. It has a hemostatic property. In aqueous solutions, it takes a dispersed form. Biodegradation in 2-3 weeks.

Ca+ - ions are the most powerful factor of hemostasis, provide rapid hemostasis by forming a blood clot.

Hemobene is obtained by mixing powdered components in the claimed proportions, sterilization and freeze-drying.

To implement the claimed method, a Matrix laser device was used. Country of origin: Russia.

Characteristic: A variety of spectral ranges: Due to the ability to use a variety of nozzles, the Matrix device (2-channel) is able to conduct both infrared and ultraviolet irradiation of the patient's blood intravenously, work in tandem with physiotherapy devices, use nozzles that differ in their properties. Banks for vacuum massage can be connected to this laser therapy device.

The main feature of the MATRIX (Two-Channel) device is the ability to adjust the type and intensity of radiation depending on the patient's biorhythms. This laser therapy device has sensors that detect radiation not absorbed by tissues and cells. As a result, therapy becomes a purely individual procedure that brings the maximum possible benefit to the body.

ALT "Matrix", thanks to its unique parameters, allows you to implement all known methods of laser therapy with maximum efficiency! The determining factor in assessing the quality of laser therapeutic equipment is its effectiveness, i.e. the technical capabilities of the device, which realize to the greatest extent the possibilities of laser therapy.

Advantages of the claimed method:

- the imposition of separate octagonal sutures on the bronchial stump, unlike a hardware suture, can be used with a short bronchial stump, eliminates excessive compression and trophic disturbance in the infected, edematous wall of the bronchial stump, and unlike a simple nodular or continuous suture provides better sealing, less trauma and a reduction in the risk of suture failure.
- Laser radiation in the spectrum of 365-400 nm accelerates wound healing, and also has an antimicrobial effect due to increased local immunity.

- Hemoben powder, when applied to the resection zone, adheres to the wound surface, forms a translucent film that provides additional sealing of the bronchial stump, prevents the penetration of microflora into the area of the sutured bronchial stump, provides hemo- and lymphostasis.

The method is carried out as follows:

A patient with EL is given a lateral thoracotomy in the 4th or 5th intercostal space from the side of the lesion and depending on the location of echinococcal cysts in which lobe. After the revision, the area of the cavity formation is lined with gauze swabs, after which an echinococcal cyst is punctured, in the presence of thick contents and it is impossible to remove it through a puncture needle, the fibrous capsule is opened and the chitin shell is removed, and in the presence of all daughter and grandchild cysts in compliance with the recommended principles of aparasitarity. After removing all the contents, the residual cavity is treated with a 3% solution of H_2O_2 (hydrogen peroxide), after which the viability of the lobe or lung, the development of irreversible processes, the volume of the lesion within the lobe, two lobes or the entire lung is evaluated. If a lesion of 2/3 of the lobe is determined, a lobectomy is performed, or multiple echinococcosis or a giant cyst on the right spreads within 2 lobes, then a bilobectomy is performed, with a complete lesion of one lung, a pneumonectomy is performed. With a marginal location of a complicated cyst, marginal resection of the lung is performed. The stump of the bronchus (Fig. 1) is sutured manually by applying separate octagonal nodular sutures to the membranous and cartilaginous edges of the bronchus stump with atraumatic monofilament absorbing suture material 3/0 (Fig. 2), one loop of which is superimposed on the side wall, and the second on the upper edges of the bronchus stump, 2-3 octagonal sutures are superimposed between these sutures with a similar suture material nodal seams at a distance of up to 4-5 mm between the seams (Fig. 3). Next, the bronchial stump is treated with Matrix laser radiation with a wavelength of 365-400 nm at a power density of 3 MW / cm2 for 1 minute, after which Hemoben powder in the amount of 60 mg per 4 cm^2 is applied to the lung wound and bronchial stump, which is completely polymerized and turns into a translucent sealed film. Sanitation of the pleural cavity, deserized areas are sutured with nodular U-shaped sutures. The water plug is hermetically sealed. Hemostasis, aerostasis, two lower drains, rib tightening, layer-by-layer suturing of the postoperative wound, aseptic dressing (Fig. 5-12).

Fig. 5. Opening of an echinococcal cyst

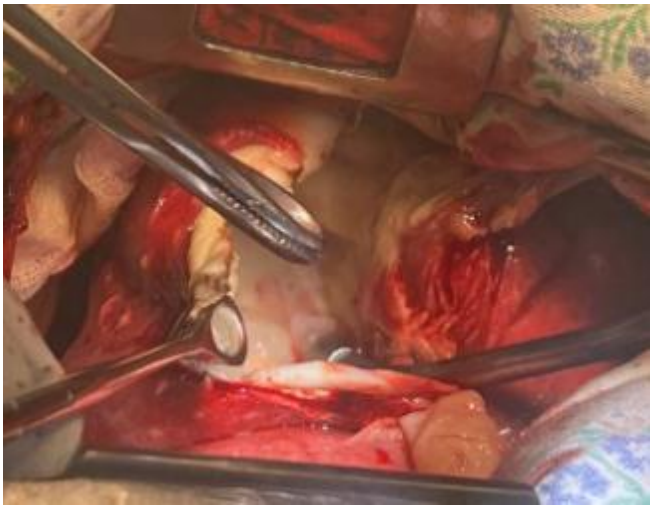

Fig. 6. Residual cavity after removal of the chitin shell

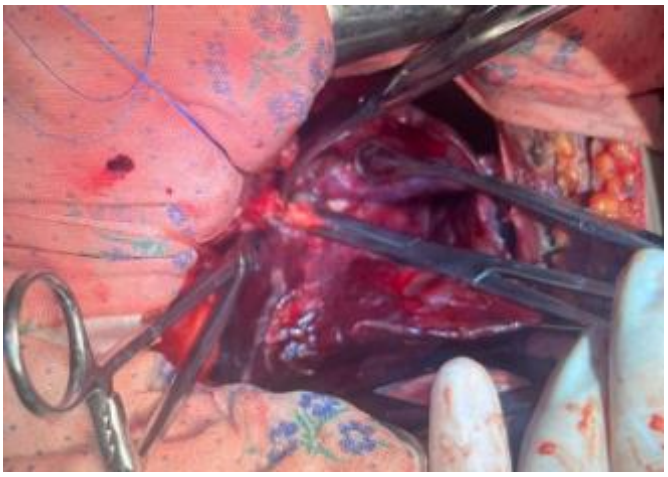

Fig. 7. Lower lobectomy stage

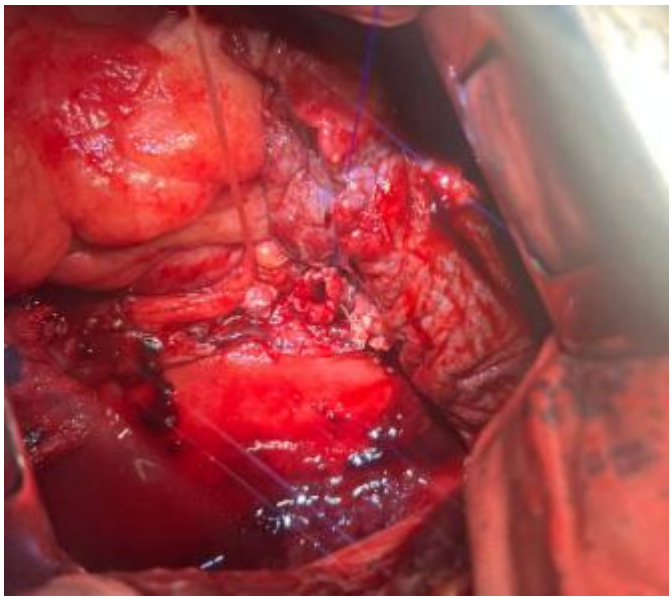

Fig. 8. Bronchial stump after lower lobectomy

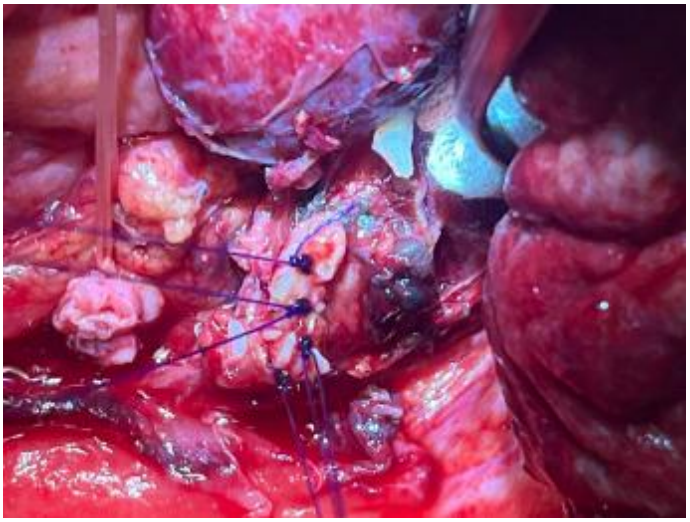

Fig. 9. Bronchial stump sutured according to the proposed method

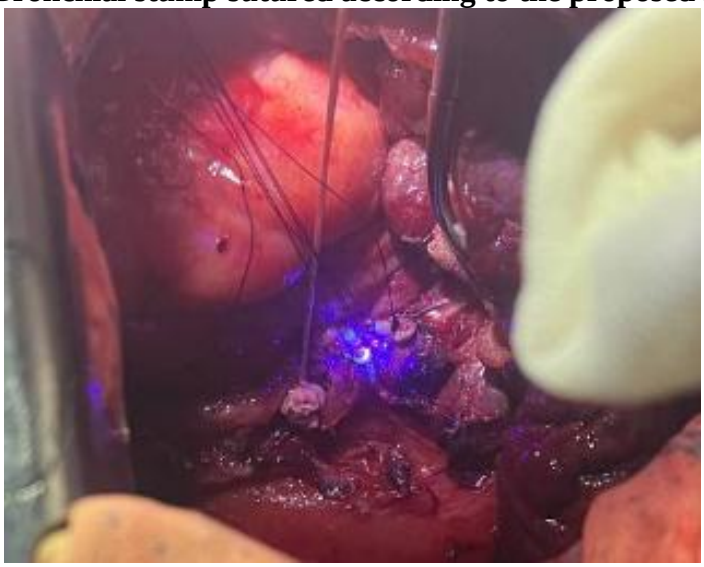

Fig. 10. Treatment of the sutured stump of the bronchus with a Matrix laser

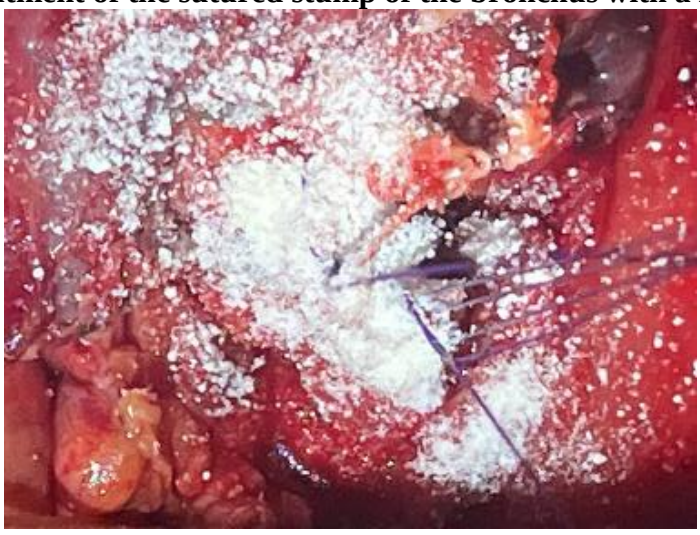

Fig. 11. Application of Hemoben powder to the area of the sutured stump of the bronchus and surrounding tissues

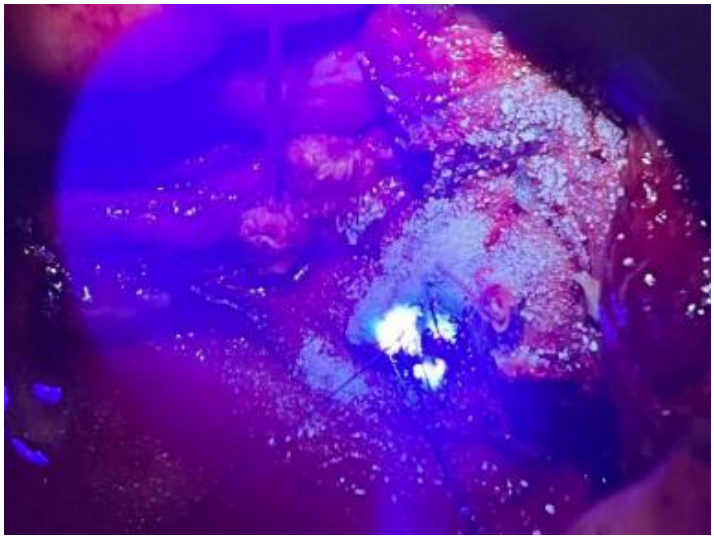

Fig. 12. Repeated treatment of the area of the sutured stump of the bronchus with a Matrix laser

The conducted research allowed us to draw the following conclusion:

For practical thoracic surgery, a method of surgical treatment of giant infected EL cysts is proposed, which consists in performing anatomical resection of the lung with manual suturing of the bronchus stump according to the proposed scheme, followed by local laser exposure and application of a powdered Hemoben composition to the wound surface of the lung and bronchus stump.

This method is characterized by the fact that the imposition of separate octagonal sutures on the stump of the bronchus, in contrast to the hardware suture, can be used with a short stump of the bronchus, which eliminates excessive compression and trophic disturbance in the infected, edematous wall of the bronchus stump, and unlike a simple nodular or continuous suture provides better sealing, less trauma and reduced risk of insolvency seams. Laser radiation in the spectrum of 365-400 nm accelerates wound healing, and also has an antimicrobial effect due to increased local immunity. HEMOBEN powder, when applied to the resection zone, adheres to the wound surface, forms a translucent film that provides additional sealing of the bronchial stump, prevents the penetration of microflora into the area of the sutured bronchial stump, provides hemo- and lymphostasis.

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