



Comparative Evaluation of the Effectiveness of A New Method For Improving the Quality of Aero- and Hemostasis in Lung Surgery

Yakubov Farkhod Radjabovich¹, Niyazmetov Sevarbek Bakhtiyorovich¹,
Sapaev Duschan Shukhratovich¹, Babajanov Kudratbek Bakhtiyarovich¹,
Khayitboeva Komila Khujayazovna¹, Reymberganov Jamshid Ikrom son¹

Urgench branch of Tashkent Medical Academy¹

(Received: 02 September 2023

Revised: 14 October

Accepted: 07 November)

KEYWORDS

Abstract. For clinical surgery, a method for preventing the development of disorders of aero- and hemostasis has been improved, which provides for a two-component strengthening of the zone of resected lung tissue by local application of a hemostatic agent with the formation of a sealed film with subsequent fixation of the parietal pleural leaf to it. It has been proven in clinical practice that the proposed method of preventing the development of disorders of aero- and hemostasis through the use of a hemostatic agent provides a stable tightness of the surface of the resected lung tissue, and fixation of the parietal pleura to this zone contributes to its additional strengthening. It was also determined that the proposed method can significantly reduce the risk of complications after resection operations on the lungs, including failure of aero- and hemostasis, reduce the need for repeated open or minimally invasive interventions, as well as the timing of drainage and the duration of postoperative hospital rehabilitation.

The relevance of the problem. Failure of aerostasis (air leaks) or alveolar-pleural fistulas, as well as problems with hemostasis remain a problem for modern thoracic surgery and one of the most common complications after lung resection [2]. The frequency of air leakage after lung resection in the literature varies from 20 to 33% [3]. Despite advances in surgical technologies and methods, this complication is the main cause of the development of empyema, pneumonia, prolonged drainage and hospitalization, as well as unsatisfactory outcomes of surgery [1, 8, 11]. At the same time, the mortality rate for the failure of aerostasis is 1-12% [9].

Another of the unresolved issues of lung surgery is the problem of effective and persistent hemostasis from damaged lung tissue, which also causes the risk of complications during and after surgery [10]. In the structure of the causes of all repeated interventions after lung surgery, bleeding accounts for more than 80% of cases [7].

Most air leaks are eliminated by themselves within 5 days after surgery and are treated by drainage [4]. However, according to other opinions, any air leak

should be considered as a surgical complication, and not just lasting seven days or more [8].

Various devices (coagulators, mechanical clippers) are used to prevent the development of insolvency in aero- and hemostasis, which are ineffective in the presence of an extensive bleeding surface. Another method of reducing the risk of these complications is the use of various implants that are applied and fixed to the surface of the lungs [5]. At the same time, indications for the use of surgical sealants are contradictory. Some studies have revealed a statistically significant reduction in the length of hospital stay when using them due to a reduction in postoperative air leakage and drainage time [6]. Other authors believe that such sealants are a potential medium for bacterial growth and can increase the frequency of postoperative infections [10].

Against this background, the development of new technologies for the use of various coatings in lung surgery remains a controversial issue. The search continues for new biological sealants and synthetic agents that will be safe when used in patients to seal lung tissue. In turn, the sealants used should be effective in



terms of the development of complications compared to standard closure methods, and should lead to both an improvement in surgical results and a reduction in costs associated with a long stay in the hospital. It is equally important that the coatings being developed should have biodegradable properties and be completely reabsorbed from the surface of the lungs within 14 days after surgery.

The analysis of the literature shows that, despite significant progress in the prevention of the development of prolonged air leakage and persistent hemostasis in lung resection surgery, there are still controversial issues of choosing the optimal coating, which on the one hand would provide high-quality aero- and hemostasis, and on the other hand, would not cause local inflammatory reactions in response to the implantation of a foreign body, that is, it should have a rapid resorptive effect.

Material and methods of research. Clinical studies were conducted among patients operated on during the period from 2019 to May 2023, the material was accumulated in the Khorezm Regional Multidisciplinary Medical Center. There were a total of 122 patients with various benign lung pathology who underwent resection interventions. In the main group of 58 patients (2022-2023), after the resection stage of lung surgery, the proposed method was applied using the domestic hemostatic agent Hemoben to achieve stable aero- and hemostasis. The comparison group included 64 patients (2019-2021) who were comparable in gender, age, pathology and other objective criteria, and aero- and hemostasis was achieved by traditional versions of surgical aids.

The ratio of men and women was virtually equal. In the age aspect, the largest number of patients were aged 20-44 years – 38 (59.4%) in the comparison group and 32 (55.2%) in the main group, persons aged 45-59 years were 19 (29.7%) and 17 (29.3%), respectively.

Among the etiological diseases that caused the marginal resection of the lung in most cases in both groups was echinococcosis – 38 (59.4%) cases in the comparison group and 34 (58.6%) in the main group. Boulez disease was noted in 16 (25%) and 15 (25.9%) cases, respectively, bronchiectatic disease – 5 (7.8% and 5 (8.6%), as well as lung abscess – 5 (7.8% and 4 (6.9%) patients. All patients were operated on as planned.

Patients' complaints did not always reflect the specific nature of the disease and were quite diverse. Among the main complaints were chest pains (in 26 (40.6%) patients

in the comparison group and 24 (41.4%) in the main group), general weakness (in 45 (70.3%) and 39 (67.2%) patients), dry cough (in 18 (28.1%) and 14 (24.1%) of patients, respectively), cough with discharge of mucosal sputum (in 11 (17.2%) and 13 (22.4%) patients), purulent sputum (in 9 (14.1%) and 11 (19%) patients), fever (in 9 (14.1%) and 10 (17.2%) patients).

All patients were operated on as planned, as indicated above, the volume of the operation corresponded to the marginal resection of the lung. According to all the necessary parameters, the study groups were comparable, including a complex of preoperative examination and postoperative management.

The program of postoperative rehabilitation included restorative, anti-inflammatory, broncholytic, desensitizing, antibacterial and analgesic therapy.

The task of the new method is to develop a technique for reliable aero- and hemostasis after resection operations on the lungs, while inexpensive and easy to perform.

The task is solved by the fact that the method of hemo- and aerostasis in lung surgery includes lung resection, application of "HEMOBEN" powder to the wound surface of the lung by insufflation at the rate of 200 micrograms of powder per 10 cm² of the wound surface of the lung, then after 2-3 minutes the excess powder composition is removed by washing with an antiseptic jet for 5 seconds, after which it is repeated the specified powdered Hemoben composition is applied at the rate of 100 micrograms of powder per 10 cm² of the lung parenchyma with the expansion of the powder spraying zone in all directions by 1.5-2.0 cm from the edge of the primary treated surface, then a free flap of the parietal pleura is applied to the treated surface and tightly pressed for 2 minutes and the operation is completed in the conventional manner.

To implement the described method, a domestic bioabsorbable surgical hemostatic agent was used from a composite polymer material from cotton cellulose derivatives "HEMOBEN", developed at the "Republican Specialized Scientific and Practical Medical Center of Surgery 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. Local production and the low price of the drug ensures its availability for medical and preventive institutions and for a wide segment of the population.



Results and discussion. After performing the main stage of marginal resection of the lung intraoperatively, when checking for tightness, only 38.5% (in both groups, 47 out of 122 patients) of cases had high-quality aero- and hemostasis, in turn, 61.5% (in both groups, 75 out of 122 patients) showed inconsistency for these factors, including 24.6% (30 patients) - inadequate hemostasis, 18.0% (22 patients) - inadequate aerostasis and 18.9% (23 patients) have a combination of these complications. The introduction of a new method of local application of hemostatic Hemoben after performing the main stage of lung resection allowed to increase the effectiveness of aero- and hemostasis from 40.6% (in 25 out of 64 patients

in the comparison group) to 87.9% (in 51 out of 58 patients in the main group), which in turn reduced the need for additional stitching lung tissue from 59.4% (in 38 patients in the comparison group) to 12.1% (in 7 of 58 patients in the main group; $\chi^2=31.022$; $df=2$; $p<0.001$), while repeated application of a hemostatic agent with fixation over the resected surface of a light leaf of the parietal pleura intraoperatively ensured 100% quality of the achieved aero- and hemostasis.

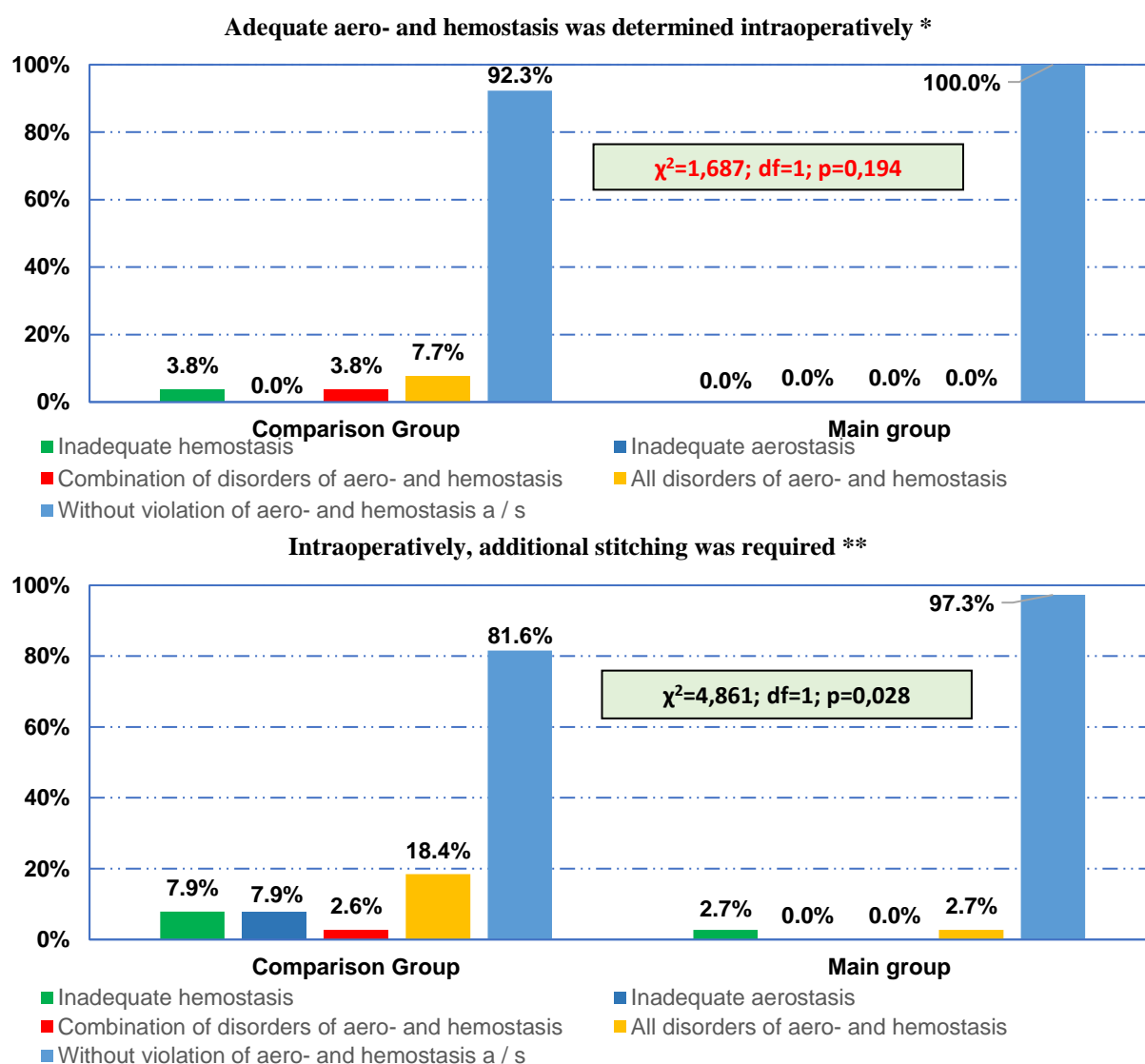
In the early postoperative period, various complications developed in 10 (15.6%) patients in the comparison group and 2 (3.4%) in the main group (Table 1).

Table 1 Frequency of postoperative complications in comparison groups

| Complication | Comparison Group | | Main group | |
|--|-------------------------------------|-------|------------|-------|
| | abs. | % | abs. | % |
| Violation of aerostasis (drainage discharge) | 2 | 3,1% | | 0,0% |
| Violation of aerostasis (pneumothorax) | 3 | 4,7% | | 0,0% |
| Violation of hemostasis | 6 | 9,4% | 1 | 1,7% |
| Empyema of the pleura | 2 | 3,1% | | 0,0% |
| Clouded pleurisy | 1 | 1,6% | 1 | 1,7% |
| Suppuration of a postoperative wound | 2 | 3,1% | 1 | 1,7% |
| Patients with complications | 10 | 15,6% | 2 | 3,4% |
| Patients without complications | 54 | 84,4% | 56 | 96,6% |
| Criterion χ^2 | $\chi^2=5,087$; $df=1$; $p=0,025$ | | | |

Complications were resolved conservatively in 3 (4.7%) patients in the comparison group and 1 (1.7%) in the main group. Also in the comparison group, retoracotomy was performed on day 2 in 1 (1.6%) patient, pleural cavity drainage due to pneumothorax in 2 (3.1%), and in 3 (4.7%) patients, prolonged pleural drainage was required. Thus, even under the condition of verified intraoperatively adequate aero- and hemostasis, in the early postoperative period, in 7.7% of cases in the control group (out of 26 patients, 1 had a hemostasis disorder and a combination of aero- and hemostasis disorders in another 1 patient), the development of these

complications was noted, while in the main group, the use of the new method allowed in 100% of cases, to achieve the absence of this risk ($\chi^2=1.687$; $df=1$; $p=0.194$). In turn, among patients with intraoperative use of additional stitching of lung tissue in the early period after surgery, the use of a new method of strengthening the resected surface of lung tissue reduced the incidence of aero- and hemostasis disorders from 18.4% (in 7 (3 - hemostasis; 3 - aerostasis; 1 - combination of aero- and hemostasis disorders) from 38 patients in the comparison group) up to 2.7% (in 1 (hemostasis) of 37 patients in the main group; $\chi^2=4,861$; $df=1$; $p=0.028$) (Fig. 1).



Note: * - in the main group - after the main stage and the first stage of the new method; ** - in the main group after stitching the lung tissue and performing the final stage of the new method

Fig. 1. Postoperative state of aero- and hemostasis depending on the intraoperative picture after the main stage of the operation

(additional stitching of lung tissue)

Accordingly, the severity of the course of the postoperative period, the need to resolve complications during their development, significantly different drainage periods and the hospital period of postoperative rehabilitation were obtained in the comparison groups. Early drainage removal was performed in 40 (62.5%)

patients in the comparison group and 48 (82.8%) patients in the main group. Drainage removal within 4-5 days after surgery was performed in 15 (23.4%) and 8 (13.8%) patients, respectively, longer drainage of the pleural cavity (more than 5 days) was in 9 (14.1%) patients in the comparison group and only 2 (3.4%) in the main group ($\chi^2=7,034$; $df=2$; $p=0.030$) (Table 2).



Table 2 Timing of drainage removal after surgery

| Days | Comparison Group | | Main group | |
|-------------------|--------------------------------|--------|------------|--------|
| | abs. | % | abs. | % |
| 2-3 days | 40 | 62,5% | 48 | 82,8% |
| 4-5 days | 15 | 23,4% | 8 | 13,8% |
| More than 5 days | 9 | 14,1% | 2 | 3,4% |
| Total | 64 | 100,0% | 58 | 100,0% |
| Criteria χ^2 | $\chi^2=7,034$; df=2; p=0,030 | | | |

The duration of postoperative hospital rehabilitation in 38 (59.4%) patients in the comparison group and 46 (79.3%) patients in the main group ranged from 5 to 7 days. On 8-10 days, 19 (29.7%) and 11 (19%) patients were discharged, respectively, and there was a longer hospitalization (more than 10 days) in 7 (10.9%) patients in the comparison group and only 1 (1.7%) in the main

group ($\chi^2=7,117$; df=2; p=0.029) (Table 3). The average drainage time in the comparison group was 3.9 ± 2.5 days, while in the main group they decreased to 2.9 ± 1.2 days ($t=2.79$; $p<0.05$). The duration of postoperative rehabilitation in the clinic was 7.7 ± 2.7 days in the comparison group and 6.3 ± 1.6 days in the main group ($t=3.53$; $p<0.05$) (Fig. 2).

Table 3 Duration of the postoperative stage

| Number of days | Comparison Group | | Main group | |
|-------------------|--------------------------------|--------|------------|--------|
| | abs. | % | abs. | % |
| 5-7 days | 38 | 59,4% | 46 | 79,3% |
| 8-10 days | 19 | 29,7% | 11 | 19,0% |
| 11 days or more | 7 | 10,9% | 1 | 1,7% |
| Total | 64 | 100,0% | 58 | 100,0% |
| Criteria χ^2 | $\chi^2=7,117$; df=2; p=0,029 | | | |

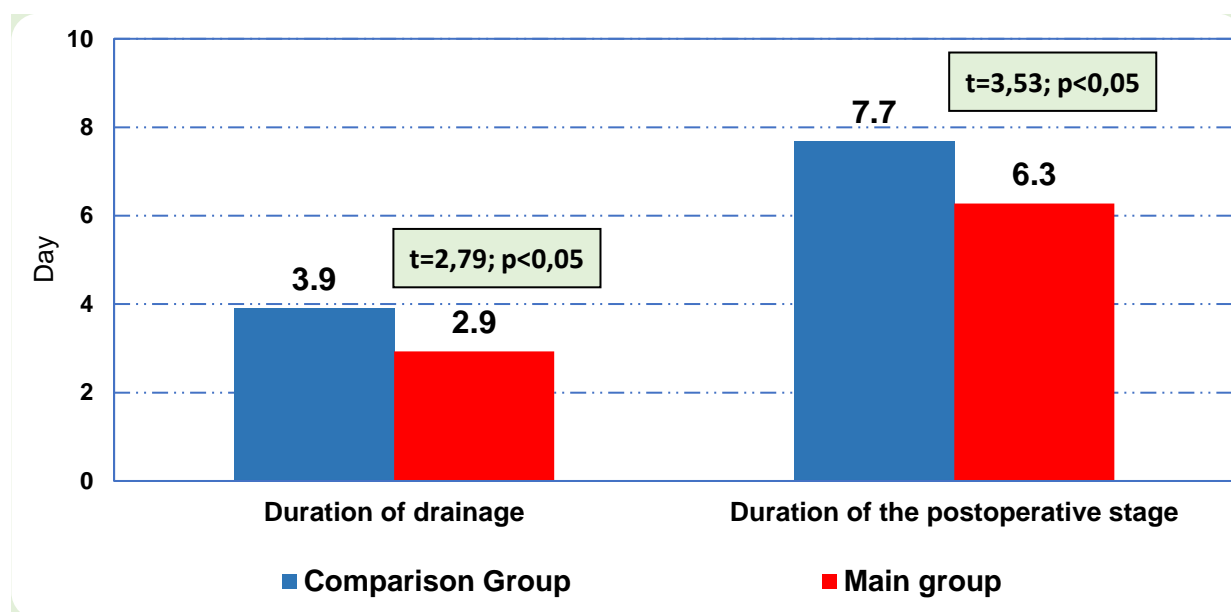


Fig. 2. Average duration of drainage and postoperative stage (days; $M \pm \sigma$)

In general, by groups, the use of a new method of hemo- and aerostasis in lung surgery provided a significant reduction in the risk of developing these complications in the early postoperative period. In general, the incidence of complications decreased from 15.6% (in 10 of 64 patients in the comparison group) to 3.4% (in 2 of 58 patients in the main group; $\chi^2=5.087$; $df=1$; $p=0.025$), among which the impairment of the viability of aero- and hemostasis decreased from 14.1% (in 9 patients in the comparison group) to 1.7% (1 patient in the main group), respectively, this reduced the need for conservative resolution of complications from 9.4% (in 6 patients in the comparison group) to 1.7% (in 1 in the main group), as well as completely leveling the risk of repeated interventions (4.7% in the group comparison; $\chi^2=6.327$; $df=1$; $p=0.043$). Reducing the risk of postoperative complications allowed to reduce the duration of drainage from 3.9 ± 2.5 days in the comparison group to 2.9 ± 1.2 days in the main group ($t=2.79$; $p<0.05$), as well as the duration of postoperative hospital rehabilitation from 7.7 ± 2.7 to 6.3 ± 1.6 days ($t=3.53$; $p<0.05$).

Conclusions.

1. The introduction of a new method of local application of hemostatic Hemoben after performing the main stage of marginal resection of the lung allowed to increase the intraoperative efficacy of aero- and hemostasis from 40.6% to 87.9%, which reduced the need for additional

stitching of lung tissue from 59.4% to 12.1% ($p<0.001$), while repeated application of hemostatic means with fixation on top of the resected surface of the lung leaf of the parietal pleura were characterized by 100% adequate aero- and hemostasis.

2. Even under the condition of verified intraoperatively adequate aero- and hemostasis, in the early postoperative period, the development of these complications was noted in 7.7% of cases in the comparison group, while in the main group, the use of the new method allowed in 100% of cases to achieve the absence of this risk ($p=0.194$), in turn, among patients with intraoperative the use of additional stitching of lung tissue in the early period after surgery, the use of a new method of strengthening the resected surface of lung tissue made it possible to reduce the incidence of aero- and hemostasis disorders from 18.4% to 2.7% ($p=0.028$).
3. In general, the use of a new method of hemostasis and aerostasis in lung surgery provided a reduction in the frequency of postoperative complications from 15.6% to 3.4% ($p=0.025$), including the failure of aero- and hemostasis from 14.1% to 1.7%, which reduced the need for conservative resolution of complications from 9.4% to 1.7%, as well as to level the risk of repeated interventions (from 4.7%; $p=0.043$), to reduce the duration of



drainage from 3.9 ± 2.5 to 2.9 ± 1.2 days ($p < 0.05$) and the duration of postoperative hospital rehabilitation from 7.7 ± 2.7 to 6.3 ± 1.6 days ($p < 0.05$).

References:

1. Babadjanov, A.K., Yakubov, F.R., Ruzmatov, P.Y., Sapaev, D.S., 2021. Epidemiological aspects of echinococcosis of the liver and other organs in the Republic of Uzbekistan. *Parasite Epidemiol. Control.* <https://doi.org/10.1016/j.parepi.2021.e00230>.
2. Bronstein ME, Koo DC, Weigel TL. Management of air leaks post-surgical lung resection. *Ann Transl Med.* 2019 Aug;7(15):361. doi: 10.21037/atm.2019.04.30. PMID: 31516907; PMCID: PMC6712254.
3. Chopra A, Hu K, Judson MA, Fabian T, Nabagiez JP, Feustel PJ, Fantauzzi J, Chieng H, Austin A, Vancavage R, Maldonado F, Rahman N, Huggins JT, Doelken P. Association between Drainage-Dependent Prolonged Air Leak after Partial Lung Resection and Clinical Outcomes: A Prospective Cohort Study. *Ann Am Thorac Soc.* 2022 Mar;19(3):389-398. doi: 10.1513/AnnalsATS.202103-235OC. PMID: 34715010.
4. Dugan KC, Laxmanan B, Murgu S, et al. Management of persistent air leaks. *Chest* 2017;152:417-23. 10.1016/j.chest.2017.02.020.
5. Gonzalez M, Karenovics W, Bédar B, Forster C, Sauvain MO, Triponez F, Christodoulou M, Krueger T, Perentes JY. Performance of prolonged air leak scoring systems in patients undergoing video-assisted thoracoscopic surgery segmentectomy. *Eur J Cardiothorac Surg.* 2022 Aug 3;62(3):ezac100. doi: 10.1093/ejcts/ezac100. PMID: 35229873.
6. Iyama S, Sato T, Murase K, et al. Successful treatment of fibrin glue sealant for pneumothorax with chronic GVHD resistant to autologous blood patch pleurodesis. *Intern Med* 2012;51:2011-4. 10.2169/internalmedicine.51.7355
7. Li J, Xue Q, Gao Y, Mao Y, Zhao J, Gao S. Bleeding is the most common cause of unplanned return to operating room after lung cancer surgeries. *J Thorac Dis.* 2020 Dec;12(12):7266-7271. doi: 10.21037/jtd-20-2651. PMID: 33447415; PMCID: PMC7797821.
8. Mueller MR, Marzluf BA. The anticipation and management of air leaks and residual spaces post lung resection. *J Thorac Dis* 2014;6:271-84.
9. Sridhar P, Little VR, Okada M, Suzuki K. Prevention of Postoperative Prolonged Air Leak After Pulmonary Resection. *Thorac Surg Clin.* 2020 Aug;30(3):305-314. doi: 10.1016/j.thorsurg.2020.04.007. Epub 2020 May 22. PMID: 32593363.
10. Wu X, Xu S, Ke L, Fan J, Wang J, Xie M, Jiang X, Xu M. [Establishment of A Clinical Prediction Model of Prolonged Air Leak after Anatomic Lung Resection]. *Zhongguo Fei Ai Za Zhi.* 2017 Dec 20;20(12):827-832. Chinese. doi: 10.3779/j.issn.1009-3419.2017.12.06. PMID: 29277181; PMCID: PMC5973385.
11. Yakubov Farkhod Radjabovicha, Sapaev Duschan Shukhratovich, & Niyazmetov Sevarbek Bakhtiyorovich. (2023). The treatment of the results of pleural empyema complicated with bronchopleural fistula. *Research Journal of Trauma and Disability Studies*, 2(4), 241–246. Retrieved from <http://journals.academiczone.net/index.php/rjtds/article/view/748>