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**EVALUATION OF THE EFFECTIVENESS OF VARIOUS METHODS OF TREATMENT OF ACUTE PURULENT-DESTRUCTIVE LUNG DISEASES IN PATIENTS WITH DIABETES MELLITUS**

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*Abstract: Background. Increasing the effectiveness of treatment of lung abscesses is an urgent problem of thoracic surgery in connection with the increase in the contingent of patients with respiratory diseases, an increase in the number of complications and adverse outcomes of purulent-destructive diseases of the lungs and pleura.*

*Keywords: acute purulent lung abscess, acute gangrenous lung abscess, diabetes mellitus, vacuum therapy, transthoracic sanitation*

**Material.** The clinical study is based on the results of treatment of 107 patients with acute lung abscesses against the background of diabetes mellitus. Patients were examined and treated in the surgical infection department of the Multidisciplinary Clinic of the Tashkent Medical Academy from 2002 to 2022 years.

**Results.** The high effect of the use of vacuum therapy in the rehabilitation of lung abscesses has a pronounced positive effect. The results are confirmed by the analysis of clinical signs in the process of transthoracic sanitation of lung abscesses, the identification of differences in the manifestation of detoxification, anti-inflammatory and immunocorrective effects in comparison with the results of fibrobronchoscopy, ultrasound and volume measurements introduced and excreted during the sanitation of liquids.

**Conclusion.** Rehabilitation of foci of destruction with the help of controlled negative pressure allowed to improve clinical outcomes with a high severity index of the disease in patients with acute lung abscesses against the background of diabetes mellitus.

**Introduction**

In recent years, the frequency of lung abscesses complicated by pyopneumothorax, bleeding, sepsis is from 15.8 to 43.6%, and the transition to a chronic form is observed in 11-32% of patients. Mortality in acute lung abscesses varies from 1 to 28.3%, in gangrenous it reaches 23.4-74.1%, and in complicated forms - 54% [3,7,9].

The main principles of treatment of lung abscesses are the effect on infection, drainage of the abscess, elimination of homeostasis disorders and increasing the body's resistance. The use of antibacterial drugs is an indispensable component of the treatment of patients with lung abscesses, while assessing the sensitivity of pathogenic microflora to antibiotics, factors of persistence of microorganisms and methods of drug delivery to the lesion are important [12,27,29].

In the treatment of patients with lung abscesses, various efferent methods are actively

used, but their effectiveness in the peripheral localization of abscesses is expressed only when combined with active methods of local sanitation. Only mechanical cleansing of the abscess cavity with antiseptic solutions does not lead to a cure, since the pathogenetic links associated with the pathological focus (regeneration processes, scar tissue formation, local immunity, etc.) are not involved. [1,7,14].

Drainage and sanitation of a lung abscess can be performed in two ways - through the bronchus and through the chest wall. A highly effective method of treatment is fibrobronchoscopy, but its role in the peripheral localization of the process is mainly reduced to the rehabilitation of concomitant endobronchitis. Indications for transthoracic sanitation of lung abscesses are limited by the depth of the abscess, its location, the presence of pyopneumothorax, etc., however, the methods of "small pulmonary surgery" are used in the treatment of patients in this group. In recent years, combined and combined methods of transthoracic sanitation have been successfully used in patients with peripheral localization of lung abscesses, which have improved treatment outcomes, but some issues of pathogenesis and clinical efficacy remain poorly understood [2,28,33].

### **Material and methods**

The clinical study is based on the results of treatment of 107 patients with acute lung abscesses against the background of diabetes mellitus. Patients were examined and treated in the surgical infection department of the Multidisciplinary Clinic of the Tashkent Medical Academy from 2002 to 2022 years. Before inclusion in the study, patients received informed consent. The protocol of the clinical examination is approved by the local ethical committee. The criterion for inclusion in the study was the presence in patients of diabetes mellitus, and acute lung abscesses with peripheral localization, which are indicated for transthoracic sanitation (ineffectiveness of conservative treatment using bronchological methods).

The criterion for exclusion from the study were absolute contraindications for transthoracic debridement: pulmonary haemorrhage, tense pyopneumothorax, common pleural empyema, chest wall phlegmon, pulmonary heart failure, hepatic-renal failure, acute disorders of cerebral and coronary circulation, respiratory failure III degree, acute psychosis, schizophrenia and epilepsy and relative contraindications: age over 70 years; ischemic heart disease; heart rhythm disturbances; subtotal contralateral pneumonia; sepsis.

To solve the tasks, all patients with acute lung abscesses were divided into 4 groups.

Group I (comparison group) included 29 patients who used standard treatment, including antibacterial (macrolides, cephalosporins, aminoglycosides) and detoxification therapy, vitamins, drugs that improve the drainage function of the bronchi, rheological properties of blood, sanational fibrobronchoscopy, transthoracic sanitation of lung abscesses with 0.01% chlorhexidine solution.

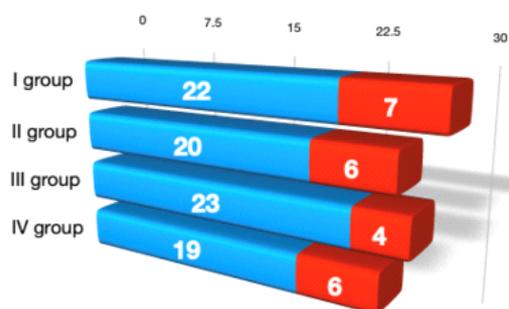
Group II consisted of 26 patients whose standard treatment was supplemented with transthoracic sanitation of lung abscesses with 0.06% sodium hypochlorite solution (instead of chlorhexidine).

Group III included 27 patients in whom standard treatment was combined with transthoracic rehabilitation of lung abscesses with a 0.06% solution of sodium hypochlorite with a controlled negative pressure system in the mode of up to -25 mm Hg.

Group IV consisted of 25 patients with lung abscesses, in whom standard treatment was supplemented by transthoracic rehabilitation of lung abscesses with differentiated modes of the controlled negative pressure system.

The main contingent of patients were men, there were 95 (88.5%), and 12 (11.5%) - were women. The median age of the patients was 49.1±1.8 years. The main localizations of abscesses were the upper lobes of the right and left lungs to them (32 and 19 patients,

respectively), the 6th segment of the right and left lungs (17 and 12 patients, respectively). The distribution of patients by clinical forms of abscesses is presented in figure 1.



**Fig.1. Distribution of patients in groups by a clinical form of abscesses**

The severity index of the disease in the groups ranged from 0.275 to 0.625. Of the total contingent, 32 (29.9%) patients had moderate (0.15-0.25), 49 (45.8%) - medium (0.275-0.5) and 26 (22.3%) - severe disease (0.5-0.75). The average value of the disease severity index in group IV was significantly higher than that in group I (Table 1).

In 42 (39.3%) patients out of 107 had complications of the underlying disease. In 49 (45.8%) patients there were previous respiratory diseases: chronic obstructive pulmonary diseases were observed in 45 (42.1%), pleuropneumonia - in 11 (10.3%), diffuse pneumosclerosis - in 7 (6.5%), exudative pleurisy - in 6 (5.6%), focal tuberculosis - in 1 (0.9%) and tuberculoma - in 2 (1.9%) patients. Chronic obstructive pulmonary diseases were the background for almost all previous respiratory diseases; 59 patients (55.1%) had concomitant diseases.

**Table 1**

**The severity of the disease according to the corresponding index in patients with lung abscesses**

The severity of the disease	I group (n=20)	II group (n=20)	III group (n=23)	IV group (n=25)
Disease severity index	0.40±0.02	0.43±0.02	0.47±0.02	0.48±0.02

Thus, all groups were comparable in gender, age compositions, localization and clinical forms of lung abscesses, the presence of complications, background, and concomitant diseases.

**Results**

Transthoracic sanitation of lung abscesses with a 0.06% solution of sodium hypochlorite contributed to a faster regression of the main clinical symptoms from the 3rd day from the start of treatment of patients: body temperature decreased to subfebrile numbers, sleep and appetite normalized, sputum discharge improved, it acquired a mucopurulent character on the 4th and mucous membrane - on the 9th day, while in group I these signs were noted on the 10th and 14th day, respectively.

With ultrasonic testing of the contents of the cavity, a significant coloring of the dense residue, a decrease in the size of pulmonary sequestrations were recorded, with fluorography, a noticeable decrease in the level of fluid in the cavity, a narrowing of the perifocal infiltration zone were noted.

With fibrobronchoscopy, it was noted that the use of sodium hypochlorite solution for sanitation by 3 days from the start of transthoracic sanitation leads to the relief of



diffuse purulent-fibrinous and purulent endobronchitis; local catarrhal inflammation with localization in the zone of the draining bronchus on the 9th day persisted only in 3 (11.5%) patients. Transthoracic sanitation of abscesses with a 0.01% solution of chlorhexidine also stopped acute inflammation in the bronchi, but signs of purulent endobronchitis in this group of patients persisted for 5 days more than in group II.

Analysis of the ratio of volumes of injected and excreted fluid during transthoracic debridement of lung abscesses showed that during the first procedure in both groups, the volumes of fluid removed from the cavity of the abscess and tracheobronchial tree were less by 8-9% compared to the volumes of injected fluid. With subsequent transthoracic debridement, this difference increased, especially in group II. Comparing clinical signs with radiological data, Ultrasound and endoscopic examinations, we concluded that this difference is due to a decrease in the size of the cavities and their cleansing of viscous purulent contents, the restoration of the drainage function of the bronchi and, most importantly, the translocation of sanitation solutions into the bloodstream through the walls of the cavities and the bronchial mucosa.

A decrease in the volume of excreted fluid in group II in comparison with the positive dynamics of general and local signs of the disease (a decrease in the size of the cavities, a narrowing of the perifocal infiltration zone, an improvement in blood flow in the abscess wall and around it, a decrease in the activity and prevalence of endobronchitis), a decrease in the disease severity index by 30% compared to group I and markers of intoxication (rates of decrease in the leukocyte index of intoxication in group II, they exceeded those in group I by 33%, the rise in the leukocyte index of intoxication - respectively, by 11%) allows us to state not only the local, but also the general resorptive effect of sodium hypochlorite.

Bacteriological analysis of the contents of abscesses showed that by 21 days from the beginning of transthoracic debridement, most pathogenic microorganisms were sensitive to sanitation media, except for *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Candida albicans* in group II, and in group I also *Staphylococcus aureus*. With repeated determinations in group II, the number of patients in whom the specified cavities were isolated in the contents of the cavities decreased. Microorganisms: they were mostly monocultures.

Clinical outcomes obtained in the II group of patients confirm this fact: complete recovery occurred in 21 (80.8%) of 26 patients, clinical recovery - in 2 (7.7%), the transition to a chronic form was observed in 2 (7.7%) and the progression of the process - in 1 (3.8%) patient. In group I, scarring of the cavity occurred in 21 (72.4%) of 29 patients, 1 patient died because of an increase in pulmonary heart failure, 3 patients were operated on in an emergency (pulmonary haemorrhage (1), progression of the purulent-destructive process (2)). In 3 patients, abscesses became chronic, and 1 more formed a dry residual cavity.

Thus, it can be stated that the use of a 0.06% solution of sodium hypochlorite for transthoracic sanitation has certain advantages compared to the use of a 0.01% solution of chlorhexidine, which is due not only to the mechanical cleaning of the cavity because of its washing with sodium hypochlorite, but also by its resorptive action. This fact is confirmed by the positive dynamics of the size of the cavities, the narrowing of the perifocal infiltration zone, the improvement of blood circulation in the cavity wall, the faster rate of decrease in the activity and prevalence of endobronchitis, the decrease in the severity of the disease and its outcomes. The antibacterial, anti-inflammatory and detoxification effects of the resorptive effect of sodium hypochlorite solution are confirmed by the results of clinical and laboratory, instrumental, bacteriological, biochemical, and immunological studies, and the very fact of resorption, in addition to these effects,

is confirmed by the difference in the ratio of volumes of injected and excreted fluid during transthoracic sanitation of lung abscesses.

Positive changes in the clinical-radiological and ultrasound picture of the disease in patients of group III occurred in a shorter time from the beginning of combined transthoracic reorganization. With fibrobronchoscopy, it was recorded that signs of local mucopurulent endobronchitis in group II persisted for 7 days from the onset of transthoracic reorganization, whereas in group III they disappeared already for 4-5 days. In 44.4% of patients of group III, the prevalence of catarrhal endobronchitis already on the 9th day was limited to the framework of the draining segmental bronchus.

The restoration of the leukocyte index of intoxication to the level of the norm in group III occurred by 14 days from the beginning of transthoracic reorganization, while in patients of group I it significantly exceeded the norm level by this time by more than two times. The leukocyte index of intoxication on the 14th day in the III group also did not differ from the norm, while in the I group its value was only 71.8% of the norm level and was lower than in the III group by 35.3%. In the II group, the decrease in the leukocyte index of intoxication was 46.1% of its level by the beginning of transthoracic sanitation, exceeding the physiological norm by 1.5 times.

The elimination of purulent inflammation in the abscess cavity was facilitated by a pronounced antibacterial effect of 0.06% sodium hypochlorite solution, both due to its local bactericidal action in the focus of purulent inflammation and because of resorption of sodium hypochlorite in the bronchopulmonary system. The introduction of vacuum therapy into the complex of transthoracic sanitation of lung abscesses contributed to the enhancement of the bactericidal effect sodium hypochlorite, as indicated by the fact that on the 21st day, only one patient was found candida albicans. In addition, in group III, by the 14th day, the number of patients in whom pathogenic microorganisms were detected decreased to 5 (18.5%), while in group I by the end of the observation period they were found in 7 (24.9%) of 29 patients, and group II - in 4 (15.4%) out of 26. We believe that the severity of the antibacterial effect, in this case, is due to the earlier resolution of perifocal inflammation as a result of vacuum therapy by increasing blood flow in the tissues of the abscess wall and around it.

A comparative analysis of the results of ultrasound examination of lung abscesses showed that a moderate degree of blood flow intensity in the walls of the cavity and around it was observed in group III already on the 5th day, while in group I, the blood flow of the same level was observed only on the 10th day. On the 7th day, patients of group III showed an increase in blood flow intensity to a pronounced degree, which persisted throughout the observed period. We believe that the increase in the intensity of blood flow at an earlier stage is because of vacuum therapy, which contributed, among other things, to a reduction in the size of the cavity.

As a result of the treatment in group III, complete recovery with scarring of the cavity was observed in 24 out of 27 (88.9%) patients, in II - in 80.8%, and in I - in 72.4% of patients. Clinical recovery with the formation of a dry residual cavity in group I was recorded in 1 patient, in II - in two, and in III - there was no similar outcome. The transition to a chronic form was observed only in 1 patient of group III, whereas in group I - in 3 and II - in 2 patients. It should be borne in mind that the presence of a dry residual cavity with its long-term existence suggests the possibility of developing suppuration in it. Consequently, the transition of abscesses to a chronic form and the formation of a dry residual cavity in the lung were maximally observed in group I of patients; in group III, the minimum number of patients who had the formation of a chronic abscess and the maximum - with a complete closure of the cavity in the lung were recorded.



Thus, the inclusion of vacuum therapy in the rehabilitation of lung abscesses has a beneficial effect on the course of the disease and significantly improves the results of treatment, which is manifested in reducing the duration and severity of intoxication, improving clinical outcomes.

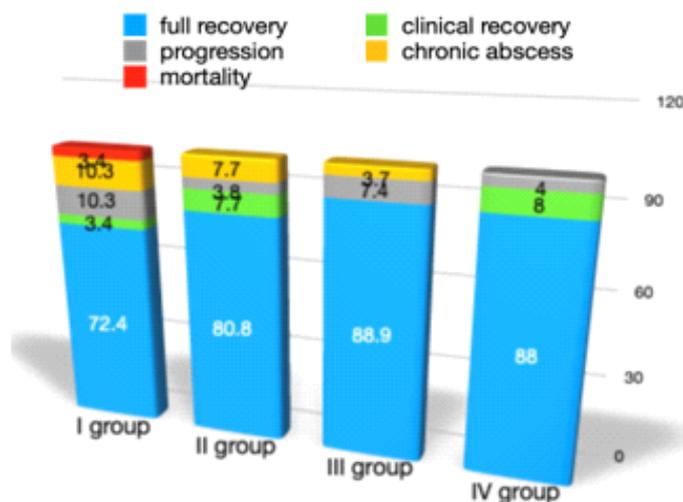
The study of the clinical, radiological and ultrasound picture of the disease in the process of transthoracic sanitation of lung abscesses in patients of group IV allowed to establish more intense rates of decrease in fluid levels and reduction of the dense residue in the cavities of abscesses, narrowing of the zone of perifocal infiltration. A comparison of ultrasound data in groups III and IV, it was shown that blood flow in the walls of the abscess cavity and around it was restored earlier and more intensively in patients of group IV. Nevertheless, a reduction in the size of the cavity by more than 4 times occurred in patients of group III.

Positive clinical, radiographic and ultrasound dynamics in patients of group IV was confirmed by the results of fibrobronchoscopy. Signs of diffuse fibrinous-purulent endobronchitis were stopped already on the 3rd day; and on the 7th day, limited purulent endobronchitis occurred only in 2 patients while maintaining local mucopurulent endobronchitis in the rest. On the 9th day, the prevalence of catarrhal endobronchitis in more than 2/3 of patients of group IV was limited to the framework of the draining bronchus, and signs of inflammation completely disappeared on the 14th day, whereas in group I, a similar picture was observed by the 18th day from the beginning of transthoracic sanitation.

Regression of clinical signs of endotoxicosis in patients of group IV was accompanied by a decrease in the leukocyte index of intoxication by 2.4 times by the 14th day from the start of treatment, by the same time in the group I, the level of leukocyte index of intoxication decreased by only 32.2%, not reaching its value in healthy individuals.

The antibacterial effect of vacuum therapy was significantly superior to that of group I. It should be noted that with repeated determinations already on the 7th day in the IV group, the number of patients in whom pathogenic microorganisms were isolated decreased. In group IV, the number of microbial associations decreased sharply during repeated transthoracic debridements, and on the 21st day, only 1 patient from the abscess cavity was diagnosed with *Candida albicans*. It should be noted a more pronounced bactericidal effect of vacuum therapy of a differentiated regimen in comparison with a stable small regimen, especially about Gram-negative microorganisms, which is apparently due to the summation of direct effects on pathogenic microorganisms. In addition, we associate an increase in the antibacterial effect with the resorption of sodium hypochlorite in the walls of the abscess and in the zone of perifocal inflammation, where microorganisms invariably persist. Perhaps this was one of the reasons for the decrease in the frequency of the transition of abscesses to a chronic form in patients of group IV.

Even though initially the course of the disease in patients of group IV was more severe, the outcomes were preferable to those in the other groups. Of the 25 patients, 22 (88%) had a full recovery, 2 (8%) patients formed a residual cavity in the lung, and another patient was operated on for pulmonary haemorrhage (Figure 2). The progression of the purulent-destructive process in the lung (including pulmonary bleeding) and (or) pleura was observed only in patients with gangrenous lung abscesses; all of them are operated on with a favourable outcome. Lobectomy was performed on 5 patients, thoracoplasty - on 2 patients. At the end of the chronic form, 2 patients from group I and one from group II were operated on, lobectomy was performed on them in a planned manner.



**Figure 2. Clinical outcomes in patients with acute lung abscesses**

Summing up the study, it can be concluded that vacuum therapy with a differentiated mode of sanitation is more effective due to its local and resorptive action, before using 0.01% chlorhexidine solution for these purposes. This statement is based on the results of the analysis of clinical signs in the process of transthoracic debridement. Lung abscesses, identifying differences in the manifestation of detoxification, anti-inflammatory and immunocorrective effects in comparison with the results of fibrobronchoscopy, ultrasound and measurements of the volumes of fluids introduced and excreted during debridement.

### Discussion

The inclusion of vacuum therapy in the complex of transthoracic sanitation of lung abscesses in patients with a moderate course of the disease made it possible to increase the effectiveness of both local and resorptive action of 0.06% sodium hypochlorite solution. The established fact of a significant increase in the intensity of blood flow in the walls of the cavity and around it in comparison with the dynamics of the difference in the volume of injected and excreted fluid suggests that vacuum therapy, in addition to direct exposure in the abscess zone, is a factor that enhances the resorption of the antiseptic in the zone of perifocal infiltration. As a result, the period of scarring of the cavity is accelerated, the zone of pneumosclerosis narrows, the possibility of the abscess becoming chronic is minimized [44,49].

The use of vacuum therapy in transthoracic debridements of lung abscesses in patients with moderate and severe courses of the disease was accompanied by an increase in the detoxification, antibacterial, anti-inflammatory effect of antiseptics. The rapid growth of positive clinical symptoms in combination with favourable changes in homeostasis made it possible to prevent the transition of abscesses to a chronic form in patients of the IV clinical group and minimize the transition of abscesses to a chronic form and minimize progression of the purulent-destructive process in the lung [25,33,51].

### Conclusion

The high clinical efficacy of transthoracic sanitation of lung abscesses with a 0.06% solution of sodium hypochlorite is due to the mechanical cleansing of the abscess, indirect antioxidant, and antibacterial action, as well as the general detoxification effect due to the resorption of part of the solution through the bronchial and tracheal mucosa. The difference in the volume of injected and excreted fluids during repeated sanitation with a solution of sodium hypochlorite increases to 10% compared to the use of a 0.01% solution of chlorhexidine, while the elimination of purulent endobronchitis occurs 5 days earlier.

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**Conflict of Interest** - The authors state that they have no conflict of interest.

**Ethical Statement** - to publish these results we obtain the Ethics Committee of the Tashkent Medical Academy. All patients were informed about the research process. All of them signed the relevant letter of consent.

**Data Availability Statement** - Data supporting the results of this study are available at the request of the respective author. The data is not publicly available because it contains information that could compromise the privacy of study participants.

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