

Comparative Assessment of the Effectiveness of the Use of Transtracheal Drainage and Bronchoscopic Debridement in the Treatment of Patients with Lung Abscesses Complicated by Bronchial Fistula

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Abstract The results of studies of 92 patients with lung abscesses complicated by bronchial fistula of various etiologies, who were treated in the purulent surgical department of the clinical base of Bukhara State Medical Institute in the period of 2010-2019, were analyzed. All patients, depending on the method of treatment, were divided into 2 groups: I - comparative group and II - main. The control group I consisted of 68 (73.9%) patients who received traditional conservative methods of treatment with the use of daily endobronchial sanitation of the bronchial lumen. In the 2nd -main group included 24 (26.1%) patients who, in addition to conservative treatment, underwent transtracheal drainage of a purulent focus with sanitation with antibacterial and thinning drugs. The analysis of the obtained results revealed that although transtracheal drainage of the purulent focus of the lung is a more effective method than the conservative method of treatment with the use of bronchoscopic lung debridement and has its drawbacks in the form of complications such as: in the form of suppuration of soft tissues in the area of microtracheostomy up to 12.5%, acute tracheobronchitis 20.8%, bronchospasm 8.3%, in 16.7% cases, there is an independent extrusion of drainage in the bronchus, loss of microdrainage from the purulent cavity 8.3%.

Keywords Transtracheal drainage, Bronchoscopic debridement, Lung abscess

1. Introduction

The authors' researches show the percentage of development of pulmonary-pleural complications with lung abscesses ranges from 30 to 70%, and the incidence of gangrenous forms from 28 to 74% [2,4,6]. In general the mortality rate also remains high with various forms of purulent-necrotic process in the lungs from 12.7% to 77.8%. [3,7]

The main treatment for an abscess is drainage. However, lung abscess is usually treated conservatively because drainage of the lung abscess is problematic. Drainage is considered only in cases of refractory lung abscess; in such cases, percutaneous lung drainage is usually used. Even when drainage is successful, percutaneous drainage is associated with the risk of complications such as pneumothorax and pleural culture; such complications occur in 16.1% of patients. [1]

The main goal of interest is the article by scientists from the American Association of Bronchology and Interventional Pulmonology (AABIP) Raman Tuhina,

McClelland Sarenthia, Bartter Thaddeus (2018) with the increase in the availability of methods for treating pleural effusion, including medical thoracoscopy (MT) and tunnel pleural catheter (TPC), in practice, there has been evolution Takaki Masahiro, Nobuaki Tsuyama, Eriko Ikeda (2019) A lung abscess is usually treated with long-term antibiotic therapy. Due to the lack of a safe and simple drainage technique, drainage is only used in special cases. [10,11]

The experience of successful closure of persistent air leaks in patients with severe pleural empyema - the use of an endoscopic unilateral endobronchial valve is presented in the work of the authors of Schweigert. [12]

Currie G.P., McKean M.E., Kerr K.M., Denison A.R. (2011) Over the past decade, the Endobronchial Ultrasound Transbronchial Aspiration Needle (EBUS-TBNA) has become one of the most exciting and innovative developments in respiratory medicine. This procedure allows for the selection of mediastinal lymph nodes and masses in both malignant and benign diseases and overcomes some of the disadvantages associated with mediastinoscopy and blind transbronchial aspiration with a needle. [9]

The use of techniques that ensure the supply of antibacterial and other drugs to the pathological focus through the vascular bed presents great difficulties for their implementation, especially in the group of seriously ill

patients and, in addition, do not solve many problems of local treatment. In this situation, it becomes necessary to carry out sanitation measures through the chest wall using the techniques of "minor pulmonary surgery". [5]

Modern methods of treatment of abscesses and gangrene of the lungs are aimed at removing purulent contents from cavities by minimally invasive methods, endoscopic or transthoracic methods. The authors (Sizdikbaev M.K., Kurtukov V.A., Shoyxet Ya.N.) argue that bronchial stenosis is an effective method in complex treatment in patients with cicatricial stenosis of the bronchi against the background of purulent-inflammatory processes in the lungs, complicated by acute lung abscess and lung gangrene. [8]

New technologies in the diagnosis and treatment of purulent-inflammatory lung diseases have made it possible over the past decades to slightly reduce the incidence, which is confirmed by existing literary publications, but the search for the most effective and low-traumatic treatment options is extremely relevant.

Purpose of the study: to reveal the effectiveness and disadvantages of transtracheal drainage and sanitation in the treatment of patients with lung abscess complicated by bronchial fistula.

2. Materials and Methods

Examined and treated of 92 patients with abscesses of mild bronchial fistula of various etiology were treated in the purulent surgical department of the clinical base of Bukhara State Medical Institute, the period from 2010 to 2019 were analyzed. All patients, depending on the method of treatment, were divided into 2 groups: I - comparison group and II - main. The control group I consisted of 68 (73.9%) patients who received traditional methods of treatment - conservative, antibacterial, general strengthening symptomatic treatment with the use of daily endobronchial sanitation of the bronchial lumen. II - the main group included 24 (26.1%) patients, for whom conservative treatment was supplemented with transtracheal drainage of a purulent focus with antibacterial and thinning drugs (trypsin, chymotrypsin).

The effectiveness of the used and proposed clinical methods for the treatment of suppurative lung diseases was assessed by the duration of bronchopulmonary symptoms, general symptoms of intoxication, the dynamics of a decrease in the size of the purulent-destructive cavity, the value of the total bed-day.

Methodology for sanitation bronchoscopy.

Sanitation bronchoscopy was performed using a flexible bronchoscope, apparatus KARL SHTORS (Germany 2006). Bronchoscopic manipulation was performed in a sitting position of the patient. For the purpose of local anesthesia, immediately before the study, the nasal and oral cavity was treated with 10% Lidocaine spray. To reduce the gag reflex at the time of the introduction of the bronchoscope, the patient was recommended to breathe shallowly and as often as possible. The endoscope was introduced into the airway

under visual control, gradually examining the underlying parts of the tracheobronchial tree from both sides. If necessary that the bronchial tree was sanitized along the way by aspiration. After sanitation from the aspiration material, a qualitative and quantitative bacteriological study was carried out, as well as the determination of the sensitivity to antibiotics of the identified microflora was carried out to determine the tactics of further antibiotic therapy.

The technique of applying microtracheostomy.

After appropriate premedication in the supine position of the patient, local anesthesia was performed on the anterior surface of the soft tissues of the trachea and along the midline of the neck. After three times skin treatment with 96% alcohol, 2 cm longitudinal incision of the skin and soft tissues was made. A puncture is performed between 2-3 cartilaginous rings of the trachea, a thin trocar, a tracheostomy is performed with the help of a microtrocar. Microdrainage is carried out through the lumen of the microtrocar with a lumen with a diameter of 2.0 mm. The microtrocar is removed, the microdrainage is fixed to the skin of the neck using polypropylene sutures, and an aseptic bandage is applied.

Technique of drainage of the abscess cavity through tracheostomy.

The position of the patient and the technique of anesthesia was carried out as noted above. A flexible bronchoscope, 5.2 mm in size, is passed through the nose, larynx and vocal cords under visual control. The inflated microdrainage is captured through the microtracheostomy with the help of the bronchoscope spike and further, under strict visual control, is brought to the fistula gate and drainage is carried out by introducing the end of the microdrainage into the abscess cavity.

3. Results and Discussion

In all patients, laboratory indicators of signs of endogenous intoxication from peripheral blood (hemoglobin concentration, leukocytosis, ESR, LII, LI, MSM), analysis of the duration of anti-inflammatory therapy, the qualitative composition of sputum micro flora, and the length of hospital stay were studied in all patients. At the time of admission and in the course of treatment, the patient's condition was assessed by clinical signs, according to laboratory and instrumental examination methods, as well as using X-ray research methods.

Bacteriological studies in patients of group I were carried out from the lavage fluid of the bronchial tree, in group II the microflora was studied from catheter discharge from the abscess cavity. In most cases, 65 (70.6%) patients had pathogenic staphylococci (*Staphylococcus aureus*) inoculated. *Pneumococcus* was sown in 30 (32.6%) cases, *E. coli* was sown in 9 (9.8%) cases. It was inoculated in 5 (5.4%) cases, followed by streptococci (*Streptococcus haemolyticus*) in 13 (14.1%) cases. *Pseudomonas aeruginosa*

(*Pseudomonas aeruginosa*) was inoculated in 8 (8.6%) patients.

The analysis of the results of indicators of intoxication of the organism of patients with purulent lung diseases of the I group of comparison revealed the following changes (table 1). As can be seen from the table, on the first day of treatment, the body temperature of patients averaged $39.3 \pm 0.41^\circ\text{C}$. The content of blood leukocytes was on average $9.9 \pm 0.46 \times 10^9 / \text{l}$. The volume of medium molecules averaged 0.199 ± 0.010 units. Similarly, an increase in LII and ESR was noted. On the third day of treatment, there was a slight decrease in body temperature indicators from 38.2 ± 0.13 to $37.8, 140.14$, the

number of blood leukocytes decreased on average to $8.4 \pm 0.45 \times 10^9 / \text{l}$. The volume of medium molecules averaged 0.168 ± 0.007 units. There was a decrease in LII and ESR indicators to 1.9 ± 0.08 and 40.4 ± 1.52 , respectively. By the seventh day of treatment, patients in the comparison group with purulent lung diseases retained a slight subfebrile condition ($37.8 - 0.14^\circ\text{C}$). At the same time, according to all indicators of organism intoxication: L, MSM, LII and blood ESR, their further decrease was noted, that is, there was a tendency towards normalization $-7.4 \pm 0.39 \times 10^9$; 0.152 ± 0.009 ; 1.7 ± 0.07 ; 34.1 ± 1.22 respectively.

Table 1. Dynamics of indicators of intoxication of the 1st comparison group (n=68)

Indicators	Observation time				
	day of admission	Day 3	Day 7	Day 14	Day 20
t° body	$39,3 \pm 0,41$	$38,2 \pm 0,13^*$	$37,8 \pm 0,14^*$	$36,9 \pm 0,14$	$36,6 \pm 0,20^*$
L blood $\times 10^9 / \text{l}$	$9,9 \pm 0,46$	$8,4 \pm 0,45^*$	$7,4 \pm 0,39$	$7,0 \pm 0,31$	$6,6 \pm 0,25$
MSM	$0,199 \pm 0,010$	$0,168 \pm 0,007^{**}$	$0,152 \pm 0,009$	$0,126 \pm 0,005^{**}$	$0,114 \pm 0,006^{***}$
LII	$2,4 \pm 0,06$	$1,9 \pm 0,08^*$	$1,7 \pm 0,07$	$1,4 \pm 0,05$	$1,2 \pm 0,04^{***}$
ESR mm / h	$45,8 \pm 1,66$	$40,4 \pm 1,52^*$	$34,1 \pm 1,22^*$	$27,2 \pm 1,11^{***}$	$15,2 \pm 0,62^{***}$

Note: * - differences relative to the data of the previous day are significant (* - $P < 0.05$, ** - $P < 0.01$, *** - $P < 0.001$)

By the seventh day of treatment, these figures, although they tended to further decrease, however, remained above the norm. With further treatment and observation, by the tenth day, all analyzed parameters of intoxication, except for ESR of blood, were within normal limits.

When analyzing control X-ray images and CT. It was established that in the 1st group of patients on the day of admission, the size of the cavities of the purulent focus averaged 6.8 ± 0.66 cm. In dynamics, throughout the entire observation period, the size of the cavity of the purulent focus decreased systematically (Table 2). By the 18-20th day of treatment, the size of the cavities decreased to 3.1 ± 0.35 cm, that is, by 45.6% of the original size.

Table 2. Dynamics of decreasing the size of abscess cavities of 1st group

Patient groups	Cavity dimensions, sm				
	day of admission	Day 3	Day 7	Day 14	Day 20
1 st group	$6,8 \pm 0,66$	$5,9 \pm 0,26$	$5,2 \pm 0,28$	$4,5 \pm 0,34$	$3,1 \pm 0,35$

Notes: - Where * the reliability of differences ($p < 0.05$) in the size of the foci of destruction between the dynamics according to the terms given in the table.

It should be noted that the analysis of the conducted studies of group I revealed the following: daily long-term bronchoscopic examination also has its drawbacks, such as: with prolonged daily bronchoscopic examination of patients of group I, complications in the form of tracheobronchitis up to 23.52%, hoarseness of the voice up to 2.94% of cases were noted, all these complications arose as a result of irritation and traumatization of the vocal cord, trachea and bronchi, which were eliminated with appropriate

conservative therapy.

The average duration of conservative treatment of lung abscess complicated by bronchial fistula in group I is 18 ± 1.5 days.

Analysis of the results of indicators of intoxication of the body of patients with purulent lung diseases of the II-comparison group revealed the following changes (table 3). As can be seen from the table, on the first day of treatment, the body temperature of patients averaged $39.5 \pm 0.38^\circ\text{C}$. The content of blood leukocytes was on average $9.9 \pm 0.36 \times 10^9 / \text{l}$. The volume of medium molecules averaged 0.198 ± 0.011 units. Similarly, an increase in LII and ESR was noted. On the third day of treatment, there was a slight decrease in body temperature indicators from 39.5 ± 0.17 to 36.9 ± 0.14 , the number of blood leukocytes decreased on average to $8.0 \pm 0.25 \times 10^9 / \text{l}$. The volume of medium molecules averaged 0.143 ± 0.009 units. There was a decrease in LII and ESR indicators to 1.6 ± 0.07 and 38.4 ± 1.34 , respectively.

By the seventh day of treatment, in patients of the comparison group with purulent lung diseases, the body temperature was normalized ($36.7 \pm 0.12^\circ\text{C}$). At the same time, according to all indicators of intoxication of the body: L, MSM, LII and blood ESR, their further decrease was noted, that is, there was a tendency towards normalization $-7.1, 20.29 \times 10^9$; 0.138 ± 0.006 ; 1.2 ± 0.08 ; 26.3 ± 1.44 , respectively. By the fourteenth day of treatment, these numbers, although they tended to further decrease, however, remained above the norm.

With further treatment and observation by the twenties, all analyzed indicators of intoxication were within normal limits.

Table 3. Dynamics of indicators of intoxication in patients with purulent lung diseases II - comparison group (n=24)

Indicators	Время наблюдения				
	day of admission	Day 3	Day 7	Day 14	Day 20
t ⁰ body	39,5±0,38	36,9±0,17**	36,7±0,12*	36,6±0,11	36,5±0,10*
L blood×10 ⁹ /l	9,9±0,36	8,0±0,25*	7,1±0,29	6,5±0,23	6,4±0,32
MSM	0,198±0,011	0,143±0,009**	0,138±0,006	0,122±0,007**	0,104±0,004***
LII	2,5±0,08	1,6±0,07*	1,2±0,08	1,1±0,06	1,0±0,05***
ESR mm / h	48,6±1,54	38,4±1,34*	26,3±1,44*	19,6±1,13***	15,1±0,60***

Note: * - differences relative to the data of the previous day are significant (* - P<0,05, ** - P<0,01, *** - P<0,001)

When analyzing control X-ray images and CT of the chest, it was found that in 2nd group patients on the day of admission, the dimensions of the cavities of the purulent focus of the lung were identical to those in 1st group. Table 4 shows that the numbers of both groups on the day of admission did not differ significantly.

Table 4. Dynamics of reducing the size of abscess cavities of the 1st and the 2nd groups

Patient groups	Cavity dimensions, sm				
	Day of admission	Day 3	Day 7	Day 14	Day 20
1 st group	6,8±0,66	5,9±0,26	5,2±0,28	4,5±0,34	3,1±0,35
2 nd group	7,1±0,72	5,3±0,22	4,7±0,27	3,3±0,38	2,5±0,37

Notes: - Where * the reliability of differences (p < 0.05) in the size of the foci of destruction between the dynamics in terms of the time given in the table.

It should be noted that the rate of reduction in the size of the cavities in patients of the 2nd group was faster than in the 1st group. By the 16-18 days of treatment, the dimensions of the cavities during treatment with the use of permanent catheterization of purulent cavities, the dimensions were reduced to 2.5±0.37 cm, that is, by 35.2% of the initial size, which in patients of group I at this time was equal 3.1±0.35 cm, that is, by 45.6%. As can be seen from this, the process of decay of purulent cavities in patients of the 2nd group proceeded much faster than in the control group.

It should be noted that, although there was a positive effect in contrast to conservative treatment, in patients with the use of permanent catheterization of purulent cavities, some complications of this method were noted. Complications were observed in the form of suppuration of soft tissues in the area of microtracheostomy 3 (12.5%), acute tracheobronchitis 5 (20.8%), bronchospasm 2 (8.3%), in 4 (16.7%) cases during treatment, there was an independent extrusion of drainage in bronchus (exit of the end of the catheter into the bronchus), which is re-introduced into the abscess cavity with the help of a bronchoscope. In 2 (8.3%) patients, spontaneous loss of microdrainage was noted, where it became necessary to re-establish it in an appropriate way.

The average duration of conservative treatment for a lung abscess complicated by a bronchial fistula with the use of transstrachial drainage is 14±1.8 days, which is 3-4 days ahead of the control group.

4. Conclusions

Thus, our research revealed the following:

With an abscess of the lung complicated by a bronchial fistula, *St. aureus* and *Pneumococcus* dominate from the pathogenic microflora.

When using the method of treatment of bronchoscopic sanitation of patients with lung abscess, complications in the form of tracheobronchitis were noted up to 23.52%, hoarseness of the voice up to 2.94% of cases. The average duration of conservative treatment of patients is 18±1.5 days.

The use of permanent catheterization of the purulent cavity and sanitation with the use of antibiotic therapy is an effective method in comparison with conservative therapy.

When used in a complex for the treatment of endotracheobronchial catheterization of purulent cavities of the lung with sanitation and antibiotic therapy, it accelerates the normalization of all indicators of intoxication and improves the dynamics of reducing the size of purulent cavities by 2-3 days.

The average duration of treatment for a lung abscess complicated by a bronchial fistula using transstrachial drainage is 14±1.8 days, which is 2-3 days ahead of the duration of treatment for a conservative method of treatment with the use of endobronchial sanitation.

Although there are advantages of a positive effect compared to conservative treatment, patients with constant catheterization of purulent cavities have some complications of this method: in the form of suppuration of soft tissues in the area of microtracheostomy up to 12.5%, acute tracheobronchitis 20.8%, bronchospasm 8.3%, in 16, In 7% of cases, there is an independent extrusion of the drainage in the bronchus (exit of the end of the catheter into the bronchus). Spontaneous loss of microdrainage is observed up to 8.3% of patients. That indicates the need to improve the methods of drainage of purulent lung cavities and which do not have the above disadvantages.

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