Volume : 3 | Issue : 7 | July 2014 • ISSN No 2277 - 8179

Research Paper

The Implementation of Silicone Implant and Valve Bronchoblocation at Collapsosurgical Treatment of Patients with Extensively Resistant Tuberculosis (XDR TB)

Medical Science

KEYWORDS : Tuberculosis with extensive drug resistance, collapsosurgical intervention, thoracomyoplasty, silicone implant, valve bronchoblocator.

Yerimbetov K.D.	National Center of TB problems.5,Bekhozhin St.,050100. Almaty,Republic of Kazakhstan
Abildaev T.Sh.	National Center of TB problems.5,Bekhozhin St.,050100. Almaty,Republic of Kazakhstan
Bektursinov B.U.	National Center of TB problems.5,Bekhozhin St.,050100. Almaty,Republic of Kazakhstan
Tursynbayeva A.S.	National Center of TB problems.5,Bekhozhin St.,050100. Almaty,Republic of Kazakhstan
Abdullina A.G.	National Center of TB problems.5,Bekhozhin St.,050100. Almaty,Republic of Kazakhstan

ABSTRACT

There were analyzed the outcomes of collapsosurgical treatment of 32 patients with extensive drug resistant tuberculosis (XDR TB). There were implemented the surgical interventions, including thoracoplasty with extrapleural filling with silicone implant and with preliminary performed valve bronchoblocation of the draining bronchus of the injured lung segment (lobe) in the main group from 13 patients, while in the remained 19 patients (the control group) there were implemented the operative interventions including extrapleural thoracomyoplasty only. The analysis of outcomes showed that the collapsosurgical interventions in both groups gave the virtually equal effectiveness: in the main group it constituted 61.5%, in the control one it did 63.1%. Despite of the equal treatment effectiveness, there were determined the advantages of the collapsosurgical method with use of silicone implant versus conventional method of thoracoplasty: a) absence of the cosmetic defect of the chest wall (OR-32, P<0.000) after operation b) disturbances of the locomotory functions in the humeral articulation (OR - 32; P<0.000); c) posture don't changed; d) to obtain the lung lobe collapse it is sufficient to conduct the resection of 4-5 ribs only (OR – 5.4; P<0.02) The developed method of thoracoplastty with implementation of the silicone implant is the alternative for choosing the surgical way to treat the young patients with XDR TB.

Introduction

Tuberculosis with extensively drug resistance is the most dangerous and virtually it don't be curable through chemotherapeutic treatment, and, as a rule, in course of this TB disease form pathomorphological changes in lungs and other factors due to the non-effectiveness of previous chemotherapy make its further treatment non promising.

To cure this category of patients surgical methods of treatment are the mostly indicative [1,2]. But it should be noted that at surgical interventions effectiveness of treatment of patients with XDR TB depends on fibrotic changes in lung tissue, body immunosupression degree, deterioration of the functional state of the vitally important organs and high spectrum of the drug resistance of M. tuberculosis to antibiotics [3,4,5].

The effectiveness of the surgical methods of treatment of multidrug resistant tuberculosis constitutes 74.2 – 82.7% with lethality 7.4%, level of post-operative complications, in particular, at XDR TB, reaches up to 50% with lethality [6,7,8,9].

It was proved that at implementing resection method for patients with XDR TB allowing to remove the main foci of TB infection simultaneously and fast, post-operative complications arise in 27.2% of patients with lethality up to 20% [6]

When took into account the above mentioned it is expediently to implement the collapsosurgical methods of treatment that allows increase the effectiveness up to 75% of the stable cure [9, 10].

To reach up the higher indicators of effectiveness of the collapsosurgical interventions importance of chemotherapy conduction is undoubted. Implementation of the surgical interventions to be done against the background of chemotherapy with antibacterial drugs of the 1st and 2nd line for patients with XDR TB allows to obtain the sputum smear conversion in 65.5% [6].

There many ways of collapsosurgical treatment of patients with pulmonary TB. The main objective of these interventions is the obtaining of the selective collapse of the injured lung area. The method of extrapleural pneumolysis with intraoperational filling for patients with destructive TB forms of pulmonary tuberculosis is the most famous among them [11].

There were proposed for filling more than 50 different materials, namely: lipid tissue, paraffin, vaselin cellulose, polyacrylat, iodinelipol, polystan et al. [12,13,14].

The great number of proposed and implemented in practice allogenic materials rather different by their physical and chemical properties did not lead to improve the immediate and follow-up outcomes of the surgical treatment of patients with pulmonary tuberculosis. They could become one of the cause of frequent hemorrhagy, formation of the solid fibrous adhesions with further development of pleuropneumocirrhosis of the collapsed lung, suppurulation of the coagulated hemothorax with development of acute and, further, chronic tuberculosis empyema, and, also, development of the tissue emphysema in the operational area, their imbibition with blood and exudate that was the cause of suppurulation of the operational wound and extrapleural cavity.

In the course of development of the idea of pressure (collapse) of the certain area of the lung in the cavity' projection we elaborated the method of different modifications of thracoplasty in combination with the extrapleural pneumolysis and we used the silicone implant in term of the material for filling [15].

Up-to-day medicine basing on innovated technologies possesses the diverse medicinal silicone tools, and the mammary gland implants are widely spread among them.

To improve the quality of the lung collapse this method of surgical intervention is conducted with preliminary valve bronchoblocation of the bronchus draining the cavity that allows enhancing for a long time and keeping the hypoventilation or atelectasis in the collapsed lung segment (lobe). As a valve bronchoblocator, we implemented

Volume : 3 | Issue : 7 | July 2014 • ISSN No 2277 - 8179

the bronchoblocator by enterprise "Medilang" (Russia) advantage of which versus others is the simplicity of its installation into draining bronchus opening and presence of the reverse valve [16].

Target of the study is to obtain the stabilization of the specific process in lungs and M. tuberculosis excretion stopping through implementation of the therapeutic thoracoplasty with extrapleural filling with silicone implant combined with valve bronchoblocation in patients with extensively resistant tuberculosis.

Material and methods of the study

To resolve the task declared we analyzed the outcomes of collapsosurgical treatment in 32 patients with extensively resistant tuberculosis. The main group constituted from 13 patients with extensively resistant tuberculosis for which were conducted the surgical interventions including therapeutic thoracoplasty with extrapleural filling with silicone implant after preliminary performance of the valve bronchoblocation of the draining bronchus of the injured lung segment (lobe).

The control group included 19 patients with extensively resistant tuberculosis to which were conducted the surgical interventions including the therapeutic thoracomyoplasty only.

Women were prevalent in both groups analyzed: in the main group there were 5 men (38.5%), 8 women (61.5%), in the control one there were 13 women (68.4%) and 6 men (31.6%).

Age compound is present in the Table 1. (not bold type)

Table 1. Age compound of the patients with XDR TB operated in the main and control groups

Group	Age						Total	
	20-29		30-39		40 or older			
	n	%	n	%	n	%	n	%
Main	3	23.0	7	54.0	3	23.0	13	100
Control	3	15.8	10	52.6	6	31.6	19	100

As it is shown in the Table 1 in the majority of cases in both groups there are the young persons from 30 to 39 years; their percentage constituted by 54.0% and 52.6% relatively. Fibrocavernous tuberculosis was in all 32 patients confirmed by bacteriological tests for drug resistance.

In the patients of the main group right location of the pathological process was determined in 7 (54.0%) while location in the left lung did in 6 (46.0%) (Table 2). In the control group pathological process was in the right lung in 8 (42.0%), in the left lung in 11(58.0%) (Table 3).

Table 2 — Distribution of the pathological process by location and volume of the injury in the main group

Volume of injury	Location				Total	
	Right lung		Left lung			
	n	%	n	%	n	%
3 segments (lobe)	5	38.5	5	38.5	10	77.0
4 segments (or more) (Lobe+S6)	1	7.7	2	15.4	3	23.0
Total	6	46.1	7	53.9	13	100

Table 3. Distribution of the pathological process by location and injury volume in the control group.

Volume of injury	Location				Total	
	Right lung		Left lung			
	n	%	n	%	n	%
3 segments (lobe)	7	36.8	7	36.8	14	73.7
4 segments or more(Lobe+S6)	1	5.3	4	21.1	5	26.3
Total	8	42.1	11	57.9	19	100

As it is shown in the table 2 and 3 the lobar injuries were prevalent in the main and control groups: 77.0% and 73.7% relatively. Percentage of the injuries of 6th segment (S6) and lower lung areas in the left and right lungs really did not exceed 26.0% in both groups.

Anamnesis of diseases revealed that up to operative treatment patients of both groups suffered from tuberculosis for a long time (Table 4).

Table 4. The durability of pulmonary TB disease before surgical treatment in the main and control group

Groups	Duration on TB disease (years)						Total	
	From 2 to 4		From 5 to 10		11or more			
	n	%	n	%	n	%	n	%
Main	5	38.5	5	38.5	3	23.0	13	100
Control	9	47.3	6	31.6	4	21.1	19	100

As the table shows the majority of patients suffered from tuberculosis from two to ten years.

In connection with the durable period of chemotherapeutic treatment all patients had many of concomitant diseases such as chronic gastritis, duodenitis, cholecystitis, anemia, chronic hepatitis. The signs of immunosuppression had all of 32 patients.

The fibrobronchoscopy revealed the active tuberculosis of the upper lobar bronchi in 3 patients of the main group and in 4 patients of the control one in the side of injury.

It was conducted the bacteriological sputum investigation for all patients of both groups before operative treatment:

1. M. tuberculosis were identified (graduation 3+ or 4+) through method of microscopy in all 32 cases.
2. The cultural investigation of the sputum revealed:

- The total resistance to all anti-TB drugs of the 1st and 2nd line in 8 (61.5%) patients of the main group, and in 7 (37.0%) patients of the control group.
- In other patients of both groups susceptibility of M. tuberculosis to one of three anti-TB drugs was kept (Table 5)

Table 5- Spectrum of susceptibility and resistance of M. tuberculosis in patients of the main and control groups.

Group	Drug resistance test				
	Resistance	Susceptibility kept			
	Full drug resistance	To 1 drug	To 2 drugs	To 3 drugs	To 4 drugs
Main (n-13)	8(61.5%)	2(15.4%)	2(15.4%)	1(7.7%)	0
Control (n-19)	7(37.0%)	4(21.0%)	3(15.8%)	3(15.8%)	1(5.2%)

Testing for drug resistance stated in patients of analyzed groups:

- susceptibility of M. tuberculosis kept in the different degree to cycloserin, PAS and prothionamid.
- In all 32 patients resistance to anti-TB drugs of the 1stline and to fluoroquinolones and aminoglicozids also.

By the type of TB disease, all patients were with treatment failure due to the absence of effect from previous conventional medicamentous therapy.

The patients of both groups were treated with anti-TB drugs of the 1st and 2nd line before hospitalization to the Department of TB Surgery. After resistance revealed to the fluoroquinolones and aminoglicozids all the patients were administrated the anti-TB drugs of the 3rdline. The patients had been proposed the surgical treatment, because of absence of the effectiveness from conventional therapy.

The indication for surgical intervention to all 32 patients was the presence of multiple destructive changes in lungs (cavities, polycavernosis) mainly in the upper area of a lung without signs of regressive development, and presence of the massive M.tuberculosis excretion.

In term of the preoperative preparation intensive symptomatic therapy targeted to improve the functions of the vitally important organs of a macroorganism to enhance the indicators of hemodynamics, external respiration function, immune status had been conducted against the background of the chemotherapy with anti-TB drugs of the 3rd line.

Two weeks before the operative intervention valve bronchoblocators had been installed to the patients of the main group after bronchological investigations at the absence of bronchial injury of specific and non-specific nature. The valve bronchoblocators were installed through endoscopic method according to the diameter of the draining bronchus of lobe or segment of the lung injured with pathological process.

Installation of the valve bronchoblocator took place on the right in the opening of the upper lobar bronchus in six patients of this group. However, because of the tuberculosis injury of the intervening bronchus, valve bronchoblocator had not be installed to one of them.

The valve bronchoblocator had been installed on the left in the opening of the upper lobar bronchus in seven patients while it had been installed in two patients in the opening of the 6th segment on the left.

There were implemented collapsosurgical interventions by method elaborated by us to the patients of the main group during different period of intensive phase of chemotherapy after preliminary valve bronchoblocation of the draining bronchus of the injured lung areas.

The essence of the method of surgical intervention is in using silicone implant of the mammary gland as a filling material at the implementation of different methods of thoracoplasty. The extrapleural installation of the silicone implant jointly with valve bronchoblocator functioning allows to obtain the fast and effective collapse of the injured lung area.

There were implemented conventional methods of thoracoplasty without valve bronchoblocation and silicone implant for 19 patients of the control group.

There were conducted surgical interventions in the groups analyzed during period of the intensive phase (Table 6).

Table 6. Time of surgical interventions in the analyzed group of patients with XDR TB

Group	Type of intervention	Time of the operational interventions in the intensive phase			Total
		0-6 мес	7-12 мес	13-15 мес	
Main	Extrapleural thoracomyoplasty with implementation of the silicone implant	6(46.1%)	5(38.5%)	2(15.4%)	13(100%)
Control	Conventional thoracomyoplasty	5(26.3%)	11(57.9%)	3(15.8%)	19(100%)

As it can be seen in the table, majority of the surgical intervention in the main and control group had been performed during first year (12 months) of the chemotherapy during intensive phase.

The collapsosurgical interventions were different by their volume depending on degree of the pulmonary tuberculosis process expansion (Table 7).

In the main group thoracoplasty had been conducted with resection and removal of 4 or 5 ribs in 61.0% to obtain the effective lung collapse, while thoracomyoplasty with removal of 7 ribs had been conducted in 52.6% of patients from the control group (Table 7) .

Table 7. Varieties of the collapsosurgical interventions implemented for patients with XDR TB in the main and control groups.

Group	Extrapleural thoracomyoplasty					Total
	4th rib's	5th rib's	6th rib's	7th rib's	8th rib's	
Extrapleural thoraco-myoplasty with implementation of silicone implant (Main)	4(30.7%)	4(30.7%)	2(15.3%)	3(23.0%)	-	13 (100%)
Conventional thoracomyoplasty (Control)	-	4(21.0%)	4(21.0%)	10(52.6%)	1(5.2%)	19 100%

In the postoperative period for patients of the control group taut chest bandage was performed in order to obtain the effective lung collapse during 1-2-3 months through pressure of scapula in projection of the ribs removed.

The abovementioned taut bandage did not implemented for patients of the main group.

Roentgenological every month' examination was conducted to monitor the cavities in the lung collapsed, monthly sputum smear collection for microscopic and cultural investigation was conducted, beside this, in the main group bronchological examination of the valve bronchoblocators state was conducted in all patients. Bronchoblocator removal occurred one year later after operation during of observation period.

The evaluation of effectiveness of the surgical treatment of patients of analyzed groups was determned by:

- Results of the sputum smear investigation on M. tuberculosis through microscopic method and culturing by Lewenstein-Jensen
- Destruction cavity closing through roentgenological and tomographic investigations (in dynamics)
- Presence or absence of cosmetic defect of the chest.

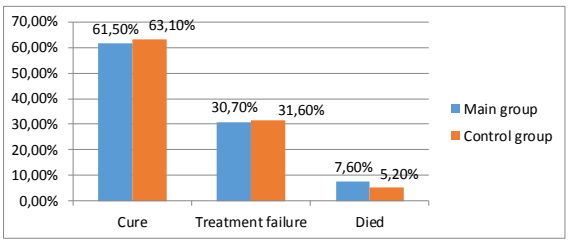
Results

After surgical interventions conducted and dynamic monitoring

Volume : 3 | Issue : 7 | July 2014 • ISSN No 2277 - 8179

during 2 years in the analyzed groups the outcomes were obtained as following (Figure 1)

Figure 1. Outcomes of treatment of patients of the main and control groups after 2 years of monitoring



As it is seen in the Figure 1, after treatment completed and 2 year's monitoring, outcome "cured" was stated in 8 (61.5%), "treatment failure" in 4 (30.7%) , one patient (7,6%) died in the main group out of 13 patients.

Analogous outcomes obtained in the control group are seen well in the Figure. In the control group outcome "cured" was stated in 12 (63.1%), "treatment failure" in 6 (31.6%), one patient (5,2%) died. The control microbiological investigations showed the results as following (Table 8).

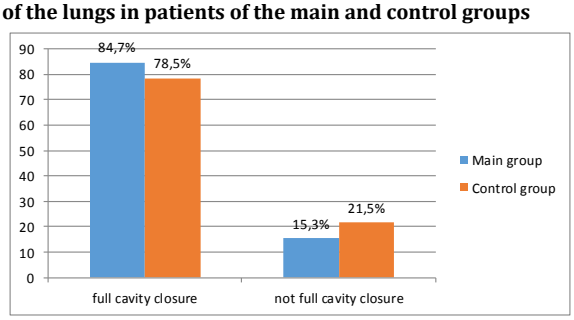
Table 8. The follow-up results of microbiological investigations of patients with XDR TB of the main and control groups

Group	Microbiological sputum investigation							
	Before operation				After operation			
	Microscopy		Culture		Microscopy		Culture	
	MBT+	MБТ-	MBT+	MBT-	MBT+	MBT-	MBT+	MBT-
Main	13	-	13		-	13	5(38.5%)	8(61.5%)
Control	19	-	19		2	17	7(36.8%)	12(63.1%)

As it can be seen in the table, during the period of surveillance after treatment completed results of investigations by microscopy method were negative in all 13 patients of the main group, but the cultural investigation identified mycobacteria in 8 (61.5%), while in the control group there were revealed 2 positive results through microscopy and 12 (63.1%) by culturing method.

The control roentgenotomographic investigations of the lungs were conducted in the main and control groups (Figure 2).

Figure 2. The control roentgenotomographic investigations of the lungs in patients of the main and control groups



As it is shown in the Figure 2, in the majority of patients operated in both groups destruction changes occurred, at this in 15.3% of the main group and in 21.5 % of the control group destruction cavities closing was not full.

In the patients with positive results of cultural investigation there were conducted the bronchological investigations , at this in 1 (7.6%) patient of the main group and in 2 (10.5%) patients of the control group active persistent bronchial tuberculosis was revealed.

The control examinations of the patients of the main group showed the absence of the cosmetic defects in the chest spatula area and disturbance of the locomotory functions in the humeral joint on the operation side. The full contrast was marked at the examination of patients of the control group: in all patients of this group cosmetic defect of the chest wall in term of the deep spatula impression on the operation side with curvature of the spine and non full locomotory humeral joint was marked.

The analysis of results obtained showed that in both groups collapsosurgical interventions were equally effective: in the main group where the silicone implants were implemented jointly with valve bronchoblocation effectiveness constituted 61.5%, while it constituted 63.1% in the control group after conventional collapsosurgical interventions .

The study of the follow-up investigations revealed that the non-full cavity closure in the lung collapsed influenced on mycobacteria excretion continuation occurred in 4 (30.6%) patients of the main group and in 6 (31.6%) patients of the control group. One of the significant factor of treatment failure in one patient of the main group and in two patients of the control group was the active tuberculosis process presence in the bronchi.

Other factor of treatment failure in both groups was the development of the acute congestional pneumonia in one patient from the main group in the early postoperative period, and development of the acute thromboembolism of the pulmonary artery in one patient from the control group that led to the death of both patients.

However, despite of the similar effectiveness of the treatment in both groups follow-up investigations proved the advantages of the collapsosurgical method with implementation of the silicone implant:

- Firstly, the principal advantage of the collapsosurgical method with implementation of silicone implant is the absence of cosmetic defect of the chest wall without disturbances of the posture and locomotory functions in the humeral joint, while in all 19 patients of the control group there were the cosmetic defects in the spatula area and asymmetry of the chest with disturbance of locomotory brachialis function on the operated side.
- Secondly, to obtain the collapse in the main group in patients with injury of the lung lobe and 6th segment resection of 4-5 ribs only was conducted, while thoracoplasty of 7-8 ribs was implemented in the analogous patients of the control group.

Thus, the comparative analysis of collapsosurgical interventions with implementation of silicone implant jointly with valve bronchoblocation and conventional methods ofthoracoplasty without implementation of silicone implant showed the equal effectiveness rates. The mycobacteria excretion stopping, destruction cavity closing occurred in 61.5 % of patients from the main group and 63.1% from control one at the lethality 7.6% and 5.2% relatively.

The non-full destruction cavity closure and active tuberculosis changes in bronchi were the causes of treatment failure in both groups.

By results of the logistical analysis there were determined the valuable criteria which state the advantages of thoracoplasty with implementation of the silicone implants versus conventional thoracoplasty in patients with pulmonary XDR TB: absence of the cosmetic defect (O.R 32 P .0.000), disturbance of humeral joint functions O.R- 32 p<0.000, disturbance of the posture (O.R- 32 P<0.000), rib resection (O.R-5.4 P<0.02) .

Table 8 - Logistic analysis of follow-up outcomes of the collapsosurgical interventions in patients with pulmonary tuberculosis with extensive drug resistance in the main and control groups (n=32)

Criteria	O.R	Value p
Cure	0.009	0.9
Died	0.078	0.8
Cavity closure	0.163	0.7
Cosmetic defect	32.0	0.000
Disturbance of the function of humeral joint	32.0	0.000
Posture disturbance	32,0	0.000
Post-operative complications	0.8	0.8
Rib resection	5.4	0.02

Taking into account the up-to-day epidemiological situation on tuberculosis in the World and trend to increase in number of patients with XDR TB of the young age, issue of their cure through collapsosurgical methods remains topical. However, after those surgical interventions cosmetic defects of the chest wall are marked. The young people refuses from that method frequently, they continue the medicamentous therapy effectiveness of which remains insufficiently high. The method of thoracoplasty with implementation of the silicone implants combined with valve bronchoblocation could be the method of choice, because of the absence of the cosmetic defect of the chest wall; minimal number of ribs are undergoing to the resection, function of humeral joint is kept. That why this method could become an alternative way to surgically treat the patients with XDR TB.

REFERENCE

1 Bogush L.K.(1979) In Russian: Surgical treatment of pulmonary tuberculosis. Moscow, Edit. "Meditzina": 296p. | 2 Perelman M.I. (1986) In Rissian: Phthisiosurgery today and tomorrow//10th Soviet Union Congress of Phthisiaters, Collection of abstracts, Kiev, 132-133. | 3 Dzhunusbekov A.D. (1964) In Rissian: Lung resection in patients with M. tuberculosis drug resistance. Synopsis of Ph Dissertation. Moscow, 19 p. | 4 Yerimbetov K.D. (2003) In Rissian: Enhancement of surgical treatment effectiveness in patients with multidrug resistant pulmonary tuberculosis associated with adequate chemotherapy// Journ. Problems of Tuberculosis and Lung Diseases, Moscow; 4: 39-41. | 5 Frolov G.A., Popkova N.L., Kalashnikov A.V. (2002) In Russian: Outcomes of the surgical treatment of patients with drug resistant tuberculosis/ Journ. Problems of Tuberculosis and Lung Diseases, Moscow; 7: 15 - 18. | 6 Yerimbetov K., Abildaev T., Alenova A., Zetov A. (2011) In Russian: The experience of surgical treatment of patients with pulmonary extensively resistant tuberculosis/ Medical and Health Science Journal; 5: 84-87. | 7 Repin Yu M., Avetissyan A., Yelkin A.V. et al. (2001) In Russian: Significance of M. tuberculosis drug resistance for lung phthisiosurgery/ Problems of Tuberculosis and Lung Diseases, Moscow, 9: 6 - 10. | 8 Mishkinis K., Kaminskayte A., Purvanetzkene B. (1999) In Russian: Outcomes of treatment of polyresistant tuberculosis by data of the Republican Tuberculosis Hospital Santarishkes/ Problems of Tuberculosis and Lung Diseases, Moscow, 1: 30-31. | 9 Grischenko N.G., Krasnov V.A., Andrenko A.A. et al. (2002) In Russian: Role of surgical methods in treatment of patients with fibro-cavernous pulmonary tuberculosis/ Tuberculosis - an old problem in the new Millenium: International conference. Collection book, Novosibirsk, Russian Federation, P 60. | 10 Levin A.V., Kagalovskiy G.M. (2000) In Russian: Organ sparing collapsosurgery Barnaul, Russian Federation: 175 p. | 11 Pushkarenko B.T. (1971) In Russian: About diminishment of the pleural cavity at partial lung resections/ Journ. Chest Surgery, 6:75-77. | 12 Kekin E.S. (1983) In Russian: Extrapleural filling of hemithorax with dry fibrinogen after lung resection in patients with tuberculosis. Problems of Tuberculosis and Lung Diseases, Moscow, 1:52-55. | 13 Petrunin A.G. (1980) In Russian: A new method of hemithorax correction at lung resections. Synopsis of Ph Dissertation, Moscow, 23 p. | 14 Yampolskaya V.D. (1963) In Russian: Extrapleural pneumothorax and oleothorax at pulmonary tuberculosis, Moscow, Edit. "Meditzina". P 3. | 15 Yerimbetov K.D., Firsov V.I., Bektursinov B.U., Sadykov S.Zh., Arymbayeva A.B. (2013) In Russian: Method of collapsosurgical treatment of destructive forms of tuberculosis with extensive drug resistance at location of TB process in lung upper lobe and 6th segment. Invention, Patent n. 80971 as of 18.04.2013.Astana, Kazakhstan. | 16 Levin A.V., Tseymakh Ye.A., Samuylenkov A.M., Zimonin P.E., Omelchenko S.A., Chukanov I.V. (2007) In Russian: Valve bronchoblocation in treatment of patients with advanced drug resistant pulmonary tuberculosis/Journ. Problems of Tuberculosis and Lung Diseases, Moscow, 4: 13-16. |