

Diagnosis and tactics of surgical treatment of early postoperative intrapleural complications

Diagnostyka i strategia postępowania w leczeniu wczesnych powikłań pooperacyjnych dotyczących opłucnej

Feruz G. Nazyrov, Shuhrat N. Khudaibergenov, Orticaly Tulaevich Irisov

Department of Surgery of Lungs and Mediastinum, Republican Specialized Centre of Surgery V. Vahidov, Tashkent, Uzbekistan

Kardiochirurgia i Torakochirurgia Polska 2011; 4: 489–493

Abstract

Surgical procedures on the lungs and trachea are at risk of the occurrence of complications representing a significant impact on postoperative mortality. This paper describes problems related to definition of complications in chest surgery, time-frames of their occurrence and possible causes concerning surgical and anesthesiologic approach. It focuses on several issues including bleeding, empyema, lung tissue leak and chylothorax. The possibility of using minimally invasive techniques in diagnostic and therapeutic treatment is also discussed.

Key words: chest surgery, complications, pleura.

Streszczenie

Operacje chirurgiczne prowadzone w obrębie płuc i tchawicy stanowią największe zagrożenie wystąpienia komplikacji z istotnym wpływem na kształtowanie się pooperacyjnej śmiertelności. Praca porusza problemy związane ze sposobem definiowania powikłań w chirurgii klatki piersiowej, ram czasowych ich występowania oraz potencjalnych przyczyn, związanych z postępowaniem chirurgicznym i anestezyjologicznym. Skupiono się na zagadnieniach występowania krwawienia, rozwoju ropniaka, przecieku płucnego oraz gromadzenia chłonki w jamie opłucnej. Opisano także możliwość wykorzystania technik mało inwazyjnych w zakresie postępowania diagnostycznego i leczniczego.

Słowa kluczowe: chirurgia klatki piersiowej, powikłania, opłucna.

Surgical complications of operations on the lungs and trachea are the most difficult, representing a significant threat to the lives of patients. Despite great advances in thoracic surgery, the issue of postoperative complications of pulmonary resection has not lost its clinical relevance. The frequency of postoperative complications maintained at 13-20% and has no clear tendency to decrease [1-4]. When operations are complex, destructive processes in the lungs complication rate reaches up to 52.3% [2, 4-6]. Complications of repeated operations on the lungs and pleura are higher than in primary interventions: 19-44.8%, with mortality of 6.4-22.4% [1, 2, 4, 5, 7]. Such a high frequency of postoperative complications depends not only on the nature of the pathological process, the type of surgery and its trauma, the surgeon's skills, quality of nursing and patient management, but also a different understanding and interpretation of the term "postoperative complication". So, Swetman and Salyer [8] defined postoperative compli-

cations only such condition for the elimination of which an additional surgery, other temporary and mild pathological conditions, which do not affect the final outcome of treatment, are required. Apostolov [9] divides the postoperative period as follows: first –absolutely smooth measures requiring conservative treatment and the second – the presence of postoperative complications. Mason et al. [10] examined postoperative complications as a condition which has worsened during the hospital stay and is dangerous or potentially dangerous to patient's life. Melnik [3] described complications as all deviations from the normal postoperative course, which may hinder recovery or cause permanent disability of the patient. The authors consider postoperative complications as only a qualitatively new pathological condition resulting from surgery. Complications of related diseases, even if they were first detected only after surgical intervention, are not postoperative complications. In his classification, Melnik [3] subdivided postoperative compli-

Address for correspondence: Orticaly Tulaevich, Dept. of Surgery of Lungs and Mediastinum, Tel: +99871-277-27-03-3712, Email: tulaevich@mail.ru

cations in lung surgery into early, late and long-term ones, which follows from the grading of the postoperative period. There is no consensus on this subject in the literature. Three periods are commonly distinguished: 1st (the first 3 days after surgery), 2nd (4-15 days after surgery) and 3rd (16th day – end of hospital stay) periods. The early postoperative period is considered as a period from 6th to 45th day, 1st – 45th day or the first 5 days post surgery [11]. Melnik [3] refers to early postoperative complications; those arising in the first 7 days after surgery, and those arising in the period from 8 days until the patient leaves the hospital are considered to be late. Early complications were observed in 52.1% of cases and late complications in 34% [3]. Among many factors contributing to the development of postoperative complications, the following play an important role: the moment of hospitalization and primary surgery, the severity of the core disease and its complications, quality of preoperative preparation, the nature and scope of surgery, tactical and technical difficulties and errors in its execution, the patient's age and severity of concomitant disease, the high virulence of the infection, the immune system of the body, etc. Early detection of such complications makes it possible to perform a repeated surgical intervention to prevent the development of purulent mediastinitis and empyema, and reduce hospital mortality.

Anesthetic maintenance of surgical interventions on the organs of the chest is one of the most difficult anesthesia problems. During these operations, the lung is easily exposed to the double aggression: surgical and anesthetic. The basic pathophysiologic changes are breaches of gas exchange and hemodynamics due to pneumothorax, mechanical ventilation, surgical trauma, and managed collapse of the operated lung, blood leakage and pathological content in healthy sites of the tracheobronchial tree, while removal of lung tissue leads to disruption of blood flow and can cause severe congestion of pulmonary. Anesthetic actions of different degree are relevant to all complications in the surgical treatment of patients and its successful combat of these complications. Therefore, a high level of cooperation between the surgeon and anesthesiologist is one of the most important conditions for the security of thoracic surgery.

Complications after thoracic operations are extremely diverse and frequent. The frequency of postoperative course complications, depending on the nature of the pathology and the type of surgical intervention, ranges from 25 to 45% [1, 12]. Major postoperative complications relate to:

- 1) Bronchopleural – intrapleural bleeding, clotted hemothorax, leakage of the pleural cavity, bronchial stump failure, bronchopleural fistula, empyema, chylothorax.
- 2) Lungs – acute respiratory failure, impaired drainage function of bronchi and atelectasis, pneumonia.
- 3) Cardiovascular system – acute cardiovascular failure, pulmonary embolism and embolism of other vessels.
- 4) Wound occurrence – suppuration of thoracotomy wound pleurothoracic fistula, osteomyelitis of the ribs and sternum.

After partial resection of the lung, quickly smoothing out of the operated lung and the elimination of residual pleural cavities are most important. For the smooth and complete unfolding of the remainder of the lung, and, consequently, for the prevention of postoperative empyema and respiratory distress, four main conditions are required:

- Free patency of bronchi;
- Tightness of the pleural cavity;
- Complete evacuation of air, blood and fluid out of the pleural cavity;
- The balance of lung volume to the pleural cavity.

The task of local treatment in the immediate and early postoperative period is to create favourable conditions for wound healing process and prevent infection in the pleural cavity, for the possibility of early diagnosis of postoperative complications. So far, bronchial fistula with empyema, observed in 4-25% of patients after pneumonectomy, is one of the major causes of deaths in the postoperative period [13-17]. The incidence of this complication depends on the method of suturing and pleurisation of the bronchial stump and the general condition of the body. To prevent the complication it is recommended to leave the bronchial stump as short as possible, preservation of vascularization of the bronchus, and minimal trauma to the bronchus during the extraction and handing, pleurisation of bronchial stump. In addition, adequate preoperative preparation and postoperative management are very important.

Causes of the lung parenchyma leakage are defects in the visceral pleura, resulting from lung extraction for obliteration, synechia of pleural cavity, from the separation of interlobar fissures, from the typical and atypical resections of the lung, as with the use of suturing devices, and without them, from imperfect suturing of bronchial fistula during echinococectomy, from technical errors during suturing of the bronchial stump, from the imposition of interbronchial anastomosis [18]. Another cause of lung parenchyma joints leaking may be barotrauma, i.e. an inadequate increase of pressure in the artificial lung ventilation apparatus.

At present, during pneumonectomy and lung resection the following methods for handling the bronchus exist: mechanical suture, the suture of Sweet and sutures without stumps. According to different authors [13, 19], failure of the bronchial stump with the development of bronchial fistula and acute empyema occurs in 2-16%. Bronchial fistula and empyema are especially dangerous after pneumonectomy. The main causes of these complications are the presence of bronchitis at the time of surgery, ischemic changes in the bronchi, the presence of technical defects during the operation on the bronchus.

Vikulin and Kustov [2] divide complications of the immediate postoperative periods into early and late. The early complications arise during the surgery and on the 1st day after it. The authors classify the early complications as the profuse bleeding into the pleural cavity, asphyxia, postoperative chylothorax, severe cardio-pulmonary failure; among the late they include: pleural empyema and bronchial fistulas, the syndrome of "unfolded lung", postoperative

atelectasis, postoperative pneumonia and exacerbation of suppurative process in the resected and the opposite lung, abscess of postoperative suture and ligature fistulas. According to the authors [2], in the early postoperative period, after 214 lung resections, complications due to nonspecific suppuration developed in 45 patients, which accounts for 21%. Often invisible development and fleeting dynamics of harsh postoperative complications do not leave clinicians with opportunities for much contemplation and numerous investigations. Patient's life depends on the correct decision taken within a few anxious hours, sometimes even minutes. Obviously, doubts about the diagnosis, lack of experience and abilities of the surgeon to make decisions in such responsible, critical, psychological and emotional situations can affect the outcome.

The reasons for the repeated surgeries are most often intrapleural bleeding (7.72%), clotted hemothorax (13.6%), failure of the bronchial stump (4.49%), leakage of the lung parenchyma joints, chylothorax, empyema and residual pleural cavity (56.17%), which can be grouped under the general title "intrapleural complications" [1, 2, 4, 5, 20].

Reviewing the literature on this issue, we propose dividing complications of the early period into surgical and therapeutical ones. The need for surgical and therapeutic correction of these complications may contribute to it. When handling the postoperative complications not all surgeons are proponents of reoperation. As an argument, they cite cases of survival of patients with the use of traditional conservative measures – drainage, endoscopic sanitation with the background of antibacterial and detoxifying treatment. Such a restrained position of surgeons can be explained by a high risk of repeated operations in the imperfect anesthetic and intensive care conditions [6, 21, 22].

One of the major complications after lung surgery is bleeding into the pleural cavity, which is observed in 1.6-19% of operated patients [1, 5, 23-25]. Intrapleural bleeding after pulmonary resection due to tuberculosis and other lung diseases occur in 1-7% of patients [23]. Intrapleural bleeding and clotted hemothorax often develop in patients with obliterated pleural cavity, as well as with the surgery duration of more than two hours [1]. The separation of extensive adhesions creates a large area of capillary bleeding, prolongs the operation time, which in turn leads to increased fibrinolytic activity of the pleura. Conservative treatment policy, which is based on blood reinfusion in the mode of hemodilution, is considered as justifiable and acceptable for this complication [1]. But we should not forget that the authors prefer conservative treatment of continued intrapleural bleeding in cases, where bleeding is of fibrinolytic nature. In addition, in their view, the development of a massive clotted hemothorax, which prevents straightening of lung and threatens the development of empyema and residual cavities, it is expedient to perform rethoracotomy within 7 days after surgery. Based on the study of 405 medical cases, Epstein [25] comes to the following conclusion: "the development of intrapleural bleeding after pulmonary resection has no direct connection with

the complexity of surgery and with the form of pulmonary pathology, but depends on not careful hemostasis, duration of operation of more than two hours, adhesions in the pleural cavity. In order to eliminate complications it is expedient to execute rethoracotomy in the early stages, during intrapleural fibrinolytic bleeding, conservative therapy can be effective".

Empyema is not less frequent and threatening postoperative complication. Postoperative empyema most often occurs after pneumonectomy. Factors complicating its course are: the presence of fibrin and blood clots in the pleural cavity, the fragmentation of the latter into many small pieces, high virulence of aerobes in association with non-sporogenous anaerobes [2, 16, 22, 25, 26]. The authors, mostly local, recommend starting treatment of postoperative empyema from puncture with one or two needles, draining two- and three-ribs tubes and washing the cavity with an antiseptic solution sometimes for up to 3-6 weeks, with the formation of fibrothorax afterwards. With the ineffectiveness of conservative therapy, L.V. Uspenskiy and colleagues conduct an open repeated sanitation of pleural cavity with ultrasound, which promotes the release of H and OH ions, altering the redox processes in microorganisms, thus leading them to destruction. Wong and Goldstraw [6] for all postoperative empyema without bronchial fistula perform resection of the rib with prolonged (3 to 12 months) draining of pleural cavity. According to Schneiter et al. [22], the most appropriate method of treatment is a radical operation with the separation of bridges and the daily tamponade of pleural cavity with an antiseptic solution till its macroscopic purification. Physical methods, including laser biostimulation in the treatment of patients with pleural empyema are also proposed. In the post-traumatic empyema it is often recommended to perform sanitation during videothoracoscopy or thoracotomy [27]. A more conservative approach, namely the drainage with fibrinolytic therapy and videothoracoscopy, plays the main role in pleural empyema treatment. Kabanov et al. [26] follow an active surgical approach based on broad application of thoracoscopic laser with necrectomy sanitation and elimination of the bronchial fistula and early surgical treatment of chronic empyemic cavities using the bactericidal properties of argon plasma.

For straightening slumped lung at the stage of fibrinopurulent inflammation, in recent years medical videopleuroscopy (thoracoscopy) has been successfully performed, during which loose seam is damaged and fibrin is removed from the surface of the visceral pleura, also ultrasound and plasma sanitation of the pleural cavity is done. Yasnogorodskiy et al. [27] believe that the main indication in videothoroscopic sanitation of pleural cavity with empyema is unsuccessful fractional cavity lavage for 2 weeks or a failure of adequate sanitation due to the presence of bronchopleural fistula with a duration of a process of not more than 1 month. The authors argue that videothoroscopic sanitation is feasible only in acute pleural empyema, before the development of cicatricial layer. When the disease becomes chronic, adequate sanitation of the pleural cavity is possible

only in open surgery (mini-thoracotomy or a traditional thoracotomy). However, the timing of transition of acute pleural empyema into a chronic one defined rather arbitrarily varies from 1 to 4-6 months. This tactics with usage of videothoracoscopy minimizes operational trauma, significantly reduces the number of postoperative complications and hospitalization time [6]. The introduction of fibrinolytics in the pleural cavity with empyema is necessary because of many small sequesters, fibrin barriers, forming separate cavities, which do not allow full-fledged local sanitation. Streptokinase and urokinase are most often used drugs.

One of the most serious postoperative intrapleural complications is the bronchial stump disability or lung tissue leak. It is usually caused by either errors in surgical technique or a large pneumolysis. With the development of this complication, many authors stick to conservative tactics (active aspiration, removal of the air with pleural punctures, etc.). And only if within 4-5 days conservative measures do not give effect, subcutaneous emphysema steadfastly maintains or increases, intense pneumothorax develops, they state about the need of rethoracotomy [5, 7].

One of the rarely seen intrapleural complications is a chylothorax. In the literature there are few reports of postoperative chylothorax. Conservative measures aimed at overall strengthening of the body, filling the volume of lost protein and energy composition during chylothorax give a positive result, however, after radical surgery for severe lung pathology, an initially difficult condition of the patient with such complications may further deteriorate. Recently, some authors hold the idea of early repeated surgery and bandaging of the proximal segment of thoracic lymphatic duct. During the repeated surgery the visualization of the proximal part of the damaged duct is not expected (the pressure on the walls of lymphatic duct decreases and the allocation of chyle is not seen). In these cases, suturing and ligation of tissues directly over the distal segment of the duct is possible. There are also reports on the successful videoclipping of the source [28].

Minimally invasive technologies, which have changed technological approaches in abdominal surgery in a revolutionary way, fundamentally influenced the adoption of supporting tactical decisions in thoracic surgery. Due to its low trauma-impact and high diagnostic capabilities, endoscopic technique allows for identifying complications in the early postoperative period. The use of sealed thoracoports for diagnostic thoracoscopy allows for identifying complications within the first days after surgery, and its low trauma-impact allows you to perform low-impact thoracoscopic interventions in patients after surgery with a high operational risk [29]. Thoracoscopic, endoscopic, endovascular, puncture and other techniques are now becoming competitive and alternative to traditional thoracotomy, making their significant contribution to the development and prevention of complications. Nevertheless, early thoracotomy in the treatment of postoperative complications remains the basis of a comprehensive solution to this problem. Thus, in the treatment of postoperative intrapleu-

ral complications there are still many unsolved problems. Each method or treatment method has its advantages and disadvantages. There are no absolute indications for use of any method of treatment. Mini-invasive thoracoscopic manipulation, of course, have their own advantages, but indications for their use are also limited.

References

1. Wagner EA, Tavrovskiy VM. Errors, dangers and complications of lung surgery. Perm, 1977.
2. Vikulin PN, Kustov VI. [Analysis of immediate postoperative complications of lung resection for nonspecific suppuration]. *Klin Khir* 1975; 6: 9-12.
3. Melnik VM. [Classification of postoperative complications in pulmonary surgery]. *Grudn Khir* 1985; 4: 49-53.
4. Slepukha IM, Mel'nik VM. [Ways decreasing the number of complications and mortality in repeated operations for lung and pleural diseases]. *Grudn Khir* 1981; 2: 61-64.
5. Sadovnikov AA, Kuznetsova AD. [Rethoracotomies in the postoperative period]. *Vestn Khir Im I I Grek* 1991; 146: 86-88.
6. Wong PS, Goldstraw P. Post-pneumonectomy empyema. *Eur J Cardiothorac Surg* 1994; 8: 345-349.
7. Ueda K, Tanaka T, Jinbo M, Yagi T, Li TS, Hamano K. Sutureless pneumostasis using polyglycolic acid mesh as artificial pleura during video-assisted major pulmonary resection. *Ann Thorac Surg* 2007; 84: 1858-1861.
8. Swetman WR, Salyer JM. A study of the role of drug resistance in the surgical treatment of pulmonary tuberculosis. *J Thorac Surg* 1957; 34: 344-348.
9. Apostolov VI. Clinical and functional characteristics of the early period after pulmonary resection (Russian). PhD Thesis. Kiev, 1979.
10. Mason LB, West BB, Vernon B, Payne JA. Complications in surgical patients. A comparison of methods for identifying occurrence. *Am J Surg* 1977; 133: 575-576.
11. Kanaev MS, Chuvakov KA. Current Issues of Pulmonology (Russian). Proceedings of the Conference on Pulmonology. Alma-Ata, 1975; 103-104.
12. Podbielski FJ, Maniar HS, Rodriguez HE, Hernan MJ, Vigneswaran WT. Surgical strategy of complex empyema thoracis. *JSL* 2000; 4: 287-290.
13. Wagner EA, Kabanov AN, Kozlov KL, Pavlov VV. Treatment of bronchial fistulas. Publishing House of Perm University. Perm, 1993; 224.
14. Perelman MI, Ots ON, Darenskaya SD. Purulent diseases of lungs and pleura: state of the problem (Russian). The Third Congress of the Association of Surgeons named after Pirogov NI. Moscow, 2001; 24.
15. Romanchishen AF, Bakhars SM. [Strategy of treatment of patients with acute purulent diseases of the lungs with bronchopleural fistulas, pyopneumothorax]. *Vestn Khir Im I I Grek* 2001; 160: 86-88.
16. Deschamps C, Bernard A, Nichols FC 3rd, Allen MS, Miller DL, Trastek VF, Jenkins GD, Pailorero PC. Empyema and bronchopleural fistula after pneumonectomy: factors affecting incidence. *Ann Thorac Surg* 2001; 72: 243-247.
17. Jadcuk E. Postpneumonectomy empyema. *Eur J Cardiothorac Surg* 1998; 14: 123-126.
18. Wait MA, Sharma S, Hohn J, Dal Nogare A. A randomized trial of empyema therapy. *Chest* 1997; 111: 1548-1551.
19. Kariyev TM, Irgashev AA, Babadjanova NA. Analysis of the causes of bronchial fistulas after pneumonectomy of TB patients (Russian). The collection of scientific papers "Current issues of tuberculosis and pulmonology in Uzbekistan". Tashkent, 1998; 69-72.
20. Muraoka M, Oka T, Akamine S, Tagawa T, Morinaga M, Inoue M, Yamayoshi T, Hashizume S, Matsumoto K, Hayashi T, Nagayasu T. Modified intrapleural cisplatin treatment for lung cancer with positive pleural lavage cytology or malignant effusion. *J Surg Oncol* 2006; 93: 323-329.
21. Kalfa N, Allal H, Lopez M, Saguintaah M, Guibal MP, Sabatier-Laval E, Forgues D, Counil F, Galifer RB. Thoracoscopy in pediatric pleural empyema: a prospective study of prognostic factors. *J Pediatr Surg* 2006; 41: 1732-1737.
22. Schneiter D, Cassina P, Korom S, Inci I, Al-Abdullatif M, Dutly A, Kestenholz P, Weder W. Accelerated treatment for early and late postpneumonectomy empyema. *Ann Thorac Surg* 2001; 72: 1668-1672.
23. Melnik VM. [Intrapleural hemorrhage after operations on the bronchi, lungs, pleura and chest wall (classification, diagnosis and therapeutic tactics)]. *Grudn Khir* 1983; 5: 30-34.

24. Ryzhankov AK, Rusin AS, Lutsenko LB. [Intrapleural hemorrhage after lung surgery]. *Probl Tuberk* 2001; 2: 36-37.
25. Epstein AM. Intrapleural bleeding and clotted hemothorax after partial resection of the lung and pneumonectomy for tuberculosis. Diagnosis and treatment of complications in surgical practice. Perm, 1990; 18-21.
26. Kabanov AN, Kozlov KK, Kotov II, Sitnikova VM, Gal'perin AM. [Surgical tactics in pleural empyema with regard to the use of a carbon dioxide laser and argon plasma]. *Grud Serdechnosudistaia Khir* 1992; 11-12: 40-44.
27. Yasnogorodskiy OO, Shulutko AM, Panyushkin PV. Results of the complex therapy of patients with nonspecific pleural empyema (Russian). *Russian Medical Journal* 2004; 3: 32-36.
28. Watanabe A, Koyanagi T, Nakashima S, Higami T. Supradiaphragmatic thoracic duct clipping for chylothorax through left-sided video-assisted thoracoscopic surgery. *Eur J Cardiothorac Surg* 2007; 31: 313-314.
29. Sidorov MA, Mazo ML. Experience of thoracoscopic interventions in the treatment of complications after pneumonectomy (Russian). *Endoscopic Surgery* 1999; 2: 59-60.