PULMONARY ARTERY PERFORATION AS A COMPLICATION OF PLEURAL DRAINAGE – CASE REPORT

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The case presented is a drainage of empyema of the left pleural cavity complicated with the penetration of the lung parenchyma and perforation of the left pulmonary artery with drain displacement to the right pulmonary artery. The cause of complications has been shown along with the possible ways of conduct. Drainage of the pleural cavity is a primary surgery in the chest. The presence of pleural air or fluid is an indication for its implementation. This procedure usually has no complications. Time pressure, anatomical anomalies, changes of the topography in the course of co-morbidities are the factors allowing for the creation of many complications.

The aim of the work is to remind about the technical performance of this simple surgical procedure and to note that its complications may directly threaten the life of the patient. This is the first case reported in Polish literature.

Key words: drainage of pleural cavity, pleural empyema, lung perforation, perforation of the pulmonary artery

Drainage of the pleural cavity is a primary surgery in the chest. It is usually performed by general and thoracic surgeons. The main indication for its implementation is the presence of pleural air or fluid. The presence of air in the pleural cavity (pneumothorax) can be a complication of lung lesions, traumas or an iatrogenic complication. The presence of fluid comprises a wider range of diseases of the pleura, lungs, heart, lymphatic system and post-traumatic cases (1-6).

The technique of this procedure has been presented in many textbooks and atlases of general surgery and thoracic surgery. In case of pneumothorax, drainage is most often performed in the fifth intercostal space in the anterior axillary line. In the presence of fluid, one should try to establish the drainage in the lowest intercostal space in which the presence of pleural fluid was found in a puncture. After pleurocentesis cavity and choosing the place of drainage and premedications in the patient, one should continue with intercostal anaesthesia above the selected rib and the anaesthesia of the intercostal bundle above. After skin incision, a “blunt” dissection of the intercostal space is performed along the upper edge of the rib, followed by passing through the pleura (or a fibrous layer of the fluid ventricle). In the presence of air in the pleural cavity, the surgeon will hear the sound of air drainage moving through the tube. In the presence of fluid in the pleura, in turn, outflow of fluid will take place. When introducing a finger into the pleural cavity, the surgeon can determine its presence and in the pleural cavity along with possible pleural adhesions. After establishing the suture, the drain is inserted into the pleural cavity. The drain can be inserted into the pleural cavity through a trocar, using a guide or
“bluntly” with a clip. The presence of drainage in the pleural cavity will be confirmed by air flow according to the breathing movements or by the outflow of the fluid previously obtained in the puncture. Complications of drainage in the pleural cavity are the result of changes in the techniques of this surgery, or the drain presence in the pleural cavity (1).

The case presented is a drainage of an empyema of the left pleural cavity complicated with perforation of the left pulmonary artery and drain displacement to the right pulmonary artery.

CASE REPORT

A 49-year-old patient was admitted to the internal diseases ward of the district hospital for the diagnosis of pain in the left half of the chest, left shoulder joint, and a loss of 20 kg of body weight. As regards imaging studies: an X-ray revealed some shading of the left pulmonary field, an USG showed the presence of fluid in the left pleural cavity in a layer of up to 8 cm. The patient also had a fever of 38.8°C, elevated CRP of 173.59 mg/l, leukocytosis of 29.97 x 10^3 µl and hyperglycaemia. Due to the lack of improvement following pharmacological treatment, a puncture of the pleural cavity was performed, producing 100 ml of turbid liquid – specific gravity of 1.015, a positive Rivalta test, protein level of 439 g/dl, amylase of 19.2 U/l, packed leukocytes in the sediment, single erythrocytes, many bacteria. The patient was qualified for a drainage of the left pleural cavity. After the drainage, liquid content was not obtained – an X-ray showed that the drain inserted into the pleural cavity was bent. The drain was introduced again in the VII intercostal space in the anterior axillary line. Immediately after the drainage was established, a massive outflow of bloody fluid of 2,000 ml appeared. The drain was clipped, and the patient experienced hypotonia to the value of 60/40 mm Hg and a tachycardia of 130/min within a few minutes. Laboratory studies revealed some anaemia up to the following values: Hgb of 4.9 g/dl, Rbc of 1.71 x 10^6 µl (initial values: Hgb of 14.9, Rbc of 4.99 x 10^6 µl). The chest X-ray performed found a pathological position of the drainage up to the pulmonary field on the opposite side (fig. 1). The patient was transfused 3 units of PRBC and fluids in a volume of 3,500 ml. The patient was then transferred to the thoracic surgery ward.

On admission, the patient was conscious, in a severe condition. Massive outflow of bloody content occurred after opening of the clip which tightened the drain. Because a CT scan could not be performed in the local unit and due to the serious condition of the patient, the idea of transporting the patient to the laboratory at another hospital and performing a CT scan before surgery was abandoned. The patient was qualified for the revision of the pleural cavity as an urgent surgery.

The drain was clamped outside the chest and secured with sterile dressing. An anterolateral thoracotomy above the left sixth rib was performed at a distance of 3 cm posteriorly from the place where the drain was inserted, partially outside the pleura. Fibrothorax was identified. During the opening of the pleural cavity, the presence of pus and fibrin deposits was revealed in the empyema ventricle located posterior-laterally from the segments 3-10. The drain was penetrating to segment 5 in adhesions with the pleura. The adhesions in this place were removed. The drain was closed with a clip along with the edge of the lung. It was then cut above in order to release the adhesions from the frontal segments (fig. 2). The drain was introduced in the lung parenchyma to a depth of 14 cm from the proximal opening of the drain. The pulmonary hilum was revealed – the vessels and the interlobular fissure were covered with think, inflammatory, fibrous pleura. The pericardial sac showed no liquid. Through palpation the left pulmonary artery presence of the drain was revealed. A dissection of the artery and the upper pulmonary vein was performed. After releasing the arte-

Fig. 1. AP chest X-ray, the end of the drain in the projection of the right lung hilum
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rio-venous ligament, a thrombus was revealed. The tunica externa was prone to bleeding, with a haematoma widening underneath. The upper pulmonary vein was dissected. Outflow from segment 1 was then tied off with linen sutures and cut between the tied off places to give better access to the pulmonary artery. The artery was dissected from the bronchus, but the site of perforation of the vessel was not revealed. The end of drain could not be examined in palpation. In the absence of possibility to reach the site of perforation of pulmonary artery, a decision was made to perform pneumonectomy. Under the control of palpation of the pulmonary artery, the drain was elevated by about 7 cm, which made it possible to tie off the pulmonary artery. The artery was tied off with 3 central linen sutures and 2 peripheral ones. It was then cut between the places which were tied off. Due to the bleeding from the drainage tube, the clip on the pulmonary edge was closed again. Further proceedings were typical of pneumonectomy. Drainage of the pleural cavity with a F36 drain was performed, followed by layered suturing of the wound. The postoperative period was without complications. The patient was discharged home in good condition on the 7th day after the surgery. Control tests for embolism were normal.

DISCUSSION

Drainage of the pleural cavity is a primary surgery in the chest. Simple as it may seem, this procedure can cause considerable difficulties, and it can be associated with many complications, sometimes very dangerous. Another difficulty in the proper performance of the procedure is the fact that the procedure is often performed on an emergency basis, with limited access to staff or more experienced doctors, and in difficult patients. What’s more, it is not a procedure performed routinely in daily surgical practice (1-6).

Complications of the drainage of the pleural cavity can be divided into three main groups, due to the technique of performance, the permeability of the drainage system and the presence of drainage in the pleural cavity. The first group includes damage to lung parenchyma, large blood vessels, pericardium, heart, diaphragm, vascular structures, nerves, chest muscles, abdominal organs (liver, spleen, stomach, colon), complications resulting from the permeability of the drainage system caused by a V-like bending of the drainage within the pleural cavity or between tissues of the chest wall, mucus plugging with fluid or tissues, and unsealing of the system. Limited permeability of the drainage system can cause subcutaneous emphysema. The presence of the drain in the pleural cavity can lead to arrhythmias and bacterial infections in case of prolonged drainage time. Evacuation of fluid or air from the pleural cavity which takes place too fast may cause pulmonary oedema (1-6).

Pulmonary artery trauma is a very rare complication of thoracic drainage. These lesions are usually present when drainage is established with a trocar. In most of the cases reported, the presence of a dense fluid (empyema, haematoma) was the indication for drainage of the pleural cavity. Dense fluid and the presence of pleural adhesions make it difficult to introduce the drain, leading to penetration of the lungs and the pulmonary artery. The outflow of blood through the drain and a hypovolemic shock clinically confirmed our suspicions (2, 4, 5).

In the case described, the drainage was performed because of empyema in the left pleural cavity. The drain, inserted through the intercostal space, penetrated the pulmonary parenchyma first. In the absence of fluid, the further penetration led through the left pulmonary artery with its perforation in the section between the segmental branches a1 + 2L and a4 + 5L, and then, in its lumen, to the right pulmonary artery, at the ostia of a1 + 3R (fig. 3, 4).

A similar case was described in 2005 by Iwao Takanami. A 74-year-old female patient
was admitted to a district hospital in Japan to treat pneumonia with an empyema of the left pleura. The drain was introduced in the fifth intercostal space in the anterior axillary line. An outflow of approx. 1500 ml pulsing blood was obtained, followed by decreased blood pressure. The drain was clamped. The thoracic CT performed showed damage of the lung and the left pulmonary artery. Left-sided pneumonectomy was performed. The patient was discharged home after 14 days with no complications in the postoperative period (2).

Damage to the left pulmonary artery which requires pneumonectomy was also described by Bozzani et al. in the Texas Heart Institute Journal (3). A 69-year-old patient was treated with the implantation of a stent graft because of aorto-bronchial fistula accompanying an aneurysm of the descending aorta. A drain was established because the fluid in the left pleural cavity. Immediately after the drainage, desaturation and hypotension occurred, followed by evacuation of more than 1,000 ml of blood in a few seconds. After the administration of a contrast agent through the drain, damage to the left pulmonary artery was revealed. The left lung was removed. The patient died on the first day after surgery in the course of multiple organ failure.

A restorative operation of the damaged main pulmonary artery was reported in 2013 by Gabriel et al. from Fann University Hospital in Dakar (4). After inserting the drain through the third intercostal space in the anterior axillary line, an outflow of approx. 2300 ml of blood was observed, accompanied with a shock and acute anaemia. A CT scan revealed penetration of the drain to the trunk of the pulmonary artery, with the tip of the drain in the lumen of the right pulmonary artery. A wound was found on the side wall of the pulmonary trunk with the access via sternotomy, along with the presence of the drain in the lumen of the right pulmonary artery. The torn wall of the pulmonary trunk in the partial extracorporeal circulation was managed efficiently. The postoperative course was described as uneventful.

A completely different (non-operative) approach to the management of damage in the pulmonary artery was presented Sundaramurthy et al. They described a case of a 74 year-old man treated for septic shock with pleural effusion. Using the “blunt” technique (without the use of trocar), they established a drain through the third intercostal space in the anterior axillary line. The procedure was described as being technically difficult due to the thickened pleura. Immediately after the introduction of the drain, approx. 1600 ml “fresh” blood was obtained. A chest CT scan confirmed the suspected damage of the right pulmonary artery. Due to the high operational risk of respiratory failure and thick, inelastic pleural peel, the decision was made to make an at-
tempt of conservative treatment. The drain was being partially ejected (2-3 cm) each day until complete removal on the fourth day. There was no deterioration in the health of the patient after surgery. A control thoracic CT performed after drain removal revealed a tube after drainage filled with thrombus (5). This case shows that drainage performed in the “blunt” technique provides no guarantee of uncomplicated pleural drainage.

The procedure adopted by the authors is characterised by lack of control of the haemostasis, the probability of boundary thrombus formation of the pulmonary artery with the possibility of thrombus displacement, and the cause of pulmonary embolism or infection of the blood clot in the tube after the drainage, leading to lung abscess (4, 5).

**CONCLUSIONS**

1. Drainage of the pleural cavity is associated with some risk.
2. Introduction of the drain using the “blunt” method with dissection of the intercostal space has fewer complications.
3. Most of the complications can be prevented. The awareness of their occurrence helps provide proper conduct.
4. The methods for dealing with damage to the pulmonary artery depend on the patient’s condition, availability of imaging studies and the extracorporeal circulation. One should always seek for a restorative operation to minimise the damage to pulmonary vessels and the loss of volume of the pulmonary parenchyma.

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Received: 18.02.2016 r.
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