Case report

Surgical management of a patient with combined heart pathologies and lung cancer. A simultaneous coronary artery bypass surgery, aortic valve replacement, tricuspid valve repair and pulmonary resection

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Abstract

Coexisting coronary artery disease and significant heart valve disease represent a considerable risk factor in patients undergoing pulmonary resection. The possibility to perform concomitant (simultaneous) heart and lung surgery could be a good option for many patients.

In the presented case report, the intervention was performed on two valves, triple coronary artery bypass and pulmonary resection, which has not been published in literature to date.

A 68-year-old woman with coronary artery disease, aortic valve stenosis, tricuspid valve regurgitation and pulmonary disease (malignant pathology) presented with triple vessel disease, moderate aortic valve stenosis, severe tricuspid regurgitation and tumorous infiltration in the upper lobe of the left lung. She underwent combined heart and pulmonary surgery—left upper lobectomy, aortic valve replacement, tricuspid valve repair and coronary artery bypass surgery. On the eighth day of surgery, she was discharged. She continues to do well on follow-up.

Simultaneous cardiac surgery and pulmonary resection for malignancy become almost standard treatment of patients who require heart and lung surgery. The most often approach is midline sternotomy that enables a comfortable cardiac intervention as well as an acceptable access to lungs. The left lower lobectomy remains an exception, in which pulmonary resection during extracorporeal circulation (ECC) is more often an option of left thoracotomy. If the use of ECC is inevitable, some authors prefer pulmonary resection before starting up ECC if the location of the neoplasm does not require resection during ECC.

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Introduction

Coexistence of heart pathology represents a considerable risk factor in patients undergoing pulmonary resection. Despite the fact that symptoms in those patients coincide, major centers present only a 0.5% rate of patients requiring both surgical interventions [1]. Moreover, the rate of e.g. smokers in this group of patients is according to published literature merely 54% in comparison to 49% in patients with lung tumor without a cardiac finding [2,3]. On the other side, the rate of patients undergoing thoracotomy and requiring a cardiac surgery performs up to 5% [4].

The first paper presenting simultaneous cardiac surgery for coronary artery disease and pulmonary resection for lung cancer by the authors Davydov et al. dates back to 1978 [5]. To the present day, numerous case reports have been published as well as small clinical groups presenting simultaneous cardiac and pulmonary surgery. However, explicit management of such patients has not been determined yet. If the pulmonary resection in patients with coronary disease is indicated, four specific approaches are presented in literature. The first is resection of the lung in advance of cardiac intervention – two stage procedure. The second is percutaneous coronary intervention (PCI) in case of coronary artery disease (CAD) followed by pulmonary resection. However, this management is not applicable if simultaneous valve surgery is indicated. The third approach is heart procedure and subsequent lung surgery – two stage procedure. The fourth alternative is simultaneous cardiac operation and lung – one stage procedure (Tables 1 and 2) [1].

The first option is possible only in patients with an appropriate cardiac status, in who cardiac intervention is not inevitable. Primary PCI in advance of lung intervention is eligible merely for an appropriate coronary angiography without a heart valves pathology. Moreover, an increased risk of in-stent thrombosis at the time of lung surgery six weeks after the PCI has been presented in literature [6]. Some authors confirm an increased risk and they suggest to postpone pulmonary resection up to 3 months, which could be almost unacceptable regarding the oncological status of patient [7].

Therefore these two procedures are not applicable in the majority of patients. The choice of a two-stage operation, whereas cardiac surgery is carried out in advance, is suitable in each patient. Nevertheless, it carries a higher risk for the patient due to two anesthesiological and surgical accesses, which is obviously more painful, and undoubtedly, worsening of cost-effectiveness is also present. An advantage of thoracotomy is a better accessibility of lymphatic nodes in the posterior mediastinum as well as a better accessibility of the left lower lobectomy or the left-side pulmectomy, which makes this surgical access partly preferable [8]. If a midline sternotomy is performed, exploration of posterior mediastinum is often inevitable in this location [1,9]. The present-day view of essential total lymph nodes dissection is yet controversial with regard to prolonged operation time and increased of morbidity [2]. The fourth possibility of performing both cardiac and lung interventions simultaneously represents an appropriate method for many patients. The opportunity of option if either sternotomy or thoracotomy as well as the timing of surgeries (and necessity of ECC) provides a wide spectrum of methods and individualization of the procedure with respect to the needs of a specific patient. Heparinization with a higher risk of bleeding in the bed after lung surgery could be a possible complication [10]. Pavia et al. present a paper with a total of 189 patients with cardiac surgery in advance and followed by pulmonary resection (two-stage procedure) as the most eligible method. The second most frequently used approach was combined cardiac and lung surgery (one-stage procedure) [11].

Case report

A case report of a 68-year-old woman with a personal history of hypertension and autoimmune thyroiditis with struma nodosa is presented. The patient was hospitalized in a regional hospital for subacute non-ST elevation myocardial infarction and transferred to our institution. Cardiac catheterization

| Table 1 – Comparison of advantages and disadvantages of varying timing of intervention for coronary artery disease and pulmonary cancer. |
|-----------------------------------|-----------------------------------|
| (+)                               | (-)                               |
| LS → CABG/VR                      | Timely oncological intervention    |
| PTCA → LS                         | Reliability                       |
| CABG/VR → LS                      | Lower bleeding risk in comparison to simultaneous performances |
| CABG/VR+LS                        | Lower load with one anesthesia less pain with one access |
|                                  | High preoperation and early postoperative risk at thoracic operation |
|                                  | Reliability necessity to postpone thoracic surgery 6 weeks to 3 months, necessity of adequate cardiac finding |
|                                  | Load of double anesthesia, two surgical wounds, short-dated delay of thoracic onco-logical operation, financial demands |
|                                  | Access via sternotomy with necessity of left lower lobectomy, bleeding risk at heparinization |

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<th>Table 2 – Explanation of abbreviations.</th>
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<td>CABG</td>
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(coronarography) revealed triple vessel coronary disease. Echocardiographic findings were moderate stenosis of aortic valve with mean pressure gradient of 25 mm Hg and severe tricuspid valve regurgitation. Pre-operative plain X-ray of thorax showed a non-homogenous overshadow of 4 cm in diameter in the left pulmonary upper lobe in the area of the second rib, linked to the left hilus (Fig. 1). Subsequently, a CT scan confirmed assumed tumorous infiltration in the upper left lobe with pleural infiltration but without mediastinal or other lymphatic involvement yet. Bronchoscopy was carried out, but brush cytology samples were negative. Considering the finding, we decided on combined cardiac surgery with per-operative histological examination of the lung malignancy and, in the case of positive malignant finding, simultaneous pulmonary resection.

58 days after the first symptoms of subacute non-STEMI, the patient underwent surgical operation. Standard midline sternotomy had been done. In the first part of operation, histological samples of the lung tumor have been harvested and subsequent pathological screening has revealed a low-differentiated adenocarcinoma. Referring to that conclusion, left upper lobectomy was accomplished. Next an EEC was established and heart was arrested by using an antegrade intermittent cold blood cardioplegic solution. Triple coronary artery bypass on left anterior descending, marginal and right coronary artery was done using autologous vein grafts. Aortic valve was replaced by a biological prosthesis Trifecta (St. Jude Medical, St. Paul, Minnesota, USA) in size 21 and tricuspid annuloplasty with Tailor ring (St. Jude Medical, St. Paul, Minnesota, USA) in size 29 has been performed. After removing of X-clamp, three proximal anastomoses were performed.

The early post-operative period was uneventful. The final outcome of histological examination showed the presence of unifocal tumor – adenocarcinoma mixed subtype grade 3 with local penetration into visceral pleura. All resection margins as well as lymphatic nodes were negative to presence of tumor cells. On the eighth day, the patient was discharged and she continues to do well on follow-up.

**Fig. 1 - Plain pre-operative X-ray of our patient's chest showing circle overshadow in upper left lobe (black arrow).**

**Discussion**

Simultaneous operations perform a parallel surgical intervention in two organs for at least two different diseases. In certain cases, cardiac surgical intervention and pulmonary resection are indicated for only one malignant pulmonary process metastasizing into the heart [12]. At present, there have also been described simultaneous combinations of other than thoracic intervention with cardiac surgery, as e.g. resection of the intestine [13]. Major apprehension of simultaneous cardiac and oncological surgical interventions aims to the necessity of using heparinization for ECC which is followed by a higher risk of bleeding complications. On the other hand, higher blood losses have been described in separate thoracic surgical interventions as well, however, in the most cases sufficient coagulation status allows their conservative management [14]. Brutel et al. describe the occurrence of hemorrhagic complications requiring surgical revision in 8.8% using ECC [10]. Dyskiewicz et al. have published two studies including utilization of a method without using ECC (off-pump) in a combined surgery on the heart and lungs. While they report on occurrence of hemorrhagic complications in 7.7%, in a study from the year 2008, the hemorrhagic complication with the need of surgical reexploration does not occur any more [1,4]. In general, there is an endorsement of a maximum possible effort of the method without using ECC in combined surgery on the heart and lungs [1,4,15]. Summarizing the reports including assemblies of patients undergoing a combined surgery on the heart and lungs, ECC was used in 72.5% and off-pump method in 27.5%, while in 81.1% lung surgery was combined only with coronary artery bypass grafting for CAD without intervention on the valves. In 8% the aortic valve was operated on, in 3.4% the mitral valve, in 2% combined surgery was done concerning the aortic valve and coronary arteries, in 2.7% the mitral valve and coronary arteries and in 2.7% another cardiac intervention was carried out [1,2,4,5,10,15–19]. In the presented case report, the intervention was performed on two valves, triple coronary artery bypass and pulmonary resection, which has not been published to date yet. The most frequently described postoperative complication after a simultaneous operation are supraventricular arrhythmias in 10.9%, pneumonia in 6.4%, pulmonary atelectases in 4.1%, pneumotorax in 1.4% and both air-leak and respiratory insufficiency in 0.5% [1,2,4,5,10,15–19]. In our case report, no postoperative complication has been found in the patient. If the using of ECC is inevitable, it is important to answer the question of timing ECC and resection of the lung. On the basis of literature we learn that in 73.8% resections had been done before establishing ECC, while during ECC resection was performed in 26.2% only. No lung resection after veaning the ECC has been reported [2,16,19]. Priority of the lung resection in advance of ECC establishment may be explained by a better coagulative condition as well as by shortening the duration of ECC. Using of ECC during lung resection has been selected due to localization of the malignant process on the lungs, whereas by choosing sternotomy, the left lower lobectomy is difficult to carry out [16,19]. Further important angle of view is the influence of ECC on dissemination of
malignancy. ECC can cause a many serious systemic reactions with progression of hematogeneous spread of tumor cells [20]. It may cause interim suppression of the immune system, which makes the metastatic process easier. In literature there are a few clinical studies presenting influences of ECC on malignancy and long-term survival. Hasegawa et al. have published a work presenting a considerable cell dissemination of thyroid papillary carcinoma whereas they demonstrate that in oncological patients a retrograde use of the aspirated blood is not recommended as in cardiac surgeries [21]. However, further work reports that the use of ECC does not influence the 5-year-long survival of oncological patients [22]. Other authors conclude in their studies that the 5-year-long survival is influenced only by the phase of the oncological process and not by using or not using either reapplication of aspirated blood or ECC in general [5]. Midline sternotomy is a preferred surgical approach in cardiac surgery. It could be used in thoracic surgery as well, predominantly if bilateral intervention is necessary [23]. The use of sternotomy in resection of the lung is connected with a disadvantageous access into the posterior mediastinum and left lower pulmonary region. With regard to the fact that radical lymphadenectomy has been abandoned at the treatment of lung cancer and the left lower lobectomy is possible while on ECC, the majority of authors incline to use sternotomy as method of choice. In spite of the fact that this approach is not ideal, is becoming almost worldwide. On the other side, there can be found papers selecting thoracotomy for combined simultaneous surgery on the heart and lungs. It is appropriate to a for patients with coronary artery disease when coronary bypass could be accomplished off-pump [9,24].

### Conclusion

Simultaneous cardiac surgery and pulmonary resection for malignancy become in a present almost standards in treatment of patients requiring cardiac and lung intervention. The most often surgical approach is midline sternotomy that enables a comfortable cardiac intervention as well as an adequate access to almost all lung segments. The left lower lobectomy remains an exception, which is possible either during ECC or without ECC via left thoracotomy. Most authors prefer, if allowed by cardiac intervention and status, the use of the off-pump method. If using of ECC is essential, more authors prefer lung resection in advance of ECC establishment if the location of the malignancy does not require resection within ECC period.

### Conflict of interests

The authors declare no conflict of interest.

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### Ethical statement

The case report was done according to ethical standards.

### Informed consent

Medical management of the patient was not influenced by case report processing. Patient did not refuse medical records processing for publication.

### References


