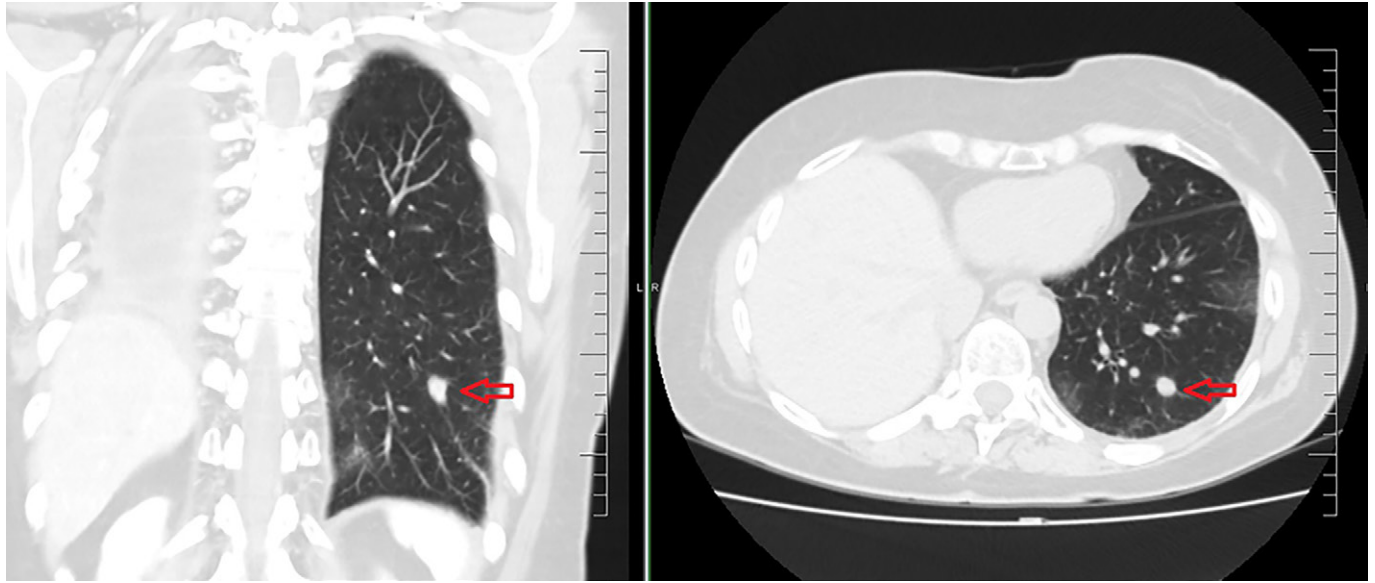


Fig. 1. Metastases of malignant melanoma, labeled with an arrow

Presentation of Cases

Between February 2019 and November 2024, fifteen VV ECMO-assisted thoracic surgeries were done at St. Anne's University Hospital in Brno. The patients included 5 women and 10 men with a mean age of 60 years. Seven patients underwent elective surgery, including five lung tumor resections and two cases of benign etiology. Eight patients were operated on urgently: one with a post-pneumonectomy bronchopleural fistula, another with a tracheal injury and massive air leak, two with empyema, two with pneumothorax (abscess rupture), one with an expanding bulla, and one with lung lobe necrosis.

In both elective and acute settings, the Cardiohelp ECMO system with HLS heparin coated sets by Maquet (Getinge Group) were used. Before the surgery in elective cases, we performed percutaneous cannulation under ultrasound guidance directly in the operating room. We performed cannulation in the intensive care unit in the same manner for acute cases. We inserted suction cannulae 23-25 F into the femoral vein and returned cannulae 19-21 F to the jugular vein. We always performed the priming of the ECMO circuit with saline, without adding any heparin. We administered only a bolus of heparin of 2000 j prior to the cannulation, leaving patients completely without anticoagulation peri- and postoperatively. We started ECMO in the same manner in acute cases, but in the intensive care unit.

In elective cases, airways were secured with orotracheal intubation and total intravenous anesthesia with propofol infusion was used. We monitored the depth of anesthesia using the bispectral index (BIS) and maintained it at BIS 40-60. During elective surgery, we completely disconnected patients from the ventilator once they reached 50 ml/kg of ECMO blood flow, enabling them to remain apneic throughout the entire procedure. In acute settings, 50 ml/kg of ECMO blood flow was usually not enough to maintain sufficient oxygenation (most of the patients were septic). Therefore, during the surgery, we selectively intubated these patients (Robertshaw endobronchial tube 37-41 Fr) and performed one-lung ventilation as well. Should the patients fail to wean off VV ECMO within 24 hours, our plan was to start anticoagulation with

heparin at a target aPTTr of 1.5–2 fold, contingent on the occurrence of bleeding. However, we weaned all elective cases from ECMO within 24 hours after surgery.

The typical indication for elective VV ECMO-assisted surgery was lung resection in a patient after a previous resection (lobectomy or pneumonectomy) on the contralateral lung, where reduced pulmonary reserve makes one-lung ventilation unsafe. Most of the surgeries were performed due to lung tumors. Specifically, one right-sided and one left-sided lobectomy were done after a left/right-sided lobectomy, one right-sided wedge resection was done in a patient after left-sided lobectomy, and metastasectomy (malignant melanoma) was performed in a patient after pneumonectomy (Fig. 1). One patient with tracheomalacia had lobectomy and one with an intrathoracic goiter compressing the trachea, who was unable to undergo selective intubation, had left hemithyroidectomy. Finally, the last patient, who had a history of three pneumothoraxes and bullous emphysema, underwent bullectomy (Fig. 2).

Indications for acute VV ECMO-assisted surgery were mainly infections in the field of ARDS (one lung abscess in a patient with COVID-19 pneumonia, two lung necroses in a patient with severe community-acquired pneumonia, and two cases of empyema). The remaining cases included one expanding bulla causing respiratory failure necessitating prolonged artificial ventilation, one bronchopleural fistulation after right pneumonectomy (Fig. 3), and two patients with iatrogenic pneumomediastinum/pneumothorax (one post-intubation tracheal trauma, one pneumothorax after failed drainage). Table 1 summarizes the details for all cases.

There were no postoperative complications in elective VV ECMO-assisted surgery. Acute VV ECMO-assisted surgery was complicated in five patients (two with hemothorax, one with hemoperitoneum, one with infection in the groin at the site of cannula insertion, and one with hematoma in the area of the iliopsoas muscle after suction cannula malposition). Three of these complications (both cases of hemothorax and the hemoperitoneum) required acute surgical revision.