



Case report

Short veno-venous extracorporeal membrane oxygenation assisted segmentectomy for second primary lung tumor in a patient with insufficient respiratory function for one lung ventilation



Konstantinos Grapatsas^{a,*}, Severin Schmid^a, Benedikt Haager^a, Torsten Loop^b, Bernward Passlick^a

^a Department of Thoracic Surgery, Medical Center-University of Freiburg, Faculty of Medicine, Germany

^b Department of Anesthesiology and Intensive Care Medicine, Medical Center-University of Freiburg, Faculty of Medicine, Germany

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ABSTRACT

Advances in extracorporeal membrane oxygenation (ECMO) have allowed safe performance of complex thoracic surgical procedures that were impossible before. Application of ECMO in general thoracic surgery is extremely rare, but allows life-saving procedures in patients in whom one-lung ventilation cannot be carried out safely. We present the case of a 66 year old man who underwent a challenging veno-venous ECMO assisted segmentectomy for a second primary lung cancer. One-lung ventilation was not feasible due to previous lobectomy on the contralateral side and consequent lack of respiratory function. After the surgical procedure was completed the ECMO was removed and under stable conditions followed the immediate tracheal extubation.

1. Introduction

Extensive lung resection for second primary lung cancer with poor contralateral lung function is rarely performed and is a challenging task for the treating disciplines [1–4]. Until recently, respective patients were rendered inoperable by conventional one-lung ventilation. The extracorporeal membrane oxygenation (ECMO) allows a safe performance of this rare operation [1–3]. We present a case of veno-venous (vv)-ECMO assisted segmentectomy for second primary lung cancer in which one-lung ventilation was not feasible (see Figs. 1–3).

2. Case presentation

2.1. Medical history

A 66-year-old caucasian male presented with a second primary tumor of the apical segment (6) of the left lower lobe (LLL) (cT1a,cN0,cM0) during routine follow-up. This was preceded by a complex oncological history with previously performed right lower lobectomy and partial resection of the diaphragm (pT3,pN2,cM0) due to lung sarcomatoid tumor 6 years before with adjuvant mediastinal radiotherapy and adjuvant chemotherapy (Vinorelbine/Cisplatin); atypical resection of the left upper lobe for squamous cell carcinoma (SCC) (pT1a,pN0,pM1b) with additional transsternal resection of lymph node metastases and resection of the internal and external jugular veins.

Furthermore, right axillar lymph node dissection for metastasis of the SCC of the LLL was performed 3 years before. Since then there was no evidence of further metastasis during follow up.

2.2. Preoperative assessment

Computed tomography (CT) scan revealed a 12 × 8mm tumor of the apical segment of the LLL. Distant and lymph node metastasis were ruled out via positron emission tomography-CT-scan. Ventilation/perfusion scintigraphy showed left/right ventilation ratio of 86/14% and perfusion ratio left/right of 81/19%. During preoperative bronchoscopy a polypoid tumor in segmental bronchus (B6b) was seen. Pulmonary function showed forced expiratory volume in 1 second (FEV1) 1.2 l and diffusing capacity of lung for carbon monoxide (DLC) 25%. The blood gas analysis (BGA) showed PO₂: 61 mmHg and PCO₂: 43 mmHg. The transthoracic echocardiography showed normal biventricular function. After the interdisciplinary evaluation of the patient's general condition and oncologic history and after discussion of his case in our institutional tumor board vv-ECMO assisted surgical excision was decided. Segmentectomy was preferred over lobectomy in order to preserve as much lung tissue as possible.

2.3. Procedure

Thoracic epidural catheter was applied the day before surgery.

* Corresponding author. Department of Thoracic Surgery, Medical Center-University of Freiburg, Hugstetter Strasse 55, 79106 Freiburg, Germany.
E-mail address: konstantinos.grapatsas@uniklinik-freiburg.de (K. Grapatsas).



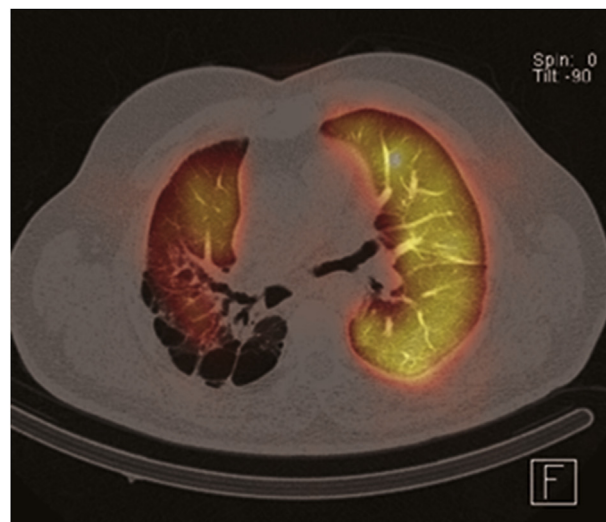
Fig. 1. Bifemoral ECMO implantation. The bifemoral vv-ECMO was established unproblematic in the operation room after the intubation of the patient.

Using percutaneous approach under general anesthesia a bifemoral vv-ECMO was established. Through left thoracotomy, extended adhesiolysis and after uncovering the intrathoracic aorta and phrenic nerve the tumor could be localized in segment 6. The pulmonary artery and venous branch as well as the bronchus were identified, ligated and severed. After demarcation of the borders within the lung parenchyma the segment was removed using a linear-stapler. Intraoperative frozen section revealed a SCC with tumor free margins. After meticulous hemostasis two chest drains were inserted before closing the chest.

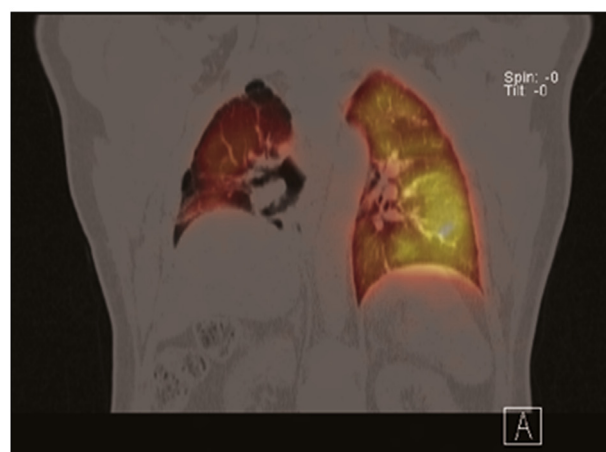
Because of perioperative anemia, 2 units (1l) of packed red blood cells were transfused. Intraoperatively BGA revealed normal gas exchange. The ECMO was explanted in the operation room and the patient could be extubated immediately and transferred to the intensive care unit. The further postoperative course was uneventful. Final histopathologic analysis revealed a second primary lung tumor as direct comparison revealed distinct histomorphologic as well as immunohistochemical patterns in the respective tissue specimen (SCC pT1b,pN0,cM0). The patient was discharged on 14th postoperative day. Follow-up after three months showed FEV1: 1,7L and DLC 30% with normal BGA.

3. Discussion

Resection of second primary non-small cell lung cancers as well as



a



b

Fig. 2. Axial (2a) and coronal planes (2b) of the Ventilation/Perfusion scintigraphy. After this abnormal pulmonary ventilation and perfusion scan it was realized that no one lung ventilation could be performed. After a multidisciplinary approach of the patient an ECMO implantation was decided.

pulmonary oligometastasis are associated with a highly favorable prognosis. Therefore, in selected cardiorespiratory fit patients a surgical therapy should be carried out [5]. Until recently, some of these patients were considered inoperable due to infeasibility of one-lung ventilation which would be associated with a great perioperative risk [2–5]. Ipsilateral lung's endotracheal ventilation through a small catheter with tidal volumes can have a limited duration of approximately 30 minutes and can lead to severe respiratory acidosis while surgery has to be carried out on a ventilated lung [2].

Routinely ECMO in general thoracic surgery is only used for lung transplantation [1,2,4]. For other indications it is rarely used and its use has been described in very few cases only. In absence of compromised cardiac function vv-ECMO was chosen for lung's support allowing prolonged apnea and safe anatomical resection. Additionally, vv-ECMO gives the advantage of a good intraoperative myocardial oxygenation and the possibility of postoperative ECMO support in case of pulmonary edema [1,2].

The possible complications of the vv-ECMO in its general thoracic surgical use are approximately the same with the ones of the general use of vv-ECMO. The major complication of the device is bleeding because of the heparin use [1–3]. However, the risk of a perioperative hemorrhage is lower than using conventional cardiopulmonary bypass [1–3]. Rinieri et al. described a 17% of bleeding with all patients



Fig. 3. The tumor at the apical segment (6) of the left lower lobe in the preoperative CT (3a) and PET-CT scan (3b).

returning in the operating room for hemostasis. We suggest that in order to avoid a perioperative bleeding a possible preoperative erythropenia and thrombocytopenia should be corrected. In addition, intraoperatively a thorough hemostasis should be performed. Furthermore, we suggest that the time of the use of ECMO should be as short as possible. Rinieri et al. reported that 2/3 of the revised patients were still under ECMO at the time of surgical revision. In our case the ECMO device was removed at the end of the operation in the operating room.

In this way hemostasis disorders because of prolonged ECMO use were avoided [4].

In addition, in order to avoid other bleeding related complications a careful preoperative planning of the operation is needed. For this reason, in order to avoid a possible spinal epidural hematoma the thoracic epidural catheter was applied the day before the surgery.

Another possible complication of the use of the ECMO device in the general thoracic surgery could be the injury of the cannulated vessels. Rinieri et al. reported a 6% of cannulation related complications. The use of the vv-ECMO gives the possibility of a peripheral cannulation. In our case, the femoral veins in both sides were cannulated. In this way a potential injury of the thoracic vessels could be avoided [1,2,4].

4. Conclusion

After a multidisciplinary approach the perioperative use of vv-ECMO allows to extent the indication of thoracic surgical interventions without increasing perioperative risk. As seen in the presented case vv-ECMO could be removed immediately after the operation and the patient showed quick postoperative recovery.

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Conflict of interest

None declared.

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