Case report

Post-pneumonectomy video-assisted thoracoscopic bullectomy using extra-corporeal membrane oxygenation

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Abstract

We describe a case of a patient who, 14 years after a pneumonectomy, required surgery for a life-threatening air-leak following accidental intubation of an emphysematous bulla in his remaining lung. To facilitate treatment by video-assisted thoracoscopic surgery, veno-venous extra-corporeal membrane oxygenation was employed.

Keywords: Video-assisted thoracoscopic surgery bullectomy; Extra-corporeal membrane oxygenation; Post-pneumonectomy

1. Introduction

Video-assisted thorascoscopic surgery (VATS) is an effective treatment of secondary pneumothorax [1] and results in less postoperative respiratory dysfunction than treatment by thoracotomy [2].

We describe a patient who, after a previous pneumonectomy, developed a pneumothorax and life-threatening air-leak following inadvertent placement of a chest drain into an emphysematous bulla in his only lung. Veno-venous extra-corporeal membrane oxygenation (VV ECMO) was used to facilitate VATS and to reduce the risk of peri-operative barotraumas.

2. Case report

A 53-year-old man who had undergone a right pneumonectomy 14 years previously for a T2N0 moderately differeniatied squamous cell carcinoma had been investigated for increasing dyspnoea (MRC 3). His spirometry showed a forced expiratory volume in 1 s (FEV1) of 0.85 l (23% predicted) and a forced vital capacity (FVC) of 2.35 l (52% predicted). A chest X-ray and CT scan confirmed centrilobular emphysema in the remaining lung with bulla formation.

He subsequently presented himself as an emergency with an acute exacerbation of dyspnoea. A left pneumothorax was diagnosed on clinical and radiological grounds and a chest drain inserted. He then developed impending respiratory failure due to the large air-leak (pO2 8.54 kPa, pCO2 6.78 kPa, with FiO2 28%). A CT scan confirmed the drain to be located in the bulla (Fig. 1). Surgery was considered the only option to control the life-threatening air-leak. Due to his previous pneumonectomy and poor respiratory reserve, we preferred the use of VATS rather than a thoracotomy. This made conventional anaesthesia with single lung ventilation undesirable. We therefore used VV ECMO to allow operation on a non-ventilated lung.

Methylprednisolone (30 mg/kg) was given intravenously 24 h prior to the operation. The patient was anaesthetized, heparinized (100 U/kg) and cannulated percutaneously via both femoral veins for VV ECMO; our standard circuit was used [3]. The patient’s coagulation factors and platelets were replenished by transfusion to a platelet count of 150,000/ml, International Normalised Ratio (INR) of <1.5, fibrinogen of >2 g/dl, and Hb of >14 g/dl. Aprotinin (1 £ 106 KIU) was administered, and an infusion was started at a dose of 500,000 KIU/h. The heparin infusion was adjusted to maintain the activated clotting time at between 180 and 200 s. The lung was deflated, the patient was cooled to a core temperature of 34°C. Up to 7 l/min of ECMO flow maintained the SpO2 at > 65%.

VATS was performed via three 2-cm incisions with meticulous haemostasis. A large bulla was found, arising from the upper lobe, adhering to the chest wall at the site of the previous drain insertion. The drain was seen to be lying in...
Fig. 1. Preoperative CT scan with drain in bulla.

Fig. 2. Intra-operative view of the drain prior to removal from bulla.
the bulla (Fig. 2); the bulla was opened and the drain removed. Bulllectomy was then performed using the EZ45 endoscopic linear stapler (Ethicon Endo-Surgery, OH). All staple lines were buttressed with dry bovine pericardial strips (Peri Strips, Bio-Vascular, MN).

After the procedure, the patient was extubated. Once the patient was alert, rewarmed and breathing spontaneously, he was decannulated from ECMO that same evening.

His postoperative recovery was uneventful and the patient was discharged home on the 5th postoperative day when mobilizing without supplemental oxygen. After review on the 11th postoperative day, the drain was removed.

Postoperative pulmonary function tests 3 months later showed a 16% improvement in the FEV1 and a 20% improvement in FVC.

3. Discussion

There are few series reporting elective lung resections for cancer in patients after a previous pneumonectomy [4–6]. Operative approaches include: posterolateral thoracotomies, muscle sparing thoracotomies, median sternotomies or VATS. The anaesthetic techniques used are conventional anaesthesia, selective ventilation of one lobe using an endobronchial blocker [7], high-frequency jet ventilation [6], and femorofemoral cardiopulmonary bypass [6,8]. The preoperative assessment includes pulmonary function tests, whereby a preoperative FEV1 of greater than 40% predicted and a predicted postoperative FEV1 of not less than 30% of theoretical values are considered a requirement for surgery [4].

In high-risk patients with emphysematous bulla, intracavitary drainage with instillation of glue has been used (Monaldi procedure) [9]. However, in our patient, this was not an option due to the large air-leak and his poor respiratory state. The best surgical circumstance in which to perform VATS bulllectomy is to isolate the affected lung. In view of his previous pneumonectomy and emphysema in his remaining lung, ECMO was selected as the method of operating on a non-ventilated lung whilst maintaining gas exchange.

Selective ventilation on one lobe has been used as an alternative technique [7]. However, it was thought that our patient would not tolerate single lobe ventilation due to his poor respiratory function. Also, visualization during VATS in emphysema may be difficult due to air trapping even with a non-ventilated lung. In addition, single lobe ventilation increases the potential for barotraumas in emphysematous lungs.

A percutaneous veno-arterial cardiopulmonary support system has been used selectively in lung volume reduction surgery in three patients with severe hypercapnia [10] and also in limited lung resections for lung cancer after a previous pneumonectomy [6,8]. Bleeding during surgery and postoperatively is a potential problem due to the requirement of anticoagulation. However, making the port incisions under direct vision with careful haemostasis, minimizing manipulation of lung tissue and omitting parietal pleurectomy as part of the procedure reduce this risk.

Although a patient with a single lung would normally not be considered for elective bulllectomy, the physiological changes due to volume reduction in this patient did result in an improvement of his respiratory function.

4. Conclusions

Veno-venous ECMO is a feasible and beneficial technique to facilitate thoracoscopic surgery in cases at high risk from conventional ventilation such as severe emphysema or in a remaining post-pneumonectomy lung.

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References