Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 8
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Operative Cooperation of One Case of Extracorporeal Membrane Oxygenation (ECMO)-Assisted Hybrid Sleeve Left Pneumonectomy

Jing Wang, Jing Li, Yanshu Wei*, Xiaoli Liu, Xuejing Li

Peking University People's Hospital operating room, Beijing 100044, China

***Corresponding author**: Yanshu Wei, wys99_20001@163.com*

Abstract: A case of surgical nursing cooperation during extracorporeal membrane oxygenation (ECMO)-assisted hybrid sleeve left pneumonectomy, which included a right open carinal resection, tracheal bronchial anastomosis, and thoracoscopic left pneumonectomy, has been documented. A thorough nursing intervention focused on patient safety and proactive measures to address potential complications was implemented throughout the surgical process. The procedure was completed without incident, and no postoperative complications were reported.

Keywords: Extracorporeal membrane oxygenation (ECMO); Hybrid; Tracheal adenoid cystic carcinoma (TACC); Operative cooperation

Online publication: August 19, 2025

1. Introduction

Tracheal adenoid cystic carcinoma (TACC) is a rare malignant tumor originating from the submucosal glands of the trachea [1]. Its invasion can cause pulmonary atelectasis and hypoxemia, requiring prompt treatment. Currently, surgical excision remains the mainstay of treatment for TACC [2]. Given the challenges associated with maintaining adequate intraoperative oxygenation during carinal resection under one-lung ventilation, which poses risks to patient safety, this procedure should be conducted in collaboration with cardiothoracic surgeons and supported by extracorporeal membrane oxygenation (ECMO). ECMO is a medical technique that temporarily reroutes the patient's blood for oxygenation and circulation, requiring careful monitoring and management by the operating room nursing team to ensure the safety of the patient's tubes and circulatory system [3]. In October 2024, the hospital successfully performed an ECMO-assisted tracheal bronchial anastomosis and thoracoscopic left pneumonectomy, termed hybrid sleeve left pneumonectomy [4]. The procedure was executed without complications, and the patient expressed satisfaction with the nursing care provided. The details of the perioperative nursing collaboration are

outlined below.

2. Case study

A 53-year-old male underwent a chest computed tomography (CT) scan that revealed atelectasis in the lower lobe of the left lung, with an elevated body temperature but no indications of shortness of breath, chest tightness, or sputum production. A subsequent contrast CT suggested central lung cancer, obstructive pneumonia, and atelectasis in the lower lobe of the left lung. A positron emission tomography-computed tomography (PET-CT) scan indicated a possible TACC diagnosis. An electronic bronchoscopy was performed under general anesthesia, which demonstrated that the lesion affected the left main bronchus, predominantly bronchioles, the left wall of the lower trachea, and tracheal bifurcation, with partial infiltration of the proximal part of the right main bronchus. Biopsy results indicated a high likelihood of adenoid cystic carcinoma.

Following a thorough examination, ECMO-assisted hybrid sleeve left pneumonectomy was performed under general anesthesia. First, cardiothoracic surgeons established ECMO using esophageal cardiac ultrasound. With ECMO support, the procedure began with the right carinal resection, followed by the right main trachea-lower trachea end-to-end anastomosis. Post-anastomosis, mechanical ventilation of the right lung was utilized alongside ECMO, gradually decreasing the level of ECMO assistance to transition to reliance solely on ventilator support. ECMO was maintained without an oxygen supply for diversion purposes. Subsequently, a thoracoscopic left pneumonectomy was performed with ECMO assistance. During this phase, anesthesiologists methodically adjusted the respiratory settings of the anesthesia machine, while cardiothoracic surgeons reduced the ECMO flow to its minimum to prevent thrombus formation.

Ultimately, the patient was positioned supine, tracheal alignment was verified, followed by clamping of the left chest tube and suturing of the subcutaneous tissues between the mandible and anterior chest wall to ensure a cervical anteriorly flexed position post-surgery. The anesthesia team and cardiac and thoracic surgeons confirmed that the patient's respiratory function was normal and oxygenation was satisfactory before discontinuing ECMO. After ECMO withdrawal, the patient's vital signs were stable, and spontaneous respiration was restored. An antagonist was administered, and once the patient was fully awake, the tracheal tube was removed, and the patient was subsequently transferred to the intensive care unit.

3. Comprehensive nursing intervention based on patient safety

3.1. Multidisciplinary cooperation in the development of surgical and coordination plans

The cardiothoracic nurses involved in the surgery participated in the preoperative case discussion with the multidisciplinary cooperation team, fully understood the patient's condition, were well-acquainted with the surgical procedures beforehand, and organized the collaboration plan for potential scenarios during the operation.

3.2. Preoperative preparation

3.2.1. Environment management

The surgery was set in a hundred-level laminar flow operating room. Before the surgery, the participant list and entry sequence were confirmed. The team entered the operating room according to the three phases of ECMO setup, right carinal resection, and left pneumonectomy. Scrub nurses coordinated the team to maintain order within

the operating room, while also ensuring that the number of visitors remained below 12, to minimize the risk of infection due to personnel movement [5].

3.2.2. Device preparation and management

This surgical procedure was divided into three sub-surgeries, with surgical instruments categorized into three groups based on the specific requirements of each sub-surgery. Instruments from each group were utilized exclusively within their designated sub-surgery, ensuring no cross-use occurred. The instrument preparation included the ECMO extracorporeal circulation package, the open chest basic instrument package, and the thoracoscope instrument package.

3.2.3. Rescue medication management

Before the surgery, it is ensured that all medications and supplies in the ambulance were ready [6]. Following the doctor's instructions, dopamine was diluted to 50 mL with normal saline at a ratio of 3 mg/kg body weight, and norepinephrine was diluted to 50 mL with normal saline at 0.3 mg/kg body weight. Additionally, 50 μg/mL phenylephrine was prepared as a backup for stable hemodynamics. During the administration process, the oral instructions were implemented according to the specified guidelines, and the verification and administration protocols were duly observed [7].

3.2.4. Instrument preparation and management

This procedure required a thoracoscope, a high-frequency electrosurgical knife, an ultrasonic knife for intrathoracic tissue dissection, and an ECMO machine and transesophageal ultrasound machine for ECMO setup. Tracheoscopy was used to confirm anastomosis closure in the tracheal lumen during the surgery. In addition, a defibrillator was on standby for emergency resuscitation, and care was taken to keep circulating tubes, gas lines, and power cords clear of walkways to prevent entanglement [8].

3.3. Perioperative cooperation

3.3.1. Cooperation by perioperative nurses

(1) Operational cooperation of key processes

(i) Cooperation in ECMO procedures: Perioperative nurses provided the puncture instruments in the sequence required, assisted the surgeon in stabilizing and securing the guidewire, and simultaneously handed over the extracorporeal circulatory cannula. After successful cannulation, nurses held the distal end of the tubes and collaborated with the surgeon to complete the tube connection, ensuring the intubated section was elevated and flat to prevent dislodgment.

(ii) Cooperation for carinal resection and left pneumonectomy: The extensive infiltration of the left main bronchial tumor resulted in significant adhesion of the surrounding tissues to the tracheal prominence. To facilitate the blunt dissection of these tissues, a peanut with barium thread was prepared. Emergency instruments, including blocking forceps and hemostasis sutures, were readily available. The principles of asepsis and tumor-free techniques were strictly implemented throughout the procedure. Instruments and dressings that came into contact with the airway and tumor were placed in the designated contaminated area to prevent reuse. Two scrub nurses verified and accurately recorded the specimen names during the procedure. After surgery, a stringent specimen management protocol

was strictly implemented, ensuring the specimen was transferred to the surgeon with the appropriate signature.

(2) Item verification and device replacement

After the establishment of ECMO tubing, tracheal anastomosis post-carinal resection counted the surgical items correctly according to the surgical items counting protocol. Surgical instruments utilized in each sub-surgery were packed and documented, while those needed for the subsequent sub-surgery were prepared.

3.3.2. Cooperation by scrub nurses

(1) Nursing cooperation in specific areas

(i) Record of surgical inventory: The inventory of each sub-surgical item was recorded separately.

(ii) Disposal of dressings and medical waste: After each sub-surgery, the dressings and medical waste used in the current sub-surgery were packed and sealed separately and then placed in the operating room.

(2) ECMO tubing and positional care

After establishing ECMO tubing with the patient in a supine position, two physicians protected the internal jugular vein and femoral vein cannulas. Then, anesthesiologists, scrub nurses, and thoracic surgeons collaborated to reposition the patient to the left lateral position for tracheal anastomosis post-carinal resection. The venous cannulas were extended to the posterior side of the bed and connected to the ECMO machine. The femoral vein cannula was secured to the edge of the lower limb position pad, while the proximal end of the internal jugular vein cannula was anchored to the side of the patient's head, with continuous monitoring of the ECMO circulatory flow. The patient was then placed in the right lateral position for left pneumonectomy.

In this position, the femoral vein tubes were straightened on the patient's ventral side, extending down the right lower limb to the caudal side of the bed, where they were properly secured. The proximal end of the right internal jugular vein tubes was secured behind the patient's right shoulder, wrapped around the underside of the upper arm, extended along the edge of the bed to the caudal side of the bed, and properly secured. Additionally, the proximal end of the right-hand support plate was slightly lowered to create a gap between the arms, preventing any compression of the tubes. Cardiothoracic surgeons confirmed the ECMO tubing's proper function after each position.

4. Proactive nursing intervention for complications

The anticipated duration of surgery and anesthesia time for this patient was projected to exceed 8 h. The extent of the open chest trauma was significant, increasing the risk of hypothermia. Additionally, the use of ECMO throughout the procedure contributed to hemodynamic changes and blood components, increasing the risk of thrombus formation [9]. To mitigate these risks, the following preventive measures should be implemented.

4.1. Prevention of medical device-related stress injury

A memory sponge mattress, gel pad, and soft cloth sheet should be utilized before the surgery. A small pad should be used to separate the patient's skin from the infusion tube. After repositioning, the chest drain, urinary catheter, ECG electrode wire, and ECMO tubing should be inspected to ensure they are not under pressure. Additionally,

any tubing that may be compressed on either side of the body should be straightened and secured appropriately to prevent medical device-related pressure injuries. It is also important to ensure that the patient's exposed skin does not come into contact with metallic objects, including the operating table, positioning frame, and tube fixation forceps [10].

4.2. Prevention of hypothermia

The room temperature should be set to 26℃ before the patient's admission, and the heating blanket should be pre-warmed to 37℃ [11]. The non-surgical area should be covered with a cloth sheet during a significant volume of fluid administration using a heated infusion device [12]. The rinsing fluid should be stored in a thermostat at 37℃ for easy access [13, 14]. A temperature probe was used to monitor the patient's nasal temperature, which was kept at 36.5℃ throughout the procedure.

4.3. Prevention of deep vein thrombosis (DVT)

Gradient medical elastic socks should be used before surgery [15]. It is essential to implement intraoperative warming measures to prevent hypothermia and DVT [16]. Additionally, protective constraints should be adjusted to accommodate one finger, to prevent excessive pressure and blood stagnation in the limb [17]. When positioning the patient laterally, avoid compressing the popliteal fossa and femoral vein. In the supine position, elevate the lower extremities without obstructing the surgical field [18]. Anesthesiologists must monitor oxygen saturation levels between 90% and 100% to prevent hypoxemia and DVT [19]. Adequate fluid replacement is necessary to prevent increased blood viscosity due to insufficient blood volume [19].

5. Conclusions

In clinical practice, the application of ECMO-assisted hybrid sleeve left pneumonectomy is relatively rare because it is a complex operation, involves many departments, and requires highly qualified operating room nurses. The present case has the following important clinical insights: (1) nurses participating in the multidisciplinary operation team provide suggestions regarding nursing care plans for patients post-surgery; (2) The present case highlights the need for connection plans for the various sub-surgeries in complex surgeries to shorten the operation duration; (3) Clinicians should conduct patient safety management through an operative cooperation approach. Nevertheless, further studies are needed to improve this procedure and optimize its application.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Ye N, Wenxin H, Dongliang B, et al., 2019, Tracheo-Bronchial Adenoid Cystic Carcinoma: A Retrospective Study. Asia-Pacific Journal of Clinical Oncology, 15(4): 244–249.

[2] Wen J, Liu D, Xu X, et al., 2018, Nomograms for Predicting Survival Outcomes in Patients with Primary Tracheal Tumors: A Large Population-Based Analysis. Cancer Management and Research, 10: 6843–6856.

[3] He L, Xie J, 2016, Development of Extracorporeal Membrane Oxygenation in Critically Ill Patients. PLA Nursing

Journal, 33(22): 37–39.

[4] Cheng S, Lu X, 2022, Application and Progress of Extracorporeal Membrane Oxygenation in General Thoracic Surgery. Chinese Clinical Journal of Thoracic and Cardiovascular Surgery, 29(3): 384–389.

[5] People's Republic of China Health Industry Standard, 2013, Technical Code for Construction of Clean Operation Department in Hospital, GB50333-2013, viewed on May 14, 2025.

[6] Huang J, Lai L, Zhang J, 2023, Application of 6S Management in Emergency Medicine Management in Operating Room. Northern Pharmacy, 20(3): 94–96.

[7] Chen X, 2008, Establishment and Implementation Effect of Emergency Plan for Emergency Operation. Jiangxi Medicine, 43(12): 1452–1453.

[8] Chen C, Huang X, 2023, Intraoperative Nursing of a Patient with Coronary Artery Disease with VA-ECMO Assisted PCI. General Nursing, 21(30): 4318–4320.

[9] Ai T, Liu S, 2023, Complications Associated with Extracorporeal Membrane Oxygenation and Its Prevention. International Journal of Cardiovascular Disease, 50(6): 383–386.

[10] Huang C, 2012, Analysis on the Causes and Prevention of Skin Scald Caused by High-Frequency Electrotome in 5 Cases. Laboratory Medicine and Clinical, 9(16): 2068–2069.

[11] Ma Z, Yi J, 2017, Expert Consensus on Prevention and Treatment of Hypothermia in Perioperative Patients (2017). Union Medical Journal, 8(6): 352–358.

[12] Campbell G, Alderson P, Smith A, et al., 2015, Warming of Intravenous and Irrigation Fluids for Preventing Inadvertent Perioperative Hypothermia. Cochrane Database Syst Rev, 13(4): CD009891.

[13] Lin S, Bie F, Feng S, et al., 2022, Effects of Different Intraoperative Thermal Insulation Measures on Coagulation Function and Surgical Site Infection in Patients Undergoing Thoracotomy. Thrombosis and Hemostasis, 28(3): 526–527.

[14] Guan L, Hong S, 2022, Application Effect of Comprehensive Thermal Insulation Measures in Thoracic Surgery Under General Anesthesia. Integrated Nursing (Chinese and Western Medicine), 8(5): 70–72.

[15] Li J, Chen Q, 2023, Effect of Pneumatic Therapy Instrument Combined with Medical Elastic Socks on Prevention of Deep Venous Thrombosis of Lower Limbs After Thoracic Surgery. Medical Equipment, 36(20): 139–141.

[16] Li W, Tian L, Luo H, et al., 2023, Research Progress of Perioperative Thermal Insulation Nursing for Prevention of Deep Vein Thrombosis. Evidence-Based Nursing, 9(16): 2946–2949.

[17] Chinese Nursing Association Operating Room Nursing Professional Committee, 2023, Practice Guide for Operating Room Nursing. Beijing: People's Medical Publishing House, 80–86.

[18] Ayatollahzade-Isfahani F, Pashang M, Omran S, et al., 2013, Comparing the Impact of Supine and Leg Elevation Positions During Coronary Artery Bypass Graft on Deep Vein Thrombosis Occurrence: A Randomized Clinical Trial Study. Journal of Vascular Nursing, 31(2): 64–67.

[19] Fang M, Gao X, Wang Z, et al., 2023, Summary of Evidence for Risk Assessment of Intraoperative Deep Venous Thrombosis of the Lower Extremity in Adult Surgical Patients. Clinical Nursing in China, 15(10): 634–639.