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CASE REPORT

Approach and anesthetic management for kidney transplantation in a patient with bilateral lung transplantation: case report

Sofia da Silva Ramos *, Ana Isabel Leite, Ana Eufrásio, Isabel Rute Vilhena, Raquel Inácio

Centro Hospitalar E. Universitário de Coimbra, E.P.E., Coimbra, Portugal

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Abstract Lung transplantation is the last resort for end-stage lung disease treatment. Due to increased survival, lung recipients present an increased likelihood to be submitted to anesthesia and surgery. This case report describes a 23-year-old female patient with history of lung transplantation for cystic fibrosis, with multiple complications, and chronic kidney disease, and who underwent kidney transplantation under general anesthesia. Understanding the pathophysiology and changes related to immunosuppressive therapy is essential to anesthetic technique planning and safety, and for perioperative management. The success of both anesthesia and surgery requires a qualified multidisciplinary team due to the rarity of the clinical scenario and high incidence of associated morbidity and mortality.
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Introduction

Lung Transplantation (LT) is a last-line therapy for lung failure. The lung graft outcome is conditioned by immediate complications, such as infections or acute rejections, or by late events, often related to immunosuppressive therapy.

Recently, a significant increase in post-transplant survival has been aimed at, therefore lung recipients are increasingly undergoing procedures that may or may not be related to lung transplant and which, depending on disease progression, may increase the likelihood of adverse events, and consequently make anesthesia management challenging.

The level of development of the pulmonary disorder and immunosuppressive therapy promote cardiovascular morbidity, progressive renal failure, and the involvement of multiple organs. Understanding pathophysiological changes is fundamental for planning anesthesia management, namely mechanical ventilation, fluid therapy, and analgesia.

The search in the medical literature revealed a clear shortage of cases reported, particularly of patients with lung transplantation submitted to other surgical interventions,[1,2] highlighting the relevance of our case report, particularly because it describes a surgical procedure associated with several peculiarities from the anesthesia and surgery point of view.

* Corresponding author.
E-mail: sofiasilvaramos.92@gmail.com (S. da Silva Ramos).

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Here we describe the anesthesia management of a patient scheduled for Kidney Transplantation (KT), under General Anesthesia (GA), with a history of bilateral LT.

Case report

We describe the case of a 23-year-old female patient, scheduled for living donor KT presenting history of bilateral LT due to CF, Chronic Kidney Disease (CKD) undergoing hemodialysis for nephropathic Cystinosis (CN), Diabetes Mellitus (DM) treated with low-weight insulin (American Society of Anesthesiologists physical status – ASA III). She had chronic pulmonary infection by *Pseudomonas aeruginosa* and *Staphylococcus aureus*, pancreatic failure, and low bone mineral density. The LT had been performed 33 months before, and there were severe postoperative complications, such as Grade 3 primary graft dysfunction, need for extracorporeal membrane oxygenation, prolonged mechanical ventilation with temporary tracheostomy, heart failure with severe low Left Ventricle Ejection Fraction (LVEF) (< 20%), pericardial tamponade, dysphagia (requiring percutaneous endoscopic gastrostomy), and functional loss of the left lower limb resulting from compartment syndrome.

On the physical examination, lung auscultation revealed slight sound reduction at the left lung base, Body Mass Index (BMI) of 16 $kg.m^{-2}$, and a Central Venous Catheter (CVC) placed in the Internal Jugular (IJ). The Airway (AW) was not predicted difficult. Pre-hemodialysis investigation showed hemoglobin of 10.4 $g.dL^{-1}$, creatinine of 7.19 $mg.dL^{-1}$, potassium of 5.6 $mEq.L^{-1}$, and LVEF of 65%. Chest X-Ray and pulmonary function tests were normal.

The patient refused regional techniques. On the morning of the surgery, lorazepam 1.25 mg was administered orally, and corticosteroid and immunosuppressive therapy was maintained.

The patient was monitored according to American Society of Anesthesiologists standards, diuresis, bispectral index, neuromuscular function, and Central Venous Pressure (CVP). She was positioned on reverse Trendelenburg, given 4 mg dexamethasone, and GA was induced administering fentanyl, propofol/etomidate mixture, and rocuronium. Orotracheal intubation was achieved on the first attempt. Anesthesia was maintained using sevoflurane and rocuronium. Volume-controlled mechanical ventilation was started with Tidal Volume (TV) of 300 mL, RR of 12–13 breaths per minute, and positive end-expiratory pressure (PEEP) of 5–8 cmH_2O. Intravenous infusion of 0.9% saline solution at a rate of 100–200 $mL.h^{-1}$, and 125 mL of 20% mannitol were administered. Blood losses were 100 mL. Analgesia was performed administering paracetamol, tramadol, metamizole, and wound infiltration with 15 mL of 0.375% ropivacaine. The surgery lasted 150 minutes, was uneventful and the patient remained hemodynamically stable.

Postoperatively, the patient remained without complaints. Immunosuppressive therapy was adjusted according to the needs inherent to the KT. Patient diuresis remained above 1 $mL.Kg^{-1}.h^{-1}$ on the following days. The patient was discharged on the fifth day.

Discussion

The preanesthetic evaluation of these patients must consider the presence of pathophysiological peculiarities that impact pulmonary response to hemodynamic changes. It must include a comprehensive assessment of the function of the lung graft and all organs indirectly involved in post-transplant treatment. Commonly, patients undergoing LT are taking several medications that should be kept on the morning of surgery and resumed orally, as soon as possible.[1]

Ventilation and AW management may be challenged by the prolonged use of corticosteroids and the incidence of DM, which promote facial volume and cervical perimeter increase, and stiffness of the atlanto-occipital joint.[3] Dexamethasone was administered prior to induction to prevent laryngeal edema. A mixture of intravenous anesthetics was used for induction to combine the fast and effective anesthetic induction of propofol with the cardiovascular stability of etomidate. Delayed gastric emptying, present in 33% of these patients, increases the risk of pulmonary aspiration during anesthetic induction.[4] Orotracheal intubation should be performed gently to avoid surgical anastomosis trauma and tracheobronchial stimuli. Reduced lung graft functional reserve, unpredictable cardiovascular response, adverse effects of immunosuppressive therapy and its interference with anesthetic drugs can impact the perioperative period.[1] Whenever possible, invasive monitoring techniques should be avoided due to the infection risk.[1]

Hypotension after induction, resulting from the depressant effect of anesthetic agents and the distension of the ventilated lungs, should not be corrected with liberal fluid therapy due to the risk of volume overload, mainly in patients with kidney disorder.[1]

The anesthetic technique must consider cardiovascular and respiratory risks related to orotracheal intubation and mechanical ventilation, and the susceptibility of the lung graft to fluid overload due to the absence of lymphatic drainage. We chose to use a 0.9% saline solution because of the risk of worsening hyperkalemia in a patient with CKD. Every single anesthesia technique can be used on a completely compensated patient.[1] However, regional anesthesia techniques should be favored, as they do not promote a bronchoconstrictor effect, they do not affect mucociliary clearance, and are associated with less hemodynamic fluctuations. The neuraxial approach may be difficult due to the presence of osteoporotic vertebrae and the risk of bleeding secondary to coagulopathy. Epidural analgesia is associated with a reduction in postoperative cardiovascular and pulmonary complications and, when compared with systemic opioids, it reduces respiratory muscle fatigue, and improves bronchial secretion clearance. The combination of GA and epidural block is safe; however, thoracic epidurals should be used with prudence, as the reduction in intercostal muscle strength resulting from the blockade should be avoided in patients with pulmonary disorders. The peripheral regional approach is well tolerated, excluding the brachial plexus block for the potential for paralysis of the phrenic nerve can compromise the ventilatory function in patients with a greater dependence on normal diaphragm muscle functioning.[1]

Anesthetic maintenance can be performed with halogenated or intravenous anesthetics and short-acting opioids.

Usually, this combination is well tolerated and prevents large fluctuations in hemodynamic parameters. Nitrous oxide is not recommended due to the risk of underlying pneumothorax, emphysematous lung or intestinal distension.[1]

Generalized muscle atrophy, particularly noticeable in the patient reported here, can modify the duration of neuromuscular blockade, delaying the recovery of spontaneous breathing, and consequently neuromuscular blockade should be monitored. Electrolyte imbalances, drug interactions, changes in metabolism disorders, and volume of distribution are factors that also contribute to the unpredictable duration of the neuromuscular blockade.

Bilateral LT generally does not show significant differences in lung compliance, which facilitates mechanical ventilation. However, airway resistance may be increased, resulting in high Peak Inspiratory Pressures (PIP). In these patients, using TV < 7 mL.kg^{-1} of ideal weight and PEEP between 5 and 8 cmH_2O may be associated with improvement in gas exchange and a lower incidence of postoperative pulmonary dysfunction. Plateau pressure between 20 −25 cmH_2O and PIP up to 30−35 cmH_2O are recommended to avoid trauma to the bronchial anastomosis and alveoli. In chronic stable hypercapnic asymptomatic recipients, minute ventilation should be adjusted to avoid hypocapnia.[1,2]

Postoperative pain control is extremely important, as insufficient analgesia precludes coughing and secretion clearance, facilitating atelectasis and respiratory infections. Non-steroidal anti-inflammatory drugs should be avoided due to possible nephrotoxicity. Opioids should be administered with caution, due to the risk of respiratory depression and moderate cough reflex inhibition. Due to its lower respiratory depressant potential, tramadol may be a reasonable alternative. Paravertebral, transverse abdominis plane, or rectus abdominis sheath blocks are safe options.

Optimizing hemodynamic, pulmonary, and metabolic parameters is critical for the favorable surgical outcome.

The absence of guidelines for the anesthetic management of these patients, due to the paucity of publications in the medical literature, motivated the comprehensive research on pathophysiology, and the preparation of a customized plan for the anesthesia and surgery. We hope that this case report will help as an adjuvant in future anesthetic management of lung transplant patients undergoing surgical procedures that may or may not be a new transplant.

Conclusion

Currently, LT is the last-line therapy for chronic pulmonary disorders. Patients with a functioning lung graft can tolerate GA without severe complications. However, a pathologically compromised graft is associated with an increased risk of postoperative respiratory failure. Other factors may contribute to increase morbidity and mortality in these patients, such as cardiovascular disorders, DM, and the unpredictable risk of infection.

Due to their greater frailty, transplant patients require greater care and surveillance by the anesthesiologist. Anesthetic management must include perioperative measures to protect the lung graft, particularly regarding mechanical ventilation, to adequately manage medication of chronic use to avoid the risk of rejection, organ failure or infection.

Conflicts of interest

The authors declare no conflicts of interest.

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