Anesthetic Management of Patients with Transplanted Lung Undergoing Non-Transplant Surgery

An Essay

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Presented by
Ramy Mohamed Mohamed Hassan
M.B.B.Ch.
Faculty of Medicine - Ain Shams University

Under Supervision of

Prof. Dr. Azza Yousef Ibrahim

Professor of Anesthesiology, Intensive Care & Pain Management
Faculty of Medicine - Ain Shams University

Dr. Manal Mohamed Kamal

Assistant Professor of Anesthesiology, Intensive Care & Pain Management
Faculty of Medicine - Ain Shams University

Dr. Iman Abo Bakr Ahmed

Lecturer of Anesthesiology, Intensive Care & Pain Management
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
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بسم الله الرحمن الرحيم

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صدق الله العظيم

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Ramy Mohamed Mohamed Hassan

List of Abbreviations

25OHD	:	25-hydroxyvitamin D
BAL	:	Broncho alveolar lavage
BLT	:	Double lung transplantation
BMI	:	Body mass index
BO	:	Broncolitis obliterance
BOS	:	Bronchiolitis obliterans syndrome
CF	:	Cystic fibrosis
CMV	:	Cytomegalovirus infection
CO	:	Cardiac output
DLT	:	Double-lumentube
ERCP	:	Endoscopic retrograde cholangio-pancreatography
FEV_1	:	Expiratory volume in one second
FVC	:	Forced vital capacity
GERD	:	Gastroesophageal reflux
HLT	:	heart-lung transplantation
ICU	:	Intensive care unit
IL	:	Interleukin
ILD	:	Interstitial lung diseases
ISHLT	:	International Society for Heart and Lung Transplantation
LDLT	:	Living donor lobar transplantation

List of Abbreviations (Cont.)

LMA	:	Laryngeal Mask Airway
LTx	:	Lung transplantation
OLV	:	One-lung ventilation
PA	:	Pulmonary artery
PACU	:	Post-anesthetic care unit
PAH	:	Pulmonary arterial hypertension
PCV	:	Pressure control mode
PEEP	:	Positive end-expiratory pressure
PFTs	:	Pulmonary function tests
POD	:	Postoperative day
PVR	:	Pulmonary vascular resistance
RAS	:	Restrictive allograft syndrome
RR	:	Respiratory rate
RV	:	Right ventricular
SaO2	:	O2 saturation: arterial carbon dioxide tension
SDB	:	Sleep disordered breathing
SLT	:	Single lung transplantation
SVV	:	Volume variation
TLC	:	Total lung capacity
TLR4	:	Toll-like receptor 4
TV	:	Tidal volume

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Introduction

Lung transplantation (LTx) is an accepted therapy for end-stage respiratory failure caused by obstructive, restrictive, and pulmonary vascular disease. The final outcome of the implanted graft may be affected by short-term adverse events such as infections or rejection and long-term complications, such as community acquired infectious diseases, neoplasms, lymphoproliferative disorders, and obliterative bronchiolitis.

In recent years, the survival rate after LTx has improved as a result of "aggressive" perioperative patient care, appropriate management of immunosuppression, and adequate treatment of medical and surgical complications (**Feltracco et al., 2011).**

Recipients of lung transplants have subsequently undergone various surgical procedures unrelated to their pulmonary disease and may have anesthetic problems. This presents a lot of challenges to the anesthesiologist and emphasizes the importance of a careful preoperative assessment of the pulmonary status (**Elsharkawy et al., 2008)** .

The survival rate after lung transplantation has increased in recent years, leading to an increase in non-

pulmonary conditions that require surgical intervention. A variety of physiologic changes occur following lung transplantation; some affect all lung transplant recipients, while others may be dependent on the type of transplant surgery performed. It is important to determine a patient's general status, medications, and transplanted lung physiology before general anesthesia. Pulmonary function tests, exercise tests, and re-hospitalization can be helpful in evaluating the functional status of the patient after lung transplantation (**Seo et al., 2014).**

Aim of The Work

The aim of the work is to discuss the Anesthetic Management of Patients with Transplanted Lung Undergoing Non-Transplant Surgery.

Physiology of transplanted lung

Important physiologic changes occur over the months to years following lung transplantation. Some changes affect all lung transplant recipients; others may be dependent upon the type of lung transplant surgery performed (single lung transplantation (SLT), bilateral sequential or double lung transplantation (BLT), heart-lung transplantation (HLT), and living donor lobar transplantation (LDLT)), or on the pre-transplant diagnosis (eg, COPD, interstitial lung disease, cystic fibrosis, pulmonary hypertension).

Generally, single-lung, double sequential, or heart and Lung transplantation cause remarkable improvement in Respiratory function, gas exchange, and exercise tolerance (**Feltracco et al., 2011)**

Anatomic changes In the process of harvesting a lung for transplantation, the vagus and sympathetic nerves, pulmonary and bronchial blood vessels, and lymphatics are interrupted. Although the pulmonary artery and pulmonary veins are reanastomosed to those of the recipient, the bronchial arteries that supply the airways are usually not revascularized. The recipient phrenic, vagus, and recurrent laryngeal nerves are sometimes injured during the operative procedure, more commonly during heart-lung

transplantation when cardiopulmonary bypass is needed) **(Roland et al., 2014).**

Physiological changes that occur after lung transplantion includes, changes affecting the airway, the lungs (pulmonary function, lung mechanics and lung volumes), changes affecting in gastro-oesophgealmotility and swallowing, changes affecting skeletal muscle including respiratory muscle and pulmonary hypertension. Also changes altering thephysiology of the denervated heart

Changes in airway physiology:

Airway reactivity mild airway hyperresponsiveness, particularly in response to certain bronchoprovocations, is common among lung and heart-lung transplant recipients abnormality may be associated with an increased risk of developing bronchiolitis obliterans syndrome (BOS). Bronchial hyperresponsiveness in response to exercise, isocapnic hyperventilation, and inhalation of histamine and distilled water has been studied in lung transplant recipients. Small studies have found that neither exercise nor isocapnic hyperventilation provokes a significant decrement in forced expiratory volume in one second (FEV_1) ; distilled water inhalation challenge stimulated only a modest response in a minority of HLT recipients) (**Roland et al., 2014)**

Metacholine challenge tests have yielded conflicting results. Hyperresponsiveness to methacholine has been confirmed in some, but not all studies. When present, hyperresponsiveness was attributed to denervation hypersensitivity of airway smooth muscle muscarinic receptors. Response to methacholine does not appear to correlate with time since transplantation, post-transplantation FEV_1, acute rejection, or airway inflammation. Although bronchial hyperreactivity is nonspecific, early bronchial hyperresponsiveness to metacholineas been associated with a higher likelihood of developing BOS **(Muylem et al., 2001).**

Cough reflex and mucociliary clearance two important lung defenses, the cough reflex and mucociliary clearance, are impaired following transplantation. These changes probably influence susceptibility to respiratory infection and the consequences of aspiration. The afferent limb of the cough reflex from the transplanted lung is interrupted during harvesting.

HLT recipients show a markedly decreased response to inhalation of nebulized distilled water despite the preservation of the laryngeal cough response, Reduced airway clearance may be a risk factor for sequelae of aspiration (eg, lung injury and infection) in that prolonged

contact time leads to greater likelihood of lung or airway injury. This problem has been demonstrated by the presence of bile acids in the broncho alveolar lavage (BAL) of some transplant recipients, which appeared to be a risk factor for bronchiolitis obliterans syndrome **(D'Ovidio et al., 2005).**

Mucociliary clearance appears to be modestly decreased in the transplanted lung, but the mechanism has not been fully elucidated. Mucociliary transport depends upon the interaction between cilia and the overlying layer of mucus. Both epithelial damage and ciliary dysfunction may contribute to poor clearance, but mucus secretion is also influenced by neurologic control. It is possible that post-transplant alterations in the quantity or the composition of mucus change, its rheologic properties and retard clearance **(Herve et al., 1993).**

Control of breathing :

Control of breathing is subtly altered after heart-lung and lung transplantation, but the changes are not clinically significant. The ventilatory response tohypercapnia has been variable. In one series of patients with obstructive lung disease, hypercapnia, and a blunted response to CO_2 rebreathing before transplantation, hypercapnia and decreased ventilatory response to CO_2 persisted during the