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List of Abbreviations

AA : Arachidonic Acid

ABG :Arterial Blood Gases

ACP **:** American College of Physicians

AP : Activating Protein

ARDS **:** Adult Respiratory Distress Syndrome

ARM :Alveolar Recruitement Manuver

ASA : American Society of Anesthesiologists

BH4 : Tetrahydrobiopterin

BAL :Bronchoalveolar Lavage

C :Complement

CABG : Coronary Artery Bypass Graft

CD :Cluster Of Difference

cGMP : Cyclicguanosinemonophosphate

CNO :ConstitutiveNO

CO : Carbonmonooxide

COPD : Chronic Obstructive Pulmonary Disease

CPB : Cardio-Pulmonary Bypass

CPET :Cardiopulmonary Exercise Test

CRI :Complement Receptor 1

CR : Complement Receptor

DHCA :Deep Hypothermic Circulatory Arrest

DLCO :Diffusion Capacity Of CO_2

EC : Endothelial Cell

ECC **:** Extra-Corporeal Circulation

eNOS **:** Endothelial Nitric Oxide

ERV : Expiratory reserve volume

$ETCO_2$:End Tidal CO_2

f : Breathing Frequency

FEF **:** Forced expiratory flow

FEV : Forced expiratory volume

FRC : Functional Residual Capacity

FRC **:** Functional residual capacity

FVC : Forced vital capacity

HUVEC **:** Human Umbilical Vein-Derived EC

IC : Inspiratory capacity

ICAM : Intercellular Adhesion Molecule

ICU : Intensive Care Unit

IKB :Inhibitor of KB

IL :Interleukins

IM : Intra-Muscular

IMT : Preoperative Intensive Inspiratory Muscle

INO :INO derived NO

INOS :Nitric Oxide Synthase

IRV : Inspiratory reserve volume

IV : Intra-Venous

LED :Light Emitting Diode

LPS : Lipopolysaccharide

MEP :Maximum Expiratory Pressure

MIP :Maximum Inspiratory Pressure

MUF **:** Modified Ultrafiltration

NF-KB : Nuclear Factor kb

NO : Nitric Oxide

NOS : Nitric Oxide Synthase

NSAID : Non Steroidal Anti Inflammatory Drugs

NSQIP : National Surgical Quality Improvement Program

OKT3 :Muromonab CD3

$\mathbf{P_a}$: Pulmonary Arterial Pressure

PA : Alveolar Pressure

PAH :Pulmonary Artey Hypertension

PaCO2 : Partial Pressure of CO2

$\mathbf{PaO_2}$: Oxygen Partial Pressure

PAF : Platelet-Activating Factor

$\mathbf{P_{alv}}$ **:** Alveolar Pressure

PCA : Patient Controlled Analgesia

PECAM : Platelet-Endothelial Cell Adhesion Molecule

PEEP : Positive End Expiratory Pressure

PEP : Positive Expiratory Pressure

PEF : Peak expiratory flow

PEFR :Peak Expiratory Flow Rate

PFTs **:** Pulmonary Function Tests

PLA2 **:** Phospholipases A2

PMN :Polymorphnuclear Leucocytes

PPC : Postoperative Pulmonary Complications

$\mathbf{P_{pl}}$: Pleural Pressure

$\mathbf{P_v}$: Pulmonary Venous Pressure

Q :Flow

RV : Residual volume

ROS :Reactive Oxygen Species

TENS : Transcutaneous electrical nerve stimulation

TH :T- Helper Cell

TLC : Total lung capacity

TNF **:** Tumor Necrosis Factor

t-PA :Tissue Plasminogen Activator

V´A : Alveolar Ventilation

$\mathbf{V_A/Q}$:ventilation perfusion ratio

$\mathbf{V´CO_2}$:CO_2 Production

$\mathbf{VO_2}$:Oxygen Consumption

VC : Vital capacity

VCAM : Vascular Cell Adhesion Molecule

$\mathbf{Vco_2}$: Body’s Rate Of CO2 Production

$\mathbf{V_D}$: Dead space

$\mathbf{V_E}$: Minute Ventilation

$\mathbf{V_t}$: Tidal volume

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Protective Lung Strategies during Cardiopulmonary Bypass

Essay

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رسالة

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مقدمة من

الطبيبة / منى محمد عطية موسى

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Introduction

Postoperative cardiopulmonary bypass (CPB)-induced lung dysfunction remains a serious complication that could lead to life-threatening problems. CPB is associated with a whole-body inflammatory response. The contact of blood components with the artificial surface of the bypass circuit causes activation of complements, upregulation of cytokines and adhesion molecules and induction of oxygen-free radicals. The pathogenic consequences are adhesions of complement-activated neutrophils to endothelial cells, neutrophil migration into the extravascular spaces, and free-radical mediated pulmonary damage. Injured endothelial cells are vulnerable to the cytokine-mediated inflammatory cascade. Moreover, CPB renders the lung being at risk for ischemic insults because lung perfusion is maintained solely by the bronchial arterial system **(Suzuki, 2010).**

Post ischemic reperfusion of the lung up regulates adhesion molecules and enhances neutrophil-endothelial cell adhesion and extravascular neutrophil sequestration, thereby aggravating further structural and functional abnormalities of pulmonary endothelial cells. Thus the systemic inflammatory response and ischemia-

reperfusion during CPB constitute a vicious network in the pathogenesis of CPB-derived lung injury **(Suzuki, 2010).**

Patients without pre-existing lung conditions can develop a wide array of pathologies ranging from diminished functional residual capacity (FRC) to acute lung injury (which may progress to adult respiratory distress syndrome {ARDS} in 12% of cardiac surgical patients). Those with preoperative lung impairment may have similar, but exaggerated effects. An estimated 8% of patients can experience prolonged postoperative mechanical ventilation and 7% required reintubation **(Siepe et al., 2008).**

By avoiding CPB, reducing its time or by minimizing the extracorporeal surface area with the use of miniaturized circuits of CPB beneficial effects on lung function are reported **(Massoudy et al., 2003).**

In addition, replacement of circuit surface with biocompatible surfaces like heparin-coated a better postoperative lung function is observed **(De Vroege et al., 2004).**

Meticulous myocardial protection by using hypothermia and cardioplegia methods during ischemia and reperfusion remain one of the maintance of postoperative lung function. The partial restoration of

pulmonary artery perfusion during CPB possibly contributes to prevent pulmonary ischemia and lung dysfunction. Using medication such as corticosteroids and aprotinin, which protect the lungs during CPB and leukocyte depletion filters for operations expected to exceed 90 minutes in CPB-time appear to be protective against the toxic impact of CPB in the lungs **(Warren et al., 2007).** The newer methods of ultrafiltration used to scavenge pro-inflammatory factors seem to be protective for the lung function **(Huang et al., 2003).** In a similar way, reducing the use of cardiotomy suction device it is expected that the postoperative lung function will be improved **(Philippou et al., 2000).**