A comparative study between sevoflurane versus propofol as a preconditioning to prevent ischemia reperfusion injury in patients undergoing lower limb orthopedic surgeries under tourniquet

Thesis

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By

Amin Mohammed El ansary Amin
M.B, B.CH, M.S. Anesthesia

Supervisors

Prof. Dr./ Ali Mohamed Ahmed Moussa
Professor of Anesthesia and Intensive Care
Faculty of Medicine, Ain Shams University

Prof. Dr./ Zakaria Abdel aziz Mustafa
Professor of Anesthesia and Intensive Care
Faculty of Medicine, Ain Shams University

Dr./ Ehab Hamed Abdelsalam
Assistant Professor of Anesthesia and Intensive Care
Faculty of Medicine, Ain Shams University

Faculty of Medicine Ain Shams University
٢٠١٠

دراسة مقارنة بين السيفوفلورين والبروبوفول كتهيئة للحد من أثر قصور الدورة الدموية ثم


قَالُوا سُبْحَانَكَ
لاَ عِلْمَ لَنَا
إِلاَّ مَا عَلَّمْتَنَا
إِنَّكَ أَنتَ
الْعَلِيمُ الْحَكِيمُ
صدق الله العظيم
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List Of Abbreviations

ADP-----Adenine diphosphate.

AGAT---L-arginine-glycine aminotransferase.

ASA-----American society of anesthesiologist (physical status).

ATP-----Adenine triphosphate.

BMI----- Body mass index.

CO^{2}-----Carbon dioxide.

$F^{6}P$-----Fructose-^{6}-phosphate.

$G^{6}P$-----Glucose-^{6}- phosphate.

GAMT—guanidino acetate-n-methyl transferase.

$H^{2}O^{2}$--- Hydrogen peroxide.

Hla------Human lactate.

HOCL—Hypochlorous acid

ICAM-^{1}—Interacellular adhesion molocule-^{1}

LTB^{4}-----Leukotriene B^{4}.

MCT ^{1}—Monocarboxylate transporter -^{1}.

MIP^{2}----Macrophage inflamatory protein -^{1}.

MODS—Multiple organ dysfunction syndrome

MPO--- Myeloperoxidase.

MPTP—Mitochondrial permiability transion pore.

NAD---Nicotinic adenosine dinucleotide.

NADH—Reduced form of Nicotinic adenosine dinucleotide.

NAP-^{1}—Neutrophil activating peptide-^{1}.

PAF—Platlet activating factor.

PCr---Phosphorylaed creatine.

PECAM-^{1}-Platlet Endothelial Cell adhesion molecule-^{1}.

PFK-١—Phosphofrucokinase-١.

PGSL-١—P-Selectin glycoprotein-١.

ROS---Reactive oxygen species.

TNFa—Tumor necrosis factor-a.

TXA٢—Thromoxane A٢.

VEGF—Vascular endothelial growth factor.

INTRODUCTION

Ischemia-reperfusion (I/R) is one of the main pathophysiological phenomena seen in the anesthetic practice (organ transplantation, coronary surgery, cardiopulmonary bypass, restoration of hypovolemic shock, etc.) and that causes local and systemic inflammatory response ***(Dirksen et al., ٢٠٠٧).***

A particular situation of I/R injury is associated with the use of a tourniquet in orthopedic surgery (to avoid intraoperative bleeding) or in emergency medicine (to arrest life-threatening extremity hemorrhage) ***(Horlocker et al., ٢٠٠٦).***

Muscle ischemia is accompanied by hypoxic cellular challenge and anaerobic glycolysis, and reperfusion by neutrophil activation, formation of reactive oxygen species, and release of vasoactive factors ***(Korth et al., ٢٠٠٠).***

Experimental and clinical data provide evidence for a protective role of volatile anesthetics against myocardium I/R injury ***(De Hert et al., ٢٠٠٥)***. The volatile anesthetics such as sevoflurane seems to have such a role in the skeletal muscle sevoflurane inhalation provides endothelial protection against

ischemia-reperfusion in skeletal muscles ***(Lucchinetti et al., ٢٠٠٧)***.

Vascular endothelium is critically involved in many steps of tissue damage originating from ischemia-reperfusion injury ***(Kharbanda et al., ٢٠٠١)***. Intact vascular endothelium is essential in maintaining arterial tone and coagulation status. Because human endothelium can be protected against ischemia-reperfusion by ischemic and pharmacologic preconditioning and postconditioing and is located in the vasculature of all tissues ***(Garcia et al., ٢٠٠٥)***.

SKELETAL MUSCLE METABOLISM

Skeletal muscle structure and function:

Skeletal muscle fiber types

Skeletal muscle is a type of striated muscle, which usually attaches to tendons. Skeletal muscles are used to create movement, by applying force to bones and joints; via contraction. They generally contract voluntarily (via somatic nerve stimulation), although they can contract involuntarily through reflexes. The whole muscle is wrapped in a special type of connective tissue, epimysium ***(Spangenburg and Booth, ٢٠٠٣).***

Muscle cells (also called fibers) are cylindrical, and are multinucleated (in vertebrates and insects). The nuclei of these muscles are located in the peripheral aspect of the cell, just under the plasma membrane, which vacates the central part of the muscle fiber for myofibrils. Skeletal muscles have one end (the "origin") attached to a bone closer to the centre of the body's axis and The other end (the "insertion") is attached across a joint to another bone further from the body's axis. The bones rotate about the joint and move relative to one another by contraction of the muscle ***(Spangenburg and Booth, ٢٠٠٣).***

There are several different ways to categorize the type of skeletal muscle fibers. Voluntary muscles contain a variety of *fiber types* which are specialized for particular tasks. Most muscles contain a mixture of fiber types although one type may predominate. The pattern of gene expression within each voluntary muscle cell is governed by the firing pattern of its single motor neuron. Motor neurons branch within their target muscle and thereby control several muscle fibers, called a *motor unit.* The high precision eye muscles have only a few fibres in each motor unit, but the muscles in your back have thousands. All the cells in a motor unit contract in union and they all belong to the same fiber type ***(Spangenburg and Booth, ٢٠٠٣)***.

Types of muscle fibers:

Type ١ or *slow oxidative fibers* have a slow contraction speed and a low myosin ATPase activity. These cells are specialized for steady, continuous activity and are highly resistant to fatigue. Their motor neurons are often active, with a low firing frequency. These cells are thin (high surface to volume ratio) with a good capillary supply for efficient gas exchange. They are rich in mitochondria and myoglobin which gives them a red colour. They are built for aerobic metabolism and prefer to use fat as a source of energy. These are the marathon runner's muscle fibres.

Type ٢A or *fast oxidative-glycolytic fibers* have a fast contraction speed and a high myosin ATPase activity. They are progressively recruited when additional effort is required, but are still very resistant to fatigue. Their motor neurons show bursts of intermittent activity. These cells are thin (high surface to volume ratio) with a good capillary supply for efficient gas exchange. They are rich in mitochondria and myoglobin which gives them a red color. They are built for aerobic metabolism and can use either glucose or fats as a source of energy. These are general purpose muscle fibers which give the edge in athletic performance, but they are more expensive to operate than type ١.

Type ٢B or *fast glycolytic fibers* have a fast contraction speed and a high myosin ATPase activity. They are only recruited for brief maximal efforts and are easily fatigued. Their motor neurones transmit occasional bursts of very high frequency impulses. These are large cells with a poor surface to volume ratio and their limited capillary supply slows the delivery of oxygen and removal of waste products. They have few mitochondria and little myoglobin, resulting in a white colour (e.g. chicken breast). They generate ATP by the anaerobic fermentation of glucose to lactic acid. These are sprinter's muscle fibers, no use for sustained performance.

These differences are nicely illustrated by the serial sections from rat diaphragm.