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THE EFFECT OF SEVOFLURANE VERSUS ISOFLURANE ON CEREBRAL OXYGENATION DURING ARTHROSCOPIC SHOULDER SURGERY USING CEREBRAL OXIMETRY.

THESIS

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Abstract

The beach chair position (BCP) has been used for shoulder arthroscopic procedures since the early 1980s. The advantages of the conventional BCP (45° 90° above the horizontal plane) include lack of brachial plexus strain, a reduced risk of direct neurovascular trauma compared with the lateral decubitus approach, excellent intraarticular visualization, and ease of conversion to an open approach if needed . In the United States, approximately two-thirds of arthroscopic and open shoulder procedures are performed with the patient in the sitting position . Although the safety of orthopedic surgery in this position has been well established, rare catastrophic neurologic events have been reported. Pohl and Cullen reported 4 cases of ischemic brain and spinal cord injury occurring after surgery in the BCP. In an additional report, visual loss and ophthalmoplegia were described after shoulder surgery in a sitting position . Eight intraoperative cerebrovascular events were reported in a survey of the American Shoulder and Elbow Surgeons Society; all events occurred during surgery in the BCP. The etiology of central nervous system injury after shoulder surgery in the BCP has not been established definitively. Several authors have hypothesized that cerebral ischemia may occur when anesthetized patients are placed in a 45° to90° sitting position.

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List of abbreviation

CBF……cerebral blood flow

CMR……..cerebral metabolic rate

CMRO2……cerebral metabolic rate of Oxygen consumption

PO2……oxygen tension

NO……nitrous xide

cGMP……cyclic guanosine monophosphate

CO2……..carbon dioxide

DCBF……delta of cerebral blood flow

DPaCO2……delta of carbon dioxide tension

ECF……extracellular fluid

BBB……blood brain barrier

LLA……lower limit of autoregulation

CPP……cerebral perfusion pressure

VIP……vasoactive intestinal peptide

MAP……mean arterial blood pressur

CBV……..cerebral blood volume

ICP……intracranial pressure

IP3……inositol triphosphate

ATP……adenosine triphosphate

MAC……...mean anaesthetic concentration

TCD……..transcranial Doppler

CSF……..cerebrospinal fluid

CMRg……cerebral metabolic rate for glucose

PGE1……prostaglandine E1

BCP……..beach chair position

EEG……..electro encephalograme

SSEP…….somato sensory evocked potential

AEP…….. auditory evocked potential

MCA……..middle cerebral artery

SjVO2……mixed venous oxygen saturation

PTiO2…….brain tissue oxygen tension

rSO2……..regional oxygen saturation

NIRS……near infrared spectroscopy

LED……light emitting diode

CVR……..cerebral vascular resistance

O_2 ……oxygen

$PaCO_2$ .....arterial carbon dioxid tension

$CMRO_2$ ……cerebral metabolic rate of oxygen

PET……positron emission tomography

FA…….alveolar concentration

FI…….inspired concentration

HFIP…….hexfluoroisopropanol

MCAv……..middle cerebral artery flow velocity

ICU…….intensive care unite

ECG……electrocardiographe

ASA…….american society of anaesthisiology

HR……. heart rate

SD……..standard deviation

Introduction

Introduction

The use of techniques to assess cerebral oxygenation is gradually gaining wide popularity. The main methods available today can mainly be classified into invasive or non-invasive. The invasive technology uses the parenchyma probes, which measure oxygen and biochemical parameters, depending upon the type of probe used. The non-invasive technique uses near infrared spectroscopy for transcranial cerebral oximetery [(1)].

Near–infrared spectroscopy (NIRS) is relatively a non-invasive new technique for monitoring intracerebral oxygen saturation. It is a reliable indicator of peripheral cortical perfusion and provides continuous and non-invasive monitoring of intracerebral oxygen saturation [(2)].

Recently relatively simple system for cerebral oximetry The FORE-SIGHT™ Cerebral Oximeter was designed to give health care providers information to guard against neurological injuries due to compromised cerebral tissue oxygenation. Cerebral tissue oxygen saturation values are important to clinicians because cerebral hypoxia (lack of oxygen supply to brain tissue) is one of the leading causes of brain injuries that occurs in many surgical and clinical situations. The FORE-SIGHT™ Cerebral Oximeter utilizes the Company's patented, optically-based Near Infra-Red

Spectroscopy (NIRS) technology to monitor absolute cerebral tissue oxygen saturation levels [3].

Spectroscopy for monitoring cerebral oxygenation was introduced in hospitals towards the end of the 20th century. The key element of a cerebral oximeter is an electrode consisting of several parts. One of them is the light-emitting diode (LED) emitting two light bundles of various wavelengths, i.e. 735 nm and 810 nm. The other relevant elements are the superficial and deep detectors, situated 3 and 4 cm from the LED. This distance between the detector and LED enables deeper tissue penetration, prevents disorganized dispersion of photons and provides better recordings by receiving devices. Moreover, it eliminates extra-cerebral artifacts and minimizes the effects of skull bones on rSO_2.There are two electrodes (right and left) put on the forehead on either sides of midline. Regional oxygen saturation is measured in the tissues 3-5 cm beneath the sensor .To make the measurement of regional cerebral saturation a sensitive marker of cerebral hypoxia, the range of rSO_2 reference values was introduced. The proper cerebral saturation is within 65±9% [4] .

The cerebral oximetry

- Measures global capillary “venous and arterial” oxygen.

-Is continuous, non-invasive and risk free for the patient

-Is well suited for all types of cardiac, vascular and general surgery procedure.

-Is precalibrated and simple to use for adults and pediatric.

The use of controlled hypotension has been successfully used during different operation as brain tumor, shoulder arthroplasty, total hip arthroplasty, radical neck dissection, radical cystectomy, middle ear surgery and other operations associated with blood loss to decrease haemorrhage and provides a better field for surgeon. The primary methods of electively lowering blood pressure are proper positioning, positive pressure ventilation, and administration of hypotensive drugs [(5)].

Patients undergoing shoulder surgery in the supine position with 45 degree head elevation may be at risk for adverse neurologic events due to cerebral ischemia because this position may alter cerebral blood flow (CBF) [(6)].

The brain has a high rate of energy utilization and a very limited energy storage capacity. It is therefore extremely vulnerable in the event of interruption of substrate (O_2, glucose) supply. The pathophysiology of ischemic neuronal injury may be focal or global according to the cause [(7)].

Isoflurane is in common use for variable surgeries. Sevoflurane is currently getting more popularity owing to its faster recovery time. The effect of different concentrations of sevoflurane and isoflurane on intraoperative cerebral blood flow, cerebral metabolism and so cerebral oxygenation might be clinically important however it is still not fully evaluated [(8)].

AIM OF THE WORK

The aim of this study is to compare the effect of one MAC sevoflurane versus one MAC isoflurane as inhalational anesthetics under steady state conditions on cerebral oxygenation during arthroscopic shoulder surgery by the aid of using cerebral oximeter to measure regional cerebral oxygenation (rSO_2).

Review Of Literature

Chapter 1

Physiology of Central Nervous System

Cerebral Physiology:

1,350 g and therefore represents about 2 percent of total body weight. However, it receives 12 to 15 percent of cardiac output [45-55ml/100g/min]. This high flow rate is a reflection of the brain‘s high metabolic rate. At rest, the brain consumes O_2 at an average rate of approximately 3.5 mL of O_2 per 100 g of brain tissue per minute. Whole-brain O_2 consumption (13.5 × 3.5 = 47 This chapter reviews cerebral physiology, and a brief discussion of the pathophysiology of cerebral ischemia and of cerebral protection. The adult human brain weighs approximately mL/min) represents about 20 percent of total-body O_2 utilization. Normal values for CBF, CMR, and other physiologic variables are provided in [table 1**]**[(9)]**.**

TABLE (1): Normal Cerebral Physiologic Values

CBF	
I-Global	45-55 ml/100g/min
II-Cortical [mostly gray matter]	75-80 ml/100g/min
III-Subcortical [mostly white matter]	20 ml/100g/min
$CMRO_2$	3-3.5 ml/100g/min
CVR	1.5-2.1mmhg/100g/min/ml
Cerebral venous po_2	32-44mmhg
Cerebral venous so_2	55%-70%
ICP[Supine]	8-12mmhg