



Faculty of Medicine
Department of Anesthesia,
Intensive Care and Pain Management

Dexmedetomidine versus Nitroglycerine Effect on Emergence Hypertension in Cranial Surgeries

Thesis

*Submitted for Partial Fulfillment of M.D. Degree
of Anesthesiology*

By

Yasmine Magdy Abdel Hamid

M.B.B.Ch. - M.Sc. - Ain Shams University

Under Supervision of

Prof. Dr. Alaa Eid Mohamad

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

Prof. Dr. Dalia Abdel Hamid Mohamad

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

Dr. John Nader Nassef

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

Dr. Mohammed Abdulmohsen Abdulnaiem

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

*Faculty of Medicine
Ain Shams University*

2018

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لَسْبَدَانِكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgement

First of all, I would like to express my deep gratitude to **ALLAH** for his care and generosity throughout my life...

No words can express my deepest appreciation and profound respect to **Prof. Dr. Alaa Eid Mohamad**, Professor of Anesthesiology, Intensive Care and Pain Management, Ain Shams University, for his continuous guidance and support. He has generously devoted much of her time and his effort for planning and supervision of this study.

Also, my profound gratitude to **Prof. Dr. Dalia Abdel Hamid Mohamad**, Professor of Anesthesiology, Intensive Care and Pain Management, Ain Shams University, for her kind supervision and support. It was great honor to work under her supervision.

I would like also to thank **Dr. John Nader Nassef**, Lecturer of Anesthesiology, Intensive Care and Pain Management, Ain Shams University Hospitals, for his support, help and constructive criticism during this work.

I would like also to thank **Dr. Mohammed Abdulmohsen Abdulnaiem**, Lecturer of Anesthesiology, Intensive Care and Pain Management, Ain Shams University Hospitals, for his support and help during this work.

Last but not least, I dedicate this work to my family, whom without their sincere emotional support, pushing me forward this work would not have ever been completed.

Yasmine Magdy

Contents

Title	Page No.
List of Abbreviations.....	I
List of Tables.....	III
List of Figures	IV
Introduction	1
Aim of the Work	3
Chapter (1): Pathophysiology of cerebral circulation ..	4
Chapter (2): Pharmacology of dexmedetomidine	24
Chapter (3): Pharmacology of nitroglycerine	41
Patients and Methods	57
Results.....	63
Discussion.....	80
Summary	88
Conclusion.....	90
References	91
Arabic Summary	-

List of Abbreviations

Abb.	Full term
μ	microgram
ASA	American Standards Association
ATP	Adenosine triphosphate
AV	Atrioventricular
BBB	blood-brain-barrier
BMI	Body mass index
BP	Blood pressure
CA	Cortical area
cAMP	Cyclic adenosine monophosphate
CBC	Complete blood count
CBF	Cerebral blood flow
CBV	Cerebral blood volume
CMR	Cerebral metabolic rate
CMR _{glu}	Cerebral metabolic rate of glucose
CMR _{lact}	Cerebral metabolic rate of lactate
CMRO ₂	Cerebral metabolic rate of oxygen
CO ₂	Carbon dioxide
CPP	Cerebral perfusion pressure
CSF	cerebrospinal fluid
CT	Computed tomography
CVP	Central venous pressure
CVR	Cerebrovascular resistance
DBP	Diastolic blood pressure
ECG	Electrocardiogram
Fig	Figure
HR	Heart rate

 List of Abbreviations

Abb.	Full term
ICP	Intracranial pressure
ICU	Intensive care unit
Iv	Intravenous
KFT	Kidney function test
LFT	Liver function test
MAC	Minimum alveolar concentration
MAP	Mean arterial blood pressure
MRI	Magnetic resonance imaging
NO	Nitric oxide
PaCO₂	Partial pressure of carbon dioxide in arterial blood
PaO₂	Partial pressure of oxygen in arterial blood
PAP	Pulmonary arterial pressure
PCWP	Pulmonary-capillary wedge pressure
PDE-5	Phosphodiesterase-5
pH	Potential hydrogen
PT	Prothrombin time
PTT	Partial thromboplastin time
PVR	Pulmonary vascular resistance
RAP	Right arterial pressure
RBS	Random blood sugar
RR	Respiratory rate
SBP	Systolic blood pressure
SD	Standard deviation
SpO₂	Arterial oxygen saturation
SVR	Systemic vascular resistance

List of Tables

No	Table	Page
1	Average values in normal healthy individuals	9
2	Demographic data	63
3	SBP changes (mmHg)	66
4	DBP changes (mmHg)	68
5	MBP changes (mmHg)	71
6	HR changes (bpm)	73
7	SPO ₂ changes (%)	75
8	ETCO ₂ changes (mmHg)	77
9	Recovery time change (min)	79

List of Figures

No	Figure	Page
1	Arterial supply of the brain (Circle of Willis)	5
2	Relationship between CBF and PaCO ₂	10
3	Relationship between CBF and PaO ₂ showing almost no effect on CBF in the normoxaemic range	11
4	Effect of changes in MAP	12
5	Relationship between cerebral blood flow and cerebral perfusion pressure	13
6	ICP elastance curve (change in pressure per unit change in volume)	18
7	Production, circulation and resorption of CSF	20
8	Dexmedetomidine	24
9	The structural formula of nitroglycerine	42
10	Columns are mean values and error bars are SD for the age	64
11	Columns are mean values and error bars are SD for the body weight	64
12	Columns are number of patients for either ASA 1 or 2	65
13	Columns are number of patients for the gender	65
14	Lines are mean SBP and error bars represent standard deviation	67

No	Figure	Page
15	Lines are mean DBP and error bars represent standard deviation	69
16	Lines are mean MABP and error bars represent standard deviation	72
17	Lines are mean HR and error bars represent standard deviation	74
18	Lines are mean SPO ₂ and error bars represent standard deviation	76
19	Lines are mean ETCO ₂ and error bars represent standard deviation	78
20	Columns are minutes for the recovery time and error bars are SD	79

Introduction

The goals of neuro-anesthesia are providing good operating conditions and ensuring stable cerebral hemodynamics without sudden increase in intracranial pressure or acute brain swelling. Fast recovery from anesthesia is often preferred to allow immediate neurological evaluation (*Basali et al., 2012*).

During recovery, abrupt increase in arterial blood pressure can cause postoperative hematoma. Although opioid analgesics prevent hemodynamic responses to awakening and extubation. It may result in respiratory depression and high carbon dioxide tension with subsequent increase in the intracranial pressure (*Tanskanen et al., 2006*).

Nitroglycerine and dexmedetomidine have been shown to decrease doses of i.v anesthetics, intraoperative opioid and volatile anesthetic requirements for maintenance of anesthesia (*Maze and Tranquilli, 2011*).

Perioperative stress associated with surgery and anesthesia evokes an endocrine response that includes stimulation of the sympathetic nervous system. This will increase the circulating plasma adrenaline and nor-

adrenaline concentrations with consequent increase in arterial pressure, heart rate and oxygen consumption (***Paola et al., 2015***).

Controlling this perioperative stress response is an important goal of modern anesthesia (***Hall et al., 2015***).

Aim of the Work

The aim of this work was to compare nitroglycerine with dexmedetomidine effect on hemodynamics and recovery responses during extubation in cranial surgeries.

Pathophysiology of Cerebral Circulation

The normal adult skull can be considered as a bony box of fixed volume. It contains brain, blood and cerebrospinal fluid (CSF).

➤ **Cerebral blood volume**

The brain receives its blood supply from the internal carotid and vertebral arteries (Circle of Willis) (Fig. 1) which drain via the cerebral veins and dural venous sinuses into the internal jugular veins. The volume of blood in the whole brain is small and contained mainly in the venous sinuses and pial veins. The cerebral blood volume of the grey matter is 4-6 ml/100g & of the white matter is 1.5-2.5 ml/100g. The grey matter is composed of the cell bodies of the neurons which are involved with the complex functions of the human body and hence requires a larger proportion of the arterial blood supply. On the other hand, the white matter is essentially composed of axons which transmit impulses in between the neurons. As it is involved with less complicated functions than the grey matter, it needs a smaller fraction of the blood supply (*Tameem and Krowidi, 2013*).

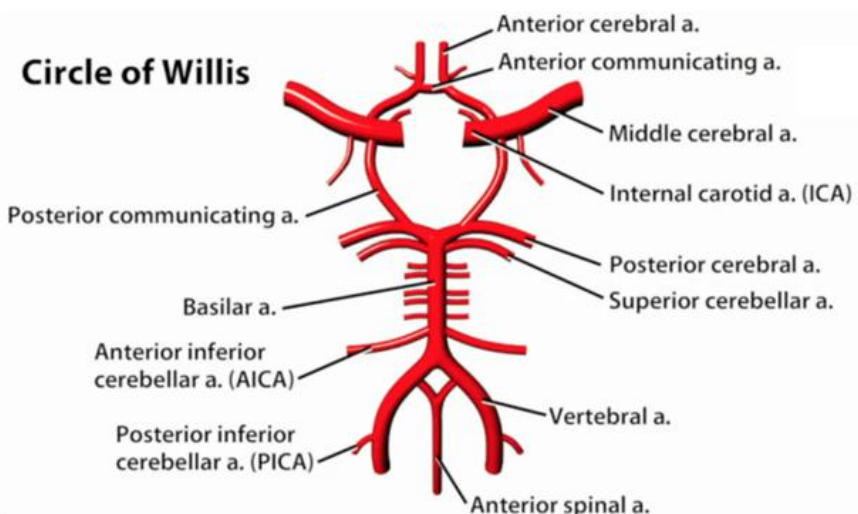


Fig. (1): Arterial supply of the brain (Circle of Willis) (*Tameem and Krowidi, 2013*).

➤ Cerebral Blood Flow:

The brain is able to withstand very short periods of lack of blood supply (ischemia). Without oxygen, energy-dependent processes cease leading to irreversible cellular injury if blood flow is not re-established rapidly (3 to 8 minutes under most circumstances). Therefore, adequate cerebral blood flow must be maintained to ensure a constant delivery of oxygen and substrates and to remove the waste products of metabolism (*Hill and Gwinnutt, 2007*).

Cerebral blood flow (CBF) depends on:

- A. cerebral perfusion pressure
- B. The radius of cerebral blood vessels

This relationship can be described by Hagen-Poiseuille formula as follow:

$$\text{Cerebral Blood Flow} = \frac{\Delta P \pi R^4}{8 \eta L}$$

- ΔP = cerebral perfusion pressure
- R = radius of the blood vessels
- η = viscosity of the fluid (blood)
- L = length of the tube (blood vessels)

(Hill and Gwinnutt, 2007)

A) Cerebral Perfusion Pressure: $CPP = MAP - ICP$

This is the difference between the mean arterial blood pressure (MAP) and the mean cerebral venous pressure. The latter is difficult to measure and approximates to the more easily measured intracranial pressure (ICP). Mean arterial blood pressure (MAP) can be estimated as equal to: diastolic blood pressure + 1/3 pulse pressure and is usually around 90mmHg. ICP is much lower and is normally less than 13mmHg (*Steiner and Andrews, 2006*).

CPP is normally about 80mmHg

Clearly, CPP will be affected by changes of the MAP or ICP. Blood loss causing hypotension will reduce MAP and CPP, while an intracerebral hematoma will increase