

BAROREFLEX INTEGRITY: A COMPARATIVE STUDY BETWEEN PROPOFOL, SEVOFLURANE AND PROPOFOL WITH SEVOFLURANE ANESTHESIA

Thesis

Submitted for partial fulfillment of MD degree in Anesthesiology

By

Mona Hamed El Sherbiny

(M.B.B.Ch.,) MSc Anesthesiology

Supervised By

Prof. Dr. Tarek Mahmoud Fahmy Abdel Barr

Professor of Anesthesiology

Faculty of Medicine

Cairo University

Prof. Dr. Jehan Helmy Ibrahim

Ass. Professor of Anesthesiology

Faculty of Medicine

Cairo University

Prof. Dr. Ahmed Abdalla Mohamed

Ass. Professor of Anesthesiology

Faculty of Medicine

Cairo University

Dr. Mohamed Hussien Abd El Aziz

Lecturer of Anesthesiology

Faculty of Medicine, Cairo University

Faculty of Medicine

Cairo University

2014

بسم الله الرحمن الرحيم

[وَأَنْزَلَ اللَّهُ عَلَيْكَ الْكِتَابَ
وَالْحِكْمَةَ وَعَلَّمَكَ مَا لَمْ تَكُن تَعْلَمُ
وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيمًا]

صدق الله العظيم

النساء .. آية ١١٣

Acknowledgement

First of all thanks to Allah who helped me to do this work,

*I would like to express my sincere appreciation and gratitude to **Prof. Dr. Tarek Mahmoud Fahmy Abdelbarr**, Professor of Anesthesia, Faculty of medicine, Cairo University & to **Prof. Dr. Jehan Helmy Ibrahim**, Assistant Professor of Anesthesia, Faculty of medicine, Cairo university for their generous supervision and kind guidance to make the realization of this work much easy.*

*I am deeply grateful to **Prof. Dr. Ahmed Abdalla Mohammed**, Assistant Professor of Anesthesia, Faculty of Medicine, Cairo University & to **Dr. Mohammed Hussien Abdelaziz** , Lecturer of Anesthesia, Faculty of medicine for their eager share, their kind support and guidance.*

*Deepest gratitude to **Dr. Ashraf Elmasry**, Lecturer of Anesthesia, Faculty of medicine for his great effort in conducting the statistics for our study & for his kind support and guidance.*

Abstract

Background: The baroreceptor reflex is the main mechanism for short-term regulation of blood pressure and a major determinant of the blood pressure responses associated with various behaviors. Baroreflex sensitivity (BRS) is the amount of change in beat-to-beat interval (RR) against a 1mm Hg systolic blood pressure deviation. BRS is traditionally measured by bolus injection of vasoactive drugs such as phenylephrine which causes increase in systolic blood pressure (SBP) or Na nitroprusside (NTP) which causes decrease in systolic blood pressure .

Methods: This comparative study included 60 patients who were scheduled for laparoscopic gynecological surgery. Patients were divided into three groups (Propofol-group) , (Sevo-group) & (combined Propofol & Sevo group) with 20 patient in each group.Pressor & depressor tests were done pre,intra & postoperative with recording systolic blood pressure & R-R interval as well as the diastolic overshoot in the awake atate,under anesthesia & postoperatively

Results: There were no significant differences in patient population demographic data, awake pretest SBP and HR. The results of our study suggest that there was no significant depression of baroreceptors except for the depressor slopes in the propofol group after induction of anesthesia with full recovery of baroreceptors in the postoperative results.Also, Our study stated that blood pressure was significantly lower among patients confined to sevoflurane group as compared to other two groups suggesting that haemodynamics were more affected when using sevoflurane alone than using propofol alone or in the combined group.

Conclusion: Data obtained from this study showed that use of propofol alone may lead to depression of baroreceptors as compared to sevoflurane alone or combined use of them. On the other hand, haemodynamics were affected when using sevoflurane alone than using propofol or combined use of them.

Key words:

Anesthesia –Propofol-Sevoflurane-Baroreflex .

List of Contents

	Page
List of Abbreviations	I
List of Tables	IV
List of Figures	VI
Introduction and Aim of the Work	1
Review of Literature	
Chapter (1): Anatomy	4
Chapter (2): <ul style="list-style-type: none">• Physiology	11
Chapter (3): <ul style="list-style-type: none">• Pharmacology	25
Material and Methods	47
Results	54
Discussion	81
Summary and Conclusion	95
References	99
Arabic Summary	

List Of Abbreviations

Abbreviation	The Full Term
ABP	arterial blood pressure.
ABR	arterial baroreflex.
ACTH	adrenocorticotrophic hormone.
AP	arterial pressure.
ARDS	acute respiratory distress syndrome.
ASA	american society of anesthesiologists.
BP	blood pressure.
BRS	Baroreflex sensitivity.
CBF	cerebral blood flow.
cGMP	cyclic guanosine 3',5'-monophosphate.
CMR	cerebral metabolic rate.
CNS	central nervous system.
CO	cardiac output.
CO ₂	carbon dioxide.
ECG	electrocardiogram.
EEG	electroencephalogram.
ED ₉₅	effective dose for desired effect in 95 % of population exposed to it.
Fe ²⁺	iron.
GABA	gamma-amiobutyric acid.
HBF	Hepatic blood flow.
Hgb Fe ³⁺	methemoglobin.
HR	heart rate.
HRV	heart rate variability.
IBI	inter-beat interval.

ICA	internal carotid artery.
ICP	intracranial pressure.
ICU	intensive care unit.
IM	intramuscular.
IV	intravenous.
LMA	laryngeal mask airway.
LRFA	laparoscopic radiofrequency ablation of liver tumors.
MAC	minimum alveolar concentration.
MAO	mono amine oxidase.
MAP	mean arterial pressure.
mmHg	millimeter mercury.
NO	nitrogen oxide.
N₂O	nitrous oxide.
NTP	Na nitroprusside.
NTS	nucleus of the tractus solitaries.
PEEP	positive end expiratory pressure.
RR	beat-to-beat interval.
SBP	systolic blood pressure.
SBR	spontaneous baroreflex.
SQ	subcutaneous.
Vd	volume of distribution.
VM	Valsalva maneuver.

List Of Tables

Table	Description	Page
1	Uses and Doses of Intravenous Propofol	30
2	Mean \pm SD, for demographic data among three groups.	54
3	Mean \pm SD. Systolic blood pressure (SBP mmHg) recorded For Group A (TIVA).	55
4	Mean \pm SD. For Systolic blood pressure (SBP mmHg) recorded among Group B (Sevoflurane).	57
5	Mean \pm SD. For Systolic blood pressure (SBP mmHg) recorded among Group C (Combined).	59
6	Mean \pm SD. SBP during preoperative, intraoperative and postoperative among three groups following administration of Phenyl-Ephrine and sodium Nitroprusside.	60
7	Mean \pm SD for R-R interval (msec) recorded among Group A (TIVA).	62
8	Mean \pm SD for R-R interval (msec) recorded among Group B (Sevoflurane).	64
9	Mean \pm SD for R-R interval (msec) recorded among Group C (Combined).	65
10	Mean \pm SD. For R-R interval (msec) during preoperative, intraoperative and postoperative among three groups following administration of Phenyl-Ephrine and sodium Nitroprusside.	66
11	mean \pm SD & Range for Δ SBP & Δ R-R intervals among	68

	group A (TIVA n=20).	
12	mean \pm SD & Range for Δ SBP & Δ R-R intervals among group B (Sevoflurane n=20).	70
13	mean \pm SD & Range for Δ SBP & Δ R-R intervals among group C (Combined n=20).	72
14	mean \pm SD. For diastolic overshoot (mmHg/msec) among all groups	74
15	mean \pm SD, for slope among Group A patients.	75
16	mean \pm SD, for slope among Group B patients.	76
17	mean \pm SD, for slope among Group C patients.	78
18	mean \pm SD. For slope among during preoperative, intraoperative and postoperative among three groups.	79

List of Figures

Figure	Description	Page
1	The topographic location of the carotid sinus is illustrated in its site at the level of the thyroid cartilage in the angle between the larynx and the anterior margin of the sternocleidomastoid muscle.	6
2	Carotid sinus and related neural structures in humans.	9
3	Central nervous system baroreceptor pathway linking baroreceptor afferents to sympathetic and parasympathetic outflow. Plus (+) and minus (-) symbols refer to excitatory synapses and inhibitory synapses, respectively.	19
4	Baroreceptor reflex effector systems. Changes in baroreceptor afferent activity reflexively influence many outputs of the brain relevant to cardiovascular regulation. ACTH, adrenocorticotrophic hormone.	23
5	Phenylephrine.	38
6	Systolic blood pressure (SBP) among Group A patients.	56
7	Systolic blood pressure (SBP) among Group B.	57
8	Systolic blood pressure (SBP) among Group C.	59
9	SBP (mmHg) among all groups.	61
10	Mean \pm SD for R-R interval (msec) among group A patients.	63
11	Mean \pm SD, for R-R interval (msec) among group B patients.	64

12	Mean \pm SD, for R-R interval (msec) among group C patients.	65
13	Mean \pm SD, for the R-R interval (msec) among all groups.	67
14	Correlation between changes in SBP Δ mmHg & R-R interval Δ msec among Group A patients (propofol n=20).	69
15	Correlation between changes in SBP Δ mmHg & R-R interval Δ msec among Group B patients (Sevoflurane n=20).	71
16	Correlation between changes in SBP Δ mmHg & R-R interval Δ msec among Group C patients (Combined n=20).	73
17	Mean \pm SD. For diastolic overshoot (mmHg/msec) among all groups.	74
18	Mean \pm SD for slope among group A (Sevoflurane n=20) patients.	76
19	Mean \pm SD for slope among group B (Combined n=20) patients.	77
20	Mean \pm SD for slope among group C (Combined n=20) patients.	78
21	Mean \pm SD for slope among all groups.	80



INTRODUCTION AND AIM OF THE STUDY

The baroreceptor reflex is the main mechanism for short-term regulation of blood pressure and a major determinant of the blood pressure responses associated with various behaviors. The cardiac branch of the baroreflex that relates blood pressure to inter-beat interval (IBI) is one relevant source of vagal influences and cardiac autonomic regulation, being the main generator of autonomic measures such as respiratory sinus arrhythmia and heart rate variability.

The baroreceptor reflex consists of two important limbs, including the sympathetic baroreflex and the cardiovagal reflex systems. Impairment of cardiovagal reflex responses has been associated with some physiological or pathologic conditions, such as aging and hypertension. More importantly, its clinical application has been highlighted by the increased incidence of cardiac dysrhythmias and decreased survival after myocardial infarction in patients with diminished cardiovagal baroreflex function.

Baroreflex sensitivity (BRS) is the amount of change in beat-to-beat interval (RR) against a 1mm Hg systolic blood pressure deviation. BRS is traditionally measured by bolus injection of vasoactive drugs such as phenylephrine which causes increase in systolic blood pressure (SBP) or Na nitroprusside (NTP) which causes decrease in systolic blood pressure . The increase /decrease in



SBP tempts an increase /decrease in the corresponding RR interval(millisecons).

Potent volatile anesthetics cause concentration dependent depressions in pharmacological baroreflex gains and continue to exert depressive effects after emergence from general anesthesia in humans. Previous studies suggest a rapid return of baroreflex sensitivities to preanesthesia, premedicated conditions after surgeries with halothane and isoflurane anesthesia.

Sevoflurane is a volatile anesthetic agent with low blood–gas solubility (0.6). Sevoflurane is now widely used for its desirable properties of rapid induction and emergence and quick control of anesthetic depth.

Propofol, an intravenous anaesthetic, is now widely used in clinical practice because of its favorable recovery profile and low incidence of side effects.

The effects of contemporary available general anesthetics, such as propofol or sevoflurane on baroreflex control of heart rate (HR) have been extensively investigated in humans. More importantly, how long volatile & intravenous anesthetics exert depressive effects on the baroreflex function after general anesthesia and, thus, how full recovery of baroreflex function actually takes place.



AIM OF THE STUDY

This study aims to evaluate the effect of using different anaesthetic drugs as sevoflurane, an inhalational anaesthetic, or propofol, an intravenous anaesthetic, on the integrity of baroreceptor reflex and its recovery after emergence from anaesthesia.

ANATOMY

A variety of receptors transmit information about cardiovascular status to the brain. The pressure receptors that respond to the tension of the arterial walls, the arterial baroreceptors, are located near the output of the heart (in the aortic branch) and in the carotid arteries where they monitor the pressure in the vessels that are essential for the brain's blood supply. There exist a number of histologically discriminable baroreceptors in the wall of the arteria carotis communis.⁽¹⁾

Three different types have been identified by means of electron microscopy. The afferent information is transmitted via both myelinated and unmyelinated fibers.⁽²⁾ Another cluster of receptors is located in the aortic branch and still others are found in the walls of the larger arteries.⁽³⁾

Finally, baroreceptors have been identified at various locations in the heart. The type A receptors in the atrium fire maximally during the arterial systole while the atrial type B receptors respond to filling.⁽⁴⁾

It is thought that the human baroreceptor system is mainly located in the proximal portion of the internal carotid artery (ICA), termed the carotid sinus. The exact neuroanatomy of the human carotid sinus is a matter of debate. A recent macroscopic study of adjacent neuronal networks demonstrates that innervation of the sinus is variable and unpredictable.⁽⁵⁾