EFFECTS OF SEVOFLURANE VERSUS PROPOFOL ANESTHESIA ON BISPECTRAL INDEX VALUES DURING ENDOSCOPIC AND LAPAROSCOPIC SURGERY

Thesis Submitted for Complete Fulfillment of the MD Degree in Anesthesia

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2012

ACKNOWLEDGMENT

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I would like to express my sincere gratitude to *Professor Mona Lotfy*, professor of anesthesiology who supervised this work with great interest and who gave me unlimited support throughout the work.

Deep and limitless thanks must be given to Professor Manar El-Kholy, Professor of anesthesiology for her continuous encouragement, precious advice and valuable guidance throughout the study.

Special thanks must be given to *Ass. Professor Dina Zakaria*, Ass. *Professor* of anesthesiology for her encouragement and guidance. She was generous in devoting enough time and effort for helping, revision and constructive criticism.

I want also to thank my family specially my lovely wife; to her I dedicate this work.

Mohammad El-Hady

Cairo 2012

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LIST OF ABBREVIATIONS

ABP ..... Arterial Blood Pressure
BET ..... Bouls, Elimination, Transfer
BIS ..... Bispectral Analysis
CACI..... Computer –Assisted Continuous Infusion
CBF ..... Cerebral Blood Flow
CMRO2 ..... Cerebral Metabolic Rate Oxygen Consumption
CPP..... Cerebral Perfusion Pressure
CSF ..... Cerebrospinal Fluid
EEG..... Electroencephalogram
ET..... Elimination, Transfer.
GABA ..... γ-aminobutyric acid
HFIP ..... Hexafluroisopropanol
HR..... Heart Rate
ICP ..... Intra-cranial Pressure
ICU ..... Intensive Care Unit
IV..... Intra Venous
LMA..... Laryngeal Mask Airway
MAC ..... Minimum Alveolar Concentration
MBP ..... Mean Blood Pressure
PET ..... Positron Emission Tomography
PIFE ..... Pentafluoroisopropenyl fluoromethylether
PMFE ..... Pentafluoromethoxy isopropyl fluoromethyl ether
TCI ..... Target Control Infusion.
TIVA ..... Total Intravenous Anesthesia
VCB..... Vital Capacity Breath
VIMA ..... Volatile Induction Maintenance Anesthesia

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ABSTRACT

Sevoflurane is a new inhalational agent, which can be used as a solo agent for induction and maintenance of anesthesia. Using infusion systems simplify the delivery of propofol when it is used as induction and maintenance of anesthesia and make the delivery of the drug accurate.

Bispectral index was recorded over the procedure.

Both drugs can be used for shot surgical procedure when rapid awaking is required, however propofol consider slightly cheaper than sevoflurane.

Key word: Sevoflurane, propofol, total intravenous anesthesia, volatile induction maintenance anesthesia, Bispectral Index (BIS) & awareness under anesthesia.

INTRODUCTION

Intravenous agents are commonly used for induction of anesthesia followed by inhalational agents for maintenance. A problem with this technique is the transition phase from induction to maintenance due to rapid redistribution of the intravenous agent before an adequate depth is attained with inhalational agent this could lead to light anesthesia[1].

The use of volatile induction maintenance (VIMA) and introduction of total intravenous anesthesia (TIVA) anesthesia has led to rediscovery of single agent anesthesia which avoids problems associated with the transition phase[2].

With the introduction of the volatile agent sevoflurane (1, 1, 1, 3, 3, 3, hexa- fluoro - 2 propyl fluoro methyl ether) in 1990; inhalational induction of general anesthesia using it has become well tolerated due to its low blood/gas partition coefficient (0.69) combined with pleasant smell, and lack of pungency and irritation[3].

These characteristics explain more rapid induction of anesthesia, more precise adjustment of its effect and faster recovery[4]. So it replaces halothane as gold standard for inhalational anesthesia. Loss of consciousness generally occurs within 1 min after a single breath induction of 8% and slightly longer if the dose of sevoflurane is incrementally increased[5].

The Food and Drug Administration places no restriction on sevoflurane anesthesia at fresh gas-flow at rates of > 2L/ min, but does not recommend the use of low-flow sevoflurane anesthesia at rates < 1L/min or the use of sevoflurane up to 2 minimum alveolar anesthetic concentration (MAC) at 1 L/min.

This is partly because there is insufficient clinical data on low-flow sevoflurane anesthesia of < 1 L/min and that the nephrotoxic threshold of Compound A in humans is uncertain[6].

Propofol (2-6 di isopropyl phenol) is a suitable intravenous agent for both induction and maintenance and this result in significantly quicker induction recovery and early return of psychomotor function. As it is metabolized mainly in the liver by conjugation to inactive metabolites which are excreted by the kidney less than 2% is excreted in feces and less than 1% is excreted unchanged in urine. Because the clearance of propofol exceeds hepatic blood flow extrahepatic metabolism or extrarenal elimination had been suggested[7].

The introduction of the target control infusion (TCI) system has enabled relatively accurate dosing by continuous infusion based on the phamacokinetic profile of propofol an average patient. This convenient system makes TIVA with propofol an attractive option with the benefit of minimal pollution to the operating room environment[8].

A series of media reports have imprinted the fear of awareness under anesthesia into the psyche of the general population. Accounts of recall and helplessness while paralyzed have made unconsciousness a primary concern to patients undergoing general anesthesia.

Some reports appear over dramatized; however, when awareness does occur, patients may exhibit symptoms ranging from mild anxiety to post-traumatic stress disorder (e.g., sleep disturbances, nightmares, and social difficulties).

Evidence of awareness under general anesthesia was found in 0.2-0.4% to be the most quoted studies.

As of 1999, the ASA Closed Claims project reported 79 awareness claims; approximately 20% for awake paralysis and the remainder for recall under general anesthesia[9].

Bispectral Index System (BIS), a parameter derived from the electroencephalogram (EEG) recently implemented to detect consciousness under anesthesia and is intended to decrease the risk of intraoperative awareness. It is a numerical value for 0 – 100 ; low values indicate more sedation and hypnosis[10-11].

AIM OF WORK

The aim of this study is to compare sevoflurane versus propofol as a sole anesthetic with regards to differences in cardiovascular effects, speed of induction, awareness under anesthesia using BIS, recovery pattern and the cost of both techniques.

SEVOFLURANE

Since the clinical introduction of halothane (in 1956) as the first non-flammable anesthetic agent, the quest for new inhalational anesthetic agents with better physical, pharmacokinetic and pharmacodynamic properties has centered upon the development of compounds with the following main properties[12].

- Rapid induction and recovery of anesthesia.
- Non irritant and tolerable on induction.
- Rapid adjustment of the depth of anesthesia.
- Adequate skeletal muscle relaxation.
- Minimal cardiovascular and respiratory depression.
- Wide margin between concentrations producing the desired pharmacological effect and those producing toxicity.
- Absence of toxic effects or other adverse events at normal doses.

By 1960 sevoflurane was synthesized but it was not used clinically until 1990 when it was approved for used in Japan.

1) PHYSICAL PROPERTIES

Sevoflurane is an fluoromethyl polyfluoroisopropyl ether.

- It is a colorless, stable liquid when stored under normal room lighting conditions.

- Containing no additives or chemical stabilizers.
- Nonflammable liquid of mild etheral odour with a lower solubility in lipids and blood than halothane or isoflurane but not desflurane[13] (Table 1).
- It is miscible with ethanol, ether, chloroform and petroleum benzene, and it is slightly soluble in water.
- The anesthetic potency of sevoflurane, quantified as the minimum alveolar concentration (MAC) is 1.7 - 2.05[12].
- As with other volatile anesthetic agents, the MAC of sevoflurane decreases with increasing age or with concomitant use of nitrous oxide or opioids[11].
- Its vapor pressure is 157 mmHg, which is comparable to halothane and isoflurane.

Table 1: Some physical characteristics of sevoflurane, nitrous oxide and other inhalational anesthetic agents[(14)].

Parameter	Sevoflurane	Desflurane	Isoflurane	Halothane	Nitrous oxide
Odour	Pleasant	Unpleasant	Unpleasant	Pleasant	
Specific gravity at 20°C (g/ml)	1.52	1.47	1.50	1.87	
Vapour pressure at 20°C (mmHg)	157	669	238	243	
Boiling point at 760 mmHg (°C)	58.6	23.5	48.5	49-51	
Potency (MAC)[a]	1.7-2.05	6	1.15	0.74	104
Partition coefficient (solubility)[b]					
Oil : gas	47.2-53.4	18.7	91	224	1.4
Blood / gas	0.68	0.42	1.38	2.57	0.47
Tissue : blood					
Brain	1.70	1.29	1.57	19.4	1.06
Heart	1.78	1.29	1.61	1.84	
Liver	1.85	1.31	1.75	2.07	
Kidney	1.15	0.94	1.05	1.16	
Muscle	3.13	2.02	2.92	3.38	
Muscle	3.13	2.02	2.92	3.38	
Fat	47.50	27.20	44.90	51.10	2.3

a Potency of an inhalation anesthetic agent as the minimum alveolar concentration (MAC) that, at steady state procedures immobility in 50% of individuals exposed to a noxious stimulus MAC data presented as percentage of 1 atmosphere.

b Ratio of the concentration of the drug at equilibrium in 2 phase or tissues.

2) CHEMICAL CHARACTERISTICS

It is one of halogenated alkane fluromethyl polyfluroisopropyl ether (Fig.1).

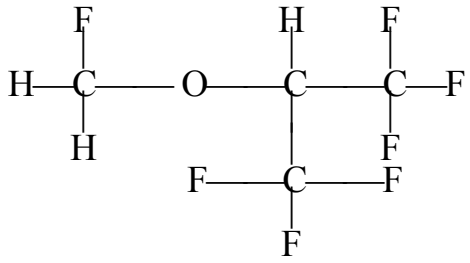

Fig.1: The structural formula of sevoflurane.

- Sevoflurane is chemically stable.
- No discernible degradation occurs in the presence of strong acids or heat.
- Sevoflurane is not corrosive to stainless steel, brass, aluminum, nickel - plated brass, chrome-plated brass or copper beryllium.

The only known degradation reaction in the clinical setting is through direct contact with CO2 absorbents[15] (soda lime and Baralyme)[16] producing pentafluoroisopropenyl fluoromethyl ether (PIFE, C4H2F6O) also known a Compound A[17].

And trace amounts of pentafluoromethoxy isopropyl fluoromethyl ether, (PMFE, C5H6F6O), also known as Compound B. Baralyme causes production of Compound A more than does soda lime.

Laboratory simulations have shown that the concentration of these degradants is inversely correlated with the fresh gas flow rate.