PREVALENCE AND RISK FACTORS FOR POSTANAESTHETIC SHIVERING

BY

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A dissertation submitted in fulfillment of the requirement for the degree of Master of Medicine (Anaesthesiology)

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ABSTRACT

Postanaesthetic shivering is one of the common complications affecting patients who undergo surgical procedure in operation theatre. Shivering can occur in patients who received either general or neuroaxial anaesthesia. Although it is not a major complication, it gives negative consequences to patient, might delay in wound healing and cause interruption in vital signs monitoring perioperatively. We conducted this study to determine the prevalence and to find the potential risk factors that might contribute to the occurrence of postanaesthetic shivering in our operation theatre. Patients who were planned for surgery, either elective or emergency that fulfilled the inclusion criteria were recruited in this study involving 143 patients. Demographic characteristics, details of surgery and anaesthesia and occurrence of postanaesthetic shivering were documented and analyzed. The prevalence of postanaesthetic shivering in our operation theatre was 18.9%. Chi-square Test analysis of demographic characteristic showed race contributed to the postanaesthetic shivering with p value of 0.038. By using Multiple Logistic Regression Analysis, Malay has 6.71 times odds of postanaesthetic shivering as compared to other ethnic group. Increased anaesthesia duration and intraoperative lowest core body temperature (˚C) was shown to increase the odds of postanaesthetic shivering by 1.007 and 0.441 times prospectively. Subjects with comorbidities had 3.689 times odds of postanaesthetic shivering as compared to those without. Subjects with Diabetes Mellitus and who received Morphine had 0.189 and 0.158 times odds of postanaesthetic shivering as compared to those who do not. Based on Multivariate Analysis of Variance, using the Wilk's Lambda test and an alpha level of 0.05, this test is significant (Wilk's = 0.95, $F(2,142) = 3.683$, $p = 0.028 < 0.05$). This study concluded that intraoperative lowest core body temperature and postoperative core body temperature were associated with occurrence of postanaesthetic shivering. The prevalence of postanaesthetic shivering in our centre is considered low as compared to previous study conducted in Malaysia. Several factors were identified to cause postanaesthteic shivering which are ethnicity, duration of anaesthesia, intraoperative lowest core body temperature, patients with multiple comorbidities and patients who received Morphine as intraoperative analgesia.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Medicine (Anaesthesiology).

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DECLARATION

I hereby declare that this thesis is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

With current advances in surgical techniques, majority diseases or injuries could be treated successfully. A timely surgery helps to improve patient's condition and their quality of life. Anesthesia plays an important role in facilitating surgeons and patients throughout the perioperative period (Feldheiser et al., 2016). It provides convenient environment for surgeons while performing the surgery and helps in reducing physical and mental stress upon patients who undergo the procedure.

Surgery and anaesthesia should be performed in operation theatre as it offers a conducive and sterile environment. An operation theatre condition should follow a standard protocol which includes temperature of 20-23˚C and relative humidity of 30-60% (Syafiq Syazwan Mustafa et al., 2019). The cold surroundings easily contribute to perioperative hypothermia and may cause unwanted complications on patients.

During anaesthesia, either general or regional, thermoregulatory mechanisms are impaired and will predispose patients to hypothermia. Redistribution of heat as a result of peripheral vasodilatation causes reduction in core body temperature up to 1.5 ˚C within the first hour. Subsequently, the body temperature will fall by 1˚C for the next 2 to 3 hours due to heat losses. After the 3rd hour, the phase will become plateau where the heat loss will be balanced by the increase in metabolic heat production. As hypothermia occurs, which is defined as temperature of less than 36 ˚C, compensatory mechanisms will be activated to prevent further heat loss through vasoconstriction and to increase heat production via shivering (Buggy & Crossley, 2000).

Shivering is defined as involuntary, rhythmic muscular activity that helps to augment metabolic heat production (De Witte & Sessler, 2002). Vigorous shivering can increase heat production up to 600% above basal level. Although many methods have been proposed to avoid or reduce incidence of postanaesthetic shivering, which include pharmacological treatment such as Pethidine, Tramadol, Ketamine and non-pharmacological measures such as pre-warmed intravenous fluids, warmed saline used in washing surgical site, warmed mattress and blanket, external forced air warmer, and minimizing exposed surgical area, the postanaesthetic shivering incidence can still be as high as 59% after neuroaxial anaesthesia (Fern & Misiran, 2015) and 57% after general anaesthesia (Powell & Buggy, 2000).

1.2 PROBLEM STATEMENT

Postanaesthetic shivering has many negative consequences to the patient. When hypothermic condition causes shivering, physically patient will feel uneasy and discomfort especially during postoperative period. The amount of oxygen consumption and also carbon dioxide production are double or even triple during shivering (Bhattacharya & Bhattacharya, 2003). Shivering may increase intraocular pressure and cause worsening surgical site pain due to the muscles stretch and muscular hyperactivity (De Witte & Sessler, 2002).

Shivering interferes with monitoring and cause inaccuracy in the readings especially for electrocardiogram, repeated measurement of non-invasive blood pressure and difficulty on detection of peripheral oxygen saturation (Lopez, 2018). These problems or difficulties again will cause patients to feel uncomfortable and painful due to repeated measurement of the vital signs. The mentioned inaccurate monitoring might

also cause delay in detection of unstable condition of patients where most of the time, medical personnel will take time to adjust the equipment to get the accurate readings.

As mentioned earlier, the incidence of postanaesthetic shivering is up to 59% in patients who received regional anaesthesia (Fern & Misiran, 2015) and the incidence is up to 57% after general anaesthesia (Powell & Buggy, 2000). Even though the exact mechanism of postanaesthetic shivering is still poorly understood, it is acceptable to say that the shivering occurs due to impairment of thermoregulatory mechanism in patients who received anaesthesia.

However, despite high incidence of postanaesthetic shivering, there are limited studies to show the associated risk factors that may contribute to its occurrence. In view that our medical centre is considered new and no study has been done to know the prevalence of postanaesthetic shivering, hence this study was conducted. The purpose of this study was to determine the prevalence of postanaesthetic shivering in our operation theatre with its associated risk factors.

1.3 PURPOSE OF THE STUDY

Prevention or reduction of postanaesthetic shivering gives best physiological and psychological experience to patients after underwent a stressful surgery. A stressful and uncomfortable condition will not only affect patient's recovery, but it causes unsatisfactory feeling amongst family members too.

After applying the standard routine measures to prevent postanaesthetic shivering perioperatively, the prevalence or incidence of postanaesthetic shivering and its potential risk factors will be determined. By having the statistic information at our operation theatre following this study, further actions and measures can be taken in the future to improve our patient management and provides greater satisfaction to patients.

1.4 RESEARCH OBJECTIVES

The study aimed to achieve the following objectives of patient care in operation theatre of Sultan Ahmad Shah Medical Centre @ International Islamic University of Malaysia (SASMEC @ IIUM).

1. To determine the prevalence of postanaesthetic shivering.
2. To determine the risk factors associated with postanaesthetic shivering.
3. To evaluate an association between intraoperative lowest core body temperature and postoperative core body temperature with the occurrence of postanaesthesia shivering.

1.5 RESEARCH QUESTIONS

This study was conducted to search for answers to the following questions regarding patient care in the operation theatre of SASMEC @ IIUM.

1. What is the prevalence of postanesthetic shivering in operation theatre?
2. What are the risk factors that contribute to postanaesthetic shivering in operation theatre?
3. Are there any association between intraoperative lowest core body temperature and postoperative core body temperature with occurrence of postanaesthesia shivering?

1.6 THEORETICAL FRAMEWORK

There are many factors that may contribute to perioperative hypothermia and subsequently to shivering such as cold environment of operation theatre, anaesthesia-induced impaired thermoregulatory control, loss of protective behavioural action, amount of exposed surgical area, types and duration of surgery and modes of anaesthesia received by the patients. Demographic difference between patients might also determine the possibility of postanaesthetic shivering occurrence.

Hypothermia causes thermal discomfort, coagulopathy, myocardial injury especially in susceptible patients, delayed drugs metabolism, delayed emergence, and shivering. Postanaesthetic shivering is a non-anaesthetic emergency condition but it needs timely and adequate treatment as it can cause further undesirable complications.

Besides thermal discomfort to the patients, stretching of wound due to muscular hyperactivity can induce and worsens pain. Shivering increases oxygen consumption and carbon dioxide production with risk of developing metabolic lactic acidosis. Intraocular and intracranial pressure is prone to increase during shivering too.

For anaesthetist, shivering interrupts vital signs monitoring via artefact electrocardiogram reading, difficult non-invasive blood pressure measurement and inaccurate pulse oximetry reading. Due to listed problems of postanaesthetic shivering, it is important to prevent or reduce the incident from occurring.

Pharmacologically, many medications have been used to help in preventing or reducing postanaesthetic shivering. Pethidine is a time-tested drug proved to reduce postanaesthetic shivering via kappa receptor stimulation, alpha-2 receptor agonist and thus decrease in shivering threshold. However, despite the good effect of it, the usage

of pethidine is restricted mainly due to its potential unwanted side effects of respiratory depression, nausea and vomiting.

Granisetron has always been known to act as antiemetic drug via inhibition of serotonin 5-hydroxytryptamine 3. However, recent studies suggested that serotonin that is found in brain and spinal cord has a role in thermoregulatory system via reduction of thermoregulation threshold, thus may help in reducing postanaesthetic shivering comparable to pethidine.

Other than pharmacological treatment, common non-pharmacological measures that can be used to reduce shivering are by active and passive warming of the patients. It includes on applying external forced air warmer, putting radiant head warmer, to wrap exposed limbs with ortho band, pre-warmed saline and using of fluid warmer especially where massive transfusion is anticipated. On surgical side, few measures could be taken such as reducing time between anaesthesia and start of the surgery, to minimize as possible the area of surgery, reduce surgical duration whenever possible and washing the surgical area with warmed saline.

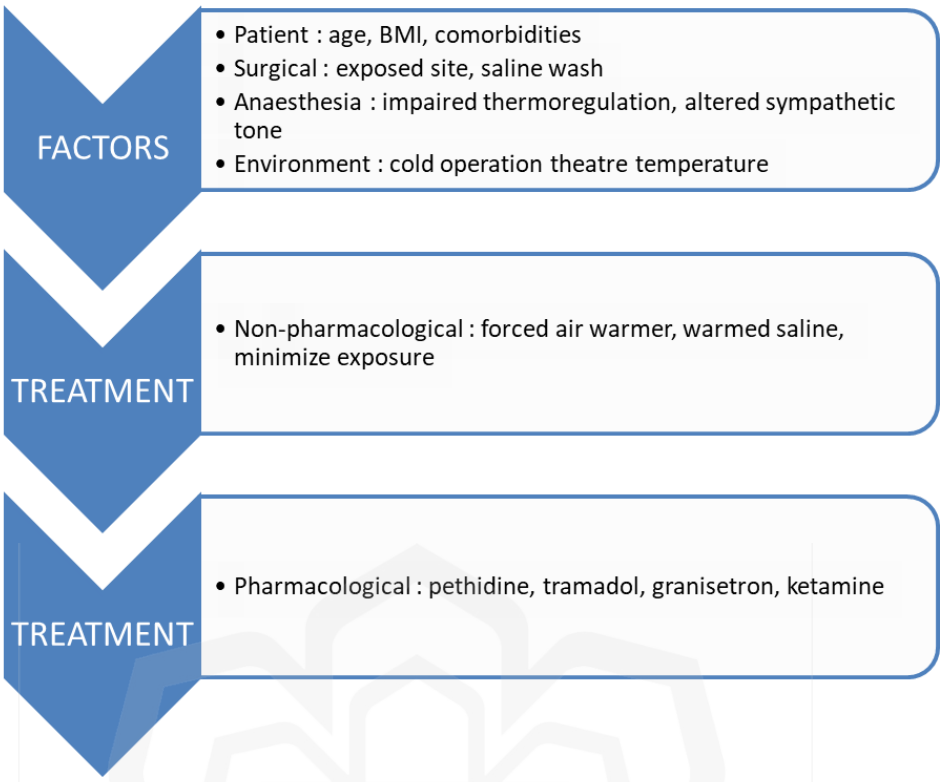

Figure 1.1: Theoretical framework

1.7 RESEARCH HYPOTHESIS

Research hypotheses are as follows:

1. Prevalence of postanaesthetic shivering in operation theatre is low compared to other centres nationwide.
2. No specific risk factors are responsible for occurrence of postanaesthetic shivering.
3. There is no association between intraoperative lowest core body temperature with postoperative core body temperature to the incidence of postanaesthetic shivering.

1.8 SIGNIFICANCE OF THE STUDY

There is no study done as current date to determine the prevalence of postanaesthetic shivering and the associated risk factors in operation theatre of Sultan Ahmad Shah Medical Centre, International Islamic University of Malaysia. By doing this study, the prevalence of postanaesthetic shivering could be determined and identify the potential risk factors, so that further improvement in the management for postanaesthetic shivering could be taken.

1.9 LIMITATIONS OF THE STUDY

There are few limitations to this study, which are:

1. Study is done in only one centre which might not reflect the prevalence of postanaesthetic shivering nationwide.
2. The assessment of shivering is subjective based on grading.
3. The assessment of shivering is done by different person at times.
4. Difficulty in monitoring core body temperature using nasopharyngeal temperature probe in subjects who received neuroaxial anaesthesia and monitored sedation.
5. Possible inaccuracy in skin or peripheral body temperature due to application of warmer.
6. Different type of thermometer used in measurement of temperature.

1.10 DEFINITION OF TERMS

Shivering: to shake or tremble, as from cold or fear (Collin Dictionary). Shivering is defined as involuntary, rhythmic muscular activity that helps to augment metabolic heat production (Horn, Werner, Sessler, Steinfath & Schulte., 1997).

Anaesthesia refers to the practice of administering medications either by injection or by inhalation (breathing in) that block the feeling of pain and other sensations, or that produce a deep state of unconsciousness that eliminates all sensations, which allows medical and surgical procedures to be undertaken without causing undue distress or discomfort (Australian and New Zealand College of Anaesthetist).

Prevalence is the facts that something is very common and happens often (Cambridge Dictionary).

1.11 CHAPTER SUMMARY

This chapter briefly described the issue of postanaesthetic shivering and explained the idea and objectives behind the process of conducting the study. The general theoretical framework is provided for better understanding about this study. It is hoped that this study would answer the research questions and provide insight to the intensity of the problem and its associated factors that will be addressed appropriately so as to improve the quality of patient care in the future.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This is a study to look for the prevalence and risk factors associated with postanaesthetic shivering. This chapter is aimed to explain regarding postanaesthetic shivering in detail, the mechanism, the prevalence or incidence, assessment of shivering, possible risk factors associated with shivering and current treatment to overcome this problem.

2.2 PERIOPERATIVE HYPOTHERMIA

Human body is homeotherms and possess the ability to conserve or release heat according to surrounding environment. Temperature of human being can be divided into two types that are core body temperature and peripheral body temperature. Core body temperature is tightly controlled and indicates the temperature of deep organs and can be measured through tympanic membrane, distal esophagus and pulmonary artery. The core body temperature can be estimated through sublingual, nasopharyngeal and the rectum (Buggy & Crossley, 2000). Peripheral body temperature is measured through skin and indicates more distal or peripheral area such as the arms and the legs. Core body temperature are warmer than the peripheral body temperature by about 2-4˚C (Sessler, 2008).

In operation theatre, the environmental temperature is kept between 20-23˚C and humidity of 30-60% as per standard local protocol (Syafiq Syazwan Mustafa et al., 2019). Patient needs to endure this cold environment throughout the surgery with

minimal clothes available. Only limited movement is allowed to prevent surgical site injury. Hence, patient will easily get hypothermia together with impaired thermoregulatory mechanism after receiving general or regional anaesthesia.

Perioperative hypothermia is defined as core body temperature of less than 36 ˚C. Once patient is anaesthetized, it is an important job of the anaesthetist to keep the core body temperature as normal as possible (between 36.5-37.5˚C). This is due to negative consequences of hypothermia such as shivering, arrhythmias, prolonged drug metabolism and clearance, thus will delay emergence (Lenhart et al., 1997), coagulopathy (Schmied, Kurz, Sessler, Kozek & Reiter., 1996), and delayed wound healing (Kurz, Sessler & Lenhart., 1996). These bad sequelaes of perioperative hypothermia are dangerous and can cause morbidity and mortality to patients especially in elderly or in patients with multiple comorbidities.

Kurtz et al. (1996) did a prospective, randomized trial upon patients admitted for colorectal surgery conducted in year 1993 until 1995 to look for the effects of hypothermia and normothermia (were given warmer during the surgery) on wound healing after surgery. A total of 200 patients were involved in this trial. Delayed wound healing occurred in 19% of the hypothermia group while only 6% in the normothermia group were affected, p value < 0.05. In the hypothermia group, there were also delay in starting of nutrition [days of first solid food 6.5 ± 2.0 , p value < 0.05] and prolonged of hospital stay [days of hospitalization 14.7 ± 6.5, p value < 0.05] as compared to the normothermia group [days of first solid 5.6 ± 2.5, p value < 0.05, days of hospitalization 12.1 ± 4.4, p value < 0.05].

2.3 MECHANISM OF POSTANAESTHETIC SHIVERING

Physiological mechanism to regulate the body temperature consists of three components: thermal afferent sensors, central regulation, and effector defences. Thermal sensors that exist in multiple sites such as skin, deep tissues, spinal cord and brain, send afferent thermal inputs to the thermoregulatory centre in the preoptic region of anterior hypothalamus to be processed. The effector pathway will then take place, through behaviour or autonomic mechanism which aim to regulate heat loss, heat conservation or retention and to increase heat production (De Witte & Sessler, 2002).

The behavioural responses help human beings to adapt in different environment at times. As for autonomic responses, it includes either sweating, arteriovenous shunt vasodilatation or vasoconstriction, shivering and non-shivering thermogenesis. Shivering is defined as involuntary, rhythmic muscular activity that helps to augment metabolic heat production (Bhattacharya & Bhattacharya, 2003).

The exact mechanism of postanaesthetic shivering is still remain unclear (Bhattacharya & Bhattacharya, 2003) but it is generally accepted as a thermoregulatory response. Shivering occurs when the preoptic area located at hypothalamus is exposed to cold stimulant from the skin or spinal cord. The afferent signals integrated in hypothalamus activates the efferent signals to generate energy to overcome the cold stimulant. Motor neurons are activated and generate rhythmic, involuntary activity known as shivering in order to produce heat as response to cold stimulant (Lopez, 2018).

Despite this, there are factors other than thermoregulatory mechanism which includes a non-thermoregulatory phenomenon such as pain, altered sympathetic tone, release of pyrogens (Horn et al., 1997), or involving numerous neurotransmitters such as opioid, alpha-2-adrenergic or serotonin system (Powell & Buggy, 2000).

2.4 PREVALENCE OF POSTANAESTHETIC SHIVERING

There is limited study done on prevalence of postanaesthetic shivering although several articles demonstrated its occurrence in various situations.

A prospective, randomized, double blind study done in 2008 by Sajedi et al. involving patients who received general anaesthesia showed the postanaesthetic shivering incidence of 57%. A total of 132 patients participated in this study which was designed to compare the efficacy of Tramadol, Pethidine, Granisetron and Saline in the treatment of postanaesthetic shivering. It showed that patients receiving saline treatment developed postanaesthetic shivering up to 57% as compared to other treatment.

A study done by Luggya et al. in 2016 demonstrated that the prevalence of postanaesthetic shivering in patients underwent caesarean section was 8.15%. The study involved 270 parturients admitted either for elective or emergency caesarean section. In this study, only those parturients who received regional anaesthesia were enrolled. A total of 22 parturients developed postanaesthetic shivering in the study which comprised 8.15% of total participants.

While another study done by Dal et al. (2005) which involved patients who received general anaesthesia showed an incidence of postanaesthetic shivering of 40%. This study involved a total of 90 patients age of 18 to 60 years who received general anaesthesia with expected duration of surgery of one to three hours. Patients are randomized into three groups with each group to receive either saline, Pethidine 20mg or Ketamine 0.5mg/kg. The medications were given about 20 minutes before the surgery ends and incidence of postanaesthetic shivering recorded. 40% from saline group developed postanaesthetic shivering once arrived in recovery bay while none of the patients in other two group developed postanaesthetic shivering.