Comparative Study between Magnesium Sulfate and Pethidine for Controlling Shivering after Spinal Anesthesia

Thesis

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Sarah Mohamed

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List of Abbreviations

Abb.	Full term
5-HT3 receptor	*5-Hydroxytryptamine Receptor (Serotonin Receptor)*
ACTH	*Adrenotrophic Hormones*
ADH	*The Anti-Diuretic Hormone*
ASA	*American Society of Anesthesiologists*
ASA-PS	*American Society of Anesthesiologists Physical Status*
COPD	*Chronic Obstructive Pulmonary Disease*
CSF	*The Cerebrospinal Fluid*
CTZ	*The Chemoreceptor Trigger Zone*
ECG	*Electrocardiography*
GI	*Gastrointestinal*
Hz	*Hertz*
MABP	*Mean Arterial Blood Pressure*
MAOI's	*The monoamine oxidase inhibitors.*
$MgSO_4$	*Magnesium Sulfate*
Na^+/K^+ ATPase pump	*The Sodium / Potassium Adenosine Triphosphatase Pump*
NA	*Not Applicable*
NMDA receptor	*N-Methyl-D-Aspartic Acid Receptor*
P- value	*Probability Value*
PACU	*Post Anesthesia Care Unit*
PAS	*Post Anesthestic Shivering*
PDPH	*Post Dural Puncture Headache*
TNS	*Transient Neurologic Symptoms*
TRI	*Transient Radicular Irritation*
TURP	*Transurethral Resection of the Prostate*

ABSTRACT

Background: Shivering is an involuntary muscular activity. Increased muscle tone during shivering is due to temperature-induced changes in neuronal activity in the reticular formation. Synchronization of motor neurons during shivering may be mediated by recurrent inhibition through renshaw cells.

Aim of the Work: To verify the efficacy of magnesium sulfate for controlling post spinal shivering, to compare the efficacy of magnesium sulfate and pethidine for controlling post spinal shivering and to detect the side effects of both magnesium sulfate and pethidine after their use for controlling post spinal shivering.

Patients and Methods: This prospective study was conducted at El-Matarya Teaching Hospital from 2018 till 2019. After obtaining approval from the Research Ethical Committee of Ain Shams University, informed patient consent was obtained before the procedure. After giving the spinal anesthesia, only patients who developed post-spinal shivering were followed for the study. 60 patients with post-spinal shivering were included with the following criteria:

Results: Regarding age, weight, height and duration of surgery; there were no statistically significant differences between the two studied groups. Comparison of the two studied groups revealed no statistically significant changes at all times of measurement.

Conclusion: Magnesium sulfate in a dose of 30 mg/kg IV infusion in 100 ml normal saline over 10 min is effective for control of post spinal shivering. Pethidine in a dose of 0.5 mg/kg IV bolus is effective for control of post spinal shivering.

Keywords: *Magnesium Sulfate – Pethidine – Shivering - Spinal Anesthesia*

INTRODUCTION

Shivering is an involuntary muscular activity. Increased muscle tone during shivering is due to temperature-induced changes in neuronal activity in the reticular formation. Synchronization of motor neurons during shivering may be mediated by recurrent inhibition through renshaw cells ***(Bhattacharya et al., 2003).***

Shivering occurring after anesthesia is common complication affecting **5–65%** of patients receiving **general anesthesia** and **33%** of patients receiving **regional anesthesia**. Post-anesthetic shivering is known as obvious fasciculation or tremor of the face, jaw, head, trunk or extremities for more than 15 seconds. Apart from the patient's discomfort, post-anesthetic shivering is associated with a number of potentially deleterious sequelae. These include increased oxygen consumption, increased carbon dioxide production, catecholamine release, increased cardiac output, tachycardia, hypertension, raised intraocular pressure and interfering with intraoperative monitoring ***(Buggy & Crossley, 2000).***

Post-anesthetic shivering is often preceded by core hypothermia and vasoconstriction. Close observation of post-anesthetic shivering, later aided by electromyographic studies, revealed that it is formed of two patterns of muscular activity: **a tonic pattern** with 4–8 cycles/ minute, resembling thermoregulatory

shivering and **a clonic pattern**, 5–7 Hertz **(Hz)**, consistent with uninhibited spinal reflexes ***(Marcos & Daniel, 2010).***

General anesthesia causes impairment in the thermoregulation because of increased warm-response thresholds and decreased cold-response thresholds, so the normal interthreshold range (between that range no effector response occurs) is increased from 0.4°C to 4.0°C. Both warm-response and cold-response thresholds are affected ***(Marcos & Daniel, 2010).***

Buggy & Crossley in 2000 found that under general anesthesia, the threshold temperatures for activation of cold effector responses (including vasoconstriction and shivering) are 'decreased', whereas those for activation of warm responses (including sweating and vasodilation) are 'increased'. Thus, the narrow range of temperature between the vasoconstriction and sweating thresholds (normally 0.4°C) is widened during general anesthesia to 4.0°C ***(Figure 1).***

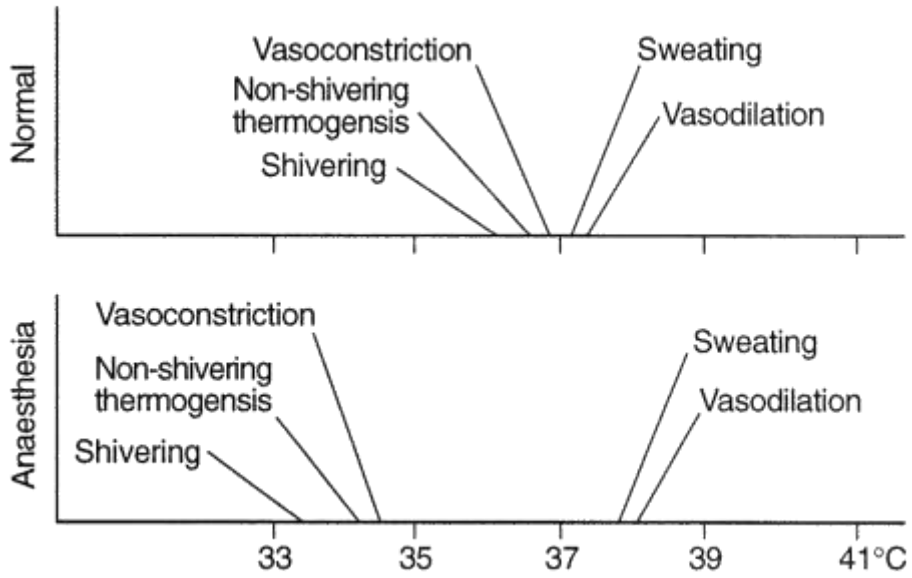

Figure (1): Activation of thermoregulatory effector responses ***(Buggy & Crossley, 2000).***

Epidural and spinal anesthesia decrease the vasoconstriction and shivering thresholds to a comparable degree, but by a lesser amount, of 0.6°C, than general anesthetics when measured above the upper level of the block. Because local anesthetics administered to the central neural axis do not directly interact with the hypothalamic control centers and local anesthetics given have no thermoregulatory effect. Shivering during regional anesthesia is, like that after general anesthesia, preceded by core hypothermia and vasoconstriction above the level of the block ***(Buggy & Crossley, 2000).***

Post-anesthetic shivering must not be managed without controlling the perioperative hypothermia. Many physical methods of treating hypothermia have been used to decrease the

occurrence of shivering. For example; forced-air patient warming systems and radiant heaters. The mainstay of treatment of postoperative shivering is, however, pharmacological ***(Marcos & Daniel, 2010).***

Many drugs, like meperidine, other opioids (fentanyl, alfentanil, sufentanil, buprenorphine), doxapram, methylphenidate, clonidine and ketanserin, have all been reported to be effective in managing the post-anesthetic shivering ***(Buggy & Crossley, 2000).***

AIM OF THE STUDY

1. To verify the efficacy of magnesium sulfate for controlling post spinal shivering.

2. To compare the efficacy of magnesium sulfate and pethidine for controlling post spinal shivering.

3. To detect the side effects of both magnesium sulfate and pethidine after their use for controlling post spinal shivering.

Chapter 1

SPINAL ANESTHESIA

Anatomical consideration

The vertebral column:

The human vertebral column is formed of 33 vertebrae; seven cervical, twelve thoracic, five lumbar, five fused sacral vertebrae and coccyx formed of four fused coccygeal segments. The spine forms four curvatures: the cervical and lumbar regions are convex forwards (lordosis), the thoracic and sacral regions are concave (kyphosis). The former are postural, the latter are produced by the actual configuration of the bones themselves ***(Ramirez-Del Toro & Prizinski, 2012) (Figure 2).***

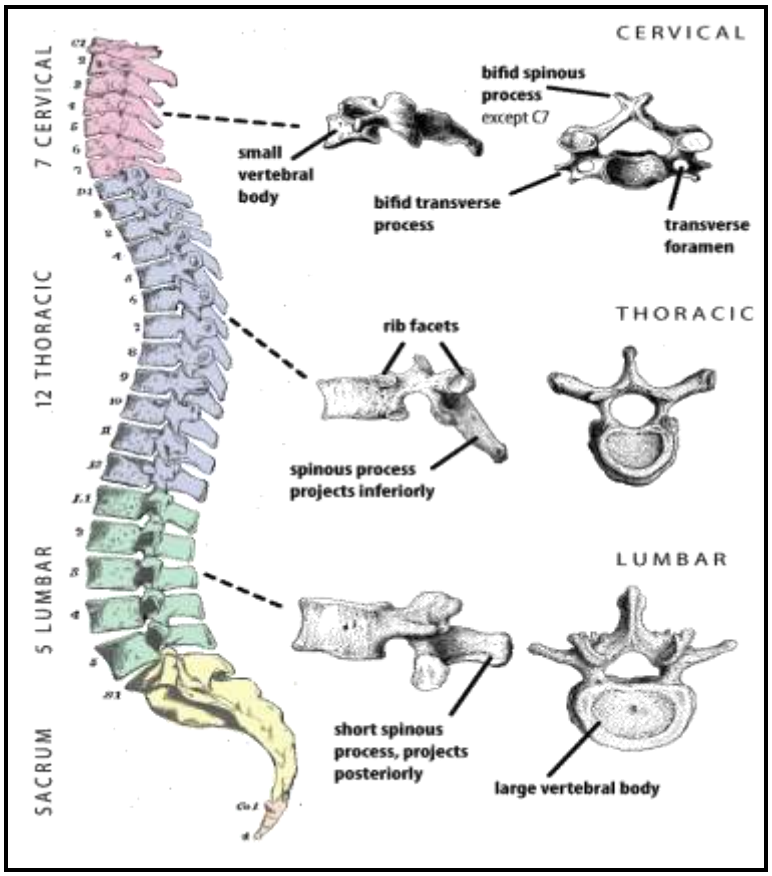

Figure (2): The vertebral column and the common features of the vertebrae ***(Wong & Niazi, 2013).***

Coverings of the spinal cord:

The vertebral column encloses the spinal cord. Surrounding the spinal cord three membranes: **the pia mater**, **arachnoid mater**, and **dura mater**. **The pia mater** is a highly vascular membrane and directly covers the spinal cord. **The arachnoid mater** is a delicate non-vascular membrane and is attached to **the dura mater**. Between these two innermost membranes is the space of interest in spinal anesthesia, **the**