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A comparison of the analgesic effect between Magnesium Sulphate and Fentanyl as adjuvants to Epidural Levobupivacaine in patients undergoing open reduction and internal fixation of Pott's fracture

Thesis

Submitted for Partial Fulfillment of M.Sc. degree in Anesthesiology

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2018

Acknowledgments

First of all, all gratitude is due to **Allah,** *almighty for blessing this work until it has reached its end as a part of his generous help, throughout my life.*

Really I can hardly find the words to express my gratitude to **Prof. Dr. Sherif Farouk Ibrahim,** *Professor of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University, for his supervision, continuous help, encouragement throughout this work and the tremendous effort he has done in the meticulous revision of the whole work. It is a great honor to work under his guidance and supervision.*

I would also like to express my sincere appreciation and deep gratitude to **Prof. Dr. Ghada Mohamed Samir,** *Assistant Professor of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine – Ain Shams University, for her constructive directions, continuous support and patience throughout the whole work.*

I cannot forget the great help of **Dr. Diaa Eldin Shalaby M Al Awady,** *Lecturer of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine – Ain Shams University, for his invaluable efforts, tireless guidance and for his patience and support to get this work into light.*

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.

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List of Abbreviations

Abb.	Full term
k	Kappa
L	First lumbar vertebra
LAs	Local anesthetics
m/s	Milli-second
MAP	Mean Arterial Pressure
Meq	Milli-equivalent
METs	Metabolic Equivalent
Mg	Milligram
Mg^{++}	Magnesium
Min	Minute
Ml	Milliliter
mmHg	Millimeter mercury
Mmole	Milli-mole
NE	Nor-epinephrine
NGF	Nerve Growth Factor
NMDA	N-Methyl-D-Aspartate
NO	Nitric Oxide
NS	Nociceptive Specific neurons
NT	Neurotransmitter
ORIF	Open reduction and internal fixation
PABA	Para-Aminobenzoic Acid
PCA	Patient Controlled Analgesia
PCEA	Patient Controlled Epidural Analgesia
PGE	Prostaglandin E
PMN	Polymorphonuclear

List of Abbreviations Cont...

Abb.	Full term
POCD	postoperative Cognitive Dysfunction
PTH	Parathyroid Hormone
R-	Rectus-
S	Sacral vertebra
S-	Senister-
SD	Standard Deviation
ST	Spinothalamic Tract
T	Thoracic vertebra
TENS	Transcutaneous Electrical Stimulation
TNF	Tumour Necrosis Factor
VAS	Visual Analogue Scale
WDR	Wide Dynamic Range neurons
α	Alpha
µg/kg	Microgram/kilogram

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INTRODUCTION

Epidural anesthesia is a safe and inexpensive technique with the advantage of providing surgical anesthesia and prolonged postoperative pain relief. It is also an effective treatment of operative pain as it blunts autonomic, somatic and endocrine responses, which may be of great help in perioperative care ***(Ghatak et al., 2010).***

Despite the availability of many new additives for central neuraxial blockade, there is a constant search for better additives to increase duration of analgesia with minimum side effects. Levobupivacaine which is the pure S - enantiomer of racemic bupivacaine that has a beneficial ratio of sensory to motor block in epidural anesthesia. Preclinical animal and volunteer studies showed less cardiac toxicity and neurotoxicity than bupivacaine. It seems to be an alternative local anesthetic agent in epidural anesthesia ***(Dubé and Granry, 2013).***

Levobupivacaine which is the pure S - enantiomer of racemic bupivacaine that has a beneficial ratio of sensory to motor block in epidural anesthesia. Preclinical animal and volunteer studies showed less cardiac toxicity and neurotoxicity than bupivacaine ***(Glaser et al., 2012)***.

Opioids like Fentanyl have been used traditionally as an adjunct for epidural administration in combination with local anesthetics to achieve the desired anesthetic effect. The

addition of opioid does provide a dose sparing effect of local anesthetic and superior analgesia but there is always a possibility of an increased incidence of pruritis, urinary retention, nausea, vomiting and respiratory depression ***(Sukhminder et al., 2011)***.

Magnesium, a divalent cation, through noncompetitive mechanism blocks the NMDA receptor in a voltage-dependent manner and results in natural calcium antagonism. Various animal and human studies have shown that magnesium possesses antinociceptive action. Magnesium has been used as an adjuvant by various routes, including intravenous, intrathecal, and epidural in different dosage regimens ***(Sonali et al., 2012).***

AIM OF THE WORK

The aim of this study was to assess the intra and post-operative analgesic efficiency of Magnesium Sulphate, as an additive to Levobupivacaine, in patients undergoing open reduction and internal fixation of Pott's fracture, in comparison to either Levobupivacaine alone or the combination of Levobupivacaine and Fentanyl. The comparison was regarding intra and post-operative hemodynamics, pain measured by the visual analogue scale (VAS), and post-operative complications.

ANATOMICAL CONSIDERATIONS

A thorough appreciation for the anatomy of the spinal structures is necessary for appropriate technique, patient selection, and management of neuroaxial anesthesia.

I- Anatomy of the vertebral column

A. Surface landmarks:

Surface landmarks are generally used to locate a particular vertebral level. The inferior margin of the 12_{th} rib lies at the level of the L_1 vertebra, Tuffier's line(the line connecting the iliac crests) crosses the vertebral column at the level of the L4 vertebra, while the posterior superior iliac spine lies at level with S_2 **(Figure 1)** ***(Priebe, 2010).***

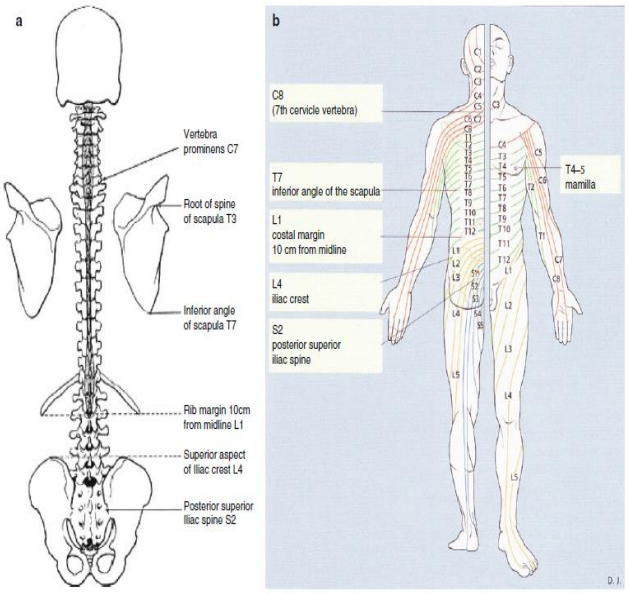

Figure (1): The common surface landmarks of the vertebral column ***(Kumra, 2008).***

B. Ligaments of the Vertebral Column:

Adjacent vertebrae are united by ligaments that run the length of the vertebral column along both its posterior and anterior aspects **(Figure 2)**. These serve to resist excess forward or backward bending movements of the vertebral column, respectively.The anterior longitudinal ligament runs down the anterior side of the entire vertebral column, uniting the vertebral bodies. It serves to resist excess backward bending of the vertebral column. The supraspinous ligament is located on the posterior side of the vertebral column, where it interconnects the spinous processes of the thoracic and lumbar vertebrae. This strong ligament supports the vertebral column during forward bending motions.

The posterior longitudinal ligament is found anterior to the spinal cord, where it is attached to the posterior sides of the vertebral bodies. The ligamentum flavum "yellow ligament" is found posterior to the spinal cord. That consists of a series of short, paired ligaments (Right and Left), each of which interconnects the lamina regions of adjacent vertebrae ***(Krechel et al., 2009).***

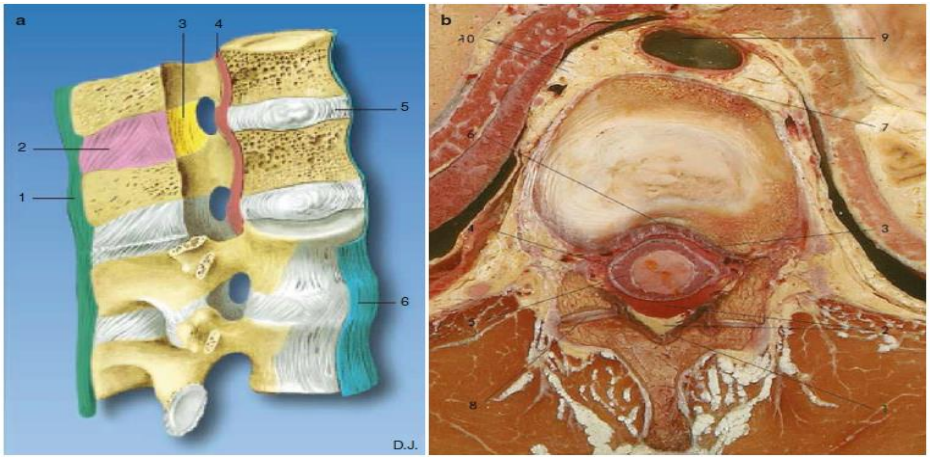

Figure (2): (a) Sagittal section of the vertebral column illustrating the ligaments of the vertebral column. (1) Supraspinous ligament, (2) interspinous ligament, (3) ligamentumflavum, (4) posterior longitudinal ligament, (5) intervertebral disc, and (6) anterior longitudinal ligament. (**b**) Transverse dissection at the level of T9(1) Ligamentumflavum, (2) posterior epidural space with fat, (3) anterior epidural space with veins, (4) spinal dura mater, (5) subarachnoid space with spinal cord, (6) posterior longitudinal ligament, (7) anterior longitudinal ligament, (8) zygapophysial joint, (9) aorta, and (10) sympathetic ganglion ***(Kumra, 2008).***

II- Anatomy of The spinal cord:

The spinal cord is about 46 cm long and is the caudal continuation of the medulla oblongata, which extends from the atlas to the conus medullaris (the lower edge of the first lumbar vertebra).The length of the spinal cord varies with age, in adults, the conus ends at the level of L_1-L_2. Spinal anesthetics must therefore be performed at the L_2 -L_3 intervertebral space or lower to avoid the risk of spinal cord injury **(Figure 3)** ***(Al-alami et al., 2009).***

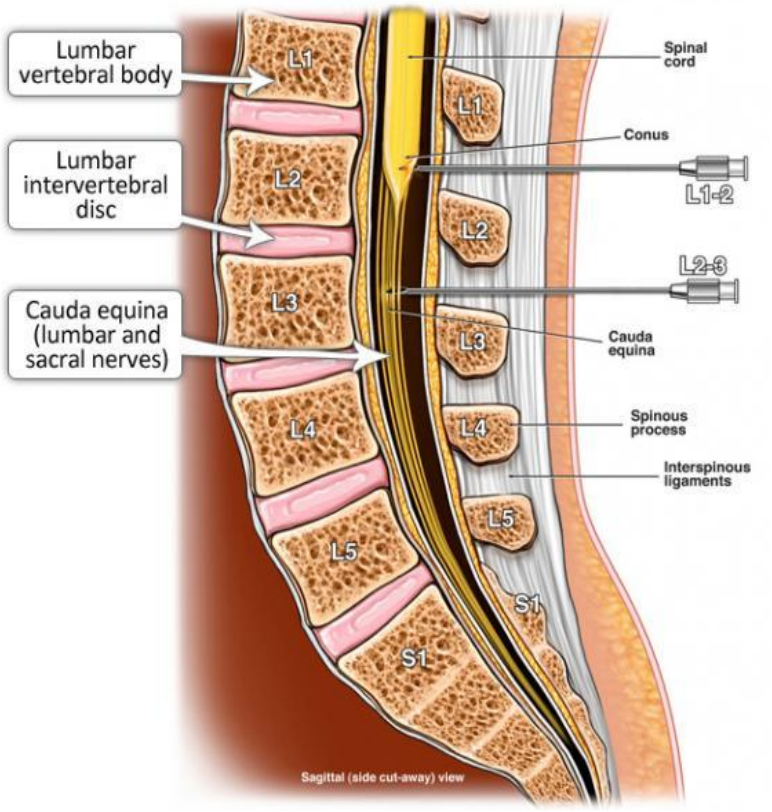

Figure (3): The termination of the spinal cord ***(Chodorowski et al., 2003).***

III- Spinal dermatomes:

Via its branching spinal nerves, each segment of the spinal cord provides the sensory supply for a specific area of skin, known as the dermatome. These areas of skin, which often overlap, are very important for checking and verifying the spread of anesthesia ***(Kumra, 2008).***

The Epidural Space (CavumEpidurale):

The epidural space (also referred to as the extradural and peridural space) lies between the dura and the borders of the

spinal canal. Anteriorly, this border is the posterior longitudinal ligament; posteriorly, it is the vertebral lamina and adjoining ligamentum flavum **(Figure 4)**.

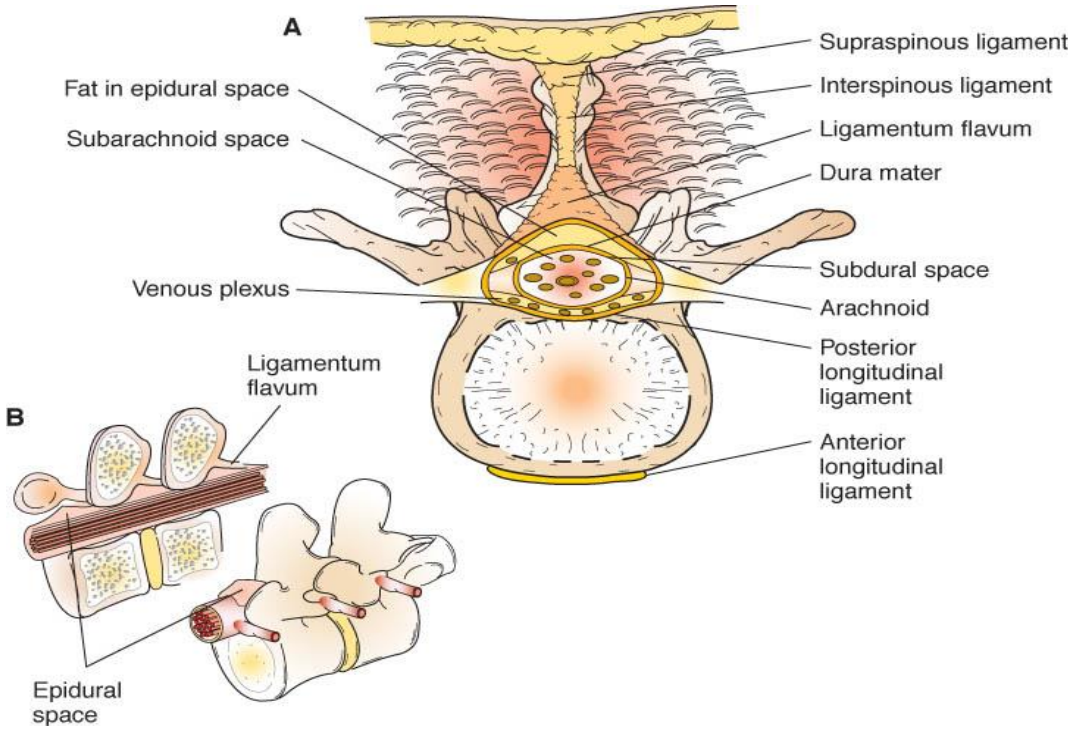

Figure (4): (a) Cross-sectional view of the lumbar region depicting the location of the epidural space and other anatomical structures associated with neuraxial procedures. As demonstrated in **(b)** the epidural space is somewhat compartmentalized, but continuous via "potential space" pathways that expand with injection of liquid. ***(Al-alami et al., 2009)***

The epidural space is somewhat compartmentalized by the sections of the dura abutting the ligamentum flavum, vertebral lamina, and other borders of the vertebral canal **(Figure 5)**. However, these compartments are joined by a "potential space" that is opened by injection of fluid or air, thus connecting the