Comparative Study between the Effect of Intrathecal Bupivacaine versus Bupivacaine Dexmedetomidine Combination in Spinal Anaeshtesia for Lower Abdominal Surgeries

Thesis

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بسم الله الرحمن الرحيم

قالوا سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

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Ahmed Morsy Ahmed

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Abb.	Full term
ASA	*American society of anesthesiologists*
C1-7	*Cervical vertebrae 1-7*
CNS	*Central nervous system*
CSF	*Cerebrospinal fluid*
DBP	*Diastolic blood pressure*
ECG	*Electrocardiogram*
HR	*Heart rate*
INR	*International normalized ratio*
IV	*Intravenous*
L1-5	*Lumbar vertebrae 1-5*
MABP	*Mean arterial blood pressure*
NIBP	*Non invasive blood pressure*
NRS	*Numeric rating scale*
NSAID	*Non steroidal anti-inflammatory drugs*
PACU	*Postanaesthesia care unit*
PT	*Prothrombin time*
PTT	*Partial thromboplastin time*
S1-5	*Sacral vertebrae 1-5*
SBP	*Systolic blood pressure*
SpO_2	*Oxygen saturation*
$t_{1/2}$	*Half life*
T1-12	*Thoracic vertebrae 1-12*
α2AR	*Alpha 2 adrenergic receptor*

INTRODUCTION

Postoperative pain is a major concern for patients and postoperative pain management is considered as a part of perioperative care ***(Chou et al., 2016).***

Lower abdominal surgeries became popular under neuraxial block because it is a cost-effective method and an easy-to-perform technique ***(Shukla et al., 2011).*** Spinal anesthesia is still the first option, due to its rapid onset, superior blockade with a lower failure rate but it is associated with such drawbacks as shorter duration of the block, short-term anesthetic effect, and the onset of pain after the absorption of the drug ***(Shukla et al., 2011).*** Different adjuvant can be used, along with local anesthetics for spinal anesthesia to relieve pain during operation and provide long-term postoperative analgesia ***(Gupta et al., 2011).***

α-2 adrenoreceptor agonists are being increasingly used in critical care and anesthesia. Beside sedation and analgesia, they also decrease sympathetic tone and attenuate the stress response to anesthesia and surgery. In addition, they are used as adjuvant drugs during regional and general anesthesia ***(Kaabachi et al., 2007).***

Dexmedetomidine is a highly selective α-2 adrenergic agonist which has been used as pre-medication and as an adjuvant to general anaesthesia. It has several beneficial actions during perioperative period. It decreases sympathetic tone with attenuation of the neuroendocrine and haemodynamic response to anaesthesia and surgery, reduces anaesthetic and opioid requirement, causes sedation and analgesia. It was first introduced into clinical practice as a short term intravenous sedative in intensive care ***(Sunil et al., 2013).***

Intrathecal dexmedetomidine prolongs both sensory and motor block and has antinociceptive action for both visceral and somatic pain. It is used to enhance the analgesic property of local anaesthetics like lidocaine, bupivacaine and ropivacaine ***(Sunil et al., 2013).***

Dexmedetomidine was first used intrathecally in humans for transurethral resection of prostate. It produced analgesia by depressing the release of nociceptive C fibers transmission and hyperpolarization of post synaptic dorsal horn cells ***(Kanazi et al., 2006).***

Aim of the Work

The aim of this study is to compare the effect of intrathecal addition of dexmedetomidine to bupivacaine on postoperative analgesia in patients undergoing lower abdominal surgeries.

REVIEW OF LITERATURE

Spinal Anaesthesia

Spinal anaesthesia was performed for the first time by professor Bier at the Royal Surgical hospital at the University of Kiel, Germany, in 1898, showing the advantage of major regional anaesthesia using neuro-axial blockade. It was also performed by Labat at the Mount Sinai Hospital in 1927 and since then spinal anaesthesia has been well incorporated into the practice of anaesthesia ***(Larson, 1996)*.**

Physiological considerations:

The physiologic response to central block is determined by the effects of interrupting the afferent and efferent innervations of somatic and visceral structures. Somatic structures are traditionally related with sensory and motor innervations, while the visceral structures are more related to the autonomic nervous system.

A- Somatic blockade:

Prevention of pain and skeletal muscle relaxation are classic objectives of central blockade. Nerve fibers are not homogenous. There are three main types of nerve fibers designated A, B and C. The A group has four sub-groups alpha, beta, gamma and delta. The functions of the main groups and sub-groups are summarized in table (1). The minimum concentration of local anaesthetic required to stop transmission of impulses varies depending upon fiber size ***(Casey, 2000).***

There is large inter individual variability in nerve root size. These differences may help explain the inter-patient differences in neuraxial block quality when equivalent techniques are used on similar patients. Another anatomic relationship may affect neuraxial blocks; although the dorsal (sensory) roots are generally larger than the anterior (motor) roots, the dorsal roots are often blocked more easily. This seeming paradox is explained by organization of the dorsal roots into component bundles, which creates a much larger surface area on which the local anaesthetics act, thus perhaps explaining why larger sensory nerves are blocked more easily than smaller motor nerves ***(Liu and Mcdonald, 2001).***

Table A: Nerve fibers classification

Class	Action	Myelin	Size
Aα	Motor	Yes	++++
Aβ	Light touch, pressure pain	Yes	+++
Aγ	Proprioception	Yes	+++
Aδ	Pain, temperature	Yes	++
B	Preganglionic sympathetic fibers	Yes	++
C	Pain, pressure	No	+

(Kleinman and Mikhail, 2006)

B- Visceral blockade:

Most of the visceral effects of central blockade are mediated by interruption of autonomic impulses to various organ systems.

1. Cardiovascular effect:

Sympathetic blockade results in cardiovascular changes of haemodynamic consequence in proportion to the degree of sympathectomy. The sympathetic chain originates from the lumbar and thoracic spinal cord. The fibers involved in smooth muscle tone of the arterial and venous circulation arise from T_5 and L_1. Arteries retain most of their tone despite sympathectomy because of local mediators and there is no arteriolar vasoplegia, but the venous circulation does not. The consequence of total sympathectomy is an increase in the volume of the capacitance vessels, especially in the splanchnic circulation, decreasing the venous return to the heart and hypotension occurs ***(Butterworth, 1998)***.

The cardiac accelerator fibers are sympathetic efferents, which increase heart rate when stimulated. When blocked by high central blockade, unopposed vagal action leads to bradycardia ***(Brown, 2005).***

Prophylactic administration of pharmacologic agents may be more effective than prehydration to prevent hypotension. α-adrenergic agents, as phenylephrine, reliably increase arterial blood pressure by increasing systemic vascular resistance, however, heart rate and cardiac output may decrease because of increased after load ***(Buggy et al., 1998).*** α- and β-adrenergic agonists, as ephedrine, are effective for increasing arterial blood pressure preventing hypotension but act by primarily increasing heart rate and cardiac output with a smaller increase in systemic vascular resistance ***(Butterworth, 1998).*** Initial treatment can be tailored to α- agonists on patients with hypotension and mixed α and β agonist on patients with both hypotension and bradycardia ***(Liu and McDonald, 2001).***

2. Respiratory effects:

Clinically significant alterations in pulmonary physiology are usually minimal with neuroaxial blockade because the diaphragm is innervated by the phrenic nerve with fibers originating from C_3-C_5. Even with high levels, tidal volume is unchanged; there is only a decrease in vital capacity, which results from a loss of abdominal muscles' contribution to forced expiration ***(Kleinman and Mikhail, 2006).***

Patients with severe chronic lung disease may rely upon accessory muscles of respiration (intercostal and abdominal muscles) to actively inspire or exhale. High levels of neural blockade will impair these muscles. Similarly, effective coughing and clearing of secretions require these muscles for expiration. For these reasons, neuroaxial blocks should be used with caution in patients with limited respiratory reserve ***(Brown, 2005).***

3. Urinary tract effect:

Neuroaxial anaesthesia at lumbar and sacral levels blocks both sympathetic and parasympathetic control of bladder function resulting in urinary retention until the block wears off ***(Brown, 2005).***

4. Gastrointestinal function:

Nausea and vomiting may be associated with neuraxial block in up to 20% of patients and are primarily related to gastrointestinal hyperperistalsis caused by unopposed parasympathetic (vagal) activity ***(Carpenter et al., 1992)***. Atropine is effective in treating nausea associated with high subarachnoid anaesthesia ***(Ramaioli and Amici, 1996)***.

Mechanism of action of Neuro-axial Blockade:

The principal site of action for neuro-axial blockade is the nerve root. Local anaesthetic is injected into CSF and bathes the nerve root in the subarachnoid space. Direct injection of local anaesthetic into CSF for spinal anaesthesia allows a relatively small dose and volume of local anaesthetic to achieve dense sensory and motor blockade. Blockade of neural transmission (conduction) in the posterior nerve root fibers interrupts somatic and visceral sensation, whereas