



Acomparative Study between Epidural Analgesia of Levobupivacaine with Fentanyl versus Dexmedetomidine for knee replacement surgeries

Thesis

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سببنا نك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

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List of Abbreviations

Abb.	Full term
μ	Mu
ABP	Arterial blood pressure.
ACLS	Advanced cardiac life support.
ACTH	Adrenocorticotrophic hormone.
ADH	Antidiuretic hormone.
ASA	American society of anesthesia.
ATP	Adenosine triphosphate.
BLS	Basic life support.
cAMP	Cyclic Adenosine monophosphate.
CBC	Complete blood count.
CNS	Central nervous system.
CSE	Combined spinal epidural.
CSF	Cerebrospinal fluid.
CVS	Cardiovascular system.
CYP	Cytochrome p.
Dex	Dexmedetomidine.
ECG	Electrocardiogram.
EEG	Electroencephalogram.
FDA	Food and drug administration.
G	Gauge.
GABA	Gamma amino butyric acid.
I.v	Intravenous.
INR	International normalized ratio.
IU	International unit.
LA	Local anesthetics.
LAST	Local anesthetics systemic toxicity.
LC	Locus coeruleus.

List of Abbreviations Cont...

Abb.	Full term
MAP	Mean arterial blood pressure.
MEq	Mille equivalent.
Mg	Milligrams.
Min	Minute.
ML	Milliliters.
NMDA	N-methyl-D-aspartate.
p value	Probability value.
PACU	Post Anesthesia Care Unit.
PC	Prothrombin concentration.
PC	Prothrombin concentration.
PCEA	Patient controlled epidural analgesia.
PDPH	Post dural puncture headache.
pH	Power of hydrogen.
Post-op	Postoperative.
PT	Prothrombin time.
SD	Standard deviation.
SNS	Sympathetic nervous system.
SPSS	Statistical Package for the Social Science.
UK	United Kingdom.
USA	United states of America.
VAS	Visual analog score.
α	Alpha.
μg	Microgram.

INTRODUCTION

Epidural anesthesia is a common technique for inducing surgical anesthesia and postoperative analgesia in lower abdominal and limb surgeries (*Paul et al., 2017*).

Postoperative pain management is one of the most important areas of anesthesia, early postoperative mobilization and rehabilitation with minimally associated pain and discomfort is the most desirable quality that has been needed in modern orthopedic surgery (*Karnawat et al., 2013; Ayyappan and Santhanakrishnan, 2017*).

Epidural anesthesia reduces the surgical stress by blocking the nociceptive impulses from the operative site and also reduces the blood loss, improve respiratory and bowel function and decreased incidence of deep vein thrombosis, but it is frequently associated with hemodynamic fluctuations due to use of large volumes of local anesthetic drug (*Bajwa et al., 2011*).

The addition of adjuvants like opioids or α -2agonist provide a dose-sparing effects of local anesthetics and would accelerate the onset of sensory blockade of epidural anesthesia and decrease the effective dose of local anesthetic, Sedation, stable hemodynamic and an ability to provide prolonged postoperative analgesia are the main desirable qualities of an epidural adjuvant (*Weerink et al., 2017*).

Fentanyl is highly lipophilic which rapidly acts on μ -opioid receptors in substantia gelatinosa producing hyperpolarisation of nerve membrane and decreasing excitability, it is 100 times more potent than morphine, It has side effects like nausea, vomiting pruritus, respiratory depression, urinary retention which are less as compared to other opioids (*Elhakim et al., 2010*).

Dexmedetomidine is a potent and highly selective α -2-adrenoceptor agonist. It has a relatively high ratio of α -2/ α -1 activity. The improved specificity of dexmedetomidine for the α -2 receptor causes it to be more effective sedative, anxiolytic, analgesic, antihypertensive, and sympatholytic properties with much less unwanted cardiovascular effects from α -1 receptor activation. It improves the quality of perioperative anesthesia and analgesia (*Elliott and Smith, 2016*).

AIM OF THE STUDY

To compare the effect of dexmedetomidine and fentanyl as an adjuvant to epidural levobupivacaine in knee replacement surgeries regarding duration of action and the analgesic potency of both drugs.

Chapter 1

ANATOMY RELEVANT TO EPIDURAL AND SUBARACHNOID BLOCKADE

Vertebral column: There are 24 individual vertebrae: seven cervical, 12 thoracic and five lumbar. The five (fused) sacral vertebrae and the coccyx (made up of 3–5 rudimentary vertebrae) are not always classed as being a part of the vertebral column. Vertebral anatomy varies according to each level. The atlas and the axis are highly atypical and the first ‘recognizably normal’ vertebra is C3. Atlas and axis anatomy are relevant to anaesthetists in that the odontoid process (dens) of the axis should be closely applied (2–3 mm) to the anterior arch of the atlas in flexion and extension (the gap is filled with cartilage). Rheumatoid arthritis and trauma may affect this relationship and the ability to recognize the relevant anatomy on lateral radiographs is important. From C3 downwards, the vertebrae (although they vary) have a recognizable anterior body, posterolateral pedicles (Latin for ‘little feet’), transverse processes and posterior laminae (‘thin layers’), which fuse to form the spinous processes. The spinal canal enclosed within these structures is also known as the epidural space, apart from the central portion occupied by the dural sac and its contents. The dura mater contains the arachnoid mater. Between the arachnoid and the pia mater, which is applied to the spinal cord, is cerebrospinal fluid. As the vertebral column grows, it leaves

behind the spinal cord so that by adulthood the cord ends at the lower border of L1 (although this can vary by one vertebra). The dural sac generally ends at the lower border of S2 below which it continues as the filum terminale, a structure clearly and frequently seen with spinal endoscopy. The dural sac contains the anterior and posterior spinal nerve roots, collectively known as the cauda equina (*Parkinson, 1991*).

Table (1): Boundaries of the epidural space.

Superiorly	Fusion of the spinal and periosteal layers of dura mater at the foramen magnum ¹
Inferiorly	Sacrococcygeal membrane
Anteriorly	Posterior longitudinal ligament, vertebral bodies and discs
Laterally	Pedicles and intervertebral foraminae
Posteriorly	Ligamentum flavum, capsule of facet joints and laminae

Quoted with permission from (*Capogna, 2017*)

Table (2): Definition of the cervical, thoracic, lumbar and sacral epidural spaces.

Cervical	Fusion of the spinal and periosteal layers of dura mater at the foramen magnum ¹ to lower margin of C7
Thoracic	Lower margin of C7 to upper margin of L1
Lumbar	Upper margin of L1 to upper margin of S1
Sacral	Upper margin of S1 to sacrococcygeal membrane

Quoted with permission from (*Capogna, 2017*)

Spinal nerves: spinal nerves exit at each level and are numbered according to the thoracic, lumbar or sacral vertebra above. As there are eight cervical spinal nerves and seven vertebrae, the nerves in this region only are numbered according to the vertebra below. The only exception is spinal nerve C8 that leaves between vertebra C7 and T1 (*Reina et al., 2000*).

Epidural space: The boundaries of the epidural space are summarized in Table 1 and the definitions of the cervical, thoracic, lumbar and sacral regions are defined in Table 2. The epidural space contains fat, the dural sac, spinal nerves, blood vessels and connective tissue (Table 3) (*Capogna, 2017*).

Blood supply: Inside the spinal canal there is an anterior and posterior arterial (and venous) arcade formed from the spinal arteries entering at each level through the intervertebral foramina. These arise from the vertebral arteries superiorly and then thoracic and the lumbar aorta. They anastomose with the anterior spinal artery, running on the surface of the spinal cord arising initially from the vertebral arteries at the circle of Willis. The nerve root (with the exception of the dorsal root ganglion) has a poor blood supply compared with the spinal cord. Despite anastomoses throughout the vertebral canal, arterial trauma can compromise the blood supply of the cord itself (*Capogna, 2017*).

Venous drainage is via the valveless vertebral venous plexus of Batson, which, fortunately for the epiduralist, is