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Comparative study between: Epidural bupivacaine versus Patient Controlled Analgesia for postoperative pain control in total knee arthroplasty

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List of Abbreviations

Abb.	Full term
Ach	*Acetylcholine*
CGRP	*Calcitonin Gene-Related Peptide*
CNS	*Central nervous system*
CORT	*cortisol*
CRH	*Corticotropin-releasing hormone*
CSF	*Cerebrospinal fluid*
E	Epinephrine
GCs	*Glucocorticoids*
GM-CSF	*Granulocyte Macrophage Colony Stimulating Factor*
GR	*Glucocorticoid receptor*
HPA	*Hypothalamic-pituitary-adrenocortical*
LC	*Locus coeruleus*
NASIDs	*Non-steroidal anti-inflammatory drugs*
NE	*Norepinephrine*
NGF	*Nerve Growth Factor*
NKA	*Neurokinin A*
NMDA	*N-methyl-D-aspartate*
NPY	*Neuropeptide Y*
PAG	*Periaqueductal gray.*
POMC	*proopiomelanocortin*
PVN	*Periventricular nucleus*
SAM	*sympathoadrenomedullary*
SP	*Substance P*
TLRs	*Toll like receptors.*
TNF	*Tumour necrosis factor.*

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Abstract

Introduction: Effective postoperative pain control in total knee arthroplasty is important, especially with starting physiotherapy and early ambulation, which enhances recovery and reduces hospital length of stay. The risk of postoperative complications, such as deep venous thrombosis and nosocomial infections, has also been shown to decrease with early mobilization. **Aim**: The aim of this study is to assess the analgesic efficacy of epidural bupivacaine compared with intravenous patient controlled analgesia (opioid and NSAIDs) during postoperative period in total knee arthroplasty. **Patients**: Forty patients, ranging in age from 20 to 70 yr, scheduled to receive total knee replacements with spinal anesthesia were randomly assigned to this study. **Methods**: patients received epidural bupivacaine 0.125% alone in (group epa) or iv nalbuphine 50mg, ketorolac 60mg via pca device. The quality of postoperative analgesia was assessed by the anesthesiologist according to Visual Analogue Score (VAS), Cortisol level 24 hours preoperative and 2 hours postoperative for stress response. **Results:** The efficacy of both epidural Bupivacaine and i.v nalbuphine & ketorolac via PCA device in controlling pain after total Knee arthroplasty however PCA was slightly less efficient especialy during the 12 hr after surgery. We found that one of the main draw backs of epidural analgesia using bupivacaine were arterial hypotension and urinary retention which required catheterization of many patients for voiding of urine. Results were comparable between the 2 groups and were against group EPA, Serum cortisol levels were elevated 2h post-surgery in all patients. This elevation is in accordance with the well-established stress response to surgery. Furthermore, cortisol levels were significantly less elevated in the group EPA, compared with group PCA. **Conclusion**: The results of the study revealed both Epidural bupivacaine and systemic opioids combined with NASID via PCA device are effective of pain control post TKA.

Keywords: TKA, bupivacaine PCA, Epidural and ketorlak.

INTRODUCTION

The management of acute postoperative pain has been dramatically improved during the last three decades. Although, clinical practice guidelines for acute postoperative pain management were developed, provision of effective analgesia for surgical patients still undertreated. Postoperative pain is one of the major concerns in modern medicine. Several methods and drugs, from analgesics to local anesthetics, are used to manage and abolish postoperative pain. Poorly controlled postoperative pain, results in harmful acute and chronic effects, adverse physiologic responses, delayed long-term recovery and chronic pain ***(Golzari et al., 2014).***

Effective postoperative pain control in total knee arthroplasty is important, especially with starting physiotherapy and early ambulation, which enhances recovery and reduces hospital length of stay. The risk of postoperative complications, such as deep venous thrombosis and nosocomial infections, has also been shown to decrease with early mobilization ***(Paul et al., 2010).***

However, evidence indicates that uncontrolled pain may harm patients by impairing cardiac, pulmonary and endocrine functions ***(Macintyre and Walker, 2010)***.

Acute pain guidelines support the link between complications and uncontrolled pain ***(Macintyre and Walker 2010)***. In addition, ***Arnstein (2002)*** suggests that pain interferes with sleep, lowers quality of life and impairs immune functioning ***(Arnstein, 2002).***

The physiological consequences of injury & pain are caused by activating peripheral and central nervous system. Trauma induces a stress response characterized by hormonal changes and inflammatory response, leading to malaise, hyperthermia and immunosuppression. Effective analgesia is able to modify many of the pathophysiological responses, thereby preventing or reducing complications and supporting recovery ***(Macintyre and Walker, 2010)***.

Cortisol level increases rapidly following the start of surgery, being stimulated by ACTH. From baseline values of around 400 nmol/litre, cortisol concentrations increase to a maximal level at about 4–6 h, and may reach >1500 nmol/litre depending on the severity of the surgical trauma, so its release is lowest with the least traumatic procedures as laparoscopic surgery and is maximal with major procedures such as joint replacement ***(Nicholson, 2014).***

AIM OF THE WORK

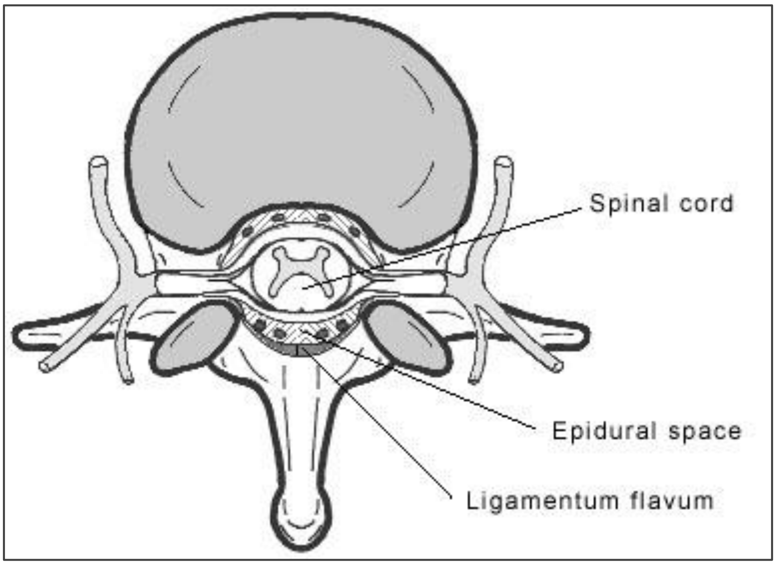
The aim of this study is to assess the analgesic efficacy of epidural bupivacaine compared with intravenous patient controlled analgesia (opioid and NSAIDs) during postoperative period in total knee arthroplasty.

LUMBAR EPIDURAL ANALGESIA

Epidural anaesthesia is a central neuraxial block technique with many applications. The epidural space was first described by Corning in 1901, and Fidel Pages first used epidural anaesthesia in humans in 1921. In 1945 Tuohy introduced the needle which is still most commonly used for epidural anaesthesia. Improvements in equipment, drugs and technique have made it a popular and versatile anaesthetic technique, with applications in surgery, obstetrics and pain control. Both single injection and catheter techniques can be used. Its versatility means it can be used as an anaesthetic, as an analgesic adjuvant to general anaesthesia, and for postoperative analgesia in procedures involving the lower limbs, perineum, pelvis, abdomen and thorax. ***(Leon Visser, 2001).***

I. Anatomy

The epidural space is that part of the vertebral canal not occupied by the dura mater and its contents. It is a potential space that lies between the dura and the periosteum lining the inside of the vertebral canal. It extends from the foramen magnum to the sacral hiatus. The anterior and posterior nerve roots in their dural covering pass across this potential space to unite in the intervertebral foramen to form segmental nerves. The anterior border consists of the posterior longitudinal ligament covering the vertebral bodies, and the intervertebral discs. Laterally, the epidural space is bordered by the periosteum of the vertebral pedicles, and the intervertebral foraminae. Posteriorly, the bordering stuctures are the periosteum of the anterior surface of the laminae and articular processes and their connecting ligaments, the periosteum of the root of the spines, and the interlaminar spaces filled by the ligamentum flavum as in **figure 1**. The space contains venous plexuses and fatty tissue which is continuous with the fat in the paravertebral space. ***(Rudolf, 2007).***



(Figure 1): Epidural space **(lee and loh, 2017)**

The epidural space is far greater than that of the subarachnoid space at the same level. It takes about 1.5 – 2.0 ml of a local anesthetic to block a spinal segment in the epidural space while the volume (0.3 ml) is far less in the subarachnoid space for a similar block. Each spinal nerve as it passes through its intervertebral foramen into the paravertebral space carries with it a collar of the fatty areolar tissue of the epidural space. Injection and dissection studies have shown that the paravertebral spaces communicate with each other through the extradural space; there is, in fact, no direct communication between adjacent paravertebral spaces. (**Ellis et al., 2004).**

The epidural space can be entered by a needle passed either between the spinal laminae or via the sacral hiatus. The spinal canal is roughly triangular in cross-section and therefore the space is deepest in the midline posteriorly. In the lumbar region, the distance between the laminae to the posterior aspect of the cord is about 5 mm. The distance from the skin to the lumbar epidural space varies between 2 cm and 7 cm, the range in the majority of patients being 3–5 cm. (**Ellis et al., 2004).**

II. Technique of placement

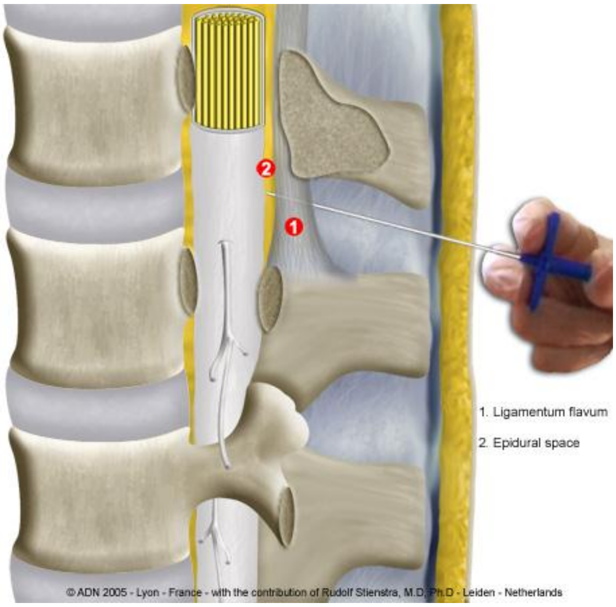
Proper positioning is essential for a successful block. Proper positioning can be difficult for several reasons:

1) Your assistant may not understand how the patient should be positioned or the rationale behind positioning.

2) The patient may not understand your instructions.

3) Sedation may make the patient unable to cooperate or follow directions.

There are three positions used for the administration of epidural anesthesia: lateral decubitus, sitting, and prone. **(Kleinman, W. & Mikhail, M., 2006).**



(Figure 2): Technique of placement, **(Lee and Loh, 2017) .**

After a sterile prep, place a skin wheal at the predetermined site of insertion. Identify midline! If off the midline it will be difficult to locate the epidural space. If the needle is inserted further than normal, blood is returned in the needle, and/or the patient complains of a paresthesia, stop. Reassess landmarks and needle insertion point. Insert the epidural needle into the ligamentum flavum. Anatomical structures transversed include skin, sub cutaneous tissue, supraspinous ligament, and interspinous ligament. If the needle is not placed in the ligamentum flavum, the anesthesia provider may experience false positives with the loss of resistance technique. In the lumbar area, the depth of skin to ligamentum flavum is approximately 4 cm for most adults. Eighty percent of adults have a skin to ligamentum flavum depth of 3.5-6 cm. The average thickness of the ligamentum flavum is 5-6 mm. Controlling the needle is important to avoid a dural puncture. In the thoracic area, needle control is important to avoid dural puncture and risk of spinal cord injury. **(Brown, D.L. , 2005).**

Loss of resistance technique: once the needle is placed into the ligamentum flavum, remove the stylet. Attach a glass syringe with 2-3 ml of preservative free normal saline and a small (0.25 ml) air bubble. The needle is held steady by the non-dominant hand. The dominant hand holds the syringe. Steady pressure is applied to the plunger to compress the air bubble. Slowly and steadily advance the needle until loss of resistance is noted. Hanging drop technique: place the needle into the ligamentum flavum. Next, apply a drop of preservative free normal saline to the hub of the needle. Apply slow, steady pressure to the needle until the hanging drop gets "sucked" in. The epidural space contains subatmospheric pressure. **(Kleinman, W. & Mikhail, M., 2006).**