COMPARATIVE STUDY BETWEEN THE EFFECT OF CONTINUOUS EPIDURAL ANALGESIA WITH ROPIVACAINE 0.2% VS BUPIVACAINE 0.2% FOLLOWING LOWER ABDOMINAL SURGERIES.

Thesis submitted for the partial fulfillment of the M.D. degree in Anaesthesiology.

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Introduction and Aim of the Work

The aim of postoperative analgesia is to provide subjective comfort with minimum side effects, and to blunt autonomic and somatic reflex responses to pain, to allow early ambulation and restoration of function ***(Jorgensen .et al, 2000).***

Epidural analgesia with local anaesthetics after lower abdominal surgery is a method of relieving postoperative pain ***(Scott.et al, 1995).***In addition, epidural local anaesthetics may reduce gastrointestinal paralysis and postoperative nausea and vomiting by inhibition of visceral reflex activity and reduced need for perioperative opioids ***(Asantila .et al, 1991).***

The problem of persistent motor block limits the usefulness of epidural infusions with local anaesthetics.

Ropivacaine has both anaesthetic and analgesic effects. At high doses, it produces surgical anaesthesia, while at lower doses, it produces sensory block [analgesia] with limited and non-progressive motor block ***(Casati .et al, 1999).***

Although controversial, it has been claimed that ropivacaine produces comparable sensory, but less intense, motor block compared with bupivacaine ***(Muldoon .et al,1998 and Gautier . et al,1999).*** This has not been investigated in patients undergoing lower abdominal surgery so the aim in this study is to compare between the effect of continuous epidural analgesia by ropivacaine 0.2% vs bupivacaine 0.2% on postoperative pain, motor block and gastrointestinal function after lower abdominal surgery.

Historical Background of Regional Anesthesia

With the evolution of the 19th century many physicians started to experiment local application of drugs for the purpose of pain relief. In 1853, Alexander Wood invented the hollow metal needle for direct injection of morphine into a painful area. Although the recognition that morphine's dominant action is systemic, yet the invention of the needle allowed three decades later a successful administration of locally acting alkaloids e.g. (cocaine) the first effective local anesthetic ***(Larson, 2005)***.

The origin of modern local anesthesia is credited to Carl Koller, an ophthalmologist, who demonstrated the use of topical cocaine for surgical anesthesia of the eye in 1884. Afterwards the surgeon William Halsted used cocaine for intradermal infiltration and for different nerve blocks. In 1898 August Bier in Germany was credited with the first spinal anesthesia, after a trial on himself using 3 ml of 0.5% cocaine intrathecally that resulted in the first experienced lumber puncture headache. Then in 1908 he was also the first to describe the local intravenous anesthesia Bier's block ***(Neal & Baker, 2006)***.

In 1904 Alfred Einhorn first synthesized procaine, and epinephrine was first added to local anesthetics to prolong the duration of their action a year later by Heinrich Braun. Caudal anesthesia was first described in 1901 followed in 1912 by the first attempt of epidural anesthesia by Fidel Pages and again by Achille Dogliotti in 1931. Additional local anesthetics subsequently introduced clinically include Dibucaine (1930), Tetracaine (1932), Lidocaine (1947), Chloroprocaine (1955), Mepivacaine (1957), Bupivacaine (1963), and Ropivacaine (1983) ***(Mandabach & Wright, 2006)***.

HISTORY OF EPIDURAL ANESTHESIA:

The deliberate single-injection of epidural anesthesia had been practiced for decades before the continuous technique gain its popularity.

Caudal anesthesia was first scoped in France as an alternative, less hazardous technique than spinal anesthesia for hernia repairs, where it was demonstrated that the epidural space is terminated in the neck, when a blue ink was injected in the epidural space of a dog through the caudal canal. The lumber approach was the first to be used for different segmental blocks.

In 1921, Pages Dogliotti in Italy was the first anesthetist to identify the epidural space using the loss of resistance technique which is still taught nowadays ***(Larson, 2005)***.

Clinical Anatomy

ANATOMY OF VERTEBRAL COLUMN:

The spinal cord and its nerve roots lie within the bony canal of the vertebral column, which is made up by the foramina of 7 cervical, 12 thoracic, 5 lumbar, 5 fused sacral vertebrae, and the coccyx. It extends from the foramen magnum down to the level of the first and second lumbar vertebrae (at birth down to second and third lumbar vertebrae). The spinal nerves are named and numbered according to the site of their emergence from the vertebral canal. C1-7 nerves emerge above their respective vertebrae. C8 emerges between the seventh cervical and first thoracic vertebrae. The remaining nerves emerge below their respective vertebrae ***(Gondim Fde A, Thomas Florian P 2009).***

The spinal column normally forms a double C, being convex anteriorly in the cervical and lumbar regions. Ligamentous elements provide structural support and together with supporting muscles help maintain the unique shape. Ventrally, the vertebral bodies and intervertebral discs are connected and supported by the anterior and posterior longitudinal ligaments. Dorsally the ligamentum flavum, interspinous ligament, and supraspinous ligament provide additional stability ***(Kleinman, 2002).***

Ligaments:

The vertebral bodies are stabilized by five ligaments that increase in size between the cervical and lumbar vertebrae. From the sacrum to T7, the supraspinous ligament runs between the tips of the spinous processes. Above T7 the ligament continues as the ligamentum nuchae

and attaches in the occipital protuberance at the base of the skull. The interspinous ligament attaches between the spinous processes and blends posteriorly with the supraspinous ligament and anteriorly with the ligamentum flavum. The ligamentum flavum is a tough, wedge-shaped ligament composed of elastin. It consists of left and right portions that span adjacent vertebral laminae and fuse in the midline to varying degrees. The ligamentum flavum is thickest in the midline, measuring 3 to 5 mm at the L2-3 interspace of adults. This ligament is also farthest from the spinal meninges in the midline, measuring 4 to 6 mm at the L2-3 interspace. As a result, midline insertion of an epidural needle is least likely to result in unintended meningeal puncture. The anterior and posterior longitudinal ligaments run along the anterior and posterior surfaces of the vertebral bodies ***(Moraca et al, 2003).***

The Dura Mater:

The dura mater is the 0utermost and thickest meningeal membrane that envelopes the arachnoid mater, cerebrospinal fluid, pia mater, spinal nerves, spinal cord and brain. Within the cranium, the dura is composed of an outer endosteal component that lies against the bone of the cranium and an inner meningeal component. These two layers are tightly adherent except where they divide to form the venous sinuses. At the foramen magnum, the endosteal layer divides from the meningeal layer and lines the spinal canal as the endosteum of the vertebral bodies. The meningeal layer continues caudally as the Dural sac, and ends at the S2 level in adults. The attachment of the meningeal dura to the endosteal Dural at the foramen magnum anatomically isolates the cranial vault from the epidural space of the spinal canal. Subdural injection has been estimated to occur in 0.82% of intended epidural injections. The radiology literature

suggests that incidence of subdural injections during Subarachnoid injection may be as high as 10% ***(Bernards, 2006).***

The Arachnoid Mater:

The arachnoid mater is a thin delcate active membrane that loosely adheres to the Dural sac and contains the brain and spinal cord bathed in CSF. Between the arachnoid and the dura lies the subdural space, a potential space through which local anesthetics can distribute via a well placed spinal needle or misplaced epidural needle or catheter. The arachnoid mater is continued along the spinal nerve roots, forming small lateral extensions of the Subarachnoid space ***(Snell, 2004).***

The Pia Mater and Spinal Cord:

The pia mater is a delicate highly vascular membrane composed of flat epithelial cells and tightly adherent to the spinal cord. A long filamentous extension of the pia, the filum terminale, pierces the caudal end of the Dural sac and blends with the periosteum of the coccyx to secure the spinal cord within the sac. The spinal cord ends at the L1-2 level in adults. The spinal roots continue caudally to the intervertebral foramina of the lower lumbar and sacral levels as the cauda equine the pia mater also gives rise to the dentate ligaments which serve to suspend the spinal cord within the meninges ***(Bernards, 2006)***.

Clinical consideration of Anatomy of the Epidural Space:

The epidural fat is mainly localized in the posterior sulcus between the ligamentum flavum and intervertebral space .The fat does not appear to hinder identification of epidural space or spread of local anaesthetic solution or contrast medium (Brown and Wedel, 1990).

The epidural space surrounds the Dural sac and is bounded by the posterior longitudinal ligament anteriorly, the ligamentum flavum and the periosteum of the laminae posteriorly, and the pedicles of the spinal column and the intervertebral foramina containing their neural elements laterally. The space communicates freely with the paravertebral space through the intervertebral foramina. Superiorly, the space is anatomically closed at the foramen magnum where the spinal dura attaches with the endosteal dura of the cranium. Functionally, however, local anesthetics can diffuse intracranially during excessively high epidural block. Caudally, the epidural space ends at the sacral hiatus which is closed by the sacrococcygeal ligament. The epidural space contains loose areolar connective tissue, semiliquid fat, lymphatics, arteries, an extensive plexus of veins, and the spinal nerve roots as they exit the dural sac and pass through the intervertebral foramina. Investigators have defined the anatomy of the epidural space using anatomical dissection, epidural injections of resins, CT epidurography, epiduroscopy in cadavers and patients and MRI ***(Westbrook et al., 1993)***.

Most recently, the cryomicrotome sectioning in frozen cadavers is considered the gold standard for anatomic investigation, due to the minimal amount of artifact associated with the technique. Cryomicrotome sectioning has resulted in findings that differ from previous studies. Several studies supported the existence of dorsomedian Ligamentous strands, that extend from the ventral side of the vertebral arch and draw the dura posteriorly into a dorsomedian Dural fold, the *plica mediana dorasalis*. But cryomicrotome sectioning has found no evidence of the plica or any septation of the posterior epidural space ***(Hogan, 1996)***.

The lumbar epidural space in adults is segmented by the presence of epidural fat that is located under the ligamentum flavum and extends under the laminae. This segmentation may impede the passage of an epidural catheter and promote coiling and misplacement. The anteroposterior dimension of the posterior space is greatest in the lumbar region and averages 5.0 - 6.0 mm in adult males. The posterior epidural space becomes more continuous in the thoracic region. In the thoracic region the anteroposterior dimension of the posterior epidural space decreases but the space becomes more continuous. A thin layer of epidural fat extends between the lamina and the dura. Epidural catheters placed thoracically may pass easier. In more cephalic cervicothoracic regions, the epidural fat disappears and the dura directly contacts lamina. The shallow space provides little room for excessive needle advancement.

The lateral epidural space communicates freely with the paravertebral space through the intervertebral foramina. Permitting the transmission of intra-abdominal pressure directly to the epidural space ***(Cousins MJ, and Bridenbaugh PO, 1992).***

A rich venous plexus surrounded by minimal amounts of fat almost entirely fills the anterior epidural space. In the thoracolumbar region (T10 - L2) the basivertebral vein originates from this venous plexus and extends into the vertebral bodies. The increasing amounts of epidural fat anteriorly may contribute to the long latency of epidural anesthesia typically observed in the L5 and S1 nerve roots ***(Cousins MJ, and Bridenbaugh PO, 1992).***

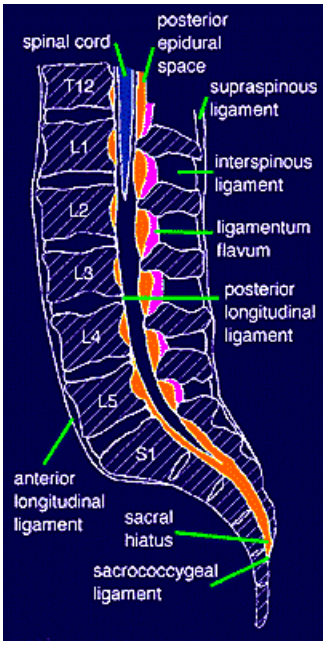

Figure (1): Illustrated Anatomy of the Epidural Space.

Katz J: Atlas of regional anesthesia, 2nd edition. Appleton & Lange, 1994.

Technique of Epidural Anesthesia:

Epidural anesthesia can be performed with the patient in either the lateral decubitus, the sitting position or less frequently practiced in the prone position. In the lateral decubitus position, the patient lies with the knees drawn up to the abdomen, the upper arm resting across the chest, the lower arm lying at a right angle to the body, and the head flexed and resting on a small pillow. The vertebral column should rest at the edge of the bed and parallel to the table. Flexion of the lumbar spine opens the interspaces. When performing the procedure without an assistant to hold the patient in this position, one can ask the patient to clasp his/her hands behind her head and flex his/her back to make the elbows and knees touch.

Sitting Position:

In the obese patient, the weight of subcutaneous tissue in the lateral position can pull the skin line -marking the middle of the back- some distance below the spinous processes. The sitting position may facilitate identification of the midline. The patient sits at the edge of the bed with the feet supported by a stool. The head is flexed on the chest and arms folded across the upper abdomen, or supported in front of the chest on a table. An assistant stands in front of the patient to hold the shoulders level and prevent lateral flexion or rotation of the spine ***(Stone et al., 1990)***.

Landmarks:

The intercrestal line (the line between the highest points of the two iliac crests) runs through the spinous process of L4. The spinous processes identify the midline. The spinous processes immediately above and below the site of needle puncture are marked. The interspace immediately above or below the L4 process is the usual site for needle insertion. This avoids the termination of the spinal cord at the L1-L2 level ***(Bromage, 1978)***.

VERTEBRAL LEVELS LANDMARKS

vertebra prominent	**C7**
root of the spine of the scapula	**T3**
inferior angle of the scapula (arms at sides)	**T7**
intercrestal line	**L4**
posterior superior iliac spines	**S2**