Comparison of Analgesic Efficacy of Caudal Dexamethasone versus Intravenous Dexamethasone as an Adjuvant to Caudal Block in Pediatric Patients Undergoing Lower limb orthopedic Surgeries

Thesis

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

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Abdullah Adel Saber Mansour

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INTRODUCTION

Caudal block is one of the most common regional anesthetic techniques employed in pediatric orthopedic surgeries ***(Singh et al., 2011).*** Local anesthetics (LAs) alone for caudal block provide good operative conditions, but they have short duration of postoperative analgesia. Therefore, various adjuvants such as opioids, clonidine, neostigmine and midazolam were added to LAs in caudal block to achieve quick, dense and prolonged block ***(Gowala et al., 2009).***

Various adjuvants such as opioids and α_2 agonists are used for better postoperative analgesia with caudal block. They have certain disadvantages such as urinary retention, nausea, vomiting, pruritus, and respiratory depression by opioids ***(De Beer and Thomas, 2003)***. Similarly, α_2 agonist can cause bradycardia, hypotension, and sedation ***(Ansermino et al., 2003).***

Bupivacaine is a widely used local anesthetic (LA) which is related chemically and pharmacologically to the amide LAs available.Using 0.5% bupivacaine in caudal block, the onset time may be up to 20 minutes (min.) with surgical anaesthesia taking up to 40 min. The duration of block ranges from 4-12 hours (hrs) with residual anaesthesia still being present at 24 hrs ***(Berde 2005).***

Dexamethasone exerts some analgesic activity by its anti-inflammatory action when given intravenously as well. It inhibits synthesis of cycloxygenase-2 in peripheral tissues and central nervous system, thus reducing the prostaglandin production responsible for inflammation and pain ***(Hong et al., 2010).***

Dexamethasone is a potent corticosteroid with analgesic, antiemetic, anti-inflammatory & immunomodulating effects. Its strong anti-inflammatory effect contributes to postoperative analgesia as tissue injury plays a significant role in the patho-physiology of surgical pain ***(Hong et al., 2010).*** Epidural corticosteroid injections (ESIs) have been used for decades as a therapeutic modality in the management of spinal pain syndromes, moreover perineural dexamethasone appears to prolong the duration of analgesia after when combined with bupivacaine. Other benefits include improved visual analogue pain scores, decreased perioperative opioid use and decreased nausea. Combinations of analgesics with different mechanisms of action may reduce or even prevent postoperative pain and prevent emergence of anomalous pain syndrome ***(Hong et al., 2010).***

Aim of the Work

The current study is conducted to evaluate the analgesic effect of dexamethasone when given systemically versus caudally as an adjuvant to caudal block for children undergoing lower limb orthopedic surgeries.

Chapter One

ANATOMY OF SACRUM & EPIDURAL SPACE

Sacrum

The sacrum is a large triangularly shaped bone formed by the fusion of the five sacral vertebrae. It has a blunted, caudal apex that articulates with the coccyx. Its superior, wide base articulates with the fifth lumbar vertebra at the lumbosacral angle. Its dorsal surface is convex and has a raised interrupted median crest with four (sometimes three) spinous tubercles representing fused sacral spines. The posterior surface is formed by fused laminae. Lateral to the median crest, four pairs of dorsal foramina lead into the sacral canal through intervertebral foramina, each of which transmits the dorsal ramus of a sacral spinal nerve, (Fig. 1). Below the4th (or 3rd) spinous tubercle an arched sacral hiatus is identified in the posterior wall of the sacral canal, due to the failure of the fifth pair of laminae to meet, exposing the dorsal surface of the fifth sacral vertebral body. The caudal opening of the canal is the sacral hiatus, roofed by the firm elastic membrane, the sacrococcygeal ligament, which is an extension of the ligamentum flavum. The fifth inferior articular processes project caudally and flank the sacral hiatus as sacral cornuae, connected to the coccygeal cornua by intercornual ligaments ***(Candido et al., 2017).***

The sacral canal is formed by the sacral vertebral foramina and is triangular in shape. It is a continuation of the lumbar spinal canal. Each lateral wall presents four intervertebral foramina, through which the canal is continuous with the pelvic and dorsal sacral foramina. The posterior sacral foramina are smaller than their anterior counterparts. The sacral canal contains the cauda equina (including the filum terminale) and the spinal meninges. Near its midlevel (typically the middle one third of S2, but varying from the midpoint of S1 to the midpoint of S3) the subarachnoid and subdural spaces cease to exist, and the lower sacral spinal roots and filum terminale pierce the arachnoid and dura maters. The lowest margin of the filum terminale emerges at the sacral hiatus and traverses the dorsal surface of the fifth sacral vertebra and the sacrococcygeal joint to reach the coccyx. The fifth spinal nerves also emerge through the hiatus medial to the sacral cornua. The sacral canal contains the epidural venous plexus, which generally terminates at S4, but which may continue more caudally. Most of these vessels are concentrated in the anteriolateral portion of the canal. The remainder of the sacral canal is filled with adipose tissue, which is subject to an age-related decrease in its density. This change may be responsible for the transition from the predictable spread of LAs administered for caudal anesthesia in children to the limited and unpredictable segmental spread seen in adults ***(Candido et al., 2017).***

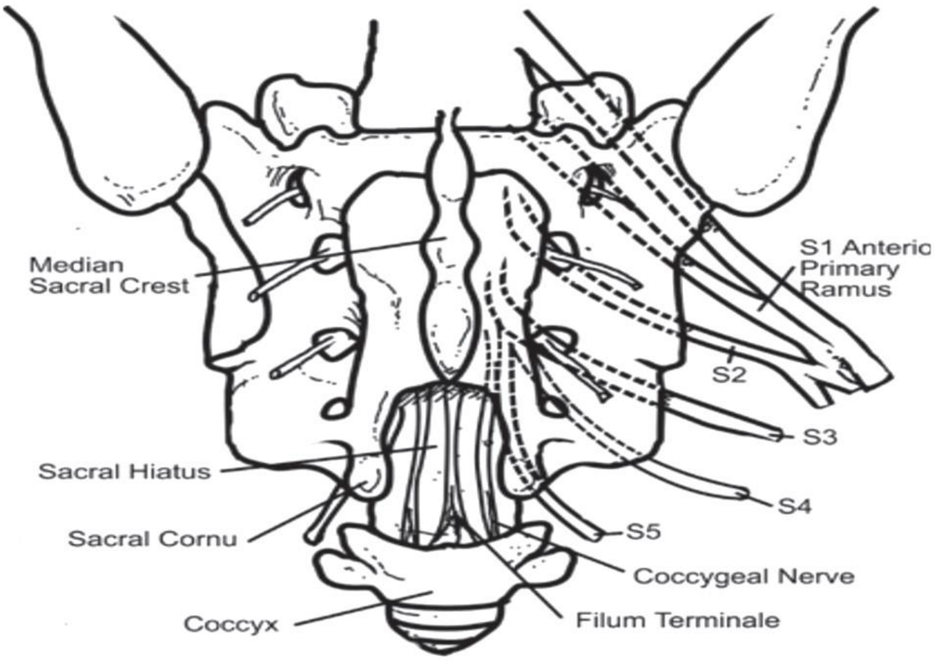

Figure (1): Anatomy of the sacrum ***(Abdelaziz, 2016).***

Anatomic variations:

Considerable variability occurs in sacral hiatus anatomy among individuals of seemingly similar backgrounds, race, and stature. As individuals age, the overlying ligaments and the cornua thicken significantly. The hiatal margins often defy recognition by even skilled fingertips. The practical problems related to caudal anesthesia are mainly attributable to wide anatomic variations in size, shape, and orientation of the sacrum. The sacral hiatus may be almost closed, asymmetrically open, or widely open secondary to anomalies in the pattern of fusion of the laminae of the sacral arches. Sacral spina bifida was noted in about 2% of males, and in 0.3% of females. The anteroposterior depth of the sacral canal may vary from less than 2 millimeters to greater than 1 centimeter. Individuals with sacral canals having anteroposterior diameters less than about 3 millimeters may not be able to accommodate anything larger than a 21 gauge (G) needle (5% of the population). Additionally, the lateral width of the sacral canal varies significantly. Since the depth and width of the canal may vary, the volume of the canal itself may also vary. Patients with smaller capacities may not be able to accommodate the typical volumes of LAs administered for epidural anesthesia via the caudal route ***(Candido et al., 2017).***

The sacral foramina afford anatomic passages that permit the spread of injected solutions such as LA and adjuvants. The posterior sacral foramina are essentially sealed by the multifidus and sacrospinalis muscles, but the anterior foramina are unobstructed by muscles and ligaments, permitting ready egress of solutions through them. The sacral curvature also varies substantially. This variability tends to be more pronounced in males than in females. The clinical significance of this finding is that a non curving epidural needle will more likely pass easily into the canal of females than males. The angle between the axis of the lumbar canal and the sacral canal varies between 7 and 70 degrees in subjects with marked lordosis. The clinical implication of this finding is that the cephalad flow of caudally injected solutions may be more limited in lordotic patients with exaggerated lumbosacral angles than in those with flatter lumbosacral angles, in whom the axes of the lumbar and sacral canals are more closely aligned ***(Aggarwal et al., 2009).***

Epidural space

The spinal meninges

The spinal cord has three covering membranes or meninges the dura mater, arachnoid mater and pia mater.

The dura mater

The dural covering of the brain is a double membrane, between the walls of which lie the cerebral venous sinuses. The dura mater that encloses the cord consists of a continuation of the inner (meningeal) layer of the cerebral dura, which is made up of dense fibrous tissue; the outer (endosteal) layer of the cerebral dura terminates at the foramen magnum, where it merges with the periosteum enclosing the skull, and is there after represented by the periosteal lining of the vertebral canal. The dural sac usually extends to the level of the 2nd segment of the sacrum; occasionally it ends as high as L5, at other times it extends to S3. As a result of this, it is occasionally possible to perform an inadvertent spinal tap during the course of a caudal injection. The dural sheath then continues as the covering of the filum terminale to end by adhering to the periosteum on the back of the coccyx. The sac widens out in both the cervical and lumbar regions, corresponding to the cervical and lumbar enlargements of the spinal cord. It lies rather loosely within the spinal canal, buffered in the epidural fat, but it is attached at the following points to its bony surroundings: