CAUDAL BLOCK FOR PAIN RELIEF IN CHILDREN UNDERGOING PERINEAL AND LOWER ABDOMINAL SURGERIES AT MUHIMBILI NATIONAL HOSPITAL DAR ES SALAAM, TANZANIA, 2012

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CAUDAL BLOCK FOR PAIN RELIEF IN CHILDREN UNDERGOING PERINEAL AND LOWER ABDOMINAL SURGERIES AT MUHIMBILI NATIONAL HOSPITAL DAR ES SALAAM, TANZANIA, 2012.

By

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled ***Caudal block for pain relief in children undergoing perineal and lower abdominal surgeries At Muhimbili National Hospital in Dar Es Salaam Tanzania,*** in(Partial) fulfillment of the requirements for the degree of Master of Medicine (Anaesthesiology) of Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGTH

I, **Dr Angela Paul Muhozya**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature:……..…… Date…….……..

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ABSTRACT

Background

Pain management is one of the important components of balanced anaesthesia. It can be provided by different methods intravenous, intramuscular, orally, topical or regional. Caudal block has evolved to become the most popular, safe and easy regional anaesthetic technique to be performed in children undergoing subumbilical surgeries.

Objective

The study was undertaken to assess the analgesic effect that is the duration and quality of analgesia provided by a single shot caudal epidural block using bupivacaine 0.25% for intraoperative and postoperative pain relief in children undergoing perineal and lower abdominal surgeries at Muhimbili National Hospital in Tanzania from April to December 2012.

Material and methods

After local ethical committee approval and obtaining informed parental consent, a cross sectional observational study was done in the main operating theatre and paediatrics surgery ward at Muhimbili National hospital from April to December 2012.

A total of 118 ASA I and II children, aged 6months to 11years, undergoing perenial, genitourinary and lower abdominal surgeries, were enrolled in the study. All surgeries were done under general anaesthesia. Following induction caudal block was performed in the lateral position. Perioperative Cardio- respiratory parameters, analgesic requirement and complications were recorded in all children. Quality of pain during recovery was assessed by Flacc pain scale for 30 minutes interval with maximum of 2hours in the recovery room and then 2 hourly in the ward for 12hours.

In the recovery room a child with score 1to 3paracetamol suppository (15mg/kg) was inserted while in the ward a child with a score of 4 or above rescue analgesia (injection morphine 0.1mg/kg) was given. Children were followed up for 24hours to identify and manage all detected complications.

Results

Caudal block was performed in 118 chidren with a success rate of (98.3%). The hemodynamic parameters were reduced or remained stable in all successful blocks. The hemodynamic alterations observed during the operation were statistically significant when compared to values before incision. ($P<0.05$).

Average duration of analgesia was (8.20±2.1) hours with a range of 3-12hours.

The duration of analgesia was prolonged in younger children when compared to those aged more than 72 months.

Inguinal surgeries had a lower duration of analgesia when compared to other type of surgeries. FLACC pain score recorded at the time of rescue analgesia were not significantly different between different age groups or type of surgery $p> 0.05$.

The Most common complication encountered was vomiting affecting 5% of 116 children, other complications rarely occurred.

Conclusions

This study has shown that caudal block success rate is high in providing intraoperative and postoperative analgesia. If there is no contraindication caudal block is the best choice analgesic technique in children undergoing subumbilical surgeries. Caudal block provide safe and effective intraoperative and post-operative analgesia with less hemonadynamic changes, complications and side effects.

Recommendation

Caudal epidural block should be part and parcel of paediatric anaesthetic management in children undergoing, genitourinary, perineal and lower abdominal surgeries in Tanzania.

List of acronyms

MUHAS	Muhimbili University of Health and Allied sciences
MOI	Muhimbili Orthopedics Institute
MNH	Muhimbili National Hospital
ASA	American Association of Anesthesiologists
FLACC	Face, Leg, Activity, Cry, Consolabity Scale
DIC	Disseminated Intravascular Coagulopathy
MRI	Magnetic Resonance Imaging
GABA	Gama Amino Butyric Acid
GA	General Anaesthesia
IPPV	Intermintate Positive Pressure Ventilation.
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
SPSS	Statistical Package for Social Science
ECG	Electrocardiogram
PSARP	Posterior Sagittal Rectoplasty
SD	Standard Deviation
IRB	Institutional Review Board
IV	Intravenous.
COXIBS	Cyclooxygenes inhibitors
NSAID	Non steroidal antinflamaotory drugs

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Introduction and literature review

Pain management is a very important component of anaesthetic management in paediatric and general population. The provision of adequate analgesia is necessary during and after any surgery and it is all more important in children who have long been under-medicated with narcotics for pain relief [1, 2]. When compared to adult children do feel pain at the same intensity as adults, but their response to pain is by crying, increase in heart rate and change in facial expression it's important that they receive the same care to alleviate pain[3,4].

A Multimodal approach is usually recommended for use whenever possible because it can improve pain control while lowering the risk of adverse effects. Multi-modal pain management involves both pharmacology and non pharmacological approaches. Pharmacological approach includes the administration of two or more drugs that act by different mechanisms for providing analgesia including local anaesthetic agents, opioid, NSAID, and paracetamol. Unless contraindicated, patients should receive an around-the-clock regimen of COXIBs, NSAIDs, or acetaminophen.. These drugs may be administered via the same route or by different routes.Multimodal techniques can be with central regional analgesics or systemic analgesics. Nonpharmacological pain management strategies in acute pain interventions includes physiological, behavioural, and cognitive techniques aimed at reducing pain and pain-related distress through the modulation of thoughts, behaviours, and sensory information. The choice of medication, dose, route, and duration of therapy should be individualized[5].

Paediatrics response to analgesics varies according to age, site of surgery and additives given together with the local anaesthetic agent, side effects are often unpredictable [6,7].

There have been a number of advances recently that have allowed improvements in pain management in children. Regional anesthetic techniques have become one of the routine interventions in children and infants[8.]

The most frequently used regional anaesthetic technique are caudal and lumbar epidural blocks,ilioinguinal, iliohypogastric and penile nerve blocks, among those technique the most preferred pediatrics regional anaesthetic technique is epidural block with a caudal approach [9,10].Indications for caudal block include anaesthesia and analgesia below the umbilicus in pediatrics [11,12].

Caudal block was first described in 1933 by Campbell, and it has become one of the most popular regional analgesic techniques today[13].The benefits of caudal analgesia are well recognized in the management of intraoperative and prevention of postoperative pain following paediatric subumbilical surgery [14, 15].

General anaesthesia will often be required in addition to caudal block. This is due to the fact that paediatric patients do not generally tolerate surgery under regional anaesthesia alone. The advantages of combined caudal block with general anaesthesia is to reduce intraoperative inhalational or opioid agent consumption but also to obtain efficient postoperative analgesia for paediatric patients undergoing inguinal hernia, circumcision, hypospadias repair , orchidopexy, lower abdominal surgeries, superficial operations such as skin grafting, perineal procedures, and lower limb surgery [16-19].In a group of 30 pediatric patients randomized to receive general anaesthesia alone or a combination of general and caudal block. Caudal block with bupivacaine (4 mg/kg) and morphine (150mcg/kg) was found to lower fentanyl requirements during cardiac surgery and shorten extubation times[20].

Caudal analgesia in combination with general anesthesia may affect the circulatory hemodynamic due to sympatholytic vasodilating effects where by lower body vascular resistance is reduced [21].A success or failure of caudal block can be determined by the hemodynamic changes following skin incision. Maintained or reduced value as compared to values before incision indicates a successful blocks. During surgery, adequate analgesia was defined by hemodynamic stability, as indicated by the absence of an increase in HR or SBP of more than 20% compared with baseline values obtained just before the surgical incision [22,]. The study done by Dalen's etal the hemodynamic status remained excellent in more than 95% of patients [23]. Other studies showed a decrease in all measured hemodynamic parameters at skin incision following caudal block [24-29].

In the very young a caudal block may be adequate to carry out urgent procedures such as reduction of incarcerated hernias, allowing return of normal bowel function prior to surgical repair .Caudal block might also be preferred as anaesthetic technique in high-risk patients as an alternative method to general anaesthesia. This includes patients with respiratory and cardiovascular conditions which may be worsened by general anaesthesia[30].

When performed as the sole method; it provides anaesthesia with great success.

Caudal block has been used for many years and is the easiest and safest approach to the epidural space. When correctly performed there is little danger of either the spinal cord or dura being damaged [30, 31]. Depending on the experience of the person performing the block the list of possible complications includes epidural abscess, meningitis, epidural hematoma, dura puncture and postdural puncture headache, subdural injection, pneumocephalus and air embolism. There are Prospective and retrospective studies done which have demonstrated a low complication rate and fewer long-term sequels after caudal epidural block in children when comparing to adults [32, 33].

Anatomical considerations.

The sacrum is a 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. Flanking the median crest, 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[34].

The caudal opening of the canal is the sacral hiatus which is below the fourth (or third) spinous tubercle. It is roofed by the firm elastic membrane, the sacrococcygeal ligament, which is an extension of the ligament flavum [22]

The 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[35]. Fig 1A &B

The shape of the sacrum and the position of the spinal cord are shown in figure 2[35].In infants the lower position of the spinal cord makes access to the extradural space, and lumbar puncture, safer in more caudal interspaces (L4-L5 and L5-S1).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 cornue[35].

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. There is an age-related anatomic difference in the epidural fat of children. This could be the reason of the marked prolongation of postoperative analgesia in our younger children [6,7,35]. During early childhood the extradural fat is loosely packed, gelatinous and has distinct spaces this contrasts with the tightly packed fat divided by fibrous strands seen in adults. This structural difference results in a low resistance to longitudinal spread and a more cephalad sensory block of the volume of anaesthetics injected in younger compared with older children. Conventional dogma suggests that the more cephalad the anaesthetic level obtained, the longer the duration of analgesia at the original level of sensory loss, in this case the sacral nerves.This change may be responsible for the transition from the predictable spread of local anesthetics administered for caudal anaesthesia in children to the limited and unpredictable segmental spread seen in adults [36, 37].

Trotter [37] summarized the major anatomic variations 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 mm to greater than 1 cm. Individuals with sacral canals having anteroposterior diameters less than about 3 mm may not be able to accommodate anything larger than a 21-gauge 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. Trotter found that sacral volumes varied between 12 and 65 mL, with a mean volume of 33 mL[37].

A magnetic resonance imaging (MRI) study in 37 adult patients found the volume (excluding the foramina and dural sac) to be 14.4 mL, with a range of 9.5 to 26.6 mL. Patients with smaller capacities may not be able to accommodate the typical volumes of local anesthetics administered for epidural anaesthesia via the caudal route[38].

In a cadaver study of 53 specimens, the mean distance between the tip of the dural sac and the upper edge of the sacral hiatus as denoted by the sacrococcygeal membrane was 45 mm, with a range of 16 to 75 mm [38].In the MRI study mentioned earlier, the mean distance was found to be 60.5mm, with a range of 34-80 mm.The membrane could not be identified in 10.8% of subjects using MRI [38, 39].

In a study of 67 blocks, it was found that the lower sacral roots were easily reached with the caudal injection, and that the S1 and S2 roots (contribution from the lumbosacral plexus) were spared. E.g. caudal injections of alcohol or phenol have been used to treat intractable pain due to cancer. In this study intrathecal injection of alcohol or phenol were given to the lower sacral roots for pain management in inoperable rectal cancer[40].

Pharmacologic Considerations for Caudal Epidural analgesia in Children

Drugs which are commonly used for caudal block includes,Lidocaine1%, Bupivacaine 0.25%, levobupivacine, and ropivacaine.

Bupivacaine is an amide local anaesthetic with a slow onset and long duration of action. It binds to the intracellular portion of sodium channels and blocks sodium influx into nerve cells, which prevents depolarization, leading to impairment of the generation of action potential [41].The pharmacokinetic variable of bupivacaine after caudal anaesthesia in children are similar to those in adults .In children a large volume of distribution and a slightly longer terminal half life of bupivacaine may contribute to prolonged analgesia duration in young children less than 5years[42]. When used with general anaesthesia, 0.25%bupivacaine provides prolonged analgesia, yet avoids unnecessary motor block. Bupivacaine has a longer duration of action than Lidocaine, is used more often and remains a commonly administered local anaesthetic for single-dose caudal blocks [43]. Levobupivacaine and ropivacaine are also used because they have fewer side effects as compared to bupivacaine [44, 45].

*Drugs used for caudal injection should come from single use ampoules and must be preservative free.

Examples of the local anesthetics typically administered for single shot caudal blocks in paediatric patients are listed in below.

Agent	Concentration (%)	Dose	onset(min)	Duration of Action (min)
Ropivacaine	0.2	2mg/kg	9	520
Bupivacaine	0.25	2mg/kg	12	2553
Ropivacaine	0.2	0.7mg/kg	11.7	491
Bupivacaine	0.25	0.7mg/kg	13.1	457
Ropivacaine	0.2	1 mg/kg	8.4	Not known
Levobupivacaine	0.25	1 mg/kg	8.8	Not known
Bupivacaine	0.25	1 mg/kg	8.8	Not known

The concentration of bupivacaine administered in caudal block is usually less compared to concentration used in other form of blocks .This is due to the fact that large volume and low concentration is more effective than small volume with high concentration. To achieve a higher level block a larger volume of local anaesthetic solution is required with a lower concentration. If undiluted 0.25% solution of bupivacaine is used the total dose of the drug is also increased and has the potential risk of increased toxicity [46, 47].

Stow showed that plasma bupivacaine concentrations in children receiving caudal block with 0.2% of the local anaesthetic (2 mg/kg) were less than equivalent doses administered via ilioinguinal or iliohypogastric block for pain control following herniotomy or orchidopexy. Additionally, the times to peak plasma concentrations were faster in the peripheral nerve block group, indicating that caudal block is a safe alternative to local infiltration techniques in inguinal surgery [48].

In a study of children age 1-6 years showed the effect of volume versus concentration. Caudal block was performed in children who underwent orchidopexy.A larger volume of dilute bupivacaine (0.2%) was shown to be more effective than a smaller volume of the standard (0.25%) concentration in blocking the peritoneal response to spermatic cord traction. There was no change in the quality of postoperative analgesia [49].

Newer local anesthetics are being used with increasing frequency because they have fewer side effects compared to bupivacaine. Ropivacaine is now an extremely common place local anaesthetic for caudal blocks and may offer distinct advantages compared with bupivacaine because ropivacaine has a relatively benign cardiovascular toxicity profile [50].

Plasma concentrations of ropivacaine after caudal block in 20 children 1-8 years of age, using 1mL/kg, demonstrated free fractions to be 5%, clearance of 7.4 mL/min/kg, and terminal half-life of 3.2 h, well below those associated with toxic symptoms in adults [51].Ropivacaine 0.5% was shown to provide a significantly longer duration of analgesia following inguinal herniorrhaphy in children age 1.5-7 years compared with 0.25% ropivacaine or 0.25% bupivacaine. All children received 0.75 mL/kg of the local anaesthetic. Unfortunately, the times to first voiding and to standing were significantly delayed in the group receiving 0.5% ropivacaine, and there was one case of motor block of the lower extremities [52].

Ropivacaine has also been used for caudal block for hypospadias repair in a double-blind, randomized study in 26 children. The minimal effective local anaesthetic concentration of ropivacaine was found to be 0.11% under general anaesthesia with a 0.5 monitored anaesthesia care of enflurane [53].

Levobupivacaine may offer the same advantage as ropivacaine. The incidence of residual motor blockade is lower with both of these agents than with bupivacaine, without diminishment of analgesic efficacy [54].

Dose calculation

Several formulae have been described to enable calculation of local anaesthetic dose for a desired height of block. Anaesthetic dose requirements may be calculated based on body weight. The simple scheme outlined by Armitage[14], (table 1) is easy to use and appears to be satisfactory in clinical practice, although it has been suggested that volumes calculated on weight are reliable in infants are not reliable in older children, in whom age may be a better guide.

The relationship between age and dose requirements is strictly linear with a high degree of correlation up to 12 years old [55].

(i)Armitage Formula [14]

0.5 ml/kg for a lumbosacral block

1 ml/kg for a thoraco-lumbar block

1.25 ml/kg for a midthoracic block

0.25% Bupivacaine up to a maximum of 20ml

*0.25% bupivacaine ─ when used for caudal, epidural, or peripheral nerve block, produces incomplete motor block mainly sensory and some autonomic blockage.

(ii)Scott's Calculation[29]:

Calculates the dose based on the child's age and/or weight. If the child is of average weight for his or her height, both figures will be the same

If the child is overweight, use the figure based on age to avoid the possibility of overdose.

Table 2: Demonstration of Scott`s dose calculation

Weight in kg	Age in years	Dose (ml) 0.25% bupivacaine for a block to T12	Dose (ml) 0.25% bupivacaine for a block to T7
12.5	2	4	6
15	3	5	7.5
16	4	5.5	8
17.5	5	6	9
20	6	7	10.5
22.5	7	8	12
25	8	9	13.5
27.5	9	10	15
30	10	11	16.5

Adjuvants to local anesthetics doses are;-

Additives to local anaesthetic agents are very important because they improve the quality of the block intraoperatively, decrease the degree of motor block, increase the duration of action of the block, Lower the concentration of local anaesthetics and have less Cardiovascular side effects compared to local anaesthetics [56] .

All adjuvant should be preservative free.

There are different types of additives that can be used opiod and non opiod .

The most commonly used non opioid adjuvant for single-shot caudal anaesthesia is epinephrine in a concentration of 1:200,000. Epinephrine modifies the pharmacokinetics of local anaesthetic agents by prolonging the duration of caudal analgesia and reduces the toxicity of local anaesthetic agent but also has the added benefit of serving as a marker for an inadvertent intravascular injection. [(6, 7, 577)]

Clonidine, an alpha-2 agonist, acts by stimulating descending noradrenergic medulla-spinal pathways which inhibits the release of nociceptive neurotransmitters in the dorsal horn of the spinal cord. The addition of clonidine (1 to 5 μg/kg) can improve the analgesic effect of local anesthetics for single-shot caudal blockade as well as prolong its duration of action without the unwanted side effects of epidural opioids. Caution should be exercised while using clonidine in very young infants due to the sedation and hypotension that may ensue.

Clonidine has been added to bupivacaine in 36 children undergoing elective surgery. A caudal catheter was placed using 1 mg/kg bupivacaine 0.125% with an equal volume of either clonidine (2 mcg/kg) or normal saline. Analgesic effect was better in clonidine group compared to the control group receiving normal saline [58].

Thirty-two adults received the clonidine local combination while a control group received local anaesthetic alone. Analgesia averaged 12 hours in the clonidine group, compared to <5 h in the group receiving only local anaesthetic. Bradycardia occurred in about 22% of patients in the clonidine group [59].

Other non opioids adjuvant includes ketamine ,neostigmine and midazolam.

Neostigmine produces postoperative analgesia by inhibiting the breakdown of acetylcholine at muscarinic receptors in the dorsal horn. When combined with bupivacaine, a significant synergistic effect is observed. The addition of neostigmine (2 μg/kg) to 0.25% bupivacaine prolongs the duration of analgesia from 5 to 20 hours after hypospadias repair [60].

The addition of ketamine or S-ketamine to single-shot caudal block prolongs the analgesic effect of local anesthetics. The main disadvantages of ketamine are its psycho mimetic effects. However, at low doses (0.25-0.5 mg/kg), ketamine is effective without noticeable behavioural side effect [61].

Epidural opioids when given together with local anaesthetic agent enhance and prolong analgesia. In the study to compare the efficacy of intrathecal low dose morphine(2 µg/kg) with placebo added to local anaesthesia showed that intrathecal morphine combined with bupivacaine provides adequate analgesia in first 12hrs after hypospadias repair compared to bupivacaine alone [62,63].

A dose of 2 µg/kg of fentanyl for single-shot caudal anaesthesia along with the standard local anaesthetic solution has been recommended for more extensive or painful procedures or in patients who have a urinary catheter in the postoperative period [64].The possibility of delayed respiratory depression from epidural opiates must be taken into account, and patients should be monitored in an intensive care or high dependency unit for 24 hours following their administration. Opioid use in an ambulatory setting may be discouraged due to the potential for respiratory depression and other unfavourable side effects (e.g. nausea and vomiting, itching, urinary retention) .Opioids and non opioids adjuvants may be combined in order to increase the analgesic effect and reduce side effects.luz studied the effect of combined clonidine 1mg/kg, morphine 30mcg/kg with local anesthetic effect which showed better results compared to when one adjuvant alone is added [65].

Technique

Under general anaesthesia caudal epidural block can be performed in the prone or lateral decubitus position. The first step is to identify the sacral hiatus. It is essential that the skin over the caudal area is cleaned with an iodine or alcohol (70%) containing solution, which is allowed to dry. Drawing an equilateral triangle by connecting the two posterior superior iliac spines (PSIS) usually locates the sacral hiatus at the apex .Palpation of the sacral hiatus at the apex of this inverted triangle should identify the puncture site. Alternatively, the convexity of the coccyx can be palpated and then move cephalad to palpate the concave sacral hiatus to identify the puncture site [66].Fig 4. Then, using sterile technique, the caudal epidural space is entered using a short 23-gauge needle or a 22-gauge IV catheter. The needle is inserted at a 60-degree angle and the needle is advanced until a "pop" is felt. The needle is then lowered to a 20-degree angle and advanced an additional 2-4 mm to make sure the bevel is in the caudal epidural space, if using a cannula withdraw the stylet and advance the cannula into the caudal space. Do not advance the needle or cannula any more than is necessary. Advancement of the cannula rather than the needle may reduce the incidence of inadvertent dura or vascular puncture and easy progression of the cannula is a good prognostic sign of success [66]. Fig 5

Confirmation of proper needle placement.

Test aspiration should be gentle as vessel walls can easily collapse producing a false negative. If no blood or CSF is aspirated then the appropriate amount of local anesthetic is injected in small amounts, with repeated aspirations throughout the injection. An epinephrine containing test dose can be used to exclude intravascular injection [67]. Dalen's [23] and the group found that inadvertent intravascular injection occurs in up to 0.4% of pediatric caudal blocks demonstrating the importance of performing epinephrine-containing test dosing in this age group. It has been suggested that an elevation of heart rate by > 10bpm or an increase in systolic blood pressure of > 15 mm Hg should be taken as indicative of systemic injection. Following intravascular injection, T wave changes on the ECG occur earliest followed by heart rate changes, and lastly, by blood pressure changes [23].The most important test for correct placement (not including intravascular placement) is ease of injection. If the local anesthetic solution can be injected with little resistance, it is mostly likely in the correct space.

If there is initial resistance or resistance develops over the course of the injection, the injection should be stopped and the needle location reassessed. Fig 6

The classic “pop”, felt as sacrococcygeal membrane is pierced is usually sought for proper caudal needle placement [66]. Fig 5

The absence of subcutaneous bulging and the lack of resistance upon injection of local anaesthetic are additional signs of proper needle placement [64].Figure 6.

Other tests to confirm proper needle placement include the “whoosh” test, the “swoosh” test, and the use of nerve stimulation. The “whoosh” test requires the injection of 2.5 ml of air through the caudal needle, with a “whoosh” being heard with a stethoscope placed over the thoracolumbar spine. However, this can lead to a patchy block. More importantly, it can cause a venous air embolism if the needle is inserted into an epidural vessel especially in small infants.

The “swoosh” technique avoids these problems by injecting local anaesthetic or saline in place of air but the benefit of confirming needle placement prior to local anaesthetic injection is lost. Excessive saline injection may dilute subsequent local anaesthetic injections and lead to an inadequate block [67].

Relaxation of the anal sphincter predicts successful caudal blockade. This is by the use of a nerve stimulator, using nerve stimulation; proper needle placement is confirmed by motor activity in the anal sphincter with 1-10 mA of current through an insulated needle [68].

Pain assessment

A first step in improving the pain management of patients must be an improved ability to assess pain, especially in the younger preverbal children whom communication of discomfort is very difficult. A variety of assessment tools have been developed. The tools are broadly divided into self-report, observational and behavioural tools and then further subdivided into their suitability for type of pain (acute procedural, postoperative, or disease-related) and setting [69].

Self report

This is the most psychometrically sound and feasible tool; it is based on age/developmental level and type of pain and has been recommended for use in clinical trials.

Can be in forms of (a) Wong and baker FACES (b) Faces pain scale an d (c) Visual analogue and numeric rating scales [70-74].

Behavioural measures

On the basis of the highest evidence of validity, reliability, and clinical utility the following behavioural tools can be recommended for children and young people aged 3–18 years.

Procedural pain: -

.FLACC (Face, Legs, Arms, Cry, and Consolability) intended for 1–18 year olds [75].

•CHEOPS (Children's Hospital of Eastern Ontario Pain Scale) intended for 1–18 year olds [76].

Postoperative pain (in the hospital setting)

• FLACC (89): intended for 1–18 year olds [78].

Physiological measures

Physiological parameters such as heart rate variability, skin conductance, and changes in salivary cortisol can be used indirectly to indicate the presence of pain. However, blood pressure, heart rate, and respiratory rate have been shown to be unreliable indicators for postoperative period in newborns, infants, and young children with wide interindividual behaviour–physiology correlations after major surgery in 0–3-year-old infants [77].

PROBLEM STATEMENT

Pain management as one of the important components of balanced anaesthesia is usually undertreated or neglected by many anaesthetic providers. This is due to the belief that children do not feel pain or they do not respond to pain to the same degree as adults [1, 2].

This was proven otherwise by different studies confirming that children do feel pain and they respond to pain in the same degree as adult[31, 69].

In Tanzania intraoperative and postoperative analgesia is commonly achieved by the use of opioids like morphine or pethidine.

There is a fear among anaesthetic providers that children may be harmed by the use of opioids .This is due to the side effects like respiratory depression, cardiovascular collapse, nausea, vomiting and depressed levels of consciousness associated with opiods use [1, 4,69] .

These fear of side effects results in no medication or under medication for pain relief in children during and after surgery.

Alternative analgesia or analgesic technique is required in order to provide adequate analgesia with less side effects and complications in pediatrics patients.

Peripheral and central blocks can be used as alternative method of providing perioperative analgesia. These blocks are not routinely done in Tanzania because of lack of knowledge on how to perform them and awareness about their benefits on providing intraoperative and postoperative analgesia.

Caudal block is one of the blocks which can be performed to provide intraoperative and postoperative analgesia in children undergoing perineal, genitourinary and lower abdominal surgeries.

RATIONALE

Pain management is very important during and after surgery for both children and adults. Perioperative pain management by the use of opiods which is commonly used in Tanzania is feared by many anaesthetic providers because of the associated side effect. Because of this children have been denied medications during surgical interventions so as to avoid the side effect.

Caudal block in children is one of the most popular regional blocks done in other countries with high success rate for children undergoing infraumbilical surgeries.[9, 66]. In Tanzania there is no published or documented data about the use of caudal block in children.The introduction or adaptation of caudal block will become a good alternative analgesic technique in children undergoing genital urinary, perineal and lower abdominal surgeries.

The study will provide necessary information on the technique, efficiency of the block in providing analgesia, complications and side effect which may be used for future research and studies.

BROAD OBJECTIVE:

To assess the analgesic effects provided by caudal epidural block for intraoperative and postoperative pain relief in children undergoing perineal and lower abdominal surgeries at Muhimbili National hospital from April to December 2012.

SPECIFIC OBJECTIVES:

(i) To assess the analgesic effect provided by caudal epidural block by the change in hemodynamics and ventilatory responses to surgery for children undergoing perineal and lower abdominal surgeries.

(ii) To evaluate the average duration of analgesia provided by caudal epidural block.

(iii) To assess the variation of analgesic effect provided by caudal epidural block with the age of the patient.

(iv) To evaluate the association between the analgesic effects provided by caudal epidural block and the type of surgery.

(v) To determine the pattern of side effects and complications associated with caudal epidural analgesia.

METHODOLOGY

Study design

A prospective observational cross sectional hospital based study.

Study setting

The study was conducted in the main operating theatre, recovery room and paediatric wards at MNH.

Muhimbili National Hospital (MNH) is a national referral hospital situated in Ilala Dar-es –salaam. It receives patient from all Municipal hospitals as well as regional hospitals.MNH has two main divisions, The Orthopaedics and Neuro units (MOI) as well as the General division catering for the rest of the conditions.

MNH is also a teaching hospital collaborating with Muhimbili University of Health and Allied Sciences (MUHAS) for both undergraduates and postgraduate students.

Study population

A total 118 ASA I and II children, aged between 6month to 11yrs undergoing a lower abdominal, genitourinary and perineal surgeries were included.

Inclusion criteria

*Children who were included were those with age 6months to 11years, ASA I and II undergoing lower abdominal, genitourinary and perineal surgery whose parents consented for the study.

Exclusion criteria

Children with the following conditions were excluded from the study

*Coagulation disorders:

*Use of anticoagulants such as heparin or Warfarin.

*Infection near the site of the needle insertion.

*Unstable blood pressure and/or heart rate

*Patient or parent refusal.

*Congenital anatomical anomalies of the spinal cord or vertebral bodies

*Children requiring controlled ventilation (IPPV)

*Children who were born premature with less than 12 month and those aged less than

6 months.

*Children allergic to local anaesthetic used or other related drugs

Sample size calculations

The sample size was calculated using the formula:

$$N = Z^2P\ (100\text{-}P)/E^2$$

Whereby:

Z is a critical value 1.96

N is an estimated sample size

E is a margin of error (5%)

P is the proportion of caudal blocks done was 92%[5]

Hence $N = (1.96)^2 \times 92(100\text{-}92)/(5)^2$

$= (3.842) \times (736)/25$

$= 113.1$

$=114$

The approximated sample size was 114 but 118 children were included in the study.

Sampling procedure

A convenient sample was taken where by all children meeting the inclusion criteria during the allocated period of the study were included.

Parents/guardians were explained the aim of the study and all the procedures involved.

They were then requested to give an informed written consent prior to surgical procedure.

Conveniently, at least 10 patients were recruited per week.

Data collection and technique

All caudal blocks were done by the principal investigator.

Data collection was done using a designed observational chart. (Appendix IV)

Intraoperative data was collected by an assistant, while postoperative data

was collected by the principal investigator.

Data collected included, hemodynamic parameters (blood pressure and heart rate), ventilator parameter (respiration rate), duration of analgesia, duration of anaesthesia,

duration of surgery, complications and dose of analgesia if given. All charts were checked daily for completeness and consistencies.

Procedure

Induction of anesthesia was done with halothane by a face mask in incremental dose of 0.5% to 3% and oxygen (4litres) until the child is well anaesthetized. Baseline vitals (blood pressure, heart rate and respiration rate) were measured and documented.

Patients monitoring included ECG, Non invasive blood pressure, pulse oximeter, precordial stethoscope and axillary thermometer. Time to start induction was documented.

IV line was secured for drugs and fluids administration, dextrose5% Nacl0.9% (4-2-1regime) was given as maintenance during the operation.

Atropine 0.02mg/kg was given to all children.

Suxamethonium 1mg/kg was given to facilitate endotracheal intubation.

The endotracheal tube was secured and children were maintained with halothane 1.5% in oxygen 4L.

Children were allowed to breath spontaneously throughout the surgery.

Caudal blocks were done immediately after induction.

Pre incision parameters (blood pressure, heart rate and respiration rate) were measured 10 minutes after the block just before skin incision.

Post incision parameters (blood pressure, heart rate and respiration rate) were measured 5 minutes after skin incision.

Halothane concentration was reduced from 1.5% to 1% 10 minutes after incision, then hemodynamic and ventilator parameters measured and documented.

In children more than 1year halothane concentration was further reduced to 0.8% fifteen minutes after incision, then the hemodynamic and ventilatory parameters measured and documented.

Halothane concentration was maintained at the same level until the end of surgery. The hemodynamic and ventilatory parameters were measured and documented after every five minutes for thirty minutes after incision.

Ability to reduce halothane concentration without increase in parameters by >10 points (blood pressure by >10mmHg, heart rate by >10 beats/minute and respiration rate >10breath /minutes) caudal block was considered successful.

If the parameters increased by more than 10 points caudal block was considered unsuccessful and those children were given IV morphine 0.1mg/kg for intraoperative and postoperative analgesia.

Technique for performing caudal epidural block

Single shot caudal epidural blockade was done to provide intraoperative and post operative analgesia. Bupivacaine 0.25% in a volume of 0.5 mls/kg was used in all patients.

Patients were placed in a lateral decubitus position with the knees drawn up to the chest for caudal epidural block placement [64], Figure 3.

The procedure was carried out with a strict aseptic technique.

The skin over the caudal area was cleaned with an iodine solution, which was allowed to dry, sterile gloves worn.

Following proper positioning, the landmarks for caudal epidural block were identified. After initially identifying the coccyx and continuing to palpate in the midline in a cephalad fashion, the sacral cornua was felt on either side of the midline approximately one centimeter apart [64] (Figure 4).

The sacral hiatus was felt as a depression between two bony prominences of the sacral cornua that is where the drug was injected. Using sterile technique, the caudal epidural space was entered using a 22 gauge needle. The needle was inserted and advanced into the sacral hiatus at approximately a 60-degree angle to the skin until a distinctive "pop" was felt as the sacrococcygeal ligament was punctured [64](Figure 5). Following this puncture, the angle of the needle was reduced to approximately 20 to 30 degrees while the needle was advanced 2 to 4 mm into the caudal canal.

Aspiration of the needle should be clear of blood and CSF this was repeated before injecting the local anaesthetic solution. After appropriate needle placement the absence of subcutaneous bulging and the lack of resistance upon injection of local anaesthetic were additional signs of proper needle placement [64] (Figure 6).

Postoperative

Recovery from anaesthesia will be assessed by Aldorete score (Appendix III).

After recovery from anaesthesia FLACC scale was used to assess postoperative pain in the recovery room and wards.

Table 3: FLACC pain scale for postoperative pain assessment by S.Merkel et al[75]

CATEGORIES	SCORING		
	0	1	2
FACE	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested.	Frequent to constant quivering chin, clenched jaw.
LEGS	Normal position or relaxed.	Uneasy, restless, tense.	Kicking or legs drawn up.
ACTIVITY	Lying quietly, normal position moves easily.	Squirming, shifting back and forth, tense.	Arched, rigid or jerking.
CRY	No cry, (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints.
CONSOLABILITY	Content, relaxed.	Reassured by occasional touching hugging or being talked to, distractible.	Difficulty to console or comfort

The scale is scored between ranges of 0–10 with 0 representing no pain.

The scale has 5 criteria which are each assigned a score of 0, 1 or 2.

Interpreting the Behavioral Score.

0 Relaxed and comfortable

1–3 Mild discomfort

4–6 Moderate pain

7–10 Severe discomfort or pain or both

FLACC score was taken for every consecutive 30minutes with maximum of 2hours in the recovery room until the patient was discharged to the ward.(Discharge criteria used (refer Appendix :II)

In the ward FLACC score was recorded 2 hourly for 12hours.

Any child with a Flacc score of 1-3 in the recovery room was given paracetamol 15mg/kg in form of suppository.

In the ward a FLACC score of 4 or greater indicated pain. Those children were given IM morphine (0.1mg /kg) as rescue analgesia.

Patients were observed for 24 hours for complications like (nausea and vomiting, motor /leg weakness or behavior disturbance.)

Motor block was scored by the modified Bromage scale for motor block [78].

Table 4: Modified Bromage score as used by Breen et al [78]

Score	Criteria
1	Complete block (unable to move feet or knees) = 100%
2	Almost complete block (able to move feet only) 80%
3	Partial block (just able to move knees)60%
4	Detectable weakness of hip flexion while supine (full flexion of knees) 50%
5	No detectable weakness of hip flexion while supine 20%
6	Able to perform partial knee bend 0%

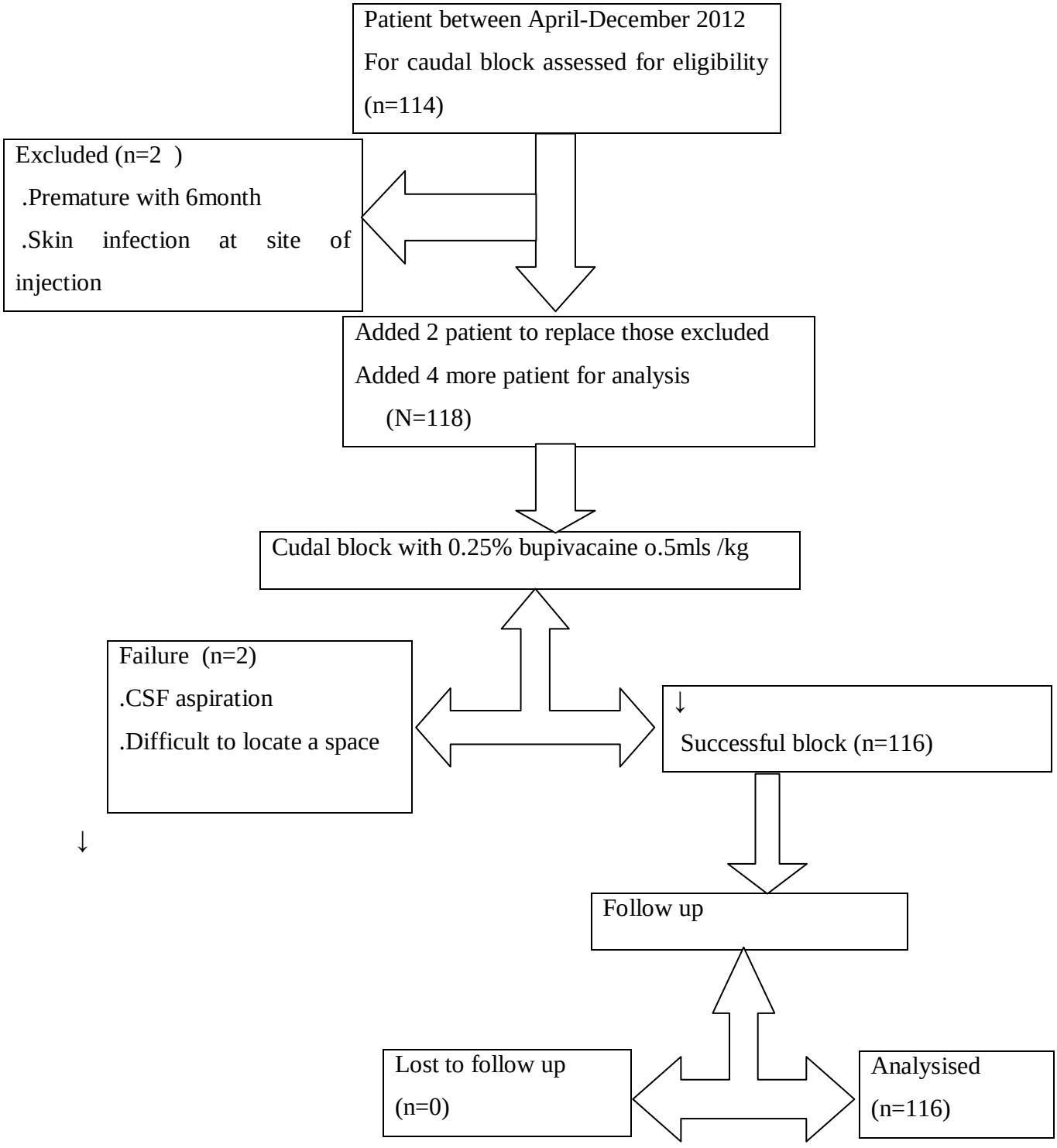
Data entry, cleaning and analysis

Data entry, cleaning and analysis was done using the Statistical Package for Social Science (SPSS) version 17.

Continuous variables were expressed as mean ± SD and analysis done by independent sample t test. A paired samples t-test was done to compare the mean of the repeated parameters at different times. Comparisons between different categories were evaluated using a chi-square test.

Differences were considered statistically significant with $p< 0.05$

Flow diagram of the study (Fig. A)



Ethical issues

- Permission was sought from the MNH management to allow the investigator to perform the required procedure and follow up the patients admitted in the pediatrics ward.
- A verbal informed consent was obtained in the ward preoperatively from parents/guardian prior to patient enrolment to the study.
- Patient/parent/guardian was educated to ensure they make an informed consent.
- Information given to the parent/guardian included aims of the study, non invasive or invasive procedures to be done when necessary, potential benefits and risks, and assurance of confidentiality of any given information and test results.
  Any other requested additional information was provided by the study personnel.
- Patients enrolled in the study were followed up to insure they receive appropriate care following the procedure.
- Patients identified to have other pathologies were channeled properly for appropriate management and follow-up.

Ethical clearance

Ethical clearance was obtained from the MUHAS high degree ethical committee of the research and publication committee.

RESULTS

Table 5: Patients distribution by age and sex

Age groups(Months)	Sex		Total
	Males	Females	
<12	15(12.7%)	9(6.7%)	24(20.3%)
12-36	41(43.7%)	12(10.2%)	53(44.9%)
37-72	20(16.9%)	11(9.3%)	31(26.3%)
>72	5(4.2%)	5(4.2%)	10(8.5%)
Total	81(68.6%)	37(31.4%)	118(100)

A total of 118 children were enrolled in the study, majority of them were males accounting for 68.6% and the male to female ratio was 2:1. Majority (44.9%) of the children were aged between 12 to 36 months.

Patients demographic and baseline data are shown in table 5 below.

Table 6:Patients demographic and clinical data

	Mean ± Standard deviation	Range
Age(Months)	36.45±27.42	6 -132
Weight (kilograms)	12.85 ± 5.18	5-37
Baselines SBP* (mmHg)	90.94 ± 16.72	60-140
Baseline HR** (beats/ minute)	123.41 ± 18.685	80- 179
Baseline RR*** (breath/minute)	50.78 ± 14.290	20-79

TABLE 7: Comparing patient systolic blood pressure before incision with values after incision.

	Mean ± SD Before incision SBP 93.62 ± 14.24	Mean decrease in SBP(mmHg)	P value
SBP 5min after incision	90.22 ± 11.48	3.42	< 0.0005
SBP 10min after incision	89.29 ± 11.24	4.35	< 0.0005
SBP 15min after incision	87.32 ±11.11	6.33	< 0.0005
SBP 20 min after incision	85.19 ± 11.18	8.46	< 0.0005
SBP 25min after incision	83.15 ± 10.92	10.50	< 0.0005
SBP 30 min after incision	80.3 ± 11.11	12.72	< 0.0005

Mean systolic blood pressure before incision was decrease when measured five minutes after incision with the mean decrease of 3.42mmHg which was significant ($p<0.0005$). There was a consecutive reduction in the mean systolic blood pressure after every five minutes .A significant reduction (13.6%) was demonstrated thirty minutes after incision where by the mean decrease reached 12.7mmHg. ($p <0.0005$).

Table 8: Comparing Heart rate change from values before incision to values after Incision

	Mean ± SD HR before incision	Mean decrease in HR	P value
	145.42 ± 12.71		
HR 5 minutes after incision	142.08 ± 12.26	3.35	< 0.0005
HR 10 minutes after incision	140.09 ± 12.31	5.33	< 0.0005
HR15 minutes after incision	137.78 ± 12.13	7.65	< 0.0005
HR 20 minutes after incision	135.39 ± 12.32	10.03	< 0.0005
HR 25 minutes after incision	133.42 ± 12.78	12.00	< 0.0005
HR 30 minutes after incision	131.38 ± 13.07	14.04	< 0.0005

Mean Heart rate five minutes after incision was reduced by 3.35 beats per minutes when compared to the mean heart rate before incision.

For every consecutive five minutes after incision the mean heart rate was further reduced. The mean decrease in heart was 14.04 beats per minutes which was a 9% reduction thirty minutes after incision ,this mean decrease was highly significant ($p<0.0005$).

Tabl 9 : Comparing patient respiration rate before incision to value after incision

	Mean ± SD RR before incision	Mean decrease in RR	P value
	54.41 ± 11.64		
RR 5 minutes after incision	52.17 ± 12.32	2.24	< 0.0005
RR 10 minutes after incision	50.26 ± 11.98	4.16	< 0.0005
RR 15minutes after incision	48.62 ± 11.78	5.79	< 0.0005
RR 20 minutes after incision	46.62 ±11.49	7.79	< 0.0005
RR 25minutes after incision	45.67 ± 14.35	8.74	< 0.0005
RR 30 minutes after incision	42.99 ± 11.40	11.42	< 0.0005

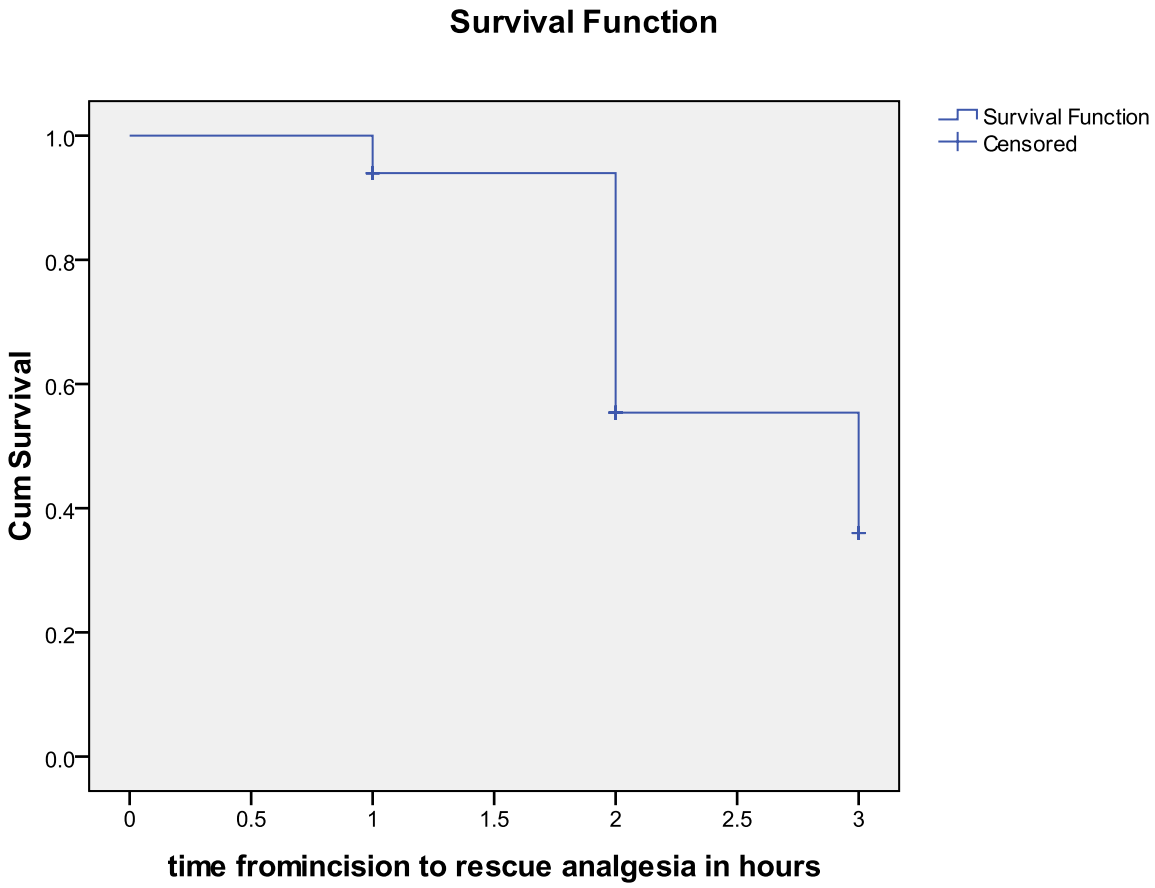
Patient mean respiration rate five minutes after incision was decreased by 2.24 breaths per minutes when compared to the rate before incision. For every consecutive five minutes after incision the mean respiration rate was further reduced.Thirty minutes after incision the mean respiration rate was reduced by 11.42 breath per minutes (19.6%)which was significant when compared to values before incision ($p<0.0005$) **.**

Table 10: Surgery, anaesthesia and analgesia durations

Duration in hours	Range(hours)	Mean SD
Anaesthesia duration	0.40 - 7.00	5.94 ± 1.23
Surgery duration	0.30 - 5.00	2.42 ± 1.74
Analgesia duration	3.00 - 12.00	8.2 ± 2.1

The mean anaesthesia and surgery duration was 5.94 ± 1.23 and 2.42 ± 1.74 hours consecutively. The average duration of analgesia was 8.2 ± 2.1 hours with the minimum of 3 hours and maximum of 12 hours.

Figure B: Survival curve demonstrating time to rescue analgesia



1=3.6hour, 2=7-10 hours and 3 = more than 10 hours

At the time of incision all children had adequate analgesia as demonstrated in the curve. Proportion of children who required rescue analgesia between 3 to 6 hours after the block was about 0.94% while the remaining of the children were censored. Cumulative proportion of children who had required rescue analgesia between 7-10 hours after the block was 0.6% while the proportion of children who required analgesia after 10 hours following the block was o.36% .The remaining proportion of children who was censored required rescue analgesia more than 10 hours after the block.

Table 11: Analgesia duration distribution by age

		Analgesia duration (hours)				
		<= 7.00	7.01 - 9.00	9.01+	Total	P value
Age (months)	<12	11 (45.8%)	9(37.5%)	4(16.7%)	24(20.7%)	0.23
	12-36	14 (27.5%)	22(43.15)	15(29.41%)	51(44%)	
	37-72	8 (25.8%)	11(35.5%)	12(38.7%)	31(26.7%)	
	72+	6 (60%)	2(20%)	2(20)	10(8.6%)	
	Total	39 (33.6%)	44(37.9%)	33(28.4%)	116(100%)	

The duration of analgesia showed an increase with increase in the age of the patient where by 37.9 % of all children had analgesia duration between 7 to 9 hours.

Younger children those aged less than 12 months, 45.8 % of them had analgesia duration of less than 7 hours. Children aged 12-36 months 43.2% of them had duration between 7 to 9 hour and children aged 37-72months 38.7% had duration more than 9 hours.

There was a decrease in analgesia duration demonstrated in older children where by 60 % of children with more than 72 months had analgesia duration less than 7 hours .

These changes in analgesia duration according to the age of the patient were not significant. (p= 023)

Table 12: Flacc score distribution by Age when rescue analgesia was given

Age group(months)	Flacc score at the time of rescue analgesia			
	FLACC SCORE=4	FLACC SCORE>4	Total	P value
<12	7(6.0%)	17(14.7%)	24(20.7%)	
12-36	25(21.6%)	26(22.4%)	51(44.0%)	
37-72	13(11.2%)	18(15.5%)	31(26.7%)	0.42
72+	5(4.3%)	5(4.3%)	10(8.6%)	
Total	50(43.1%)	66(56.9%)	116(100%	

In all age groups majority (56.9%) of children had a Flacc score of more than 4 hours at the time of rescue analgesia.

In children less than 12 months 14.7% had a flacc score of more than 4hours, 12-36 months age group 22.4%, 37-72 months 15.5% and lastly for those aged more than 72 months 4.3% had flacc score more than 4 at the time of rescue analgesia.

This demonstrated that the quality of analgesia observed was not significantly different between different age group (p= 0.42)

Table 13: Analgesia duration distribution by surgery type

Surgery types	Analgesia duration in hours			Total	P-value
	<= 7.00	7.01 - 9.00	9.01+		
Herniotomy	16(13.8%)	6(5.2%)	3(2.6%)	25(21.6%)	
Orchidopexy	2(1.7%)	5(4.3%)	2(1.7%)	9(7.8%)	
Hypospadias repair	1(0.9%)	2(1.7%)	0(0%)	3(2.6%)	
Colostomy	7(6.0%)	14(12.1%)	11(9.5%)	32(27.6%)	P=0.008
Circumcision	3(2.6%)	4(3.4%)	0(0%)	7(6.0%)	
Pullthrough	0(0%)	3(2.6%)	2(1.7%)	5(4.3%)	
PSARP	0(0%)	3(2.6%)	6(5.2%)	9(7.8%)	
others	10(8.6%)	7(6.0%)	9(7.8%)	26 (22.4%)	
Total	39(33.6%)	44(37.9%)	33(28.4%)	116(100%)	

Among the children who had herniotomy 13.8% had the analgesia duration less than 7 hours which was shorter duration compared to other types of surgeries.

Children operated for PSARP 5.2% had a longer duration of more than 9 hours when compared to other surgeries done.

The duration of analgesia was between of 7 and 9 hours in majority of the remaining surgeries, 1.7% of hypospadias repair, 12.1% of colostomy, 3.4% of circumcision and 2.6% pull through. The difference in analgesia duration between different type of surgery was significant (p=0.008)

Table 14: Type of surgery by Flacc score at the time of rescue analgesia

		Flaccscorerescue			
		flaccscore = 4	Flaccscore > 4	Total	
Surgery types	Herniotomy	6(5.2%)	19(16.4%)	25(21.6%)	P=0.13
	orchidopexy	3(2.6%)	6(5.2%)	9(7.8%)	
	Hyposadias repair	3(2.6%)	0	3(2.6%)	
	colostomy	18(15.5%)	14(12.1%)	32(27.6%)	
	circumsion	3 (2.6%)	4(3.4%)	7(6.0%)	
	pull through	2(1.7%)	3(2.6%)	5(4.3%)	
	PSARP	5(4.3%)	4(3.4%)	9(7.8%)	
	other	10(8.6%)	16(13.8%)	26(22.4%)	
	Total	50 (43.1%)	66 (56.9%)	116(100.0%)	

In all type of surgeries majority (56.9%) of children had a Flacc score of more than 4hours at the time of rescue analgesia.

In herniotomy 16.4 % , orchidopexy 5.2% , circumcision 3.4 % , pull through 2.6 % and others 13.8% all this surgeries had a Flacc score of more than 4 months at the time of rescue analgesia ,

Hypospadias repair 2.6% ,colostomy 15.5% and PSARP 4.3% had a Flacc score of 4 at the time of rescue analgesia . The difference in Flacc score recorded at the time of rescue analgesia was not significant P= 0.13 .

This demonstrated that the quality of analgesia was not significantly different between different types of surgeries.

TABLE 15: Patient complication distribution

		Frequency	Percent
Type of complication	none	108	91.5
	vomiting	2	1.7
	bleeding at injection site	1	0.8
	motor/leg weakness	1	0.8
	nausea and vomiting	4	3.4
	abnormal behavior	1	0.8
	Total	117	99.2

About 91.5% of children did not have any complications postoperatively. About 4 children (3.4%) had nausea and vomiting, 2(1.7%) developed only vomiting and 1 child has bleeding from injection site. All children were able to perform partial knee bend immediately after surgery with the Bromage scale of 6 .Except one child who had prolonged mild motor weakness for 2hrs which corresponds to Bromage scale of 5(20%).

DISCUSSION

Pain during and after surgery is common and the relief of acute pain has been inadequate in most places. The situation is worse in children, since they have long been denied or under medicated for acute pain [1, 2]. Caudal block is one of the common regional anaesthetic techniques used in paediatrics age group undergoing infraumbilical surgeries.Easy of performance and reliability makes caudal epidural block the most performed procedure in paediatrics[28,30].Caudal block provides excellent analgesia during surgery as well as during postoperative period following infra umbilical surgeries in children [11,12].

In our study all caudal blocks were regarded as clinically successful. None of the children had an increase in hemodynamic or ventilatory parameters during surgery. All parameters were significantly reduced by 20% with a big effect seen thirty minutes after incision. This reduction in parameters was mainly the result of mild sympatholytic effect produced by the block. The hemodynamic parameters with regard to the mean systolic blood pressure and mean heart rate were consecutively reduced after every five minutes when compared to values before incision. With regard to the mean respiratory rate the mean values were also reduced in the same manner.

Our study correlates with study done by Galante etal[24] where there was a decrease in all measured hemodynamic parameters at skin incision when compared to value before incision. The same changes have been reported by Dalen's etal whereby in his study the hemodynamic values were not increased but remained excellent in more than 95 % of patients [23].

In another study done by Mostafa etal the mean heart rate and Systolic blood pressure after incision were reduced by 15-20% when compared to values before [26]. In the study done by Shabir etal the hemodynamic values with regards to pulse rate and systolic blood pressure in bupivacaine group were reduced. The changes showed a benign profile without any clinical relevance[50].

The reductions in hemodynamic and ventilatory parameters demonstrated in our study were in agreement with other more studies[24, 27, and 81].

Diastolic blood pressure remained constant or showed a benign profile and no clinical relevant changes were observed at various stages. Despite the reduced values observed no patient required drug therapy to treat hypotension or bradycardia.

Our results showed that a single shot caudal injection of 0.25% bupivacaine provided a long lasting analgesia. Caudal bupivacaine provided analgesic duration which ranged from 3-12 hours postoperatively with the mean duration of 8.2 ± 2.1 hours. This correlated with the study done by Mahesh et al where by the analgesia duration provided by 0.25% bupivacaine was 5-12hours with the mean duration of 8.2 ± 2.4 hours [6], other studies which also had the same findings included study by Warner etal and Manjushree etal[6, 79] . Less duration of analgesia was demonstrated in study by Lynod[69] where the duration ranged between 4-8hours, study by Shabir etal [48]the mean duration was 7.4± 1.0 other less duration was demonstrated by more other studies [25,45,74.]

The impact of age on the duration of analgesia demonstrated that there was an increase in analgesic duration with increasing age up to 72 months (Table 10).This was followed by a decrease in analgesic duration in older children those with more than 72 months. This correlates' with the study done by Lynod whereby longer duration was demonstrated in younger children than older ones. There was prolonged analgesia duration in children less than 6 years when compared to those more than 6years. This was due to anatomical differences between younger children and older ones .In young children the epidural fat is loosely packed allowing a more cephalic spread of local anaesthetics agent hence prolonged duration. But also small children have a large volume of distribution than older children resulting in pronged duration of analgesia [69].

The same findings were demonstrated by Dalens etal where by children less than 7 years had a prolonged analgesic duration when compared to those with more than 7 years. In children order than 7 years the spread of local anaesthetic agents was unpredictable due to fibrous and less gelatinous epidural fat resulting in shorter analgesic duration[23]. Other studies with the same findings included those done by Warner et al and Khairat etal where by the analgesia duration was prolonged in younger children when compared to older children [6,7.]

Younger non verbal children had a shorter duration of analgesia of less than 7 hours when compared to older children. This abrupt changes in the durations of analgesia from non verbal(less than 12month) to early verbal ages could be due to the fact that the evaluation of onset of pain in younger children by their activity ,face and cry could be misleading. Cries, kicking of legs or different activity of young children could be due other causes like hunger, nausea, or fear not necessary pain. The same findings was demonstrated by study done by Warner etal [6] where there was an abrupt change in duration of analgesia from non verbal to verbal children with low duration in non verbal group(1-2years) the changes in Warner study was not significant[5].The pain score recorded in different age group was the same with majority of children having a pain score of more than 4 at the time of rescue analgesia.

The analgesia duration provided by caudal bupivacaine was affected by the operative site or type of surgery. Children operated for inguinal hernia demonstrated analgesia duration less than 7 hours (Table12) which was less compared to other types of surgeries. The same findings was demonstrated in the study done by Warner etal where by to a lesser degree the duration of analgesia was longer in penoscrotal surgeries than in the inguinal procedures. This was explained by the differences in areas with sacral innervations that resulted in prolonged postoperative analgesic periods after caudal blocks compared to other areas [6].

The same findings were demonstrated by study done by Kharat etal [6] where by to a lesser degree analgesia duration was longer in penoscrotal and genital urinary than in the inguinal procedures. There was no significant difference in pain score recorded between different types of surgery at the time of rescue analgesia.This indicated that all children regardless of the type or site of surgery had the same pain score during recovery and at the time of rescue analgesia.

Adverse post operative response was infrequent (Table 14). About 91.5% of children did not have any side effect or complications postoperatively. Post operative nausea and /or vomiting was the most common side effect which occurred in 6 (5%) of all children. These findings correlates' with study done by Dalen's etal where by postoperative nausea and/or vomiting was the main side effect which occurred in 12% of the patients. In study done by Mc Gown Postoperative vomiting occurred in 5 % of all children, 2% in the studies by Yeoman etal[47] and Kharat et al [7] and lastly 8% of children in the study by Warner etal[5] had nausea and vomiting as the main complication.

Only one child had bleeding from injection site and abnormal behavior. All children were able to perform partial knee bend immediately after surgery with the Bromage scale of 6.Except one child who had mild.

Motor weakness for 2hrs with Bromage scale of 5(20%) despite of receiving the same analgesic dose of bupivacaine . (Table3)

Caudal block failed in two children, one child had a scar at the site of injection and it was difficult to locate the space .In another child there was repeated aspiration of cerebral spinal fluid and the procedure was abandoned. The two children received intravenous morphine for intraoperative and postoperative pain management.

Conclusion

Caudal block provided adequate intraoperative and postoperative analgesia for children undergoing genital urinary, perineal and lower abdominal surgeries with success rate of 98%.Duration of analgesia demonstrated was between 3-12 hours with average of 8 hours. Hemodynamic and ventilatory parameters after incision were reduced when compared to values before incision. These changes were not statistically significant.

There were few side effects commonly nausea and vomiting which affected about 5% of the children.

Study limitations

1. This study included children from Muhimbili National hospital alone which may not be a representative of the whole country.
2. The actual time for the onset of pain was difficult to identify since patient monitoring and scoring for pain was recorded 2hrly
3. There were surgeries which could not be done due to lack of resources ‘like stitches and expertise causing a lot of bias in the study since those conditions could not be well assessed. For example hypospadias repair few were done due to lack of stitches, pull through and PSARP few were done due to lack of expertise.

Recommendations

1. Caudal block can be used as a routine analgesic technique in Paediatric patients undergoing genitourinary, perenial and lower abdominal surgeries.
2. All anaesthetic providers should be trained on how to do caudal block so that it can be their analgesic technique of choice when operating on children below the umbilicus .
3. The hospital should make sure that drugs for caudal block like isobaric bupivacaine are available as required.
4. Children from other hospitals should be given a chance to have caudal block as analgesic technique of choice when undergoing genital urinary and lower abdominal surgeries.

REFERENCES

1. Scheter NL,Allen DA,Hanson K. Status of paediatric pain control: A comparison of hospiatal analgesia usage in children and adult. paediatrics 1986;77:11-15
2. McCaffery M, Han L. Undertreatment of acute pain with narcotics. A merican Journal of Nursing 1976; 76: 1586-1591.
3. Beyer JE, DeGood DE, Ashley LC, Russel GA. Patterns of post-operative analgesic use with adults and children following cardiac surgery. Pain 1983; 17: 17-81.
4. Owens ME. Pain in infancy: conceptual and methodological issues. Pain 1984;20:213-30
5. White PF, Kehlet H Anesthesiology: multimodel ArticlesPractice Guidelines for Acute Pain Management in the Perioperative Setting: An Updated Report by the American Society of Anesthesiologists Task Force on Acute Pain Management February 2012 - Volume 116 - Issue 2 - p 248–273
6. Warner MA,Kunkel SE,offord KO, AtchisonSR,Dawson B:The effects of age, epinephrine and operative site on duration of caudal analgesia in paediatric patient . Anest Analg,1987oct ;66(10):995-88.
7. Khairat Mohd, Yasir, G. A. Mir Effect of Age, Adrenaline and Operation Site on Duration of Caudal Analgesia in Paediatric Patients vol 5 ,no 2,April-june 2003.
8. Ross AK, Eck JB, Tobias JD. Paediatric regional anaesthesia: Beyond the caudal. Anesth Analg. 2000;91:16–26.
9. Markakis DA. Regional anaesthesia in paediatrics . Anesthesiol ClinNorth America. 2000;18:355–81.
10. Mc Gown .Caudal analgesia in Children Five hundred cases for procedures below the diaphragm .Anaesthesia1982;37:806-818
11. MillerRD,FleisherLA,johnsRA,etal.MillersAnaesthesia.Houston: Elsevier,2005;1732-1734
12. Litman RS.Paediatric Anaesthesia the Requesites in Anaesthesiology, st. Louis mosby,2004;p.160-165
13. Campbell MF.Caudal anaesthesia in children.Am jurol 1933:30;245-9
14. Armitage EN. Caudal block in children Anaesthesia 1979;34:34-96

15. Broadman LM,Hannallah RS ,Norden JM,McGill WA"kiddie caudals" experience with 1154 consecutive cases without complications Anaesthesia anad Analgesia 1987;66:748-754

16. Hudson-Goodman P, Martin J. Beneficial effects of the combined techniques of caudal and general anesthesia in the pediatric patient: two case reports..CR1992 Nov;3(4):183-563.

17. Gunter JB, CM, BennieJB,et al, Optimum concentration of bupivacaine for combined caudal-general anaesthesia in children , Anesthesiology 1991:75:57-61

18. Tobias JD. Postoperative analgesia and intraoperative inhalational anaesthetic requirements during umbilical herniorrhaphy in children: Postinsicional local infiltration versus preinscional caudal block. J Clin Anesth. 1996;8:634–8.

19. Jehan.m.kamal Abdul-halim.Comparison of induction and recovery characteristics of sevoflurane, halothane and propofol in paediatrics.

20. Rojas-Perez E, Castillo-Zamora C, ~ava-Ocampo A: A randomized trial of caudal block with bupivacaine 4 mg x kg-1 (1.8 mL x kg1) plus morphine (150 micrograms x kg-I) vs general anaesthesia with fentanyl for cardiac surgery. Paediatr Anaesth 2003; 13:311317.

21. Hong JY, Ahn S, Kil HK. Changes of dorsalis pedis artery flow pattern after caudal block in children: observational study using a duplex sonography.
2011 Feb;21(2):116-20.

22. Hunt and Luck Aetal:Day case hemorrhoidectomy.BJS1999.86-255-528

23. Dalens B, Hansanoui A: Caudal anaesthesia in pediatric surgery: Success rate and adverse effects in 750 consecutive patients. Anesth Analg 1989;8:83-89.

24. Galante. Detal: Hemodynamic effects of levobupivacaine after pediatric Caudal anesthesia evaluated by transesophageal Doppler 14609592.2008.02786.x.

25. Mahin Seyedhejazi, Rasoul Azerfarin, Fahime Kazemi, Maryam Amiri Comparing caudal and penile nerve blockade using bupivacaine in hypospadias repair surgeries in children .2011 Sep-Dec;8(3):294-7.

26. Mostafa EL Hamamsy MDet al prolongation of caudal Analgesia in Paeatricsurgery: Comparison between Dexmedetomidine, clonidine, Tramadol and Fentanyl.

27. Deng M,Wang X,Wang L,Zheng : The hemodynamic effects of newborn caudal anesthesia assessed by transthoracic echocardiography: a randomized, double-blind, controlled study. Nov;18(11):1066-742008 Nov;18(11):1075-81.

28. Athur DS ,MC Nicoliller Local anaesthesetic techiqunique in paeditric surgery Br .j.Anaesthesia 19861:85-760,

29 . Alice Edler MD, M Vinit G.Wellis, MD,Caudal EpiduralAnesthesia for Pediatric Patients: a safe, reliable and effective method indeveloping countries Assistant .

30. Uguralp S, Mutus M, Koroglu A, Gurbuz N, Koltuksuz U, Demircan M. Regional anaesthesia is a good alternative to general anaesthesia in pediatric surgery: Experience in 1,554 children. J Pediatr Surg. 2002;37:610–3.

31. Fortuna A ,Caudal Analgesia : A simple and safe technique in paediatric surgery . Br.j.Anaesthesia .1967;39:165-17019.

32. Rowney DA, Doyle E. Epidural and subarachnoid blockade in children. Anaesthesia 1998;58:980-1001The Internet Journal of Anesthesiology ISSN: 1092-406X

33. Schuepfer G, Konrad C, Schmeck J, Poortmans G, Staffelbach B, Jöhr M. Generating a learning curve for pediatric caudal epidural blocks: An empirical evaluation of technical skills in novice and experienced anesthetists. Reg Anesth Pain Med. 2000;25:385–8. 9.27

34. Porterfield,JA, DeRosa,c.Mechanical low Back Pain:Perspective in Functional Anatomy .philadefia,,PA:W.B.saunder's Co:1976.

35. Igarashi T, Hirabayashi Y, Shimizu R, et al: The lumbar extradural structure changes with increasing age. BrJAnaesth 1997;78:149-J52.

36. Tretjakoff D. Das epidurale Fettgewebe. Zeit f Anat 1916; 79:83- 392.100

37. Trotter M: Variations of the sacral canal: Their significance in the administration of caudal analgesia. Anesth Analg 1947;26:192-202.

38. Crighton I, Barry B, Hobbs G: A study of the anatomy of the caudal space using magnetic resonance imaging. Br JAnaesth.

39. Lanier VS, Mc Knight HE ,Trotter M.Caudal analgesia :an experimental and anatomy study .American journal of obstetrics and Gynecology1944;47:633-41.

40. Porges P, Zdrahal F: Intrathecal alcohol of the lower sacral roots in inoperable rectal cancer. (German) Anaesthetist 1985;34:627-629.

41. Murat I, Delleur MM, Montay G, Saint-Maurice C. Bupivacaine pharmacokinetic during continuous epidural anesthesia in children (abst). Anesthesiology 1986;65:A425

42. Mazoit JX, Denson DD, Ahmad R, Samii K. Pharmacokinetics of bupivacaine in infants after caudal anesthesia (abst). Anesthesiology 1986;65:A431.

43. Ecoffey C, Desparmet J, Maury M, Berdeaux A, Giudicelli JF, Saint- Maurice C. Bupivacaine in children: pharmacokinetics following caudal anesthesia. Anesthesiology 1985;63:447-8.

44. Dr Bela Vadodaria and Dr David Conn Caudal Epidural Anaesthesia, Department of Anaesthetics, Royal Devon & Exeter Hospital.

45. Dr Manjushree Ray MD,Associate Professor, N. R. S. Postoperative Analgesia comparison between bupivacaine and ropivacaine MedicalCollege,Calcutta-700;01460 .

46. Silvani P, Camporesi A, Agostino MR, Salvo I. Caudal anesthesia in pediatrics: An update. Minerva Anestesiol. 2006;72:453–9.

47. Yeoman PM,cooker,Hain WR .Penile block for circumcision Anaesthesia1984;38;862

48. Stow P, Scott A, Phillips A, et al: Plasma bupivacaine concentrations during caudal analgesia and ilioinguinal-iliohypogastric nerve block in children. Anaesthesia 1988;43:650-653. 66.

49. Verghese S, Hannallah R, Rice LJ, et al: Caudal anaesthesia in children: Effect of volume versus concentration of bupivacaine on blocking spermatic cord traction response during orchidopexy.AnesthAnalg 2002;95:1219-1223.

50. Shabir ahmad et al caudal analgesia in paediatric patients: comparision between bupivacaine and ropivacaine**.**

51. Lonnqvist P, Westrin P, Larsson B, et al: Ropivacaine pharmacokinetics after caudal block in 1-8 year old children. Br J Anaesth2000:85:506-511.

52. Koinig H, Krenn C, Glaser C, et al: The dose-response of caudal ropivacaine in children. Anesthesiology 1999:90:1339-1344.

53. Deng S, Xiao, W, Tang G, et a1: The minimum local anaesthetic concentration of ropivacaine for caudal analgesia in children. Anesth Analg 2002:94:1465-1468. 4. 2914.

54. Ingelmo PM, Fumagalli R. Central blocks with levobupivacaina in children. Minerva Anestesiol. 2005;71:339–45.

55. Busoni P, Andreuccetti T. The spread of caudal analgesia in children: A Mathematical model. Anaesthesia and Intesive 1986; 14: 140-144.

56. Marri SR.Adjuvants agents in regional anaesthesia. Anaesthesia and Intensive care Medicine.2009.10;11

57. Van Obbergh LJ, Roelants FA, Veyckemans F, Verbeeck RK: In children, the addition of epinephrine modifies the pharmacokinetics of ropivacaine infected caudally. Can J Anaesth. 2003 Jun-Jul;50(6):593-8.

58. Joshi W, Connelly R, Freeman K,et al: Analgesic effect of clonidine added to bupivacaine 0.125% in paediatric caudal blockade.Paediatric Anaesth2004;14:483-486.

59. Van Elstraete A, Pastureau F, Lebrun T, ct al: Caudal clonidine for postoperative analgesia in adults. Br JAnaesth 2000; 84:401-402.

60. Enneking FK et al.Non-opioid additives to local anesthetics. Techniques in Regional Anaesthesia and Pain Management.2004;8(3)

61. Hager et al. S(+)-Ketamine and clonidine for caudal Blocks.Anesth Analg.2002;94:1169-72.

62. Henneberg SW, Hole P, Madsen de Haas I, Jensen PJ: Epidural morphine for postoperative pain relief in children. Acta Anaesthesiol Scand,1993 Oct;37(7):664-7 65.

63. Mahesh K. Arora , S. Rajeshwari, Hira L. Kaul :Comparison of Caudal Bupivacaine and Morphine for Relief of Post Operative Pain in Children New Delhi – 110 029 India.

64. Lejus C, Surbled M, Schwoerer D, Renaudin M, Guillaud C, Berard L: Postoperative epidural analgesia with bupivacaine and fentanyl: hourly pain assessment in 348 paediatric cases Paediatr Anaesth.2001May:11(3)7-32 .

65. Luz G, Innerhofer P, Oswald E, Salner E, Hager J, Sparr H. Comparison of clonidine 1mg kg±1with morphine 30 mg kg±1 for post-operative caudal analgesia in children.Eur J Anaesth 1999; 16: 42±627.

66. Bainbridge, W etal .Paediatric Epidural and caudal analgesi aand anaesthesia in children ; 2009:14:3

67. Tobias JD. Caudal epidural block: A review of test dosing and Recognition of systemic Injection in children. Anesth Analg. 2001;93:1156–61.

68. Verghese S, Mostello L, Patel R: Testing anal sphincter tone predicts the effectiveness of caudal analgesia in children. Anesth Analg 2002:94:1161-1164.

69. Lloyd-Thomas AR. Pain management in paediatric patients. Br J Anaesth. 1990;64(1):85-104.

70 Simons J, MacDonald LM. Changing practice: implementing validated paediatric pain assessment tools. J Child Health Care 2006; 10: 160–176.

71 . Wong D, Baker C. Pain in children: comparison of assessment scales. PediatrNurs1988; 14: 9–17.

72: Hunter M, McDowell L, Hennessy R et al. An evaluation of the Faces Pain Scale With young children. J Pain Symptom Manage 2000; 20: 122–129.

73: Hester N. The preoperational child's reaction to immunizations. Nurs Res 1979; 28: 250–255.

74. Hester NO, Foster R, Kristensen K. Measurement of pain in children Generalizability and validity of the pain ladder and the poker chip tool. Adv Pain Res Ther 1990; 15: 79–84.

75. S Merkel e tal .The lLacc:A behavioural scale for scoring postoperative pain in young children 1997,paeditr Nurse 23(3),p 293-297.

76. Mc Grath P, Johnson G, Goodman J et al. CHEOPS: a behavioral scale for rating Postoperative pain in children. Adv Pain Res Ther 1985; 9: 395–402.

77. Sweet S, McGrath P. Physiological measures of pain. In: Finley GA, McGrath PJ, eds. Measurement of Pain in Infants and Children.Seattle, WA: IASP Press, 1998: 59–81.

78. Breen TWetal.Epidural anaesthesia for labour in an ambulatory patient. Anaesth Analg 1993;77:919-24

79. Dr Manjushree Ray ,MD Postoperative Analgesia In Paediatric Day Case Surgery ;Issue 12(2000)Article 9:Page 1

80. Johnston CC, Strada ME. Acute response in infants: a multidimensional description Pain 1986;24373-82.

81. Abu-Saad H. Assessing children's response to pain. Pain1984; **19:** 163- 171.

82. Norden J,Hanallah R,GetsonP. Reliability of an objective pain scale in Children. Journal of pain and symptom Management.1991:6:196

83. Abdelfattah Saoud et al: Efficacy of Preemptive Caudal Analgesia in Single Level Lumbar Spine Decompression and Fusion Surgery wsj3:71-79, 2012 .

Appendix IA

INFORMED CONSENT FORM, ENGLISH VERSION

Dear parent/guardian, we would like to enroll your child in the study that will be included as part of anaesthetic management during the operation he/ she is going to undergo the procedure and followed up later for the outcome and complications.

Study objective

To assess the analgesic effect of caudal block for pain relief in children undergoing genitourinary, perineal and lower abdominal surgery at MNH.

Methodology

All children scheduled for genitourinary, perineal and lower abdominal surgery whose parents/guardian provide consent caudal block will be performed to them after GA induction. This children will be followed up after every 30 minutes in the recovery and then 2hourly for 12 hours post caudal block to observe the time from establishment of the block until the first registration of a FLACC score = or > 4 where a rescue analgesia will be given .Side effect and complication due to drugs and the technique will be identified and managed.

Benefits of the study

The study will provide an update on the caudal analgesic technique and its effectiveness in providing analgesia during and after the perineal and lower abdominal surgeries in children.

The study will also reduce the use and complications associated with opioids use.The technique will help to reduce the amount of inhalational agent used during the operation.

Negative effects

The procedure may be associated with different complications' which the parent or guardian should be aware off.

Confidentiality

Participation of patients will be anonymous; particulars of patients will not be open to the public in any way.

For any problem or question please contact the following:

(i) Principle investigator:
Dr. Angela Muhozya,
Department of Anaesthesiology,
MNH,
P.O.BOX 65000,
Dar es Salaam.

(ii) Research supervisor:
Prof: Victor Mwafongo,
EMD Department of MNH,
Associate professor MUHAS,
P.O.BOX 65001,
Dar es Salaam.

(iii) Director of Research and Publications,
MUHAS,
P.O.BOX 65001,
Dar es salaam

Conclusion

I have received and understood the information provided above, my questions have been answered and lam ready/not ready to participate in the study.

Signature of parent/guardian.....

Signature of Principal Investigator.....

Date……

Appendix I B : INFORMED CONSENT, SWAHILI VERSION

Ndugu mzazi/mlezi, tunapenda kumshirikisha mwanao kwenye utafiti wetu utakaofanyika kama sehemu ya matibabu atakayopewa wakati wa upasuaji na kumafatilia ili kuona maendeleo yake kwa masaa 24 wodini baada ya upasuaji.

Madhumuni ya Utafiti

Kuhakiki uwezo wa matibabu ya ganzi kwa kutumia bupivacaine katika kuondoa maumivu wakati na baada ya upasuaji .

Namna utafiti utakavyofanyika

watoto wote waliopangiwa kufanyiwa upasuaji wa maeneoneo ya chini ya tumbo pamoja na njia ya haja kubwa na ndogo ambao wazazi/walezi wao watakubali kushiriki watapewa matibabu husika.

Watoto hao watafatiliwa kwa masaa 12 na kuangalia maumivu yanayohitaji dawa ya ziada na kwa masaa 24 kuangalia madhara yanayoweza kuletwa na dawa zitakazotumika.

Kufanikiwa kwa matibabu kutapimwa kwa scale ya FLACC.

Faida za utafiti

Utafiti utatoa hali halisi ya matibabu husika na faida zake katika kuondoa maumivu wakati na baada ya upasuali wa maeneo ya chini ya tumbo pamoja na njia ya choo na mkojo.

Utafiti utapunguza matumizi na matokeo mabaya ya dawa za kupunguza maumivu aina ya opioid

Matibabu husika yatapunguza kiasi cha dawa za mvuke zinazotumika wakati wa upasuaji.

Madhara ya matibabu

Matibabu yanaweza kuambatana na matatizo ambayo mzazi atataarifiwa.

Usiri

Jina na habari nyingine zote za mgonjwa zitakuwa ni siri kati ya mgonjwa na mtafiti, hakuna mtu mwingine yeyote atakayeruhusiwa kuziona

Tafadhali usisite kuwasiliana na wafuatao kama utakuwa na maswali au matatizo yoyote kuhusiana na utafiti huu:

(i) Mtafiti

Dr. Angela Muhozya,

Idara ya matibabu ya usingizi,

MNH,

P.O.BOX 65000,

Dar es Salaam.

(ii) Msimamizi wa Utafiti

Prof. Victor Mwafongo,

Mkuu wa kitengo cha magonjwa ya dharura ,

MNH,

P.O.BOX 65001,

Dar es Salaam.

(iii) Director of reseach and publication,

MUHAS,

P.O.BOX 65001

Dar es salaam.

Hitimisho

Nimepewa na nimeelewa maelezo yote hapo juu, maswali yangu yote yamejibiwa, nimekubali/sijakubali kushiriki kwenye utafiti huu

Sahihi ya mzazi/mlezi .....

Sahihi ya mtafiti .....

Date.....

Appendix II

DISCHARGE CRITERIA FOR CHILDREN FROM THE RECOVERY ROOM

The patient must demonstrate the following criteria to be discharged from the Pediatric PACU:

A) Hemodynamic, respiratory and neurologic stability

1. Stable vital signs with BP, P and R being within 20% of baseline. BP is required on admission an thereafter, but this monitoring may be waived by the anesthesiologist
2. Neurologic status at pre Surgrcal baselines
3. Stable respiratory status, 02 Saturation > or = to 95%, ability to maintain and protect the airway. Clear bilateral breath sounds
4. Absence of excessive bleeding
5. Activity – movement of extremities

Post anesthetic Aldrete recovery score is used to evaluate the above parameters

B) Normothermia.

C) Pain score less or = 3/10

D) Urinary output 1-2 mls/kg/h when catheterized

Appendix III

ALDORETE SCORE

Able to move 4 extremities voluntarily or on command = 2

Able to move 2 extremities voluntarily or on command = 1 ACTIVITY

Able to move 0 extremities voluntarily or on command = 0

Able to deep breathe and cough freely = 2

Dyspnoea or limited breathing = 1 RESPIRATION

Apnoeic = 0

BP" 20% of Pre anesthetic level = 2

BP" 20-50% of Pre anesthetic level = 1 CIRCULATION

BP" 50% of Pre anaesthetic level = 0

Fully Awake = 2

Arousable on calling = 1 CONSCIOUSNESS

Not responding = 0

Pink = 2

Pale, dusky blotchy, jaundiced, other = 1 COLOR

Cyanotic = 0

Appendix IV:American society of Anaesthesiology classification

ASA	Patient's Health	Status of Under-lying Disease	Limitations on Activities	Risk of Death
I	excellent; no systemic disease; excludes persons at extremes of age	None	none	None
II	disease of one body system	well-controlled	none	None
III	disease of more than one body system or one major system	controlled	present but not incapacitated	no immediate danger
IV	poor with at least 1 severe disease	poorly controlled or end stage	incapacitated	Possible
V	very poor, moribund		incapacitated	Imminent

*ASA I excludes chidren< 6month and premature babies

Appendix V: PATIENT OBSERVATION CHART

File no…….. Date……

Age (month)……. Sex…..... ASA…….

Type of surgery……

Baseline information;- (i) Time……..

BP……..., PR……, RR……. Temp……..

(ii) Time……..

BP…….PR……..RR……..Temp…….

Induction; Time……..

Drugs;- Atropine(mg)……., Halothane(%)……, Suxamethonium(mg)……

ETT size ……

Caudal block;-Time performed ……, bupivacaine0.25%(mg)……..

Intraoperative ;-Observations

Incision time (min)……. BP……. PR…….. RR……

(After skin incision)

5 min BP……..,PR……..,RR……Inspired conc of halothane(%)……..

10 min BP…….,PR……..,RR……Inspired conc of halothane(%)……

15 min BP…….,PR……..,RR……Inspired conc of halothane(%)…….

20 min BP……,PR……RR……...…Inspired conc of halothane(%)……

30min BP…….,PR……..,RR……... Inspired conc of halothane (%)…….

Maintenance fluid (mls) …….

Supplementary opioids……, Time (min)……

Paracetamol Suppository insertion Time (min)…… Dose……...

Postoperatively

Recovery .Time……FLACC score……..

Ward FLACC score…….after every 30 minutes

Time for rescue analgesia…… Dose(mg)…….

Complications

Nausea

Vomiting,

Bleeding from the site of injection,

Motor /leg weakness,

Behaviour disturbance,

FIGURE 1: ANATOMY OF THE SUCRUM POSTERIOR VIEW

(Showing the sacral canal) by Porterfield etal [34]

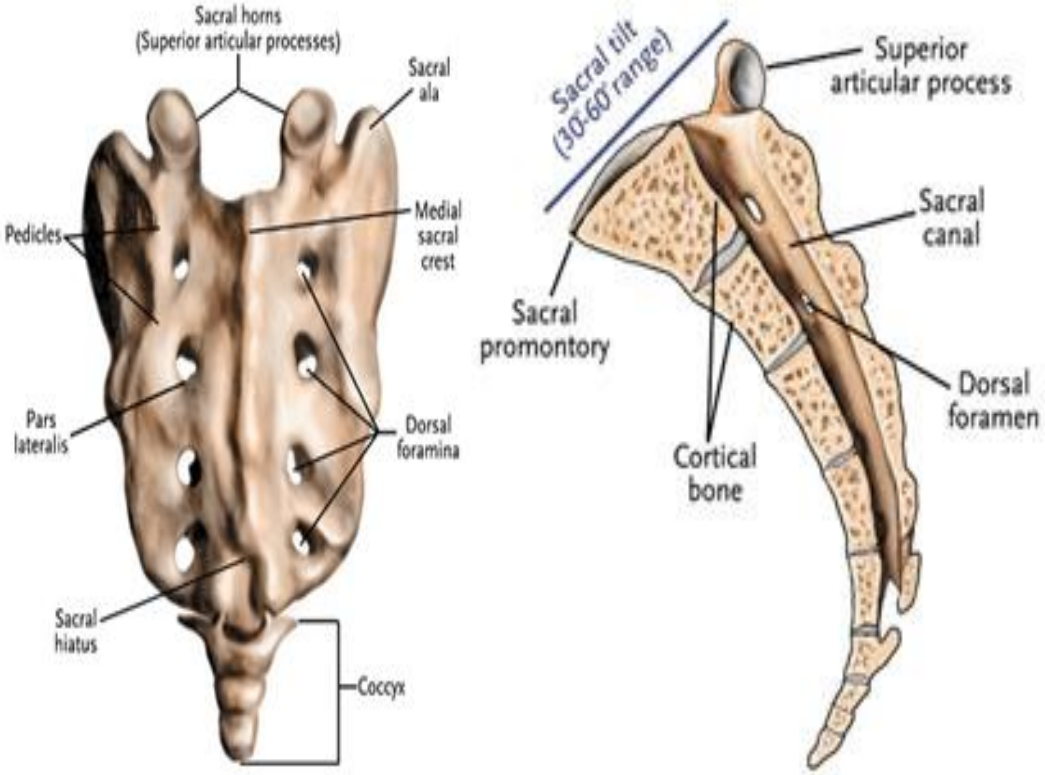
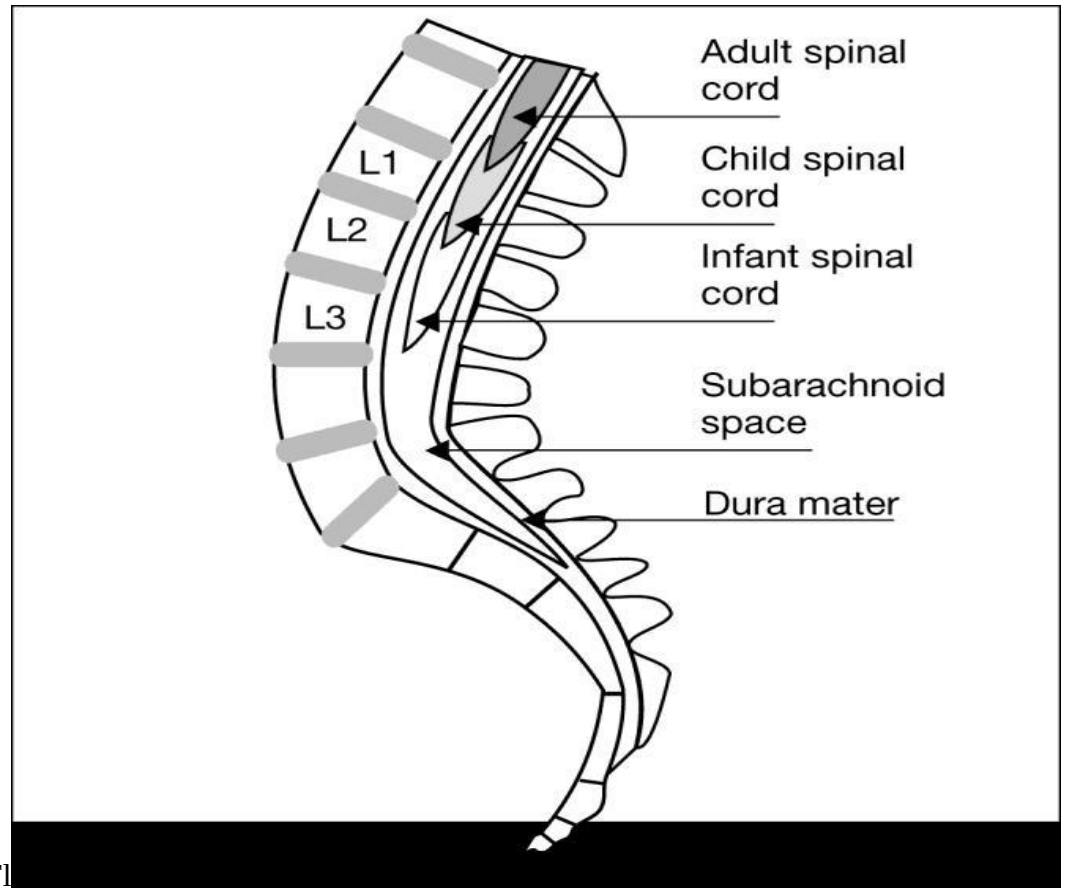


FIGURE 2: LEVEL OF SPINAL CORD AND SUBARACHNOID SPACE by Porterfield etal [34]



Fl

Figure 3. Patient Positioning. Shown is left lateral position with hips Maximally flexed by Bainbridge, W etal [66]

Figure 4. Landmarks for caudal anaesthesia. Shown are posterior superior iliac spines (two fingers) which form equilateral triangle with sacral cornea (single finger)by Bainbridge, W etal [66]

- Posterior superior iliac spines and sacral hiatus form equilateral triangle.
- Sacral Cornua either side of hiatus (0.5-1.0 cm apart).
- Dural sac extends to S4 in the infant less than 1 year (S2 in the adult)

Figure 5. Needle advancement in caudal block. Cannula is cephalic in a cephalic direction. Occasionally, a pop is felt as the sacrococcygeal ligament is penetrated. At this point the cannula is advanced a few 2-4 mm off the needle. By Bainbridge, W etal [66]

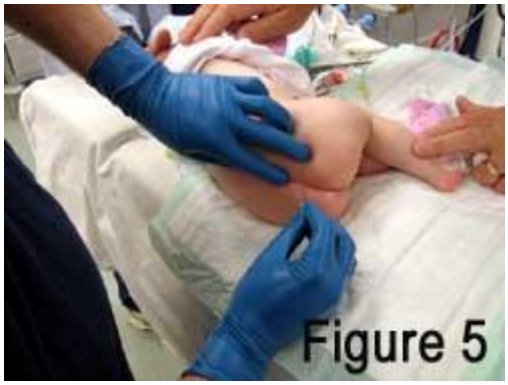


Figure 6. Cannula placement. Easy passage of the cannula confirms correct placement. by Bainbridge, W etal [66]