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Case Report

Post-Herniotomy Pain Management at Federal Medical Centre Umuahia: A Case Report and Literature Review

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Abstract

Background: hernia is a protrusion of viscus through a defect in the wall of an organ. inguinal hernia has a peak incidence in infancy and childhood and, represents about 70% of all hernias. surgery (herniotomy) is the recommended treatment for paediatric inguinal hernia. Post-operative pain relief in children poses a challenge to physicians especially in resource-limited settings. Consequently, effective and cost-beneficial post-operative analgesic regimens are essential for optimal care of children who receive surgeries in such environments. Case presentation: we report a case of master b, a 30-month-old boy who had herniotomy at the main theatre of federal medical centre, umuahia, abia state, nigeria for inguinal hernia of 7 months duration. bupivacaine caudal analgesia (with neostigmine adjuvant), nitrous oxide and halothane were employed for surgical anaesthesia. Post-operatively, a single dose of diclofenac suppository (25mg) and regular paracetamol were employed to achieve effective post-operative analgesia. Conclusion: we presented caudal anaesthesia/ analgesia, diclofenac suppository and paracetamol as co-analgesic regimen for post-herniotomy pain relief. If a child received caudal anaesthesia/analgesia for herniotomy, such non-opioid combined regimen could be recommended for effective post-operative analgesia.

Keywords: 'Herniotomy' 'caudal-anaesthesia' 'diclofenac' 'paracetamol' 'co-analgesic'.

INTRODUCTION

A hernia may be described as protrusion of tissue or organ through a defect in the wall of its cavity; it is usually noticed at points of structural weakness. Different types such as inguinal, umbilical, epigastric, hiatus and incisional hernias have been described. Inguinal hernia is most common, constituting about 70% of all hernias and is more in males than females, due to obvious anatomical differences. Paediatric inguinal hernia may occur at any age however, peak incidence is recorded during infancy and early childhood, (Lee *et al.,* 2011). Incidence of inguinal hernia is high amongst premature infants (30%) compared to 3-5% in healthy babies. In its early stages, paediatric inguinal hernia presents with groin swelling that is more pronounced when a child cries or strains. The swelling progresses with time and may present with pain, physiological and behavioural changes and, if obstructed or strangulated, would require urgent surgical intervention.

The recommended treatment for paediatric inguinal hernia is herniotomy, usually performed electively when an infant with inguinal hernia reaches 6 months or older. If the hernia is irreducible, obstructed or strangulated, emergency herniotomy becomes mandatory. Herniotomy may be performed traditionally (open) or laparoscopically. A male neonate's processus vaginalis is usually open at birth; this closes before two years of age. During open herniotomy, the patent processus vaginalis (sac) is separated from the spermatic vessels and vas deferens,

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its neck transfixed at the external inguinal ring and excised. The surgical wound is closed thereafter. Laparoscopic herniotomy is attractive because it provides better cosmesis; reduced post-operative pain and adhesions, (Lee *et al.,* 2011). However, equipment and skills for such are not universally accessible.

Post-operative pain after this procedure may be distressful to the child and his carers. Adequate postoperative analgesia is necessary to ensure patient comfort, prevent adverse physiological and psychological sequalae and forestall central sensitization and development of chronic pain states, (Sinatra, 2010). Effective postoperative analgesia also facilitates early mobilization, less postoperative complications and hospital stay. Different methods of postoperative analgesia such as opioid therapy, simple analgesics with non-steroidal anti-inflammatory drugs (NSAIDS), caudal analgesia and wound infiltration have been employed following herniotomy. Opioids are effective in postoperative pain management but they are associated with deleterious side effects like respiratory depression, sedation/drowsiness, constipation, nausea and vomiting, (Wheeler *et al.,* 2002).

NSAIDS and caudal analgesia are popular in the postoperative pain management of these children because they are effective and possess better side effect profile than opioids. This analytical case report considers a child who received caudal anaesthesia with 0.25% bupivacaine and diclofenac suppositories with oral paracetamol for pain relief after elective herniotomy. It will also consider other evidence-based postoperative pain relief strategies in children who receive such intervention. Evidence from research will be used to support or discourage these interventions.

CASE HISTORY

Master B, a 30 months old boy with a 7 months history of progressive right inguinal hernia was admitted to the paediatric surgical ward of the Federal Medical Centre Umuahia for elective herniotomy. There was no history of intercurrent medical ailment and he had not experienced surgery or anaesthesia previously. Master B weighed 12.0kg on admission to the ward. Preoperative assessment revealed no other medical abnormality. His haemoglobin concentration was 14.8g/dl. Other laboratory results were within normal limits. Postoperative analgesic options and fasting protocol were discussed with the mother and written informed consent for anaesthesia, post-operative pain management and surgery was obtained from her.

Surgery was performed under caudal epidural anaesthesia using 12mls of0.25% plain bupivacaine (1ml/kg) plus neostigmine (18µg). This was preceded by sedation with 0.75-2% halothane, which was maintained intra-operatively at 0.6-0.8% in 100% oxygen at a flow rate of 3L/min via a face-mask. The herniotomy (open) lasted about 29 minutes and intra-operative blood loss was less than 20mls. The total duration of anaesthesia was 45 minutes and the patients cardiovascular, respiratory and neurological status remained stable throughout the procedure. A single dose of diclofenac rectal suppository (25mg) was administered at the end of the surgery. He was transferred to the recovery room following recovery from anaesthesia.

In the recovery ward, a FLACC score of 3/10 was noticed after 2 hours and he was given intravenous paracetamol 200mg (15mg/kg) stat. After a total of 3 hours observation in the recovery ward, his temperature and vital signs were stable and FLACC score improved to 2/10. He was then transferred back to the ward. In the surgical ward, postoperative pain was controlled with syrup paracetamol 150mg 6-hourly for 24 hours. He became ambulant and voided urine about 6 hours after surgery. Oral diet was commenced at this time too. After 24 hours of satisfactory postoperative recovery with a mean FLACC score of 3/10, Master B was discharged home on syrup paracetamol 150mg to be taken 6-hourly. His mother was advised to strictly administer the analgesic by the clock and at the dose prescribed for the following 6 days. The patient was scheduled for review at the surgical outpatient clinic at the 7thpost-operative day.

LITERATURE REVIEW AND CRITICAL ANALYSIS

A survey had shown that 40% of paediatric surgical patients experienced moderate to severe postoperative pain and 75% of these had insufficient analgesia, (Mather and J Mackie, 1983). Although numerous methods of postoperative analgesia have evolved thereafter, postoperative pain in children still presents a challenge to clinicians. Postoperative pain may have adverse physiological, psychological and social sequalae if not properly managed. Physiological manifestations of postoperative pain are multi-systemic and include increased secretion of stress hormones and oxygen consumption, elevated blood pressure and heart rate, at electasis, pneumonia, depressed immunity and delayed wound healing, (Sinatra, 2010; Lonngvist and Morton, 2005). While it is also associated with negative mood and behavioural changes, inadequate management may lead to central sensitization and development of chronic pain states, (Sinatra, 2010). Therefore, Safe and effective postoperative management techniques are necessary to reduce associated morbidity and mortality.

Several paediatric postoperative analgesic regimens have been described, (Lonngvist and Morton, 2005; McNeely *et al.,* 1997). Although various degrees of success are reported, these protocols share the same principles of multi-modal analgesia, (Lonngvist and Morton, 2005; Morton, 1996). This involves co-analgesia with different combinations of analgesics, namely local

anaesthetics, opioids, non-steroidal ant-inflammatory drugs and acetaminophen, (Lonngvist and Morton, 2005). The inclusion of local/regional analgesic techniques is encouraged in treatment of all paediatric postoperative pain states except where it is contra-indicated, (Lonngvist and Morton, 2005; Morton, 1996; Kokinsky and Thonrnberg, 2005).

Caudal analgesia is the favourite technique for post-herniotomy pain management, (Mahajan *et al.,* 2004). It is the most commonly performed regional block in the developed world for paediatric surgical procedures below the umbilicus and the lower limbs. Injection of local anaesthetic into the caudal canal blocks neural transmission through the sacral and lumber nerve routes. It may be used to supplement general anaesthesia and for provision of postoperative pain relief. The procedure is performed after a child has been sedated. Correct placement of the needle may be confirmed by auscultation of the needle site ("the swoosh test"), (Orme and Berg, 2003). However, ultrasound has been used recently to locate sacral hiatus and visualize local anaesthetic injection into the sacral epidural space, (Samuel *et al.,* 2002). However, duration of postoperative analgesia after a single shot of caudal bupivacaine is limited. Adjuncts to caudal bupivacaine such as opioids, epinephrine, neostigmine and ketamineare known to prolong the duration of postoperative analgesia. Its duration of action may be prolonged by caudal catheter, which allows intermittent and continuous infusion of local anaesthetic agents. However, a high risk of infection and catheter displacement associated with this technique makes it unpopular, (Kost-Byerly *et al.,* 1998)

Master B had caudal epidural anaesthesia using 0.25% plain bupivacaine and neostigmine. Bupivacaine is an amide local anaesthetic agent that is widely used in caudal anaesthesia because of its long duration of action (2-4 hours) and relatively beneficial ratio of sensory to motor blockade. Maximum safe dose of bupivacaine is 2.5mg/kg as a single injection, (Eyres *et al.,* 1983). Likely side effects of caudal bupivacaine include urinary retention, motor block, cardiovascular and central nervous system toxicity.

In this patient, neostigmine was added as an adjuvant to caudal bupivacaine. Neostigmine is an anti-cholinergic, which consists of a carbamate moiety and a quaternary ammonium group. It does not pass through the blood brain barrier. Neural administration of neostigmine inhibits the breakdown of epidural acetylcholine, which has been shown to produce analgesia, (Yaksh *et al.,* 1996). Safety of neuroaxial neostigmine is well documented and studies have shown significant increase in duration of analgesia when it is combined with bupivacaine compared to administration of caudal bupivacaine alone, (Mahajan *et al.,* 2004). Side effects of neostigmine such as bradycardia, increased bronchial secretion, salivation and nausea/vomiting are minimal following caudal administration. This is due to the relatively small doses of neostigmine used (1.5-3µg/kg) and minimal systemic spread.

Several randomised clinical trials have assessed the efficacy of caudal bupivacaine with neostigmine for postoperative analgesia in paediatric lower abdominal and lower limb surgeries. Mahajan *et al.,* (2004), conducted a randomised control trial on 80 boys who had repair of hypospadias under caudal anaesthesia. The study evaluated the analgesic efficacy of caudal bupivacaine (0.5ml/kg of 0.25% concentration) alone (group-I) or in combination with neostigmine (groups II-IV) in doses of 2, 3 and 4µg/kg. They reported a similar, dose-independent analgesic effect (groups II-IV) using escalated doses of caudal neostigmine with caudal bupivacaine in children. Duration of analgesia was significantly longer in the bupivacaine plus neostigmine groups (16.9, 17.2 and 17.1 hours) compared with the group that had only bupivacaine (5.1 hours), $p<0.05$. However, duration of analgesia may have been enhanced by the prolonged use of nitrous oxide (a potent analgesic) intra-operatively. A significantly larger total analgesic consumption in the group that received bupivacaine alone ($p<0.05$) was also reported. However, Pain interpretation and behaviour across the wide age range (2-8 years) may be dissimilar thereby affecting uniformity of standard and results obtained. The use of non-validated pain assessment tool such as 'modified observational pain scoring system' could affect credibility of the results. It would have been more appropriate to use validated, age related pain assessment tools such as FLACC, Faces and paediatric visual analogue scales in order to maintain standard; instead of the singular pain assessment tool used in the study. Interestingly, despite prolonging the duration of analgesia by about 300%, caudal bupivacaine and neostigmine combination therapy shared similar side effect profile with caudal bupivacaine alone in postoperative pain management of the children in the study.

A related randomised controlled clinical trial, which compared the postoperative analgesic effects of caudal bupivacaine alone with caudal bupivacaine and neostigmine was reported in 2014. They reported a significantly prolonged duration of analgesia in the group that had bupivacaine plus neostigmine (460±60.2 minutes) compared to the group that received bupivacaine alone (286.4± 47.8 minutes), $p<0.001$. Although, their result confirms that combination of caudal bupivacaine with neostigmine significantly extends the duration of analgesia in this age group, the wide standard error of mean raises a suspicion of type 2 error. They also observed that children, who received caudal bupivacaine alone, consumed more analgesics ($p<0.001$). Neuraxial local anaesthetics reduce blood pressure by decreasing sympathetic outflow.

The higher haemodynamic values observed in the neostigmine plus bupivacaine group may be explained by a reported stimulatory effect on sympathetic outflow by

neostigmine, (Yaksh *et al*., 1996). However, this difference in haemodynamic parameters between the two groups was not statistically significant. One patient in the neostigmine with bupivacaine group had fever 4 hours post-surgery. Fever may be sign of infection, which could complicate surgery and/or neuraxial technique, especially when there is a breech in asepsis, (Manzar and Mujeeb-Ur-Reliman, 2009). The fever was attributed to malaria and the child promptly responded to tepid sponging, antipyretics and anti-malarials. There was no incidence of respiratory depression in this study. In contrast, respiratory depression is common following neuraxial administration, this is attributed to the effect of the drug on the intercostal nerves or brainstem (ventral medulla) following a cephalad spread, (Etches *et al.,* 1989)

In a systematic review and meta-analysis that compared caudal blockade and alternative strategies for paediatric inguinal hernia repair in children, (Kokinsky and Thonrnberg, 2005). RCTs involving caudal analgesia, wound infiltration and regional blocks were analysed. No significant difference in postoperative pain scores or rescue analgesics was found between the three interventions. However, caudal analgesia is still considered unique because it provides adequate intra-operative and postoperative analgesia compared to local infiltration. The technique of caudal analgesia is simpler than the other regional nerve block techniques. Moreover, caudal block is effective for a wider area than the alternative techniques analysed and provides adequate analgesia for bilateral operations when required, (Baird *et al.,* 2013).

Another analgesic used in postoperative pain management of Master B was paracetamol. It is a simple analgesic with antipyretic but no anti-inflammatory properties. It is well tolerated in children and although there is insufficient evidence of its analgesic supremacy over other NSAIDS, it has a safer adverse effect profile, (Kokinsky and Thonrnberg, 2005). It may be given orally, rectally of intravenously. Intramuscular injection is painful; absorption is also unpredictable hence not commonly used in children, (Kokinsky and Thonrnberg, 2005).

A randomised double-blind placebo controlled clinical trial, found that intravenous paracetamol had similar analgesic efficacy and opioid sparing effect compared with dipyrone in paediatric day-case tonsillectomy, (Kocum *et al.,* 2013). The study also showed that both paracetamol and dipyrone significantly reduced pethidine requirement compared to a placebo. However, pethidine and dipyrone used in this study have become unpopular in pain management because of their high side effect profiles, (Wheeler *et al.,* 2002). Paracetamol is preferred as a co-analgesic in paediatric postoperative pain management, (Lonngvist and Morton, 2005; Kokinsky and Thonrnberg, 2005).

ALTERNATIVE MANAGEMENT

Another postoperative analgesic regime that could have been offered to Master is wound infiltration with diclofenac suppository. This multimodal analgesic protocol would have blocked transmission of nociceptive stimuli from the site of surgical injury as well as minimized inflammatory response to surgical injury. Master B's herniotomy could have been performed under general anaesthesia with nitrous oxide, intravenous paracetamol, sevoflurane, and oxygen. Wound infiltration with bupivacaine would then be administered after surgical wound closure but before wound dressing and reversal of general anaesthesia. This may have been achieved by sub-cutaneous injection of 6ml plain bupivacaine 0.25%, throughout the length and about 1cm from the edge of the surgical wound on both sides. This would supplement 25mg diclofenac suppository (12 hourly) starting at the end of surgery until discharge from the hospital. Any breakthrough pain in the ward wouldbe controlled by syrup paracetamol 200mg as required. The child would be discharged home on paracetamol syrup 200mg 6 hourly until review at the surgical clinic at the 7th postoperative day.

Bupivacaine is a local anaesthetic agent, which causes reversible blockade of norciceptive impulse transmission by prevention of generation of action potential. To achieve this, bupivacaine reversibly binds to sodium ion channels intracellular. Wound infiltration provides analgesia while avoiding side effects such as muscle weakness, urinary retention, haemodynamic fluctuations and accidental intrathecal injection, which can occur in caudal analgesia, (McNeely *et al.,* 1997). Many clinical research papers have compared postoperative wound infiltration with caudal analgesia and other methods of paediatric postoperative pain management, (Fell *et al.,* 1988) conducted a randomised control trial which compared the analgesic efficacy of wound infiltration with caudal analgesia in children who had day-case herniotomy, (Fell *et al.,* 1988). Plain bupivacaine (0.25%) was used in the two interventions. Surgery was performed under general anaesthesia and the children were monitored for 4 hours postoperatively before discharge home. They noticed that wound infiltration provided similar postoperative analgesia compared with caudal analgesia.

However, sensitivity of the study may have been diminished by their use of '3-point verbal rating scale' in pain assessment. Classification of the pain experience of the toddlers involved in the study into mild, moderate and severe pain may not have been robust enough to differentiate the analgesic qualities of the two interventions. Although they reported similarity of side effects in both groups, 2 children in the caudal analgesia group (8%) and none in the wound infiltration group experienced urinary retention. Wound infiltration is a simple, quick and effective technique of postoperative pain management with minimal side effect profile, (Baird *et al.,* 2003). Possible side effects such as systemic

toxicity, wound infection and injury to contagious structures, demand meticulous attention to details. However, wound infiltration may be attractive because it requires less time, material resources and expertise compared to caudal analgesia.

Later on, another randomised control study confirmed that wound infiltration with 0.25% bupivacaine provided effective postoperative analgesia that is similar to caudal analgesia using the same local anaesthetic agent, (Machotta *et al.,* 2003). They also reported no significant difference in opioid consumption, duration of analgesia, side effect profiles and time of discharge from the post anaesthetic care unit between the two interventions. Their findings suggest that wound infiltration may be employed as a viable alternative to caudal analgesia. This method might be encouraged because it also avoids the risk of accidental intravenous injection and total spinal anaesthesia that has been reported using caudal analgesi, (Eyres *et al.,* 1983; Desparmet, 1990).

As an alternative, Master B would have received diclofenac suppository pre-emptively as a co-analgesic. Local inflammation occurs due to surgical injury, which leads to exudation of protons and neurotransmitters and attraction of immune cells to the damaged tissues. The immune cells release inflammatory mediators like prostanoids and bradikinins (prostaglandins) that sensitize and decrease the firing threshold of local nociceptors, (Kokinsky and Thonrnberg, 2005). Diclofenac is a non-steroidal anti-inflammatory drug that prevents prostaglandin synthesis via inhibition of the cyclo-oxygenase enzyme. Thereby reducing inflammation and pain, a randomised control trial, which compared the efficacy of caudal analgesia with rectal diclofenac after herniotomy, found rectal diclofenac to be a useful alternative to caudal analgesia in children, (Moores *et al.,* 1990). The study revealed that, rectal diclofenac reached comparable analgesic levels with caudal bupivacaine within 2 hours postoperatively. This might be explained by the delay in onset of action of rectal bupivacaine. Presence of faecal matter is known to delay onset of action and achievement of peak plasma concentration of drugs administered rectally, (Kokinsky and Thonrnberg, 2005). Other possible side effects of diclofenac such as renal toxicity and interference with platelet aggregation, call for caution with its use. Thus, diclofenac is unsuitable for children with renal failure, dehydration, heart failure or asthma, (Moores *et al.,* 1990). However, when used for 1-3 days for postoperative pain, NSAIDS do not produce gastro-intestinal problems than placebo.

REFLECTIVE ANALYSIS

Master B needed effective postoperative analgesia after an elective herniotomy. It has been shown that adequate postoperative pain relief is required for good recovery, (Lonngvist and Morton, 2005). The preferred regimen should give effective post-operative pain relief with few side effects, (Kokinsky and Thonrnberg, 2005). He was a healthy child with no co-morbidities besides inguinal hernia. Intra-operative blood loss was also insignificant. This enabled a fair selection from a range of available postoperative analgesic options. Herniotomy is a procedure that is usually performed as day case surgery, (Fell *et al.,* 1988). However, parents to Master B lived far away from the hospital and their social circumstances did not satisfy criteria for day case surgery. Caudal epidural anaesthesia was chosen because it provides good surgical anaesthesia for herniotomy and effective analgesia in the immediate post-operative period. Postoperative analgesia was supported by single dose of diclofenac suppository and maintained with regular paracetamol. Although opioids may have offered alternative analgesia, the regimen described above, effectively controlled Master B's postoperative pain.

This regimen agrees with some authors who believe that post-herniotomy pain is not sufficiently painful to justify routine use of narcotic analgesics, (Smith and Jones, 1982). Known adverse effects of opioids (earlier mentioned) made their use in this instance less attractive. Caudal analgesia has been shown to sustain postoperative pain relief for about 17 hours, (Mahajan *et al.,* 2004). Paracetamol was commenced as pre-emptive analgesia before the expected expiration of the effects of caudal analgesia; it was thereafter continued for 6 days with satisfactory results. It is interesting that possible side effects of caudal anaesthesia such as urinary retention, motor weakness or haemodynamic fluctuations, were not encountered.

Wound infiltration is another viable alternative that could have been employed in the management of Master B's postoperative pain. Although studies analysed did not specify duration of analgesia obtainable with wound infiltration, concurrent administration of diclofenac as co-analgesic would have addressed such concerns. Onset of action of 2 hours following administration of rectal diclofenac has been reported, this enables onset of analgesia before the analgesic effect of wound infiltration with bupivacaine is lost (>4 hours), (Fell *et al.,* 1988; Desparmet, 1990; Moores *et al.,* 1990). This combination is attractive because the technique is simpler and requires less time resources than the regimen used for Master B. However, careful patient selection is required to achieve satisfactory outcome.

CONCLUSION

This report presented caudal epidural anaesthesia/ analgesia, diclofenac suppository and paracetamol as co-analgesic regimen for post-herniotomy pain relief. If a child received caudal anaesthesia/ analgesia for herniotomy, such non-opioid combined regimen could be recommended for effective post-operative analgesia. This

promises an effective and affordable paediatric post-operative analgesic regimen that could be employed following herniotomies and other lower abdominal surgeries in children. Especially in resource challenged settings were opioids and equipment for monitoring of opioid side-effects may be limited.

Conflict of interest: None

Sponsors: None.

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