



Continuous caudal analgesia as a safe and effective method for pediatric post - chordectomy analgesia



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ABSTRACT

It brings great satisfaction for medical officers to be able to see children smiling, laughing, and playing without pain after surgery, yet many children still experience inadequate postoperative pain management. This phenomenon could lead to serious immediate and long term effects in the pediatric patient. Disruption of the healing process caused by pain could become the source of morbidity and mortality in the early postoperative period. Opioid side effects and transformation from acute to chronic pain due to inadequate analgesia are other

problems met when dealing with postoperative pain management. This is where regional analgesia takes advantage. Caudal analgesia is an old yet very popular method in pediatric anesthesia and has gained widespread use. It can be delivered as a single injection or continuous infusion. The continuous technique provides a longer duration of analgesia than single injection does. We report a satisfying result from using continuous caudal analgesia for post chordectomy pain management in a 5-year-old boy.

Keywords: *pediatric, postoperative pain, continuous caudal analgesia*

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INTRODUCTION

Undertreated postoperative pain in a pediatric patient could lead to detrimental effects not just in immediate but also in long term postoperative period. Healing process disruption through ongoing catabolic stress, sleep deprivation, decreased appetite, and lack of early ambulation caused by pain can be the source of serious morbidity and mortality in the early postoperative period. Evidence from recent studies has shown that intense pain in early life could increase a child's sensitivity to pain in his/her later life through nociceptive activation of multiple brain regions.¹ Many methods have been used to achieve postoperative pain relief, either alone or in combinations. The goal is not just to relieve the pain, but also to hasten the patient's recovery process, thus, avoiding or minimizing side effects is a crucial part in pediatric postoperative pain management.

Caudal analgesia is an old yet very well known method in pediatric regional anesthesia and has gained popularity for its advantages, like providing excellent analgesia and facilitates early ambulation, relatively easy, quick, and safe to conduct, can be given as a single injection or continuous infusion, can reduce the amount of systemic analgesia consumption thus reducing its adverse effects, and can be implemented in a lot of procedures, either intraoperatively (usually combined with general anesthesia to decrease the amount of volatile agents

and opioid used) or postoperatively as a part of acute pain management.^{2,3} Single shot injection can cover all kinds of infraumbilical surgery but within a limited duration of time. Threading catheter into epidural space allows for continuous coverage even for higher locations such as upper abdominal and thoracic regions with less amount of local anesthetic loading dose. Most anesthesiologists are also more familiar with caudal block than with other pediatric regional anesthesia techniques such as peripheral nerve block.⁴

CASE REPORT

A 15 kg, 5-year-old boy diagnosed with webbed penis and chordae was scheduled for elective release web and chordectomy. He has admitted with American Society of Anesthesiology physical status I. Physical examination revealed no vertebrae anomaly and the sacral hiatus was easily identified. The patient was planned for general anesthesia and continuous caudal analgesia. We provided written informed consent to the parents for the possibility of future publications of this case.

He was premedicated with 1 mg of intravenous midazolam. Standard monitoring like pulse oximetry, electrocardiography, noninvasive blood pressure, and temperature measure was applied. The patient was induced with sevoflurane and oxygen. Intravenous atracurium at 0.5 mg/kg dose was administered to facilitate intubation. After

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confirming the proper position of an endotracheal tube and securing it, the patient was placed in the left lateral position for caudal catheter insertion.

A short 20G intravenous catheter was introduced into caudal space via sacral hiatus under sterile technique. After piercing sacrococcygeal ligament, the cannula was advanced into the caudal space while the needle was withdrawn to provide an entry for local anesthetic and epidural catheter. We delivered a loading dose of 0.75 ml/kg of 0.25% bupivacaine into caudal epidural space after confirming no aspiration of blood and cerebrospinal fluid. This action was followed by the insertion of 5 cm of a 24G epidural catheter into the same space. The puncture site was covered with a sterile transparent dressing and the catheter was tunneled. The rest of the catheter was brought over the shoulder and secured to chest skin with tape. The patient was then turned back into supine position.

The surgery went uneventfully and lasted for 1 hour and 15 minutes. Sevoflurane concentration was reduced to 1.2% during the whole procedure. Upon completion, sevoflurane was ceased and muscle relaxant was reversed with neostigmine and atropine sulfate. The patient was then extubated and awoke without any remarkable event.

Postoperative pain was managed only with the caudal continuous infusion of 0.0625% bupivacaine at a rate of 2 ml/h (0.13 ml/kg/h) for 72 hours. There was no need for rescue or additional systemic analgesia from an immediate postoperative period until the removal of epidural catheter at the 4th postoperative day. Wong-Baker Faces Pain Rating Scale was always 0 during this period. Hemodynamic profile remained stable with no signs of local anesthetic systemic toxicity. No side effects such as nausea or vomitus were encountered during the 72 hours. We could not assess the effect of caudal analgesia on urinary retention due to urinary catheter placement. The patient was able to walk in his room since the 1st day after surgery, indicating no motor weakness caused by caudal analgesia. The daily inspection revealed no signs of catheter-related infection or other complications due to its placement in epidural space. The catheter was removed after 72 hours without any difficulties and pain management was switched to an oral regimen.

DISCUSSION

Caudal analgesia is basically an epidural block conducted via sacral hiatus. It is a relatively a safe procedure and has a high success rate of insertion in the pediatric group even if it is established in blind fashion way since sacral hiatus is easy to identify until 7-8 years of age.⁵

The caudal approach has a lower risk of the dural puncture as compared to lumbar or thoracic approach. The distance between the apex of sacral hiatus and dural sac has a mean value of 1.78 cm at 4-6 years of age.⁶ As long as the needle is not too far advanced (2-3 mm is sufficient) after piercing sacrococcygeal ligament, one might avoid intrathecal injection. Our patient was 5 years old without any vertebrae anomaly, thus it was relatively easy to identify his sacral hiatus. Aspiration went negative for blood and cerebrospinal fluid. The caudal block was successfully performed on the first attempt.

A caudal block is a relatively safe procedure regarding cardiovascular state in children up to 8 years of age. Vasodilation induced by caudal block causes only minimal blood pooling in legs because of a relatively low circulation volume in the lower part of the body.⁴ Even this vasodilation is compensated by vasoconstriction in innervated areas like arms. However, it is important to keep patient in the normovolemic state because hypovolemia could lead to severe hypotension. Another mechanism involved is increased descending aortic blood flow from caudal block.⁷ All of these factors are responsible for the maintenance of cardiac output. 0.25% bupivacaine did not cause any hemodynamic disturbance in our patient, furthermore the 0.0625% concentration which was far below.

Caudal analgesia has been acknowledged by many experts a versatile method, one technique for many procedures, especially in the thoracic, upper abdominal, and infraumbilical surgeries. One does not have to perform different blocks for every different procedure, and it covers a wider area with less volume of local anesthetic than peripheral nerve block does. It also gives an advantage of not having to block two sides for bilateral procedures.⁸ In our case, an incision was made midline at scrotal and ventral penis area, so caudal analgesia was a proper choice for our patient.

The caudal block can be performed as a single shot or as a continuous technique. The significant drawback of a single shot injection is its limited duration. Even by adding adjuvants, it still cannot last for days. Single shot technique is also reliable only for infraumbilical procedures. Continuous caudal block solves both of these problems. By threading catheters into epidural space and adjust its location within to reach the desired dermatomal level, it provides continuous delivery of drugs for a longer duration of analgesia as compared to single injection technique, and coverage of even supraumbilical region with less amount of local anesthetic loading dose.⁵ We took advantage of a longer duration of analgesia (72 hours) from the continuous technique which cannot be provided by a single injection.

As with any other methods, the continuous technique is not without flaws. Coiled catheters may occur leading to inadequate analgesia to the desired dermatome level. It even requires large bore catheters or catheters with the stylet to properly place the catheter tip at a higher level such as the thoracic region.⁵ However, in our case, we did not aim for a high dermatome level of analgesia since the surgery area was infraumbilical. Some other rare reported complications are retained catheter fragments and pseudomeningocele after catheter removal which we did not encounter.^{9,10}

The proximity of catheter insertion site to the anal region has led to a concern about the risk of infection caused by fecal contamination, and it is advised not to leave the catheter in its place for more than 36-48 hours. However, the risk of infection can be reduced by tunneling the catheter subcutaneously, using clean occlusive dressing, and routine daily inspection.^{5,11} In fact, there was no correlation between catheter implantation duration and bacterial colonization in tunneled catheters.¹² We conducted all of the three measures and found no signs of catheter-related infection even after 72 hours.

Continuous technique raises more concern regarding systemic toxicity especially in neonates and young infants due to lower levels of serum albumin and alpha1-acid glycoprotein. A few adjustments are necessary for this group of age. The loading and maintenance doses should be reduced by 50 % and the infusion rates should be reduced by one-third after 24 hours and terminated after 36 hours to avoid accumulation.¹³ It was not necessary to adjust the dose and duration of infusion in our patient since he was already 5 years old.

We found no signs of local anesthetic systemic toxicity in our patient both during the surgery and postoperative period. Several measurements were made to prevent this from happening. The bupivacaine loading dose for intraoperative anesthesia did not exceed its maximum dose which is 2.5 mg/kg (1.8 mg/kg in our case). The bupivacaine continuous rate was far below its maximum recommended dose for his age which is 0.4 mg/kg/h (0.08 mg/kg/h in our case). And last, our patient was neither neonates nor infant, thus lower risk for drug accumulation after a certain duration of local anesthetic infusion.

Levobupivacaine and ropivacaine are replacing bupivacaine in daily practice for having similar analgesic potency to bupivacaine but with the less motoric blockade and systemic toxicity risk. However, bupivacaine may still be used as long as the recommended doses are strictly followed.

The concentration of 0.0625-0.125% of levobupivacaine and 0.1-0.2% of ropivacaine have been used for epidural infusion without any evidence of accumulation.¹⁴⁻¹⁶

Caudal analgesia reduced the risk of systemic opioid side effects. The reduced risk of respiratory depression is very beneficial in former preterm infants as postoperative apnea risk is high in this group. It also promotes early extubation and early feeding.¹⁷ Early ambulation is another benefit, provided there is no motor block. There was not a single time where our patient needed rescue or additional systemic analgesia, thus, we did not have to deal with opioid side effects. Our patient also did not experience any motor weakness proven by the ability to walk. Continuous infusion of 0.0625% bupivacaine was able to provide satisfying analgesia without negative impact on motor function. Hence, it facilitates early ambulation to our patient.

The overall low rate of complications makes caudal analgesia an effective method. An analysis of 18,650 caudal blocks from Pediatric Regional Anesthesia Network (PRAN) Database revealed that caudal block is a safe method for children with an overall estimated incidence of 1.9% and without temporary or permanent sequelae.¹⁸ Failed block, blood aspiration, and intravascular injection were found to be the most complications made.

CONCLUSION

With careful attention, continuous caudal analgesia is an effective and safe method for pediatric postoperative management.

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