

Caudal epidural blockade in adolescents

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ABSTRACT

Background: Various options are available for the provision of analgesia following major surgical procedures including systemic opioids and regional anesthetic techniques. Regional anesthetic techniques offer the advantage of providing analgesia while avoiding the deleterious adverse effects associated with opioids including nausea, vomiting, sedation and respiratory depression. Although used commonly in infants and children, there is a paucity of experience with the use of caudal epidural blockade in adolescents. **Methods:** We retrospectively reviewed the perioperative care of adolescents undergoing major urologic or orthopedic surgical procedures for whom a caudal epidural block was placed for postoperative analgesia. **Results:** The cohort for the study included 5 adolescents, ranging in age from 13 to 18 years and in weight from 42 to 71 kilograms. Caudal epidural analgesia was accomplished after the induction of anesthesia and prior to the start of the surgical procedure using 20-25 mL of either 0.25% bupivacaine or 0.2% ropivacaine with clonidine (1 µg/kg). The patients denied pain the recovery room. The time to first request for analgesia varied from 12 to 18 hours with the patients requiring 1-3 doses of analgesic agents during the initial 24 postoperative hours. **Conclusions:** Our preliminary experience demonstrates the efficacy of caudal epidural block in providing analgesia following major urologic and orthopedic surgical procedures. The applications of this technique as a means of providing postoperative analgesia are discussed.

Key words: Caudal epidural block, postoperative pain, regional anesthesia

INTRODUCTION

Various options are available for the provision of analgesia following major surgical procedures including systemic opioids and regional anesthetic techniques. The most commonly performed pediatric regional technique is the caudal epidural block. First described for pediatric use in 1933,^[1] caudal epidural analgesia involves accessing the epidural space through the sacrococcygeal ligament via the sacral hiatus at the base of the sacrum. In infants and young children, the technique is relatively easy to perform and combines a high success rate with a low risk of complications. Caudal epidural blockade is particularly popular in pediatric practice because of the ability to obtain analgesia extending to the mid-thoracic dermatomes when volumes of 1.3-1.5 mL/kg are used in infants and young

children while approaching the epidural space below the level of the spinal cord. In general, caudal epidural block can be used to provide effective analgesia for procedures at the umbilicus and below.

Despite its popularity in the pediatric population, it is not routinely used in older children, adolescents or adults. Over the past 20 years, its most frequent application in the older population has been in the treatment of chronic pain.^[2,3] When considering the anatomy and techniques used for performance of the block, there are no specific issues which would preclude its use in the older pediatric population and even in adults. In fact, the recent literature has shown some renewed interest in the use of the caudal approach to the epidural space in adults both instead of general anesthesia for urologic or gynecologic procedures as well as a means of providing postoperative analgesia.^[4-7] When used for postoperative analgesia, regional anesthetic techniques offer the advantage of providing analgesia while avoiding the deleterious adverse effects associated with opioids including nausea, vomiting, sedation and respiratory depression. Additionally, these techniques may be particularly advantageous in austere environments when there are limited options for postoperative analgesia following major surgical procedures. We retrospectively

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review our experience with caudal epidural block for postoperative analgesia in a cohort of adolescents undergoing major urologic or orthopedic procedures in developing countries. The application of this technique as a means of providing postoperative analgesia is discussed.

METHODS

This retrospective review was approved by the Institutional Review Board of Nationwide Children's Hospital. The patients in the current report were cared for in either San Miguel, Mexico during an orthopedic surgical trip of Kid's First (Nashville, Tennessee) or in San Pedro Sula, Honduras during a urologic surgical trip of International Volunteers in Urology (Salt Lake City, Utah).

The following demographic data were retrieved: Age, weight, gender, and the presence of co-morbid conditions. The following information regarding the caudal epidural block was obtained: Local anesthetic used (volume and concentration) and the use of adjunctive agents such as clonidine. The efficacy of the block was judged by time until first request for analgesia during the postoperative period.

RESULTS

The cohort for the study included 5 adolescents. The demographic data and information regarding the caudal epidural block are outlined in Table 1. Caudal epidural analgesia was accomplished after the induction of anesthesia and prior to the start of the surgical procedure. A 22 gauge needle with a stylet was used in patients who weighed less than 50 kilograms while a 3.5", 22 gauge needle with a stylet was used in patients who weighed more than 50 kilograms. The choice of local anesthetic was 0.2% ropivacaine in 2 patients and 0.25% bupivacaine in the 3 other patients. In all patients, clonidine in a dose of 1 µg/kg was added to the solution. Intraoperative

anesthesia consisted of sevoflurane in air and oxygen titrated to maintain hemodynamic stability administered either through an endotracheal tube or a laryngeal mask airway. The block was judged successful in all cases by the need for a limited expired concentration of the volatile agent of 1-1.2 MAC (minimum alveolar concentration) and limited intraoperative opioid administration (0-2 µg/kg) during the 2-4 hour surgical procedures. All of the included patients denied pain in the recovery room. The time to first request for analgesia varied from 12 to 18 hours with the patients requiring 1-3 doses of analgesic agents during the initial 24 postoperative hours. The analgesic agents included a non-steroidal anti-inflammatory agent for mild pain such as oral ibuprofen by mouth or PR/IV diclofenac. Severe pain was treated with intravenous tramadol or pethidine.

DISCUSSION

Although well described in the younger pediatric population, there is a paucity of literature regarding the use of caudal epidural blockade in older children and adolescents. Our preliminary experience demonstrates the efficacy of this technique in providing pain relief following major urologic and orthopedic surgical procedures in a 5 adolescents. Although other options exist, such as opioids delivered by patient-controlled analgesia, the cost of such practices is high and this technology is frequently lacking in developing countries thereby necessitating the use of other techniques.

Caudal epidural anesthesia is achieved by injecting local anesthetic into the caudal canal, which is contiguous with the epidural space. The caudal canal can be accessed by inserting a needle into the sacral hiatus and piercing the sacrococcygeal ligament. The sacral hiatus is identified above the coccyx, at or near the superior aspect of the gluteal crease, by palpation of the two sacral cornu, which represent the posterior bony elements of the S₅ vertebral body. Although a simple technique in infants and young

Table 1: Demographic and anesthetic data regarding patient cohort

Patient	Age (years)	Weight (kilograms)	Gender	Surgical procedure	Agents for caudal block	Time to first request for analgesia (hours)	Total doses of analgesic agents during first 24 postoperative hours
1	13	42	M	Hip arthroplasty and femoral osteotomy	0.2% ropivacaine (20 mL)+clonidine (1 µg/kg)	14	2
2	14	45	M	Bilateral femoral osteotomy	0.25% bupivacaine (20 mL)+clonidine (1 µg/kg)	12	3
3	15	51	F	Femoral osteotomy	0.2% ropivacaine (25 mL)+clonidine (1 µg/kg)	14	2
4	17	62	F	Vaginal reconstruction	0.25% bupivacaine (25 mL)+clonidine (1 µg/kg)	17	1
5	18	71	M	Redo hypospadias repairs	0.25% bupivacaine (25 mL)+clonidine (1 µg/kg)	18	1

children, anatomic differences may increase the difficulty of this technique in adolescence. With age, a sacral fat pad can develop making the sacral cornu more difficult to palpate. In this situation, it can be helpful to identify the two posterior superior iliac spines. A line drawn between these two points will form the base of an equilateral triangle, with the apex of the triangle lying over the sacral hiatus.^[8] Using appropriate sterile technique, a needle is inserted midway between and slightly inferior to the two sacral cornu at a 30-45° angle to the skin. The needle angle may be decreased immediately after passing through the skin or if bone is encountered. In the latter situation, it is likely that the posterior wall of the ventral sacral elements has been contacted and the needle should be withdrawn slightly and redirected. The needle is advanced, readjusting the angle as needed, until a characteristic "pop" is achieved, indicating passage of the needle through the sacrococcygeal membrane. As with other types of regional anesthesia, the use of ultrasound has been suggested as a means of facilitating successful needle placement.^[9] After piercing the sacrococcygeal ligament, the needle is oriented to be nearly parallel with the patient's back and advanced several millimeters. After negative aspiration, a test dose can be given while the patient is monitored for heart rate, blood pressure, and ST changes. The remainder of the local anesthetic can then be administered in incremental doses while the electrocardiogram is continuously monitored.^[10]

Once the sacrococcygeal ligament is penetrated, the needle should not be advanced more than a few millimeters as the dural sac can be as low as the S₃ or S₄ level in infants which can be less than 1 centimeter from the sacral hiatus.^[11] While the dural sac is typically more cephalad in the adult population, dural puncture is still a significant concern. Although a study of adult cadavers found that the mean distance from the apex of the sacral hiatus to the dural sac was 31.6 millimeters, the shortest distance was 5.76 millimeters.^[12] Other potential sites of improper needle placement include intraosseous (unlikely in adolescence given the ossification of the sacrum), in an epidural vein, subdural, intrathecal, into a lateral foramen, and under the sacral ligament. Intraosseous and intravascular injection local anesthetic can lead to a rapid rise in systemic levels and a subsequent toxic reaction. Although it is not 100% sensitive, a test dose containing 0.5 µg/kg epinephrine, can be administered to help detect systemic injection.^[10] In adults, a positive test dose is considered to be a heart rate change of 30 beats per minute.^[13] In children, a positive test dose can be indicated by T-wave amplitude changes, systolic blood pressure increase by 15 mmHg, or a more conservative heart rate increase of 10 beats per minute.^[10] Although there are no large studies of test doses specifically targeting the adolescent population, it seems reasonable that blood

pressure, heart rate, and T wave amplitude be closely monitored. Albeit rare, some have implicated tissue coring in the late development of epidermoid tumors.^[14,15] These authors have suggested that epidermoid tumors can occur up to 4-14 years after inadvertent tissue coring with a hollow needle. The use of styleted needles has been advocated to prevent coring, although consensus in the literature is lacking.^[16,17]

Even in the adult population, the caudal approach to the epidural space is generally easily accomplished and can be used to provide effective analgesia following lower abdominal procedures. In a prospective study of 51 elderly patients undergoing lumbosacral surgery under general anesthesia, patients who received a caudal epidural block had significantly lower visual analog scale (VAS) pain scores at 48 hours, as well as shorter time to ambulation when compared to control.^[4] The authors did not report any increased technical difficulty in the elderly population. Kita *et al.* compared lumbar epidural anesthesia (*n*=16), caudal epidural anesthesia (*n*=16), and general anesthesia alone (*n*=9) for hip arthroplasty in adults.^[5] The study was motivated by difficulties in placing lumbar epidural catheters in adults given the rising rates of obesity and lumbar spine pathology. The VAS pain scores and total opioid consumption were higher during the first 24 hours in the general anesthesia groups when compared to either the lumbar or caudal epidural anesthesia. The authors also noted the ease and shorter time required for placement of the caudal block when compared with a lumbar epidural approach. No neurologic, hemodynamic, or respiratory complications were noted in the caudal group.

When used instead of general anesthesia, Wong *et al.* reported a 95.9% success rate in a cohort of 172 adult woman undergoing minor gynecologic surgery.^[6] The failures required rescue with only intravenous opioids. Caudal epidural block was placed using 20 ml of 1.5% lidocaine. The only complication reported was minor hypotension in 4 patients, which was responsive to intravenous fluid.

There are various dosing recommendations for caudal blocks in children and adults.^[18-20] The height of the dermatomal level depends on the volume of the medication administered while the density of the block depends on the concentration of the local anesthetic. In children, a commonly used regimen is 1 mL/kg of 0.25% bupivacaine with 1:200,000 epinephrine which typically produces analgesia to the T6-8 level. In adults and adolescents, a regimen of 15-20 mL for perineal procedures or 20-30 mL for lower abdominal procedures is recommended. As demonstrated in our patients, clonidine, an α₂-adrenergic agonist, can be added to the local anesthetic solution to prolong the duration of the block. Its analgesic action stems from inhibition of nociceptive

neurotransmitter at the spinal level via stimulation of α_2 -adrenoceptors in the dorsal horn gray matter.^[21] Its efficacy has been demonstrated in both pediatric and adult populations.^[22,23] A dose of 1 $\mu\text{g}/\text{kg}$ is recommended as commonly recognized adverse effects of hypotension, bradycardia and sedation are uncommon when compared to higher doses (2 $\mu\text{g}/\text{kg}$).

In summary, we noted that caudal epidural block provides effective analgesia following major urologic and orthopedic procedures in adolescents. The latter may be particularly beneficial in austere environments when the options for prolonged analgesia are limited. Although used most commonly in infants and children, there are no anatomic changes which preclude its use in adolescents and adults. In the adult population, it has been shown to be as effective as lumbar epidural analgesia with less time required for placement. In addition to be generally effective, its adverse effect profile is limited.

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