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Caudal epidural block in children and infants: retrospective analysis of 2088 cases

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BACKGROUND AND OBJECTIVES: Regional anesthesia is usually preferred as caudal block via the epidural space. However, the number of large-scale studies including pediatric caudal blocks is small. The objective of this study was to evaluate complications and side effects of local anesthetics and adjuvant drugs.

DESIGN AND SETTING: Retrospective, descriptive study of cases occurring during the period December 2007 to October 2009.

METHODS: Of 4815 medical records were screened, 2088 pediatric cases were identified and included in this study.

RESULTS: As a local anesthetic, we preferred mostly levobupivacaine in 1669 (79.9%) patients and bupivacaine in 419 (20.1%) patients. As adjuvant drug, we preferred mostly morphine (41 patients), fentanyl (7 patients) and adrenaline (6 patients) in 54 (2.5%) patients. For general anesthesia induction, we preferred mostly propofol (1996 patients, 94.2%); for maintenance, sevoflurane (1773 patients, 84.9%). For airway control, we preferred mostly the ProSeal laryngeal mask (PLMA), in 1008 (48.2%) patients. One thousand six hundred five (76.9%) patients were from outpatient clinics and 483 (23.1%) patients were from inpatient clinics. No permanent complication was encountered after caudal blocks.

CONCLUSION: We conclude that caudal epidural blocks are a safe and effective method for subumbilical day-case pediatric surgeries when performed by anesthetists.

Regional anesthesia techniques have become routine interventions in children and infants.^{1,2} The most preferred pediatric regional anesthesia techniques are caudal and lumbar epidural blocks, and ilioinguinal, iliohypogastric and penile nerve blocks.²⁻⁴ The most frequently used regional anesthesia technique is epidural block with a caudal approach. Caudal block was first described in 1933, and it has become one of the most popular regional anesthesia techniques today.^{5,6} Caudal block is usually combined with general anesthesia to obtain efficient postoperative analgesia for pediatric patients undergoing inguinal hernia, circumcision, hypospadias, orchiopexia, lower extremity, perineal, and lower abdominal surgeries.⁷⁻⁹ When combined with general anesthesia, it reduces intraoperative inhalational or opioid agent consumption.^{8,9} Besides, caudal block might also be preferred in high-risk patients as an alternative method. When performed as the sole method, it provides anesthesia with great success.^{3,4,7} There are very few large-scale ret-

rospective studies of caudal block in the pediatric age group.^{10,11} In this study, we screened 4815 case files in our pediatric surgery department. All the local anesthetic and adjuvant drugs used, side effects and complications were recorded in the anesthesia charts.

METHODS

After approval by the local ethics committee, we screened 4815 cases and included 2088 caudal blocks carried out in the period December 2007 to October 2009 in Diyarbakir Children's Hospital. From the anesthesia charts, we recorded patient age, sex, weight; types of surgeries performed; and details regarding general anesthesia induction and maintenance agents, airway control routes, local anesthetics and adjuvant drugs. In addition, we also recorded unsuccessful interventions and complications (hypotension, subcutaneous injection, intravascular injection, intraosseous or intracolonic injections). If any analgesic was given in the postoperative care unit, caudal block was classi-

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fied as unsuccessful.

All the caudal blocks were performed by three anesthesiology specialists at our clinic. No caudal block was planned for patients who had bleeding-clotting disorders, local infections, sepsis, abnormal vertebral anatomy, low body weight (<2 kg). Inside the operating room, standard monitoring was performed for all children (electrocardiogram, noninvasive blood pressure, peripheral oxygen saturation). Intravenous catheters were placed before the patients were taken to operating rooms. General anesthetic induction was given with IV agents (propofol, sodium thiopental, ketamine). If no IV catheter could be placed, induction was performed by sevoflurane inhalation. The airway was controlled by mask ventilation, classical laryngeal mask (cLMA), ProSeal laryngeal mask (PLMA) (LMA, International Services UK Limited), and endotracheal tube (ETT). Sevoflurane or desflurane was used for maintenance. In the left lateral decubitus position, caudal anesthesia was performed after local cleaning using needles of appropriate size under sterile conditions.

SPSS for Windows 17.0 software program was used with descriptive statistical methods (frequency analysis, cross-table analysis, percentage, mean, standard deviation) for evaluation of study data and statistical analysis.

RESULTS

The minimum and maximum ages of caudal block patients were 18 days and 11 years, respectively, and the mean (SD) age was 5.6 (2.8 years). **Figure 1** shows the distribution of ages at which caudal block was performed. Two hundred eighty-seven (13.7%) of the patients were females, and 1801 (86.3%) were males. Minimum, maximum and mean (SD) body weights were 2.2 kg, 38 kg and 16.1 (6.7) kg, respectively. The local anesthetic of choice in caudal block was levobupivacaine in 1669 (79.9%) patients, and bupivacaine in 419 (20.9%) patients (**Table 1**). Adjuvant agents were used in 54 patients; mostly morphine, followed by fentanyl and adrenaline (in 41, 7 and 6 patients, respectively). The most frequently used induction agent was propofol and most frequently used maintenance agent was sevoflurane and the airway was controlled with PLMA (**Table 2**).

All the caudal blocks were performed by the same two anesthetists. Because of dural puncture, subcutaneous infiltration, obesity, blood vessel puncture and bleeding, caudal block was terminated in 101 (4.8%) patients and it was classified as unsuccessful (**Table 3**). No sequelae were encountered due to caudal blocks. Additional analgesics (IV tramadol, IV paracetamol or rectal paracetamol in 97, 20, 14 patients, respectively) were administered to 131 (6.3%) of the 2088 patients. Four hundred eighty-three (23.1%) patients were from

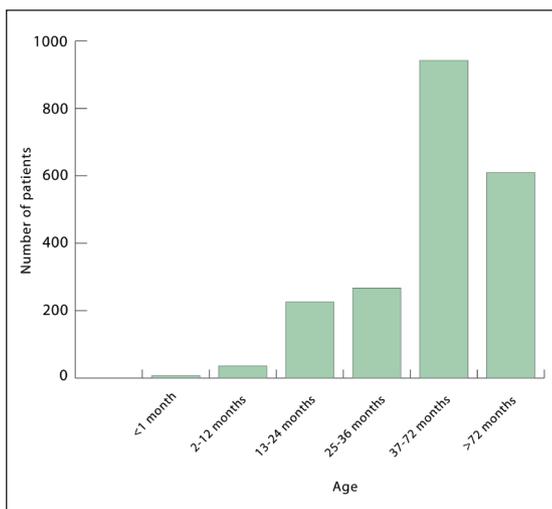


Figure 1. Age-wise distribution of caudal block patients.

Table 1. Distribution according to operation type and local anesthetic.

Operation type	Levobupivacaine	Bupivacaine	Number of patients
Circumcision	152	32	184 (8.8)
Inguinal hernia	796	189	985 (47.2)
Hydrosele	202	42	244 (11.6)
Undescended testicles	89	53	142 (6.8)
Hypospadias	124	31	155 (7.4)
Appendectomy	279	23	302 (14.5)
Othera	27	49	76 (3.7)
Total	1669 (79.9%)	419 (20.1%)	2088 (100%)

^aAnal interventions, cordon cysts, invagination, and others.

Table 2. Distribution according to methods used for induction, maintenance and airway control.

Anesthesia induction n (%)		Anesthesia maintenance n (%)		Airway control n (%)	
Propofol	1966 (94.2)	Sevoflurane	1773 (84.9)	Mask	68 (3.5)
Thiopental	16 (0.8)	Desflurane	299 (14.3)	cLMA	618 (29.5)
Ketamine	10 (0.5)	TIVAa	16 (0.8)	PLMA	1008 (48.2)
Sevoflurane	96 (4.5)			ETT	394 (18.8)

^aTIVA: total intravenous anesthesia, cLMA: classical laryngeal mask, PLMA: ProSeal laryngeal mask, ETT: endotracheal tube

Table 3. Complications and number of patients.

Complication	Number of patients (%)
Obesity	26 (1.24)
Subcutaneous infiltration	31 (1.48)
Dural puncture	4 (0.19)
Blood vessel puncture	40 (1.91)

inpatient clinics, whereas 1605 (76.9%) were from outpatient clinics.

DISCUSSION

Caudal block is increasingly performed in pediatric regional anesthesia practices. It is preferred in order to relieve postoperative pain in children of all age groups undergoing sub-diaphragmatic surgeries.^{10,12-14} Day-case surgical procedures comprise a majority of interventions performed by our pediatric surgery department. Therefore, postoperative pain should be effectively relieved in a safe manner. These patients have a shorter hospital stay, and side effects may not be noticed at home. Caudal block has the importance in decreasing consumption of systemic analgesics.

In caudal block, the most used local anesthetic agent is bupivacaine, because it is readily available, has a long duration of action and its side effects are very well known.^{12,15} A single-shot caudal injection of bupivacaine as sole local anesthetic provides effective postoperative analgesia.^{12,13} For inguinal region surgeries, 2-2.5 mg/kg bupivacaine is given caudally, and this provides effective postoperative analgesia for 2 to 4 hours without any additional analgesics.¹² Similarly, 20.1% of our patients received bupivacaine for caudal block, and mean (SD) postoperative analgesia duration was 314 (39) minutes, whereas our levobupivacaine group had a postoperative analgesia duration of 359 (25) minutes.

Levobupivacaine is an isomer of bupivacaine and has some advantages. It leads to less motor blockage and longer sensorial blockage. Also, it is less toxic to the central nervous and cardiovascular systems.^{14,16} Due to these advantages, anesthetists at our hospital prefer levobupivacaine. The duration of block can be extended by adjuvant drugs, which are given into the caudal space, together with a local anesthetic agent; thereby more efficient postoperative analgesia can be obtained. For this purpose, many drugs are being used today as adjuvants.^{13,14} Some of these adjuvant drugs are not always available in the clinics, but some of them are readily available. In the literature, there are many studies on the usage of adjuvant drugs in caudal anesthe-

sia. Adrenaline was previously the most used adjuvant drug,¹⁷ but not today due to its adverse effects. The most preferred adjuvant agents are morphine, fentanyl, ketamine, neostigmine and clonidine.^{15,18,19} Similarly, in our practice, opioids are the most frequently used adjuvant agents. Morphine was the agent of choice in our study. Morphine should be given in caudal block as an adjuvant for patients who are supposed to be hospitalized for at least a few days, especially for appendectomy (302 patients). Caudal adjuvant opioids significantly extend the analgesic effect; however, their routine use is limited due to serious side effects. In one study, morphine provided longer-lasting and more effective analgesia, but the incidence of nausea/vomiting was high.²⁰ In our study, no patient had nausea/vomiting due to caudal adjuvant opioids, probably because the number of patients was small. Postoperatively, the most important reason for delaying discharge of a patient is the postoperative pain and nausea/vomiting. Therefore, efficient techniques that have lesser side effects are being chosen.¹³ Likewise, in accordance with the current literature, we preferred longer-lasting levobupivacaine, mostly without any adjuvants, for caudal blocks.

The PMLA is a modification of the cLMA and has been in use for the last 10 years. If properly placed, it can efficiently prevent leakage. It functionally separates the gastrointestinal and respiratory tracts, goes deeper than cLMA, resides more strongly inside periglottic tissue and has a dorsal cuff in addition to the ventral cuff.²¹ When compared according to oropharyngeal pressures, PLMA prevents leakage more efficiently than cLMA, with lesser mucosal pressure and lesser cuff volume. In many studies, it has been reported that PLMA can be used for surgical operations up to 2 to 3 hours.^{21,22} Accordingly, we also used PLMA in 1008 (48.2%) patients because of the advantages of airway control and shorter duration of operation.

Propofol is the most preferred intravenous general anesthetic induction agent because of a lower nausea/vomiting incidence in the postoperative period, faster recovery and softer induction.²³ At the same time, it is reported to have a faster onset of action, shorter duration of action and better hemodynamic stability.^{24,25} In our hospital, day-case surgeries are conducted very frequently; therefore, propofol is the agent of choice for induction (1966 patients, 94.2%).

Recently, there are reports that needles without stylets might cause epidermal-dermal cell transportation during caudal and spinal blocks.^{13,26} To prevent this epidermal-dermal cell transportation, researchers suggest that all blocks be performed by needles with stylets.^{27,28} Thus, we used needles with stylets for all our caudal blocks.

Caudal block is our most performed regional anesthetic technique. It is a relatively easy and safe technique. The rate of serious complications was reported as 1/40 000 and the total complication rate was 1.5/1000.⁶ During caudal block, the most frequent complications (due to the technique) encountered were vessel perforation (1.6%-10.6%) and subcutaneous infiltration (5%-19%).^{10,11,29} A more serious complication was dural puncture, which has been reported by Begeç et al.,¹⁰ 5/2262 (0.22%); Veyckemans et al.,¹¹ 1/1100 (0.09%); and Dalens et al.,²⁹ 1/750 (0.13%). Similarly, complications encountered in our study were vessel perforation in 40 (1.91%) patients, subcutaneous infiltration in 31 (1.48%) patients, and dural puncture in 4 (0.19%) patients. In a study of 1100 pediatric patients, Veyckemans et al.¹¹ reported that obese patients had difficulty in de-

termining sacral hiatus (incidence rate, 11.2% of the total patients). However, in only 26 (1.24%) of our patients was there difficulty in determining sacral hiatus due to obesity. We attribute this low rate to the increase in our experience during performance of 2088 caudal blocks in a relatively short time. Other complications encountered were hypotension, total spinal block, arrhythmia, and injection of the bone, colon and intravascular area.

In conclusion, caudal block is an easy, simple and safe anesthetic technique. It can be performed in subumbilical surgeries in children and infants, with a high success rate and a low incidence of complications or side effects. It can be concluded that so far, single-shot caudal block with local anesthetic has proved to be an appropriate and effective method for day-case surgeries, especially in pediatric patients.

REFERENCES

- Ross AK, Eck JB, Tobias JD. Pediatric regional anesthesia: Beyond the caudal. *Anesth Analg* 2000;91:16-26.
- Markakis DA. Regional anesthesia in pediatrics. *Anesthesiol Clin North America* 2000;18:355-81.
- Ansermino M, Basu R, Vandebek C, Montgomery C. Nonopioid additives to local anaesthetics for caudal blockade in children: A systematic review. *Paediatr Anaesth* 2003;13:561-73.
- Tobias JD. Caudal epidural block: A review of test dosing and recognition of systemic injection in children. *Anesth Analg* 2001;93:1156-61.
- 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.
- Markakis DA. Regional anesthesia in pediatrics. *Anesthesiol Clin North America* 2000;18:355-81.
- Silvani P, Camporesi A, Agostino MR, Salvo I. Caudal anesthesia in pediatrics: An update. *Minerva Anestesiol* 2006;72:453-9.
- Giafre E, Dalens B, Gombert A. Epidemiology and morbidity of regional anesthesia in children: A one-year prospective survey of the French language society of pediatric anesthesiologists. *Anesth Analg* 1996;83:904-12.
- Tobias JD. Postoperative analgesia and intraoperative inhalational anesthetic requirements during umbilical herniorrhaphy in children: Postinscisional local infiltration versus preinscisional caudal block. *J Clin Anesth* 1996;8:634-8.
- Begeç Z, Durmuş M, Toprak Hİ, Köroğlu A, Ulger H, Ersoy MO. Caudal block in paediatric surgery: A retrospective survey in 2262 patients. *JTAICS* 2005;33:388-94.
- Veyckemans F, Van Obbergh LJ, Gouverneur JM. Lessons from 1100 pediatric caudal blocks in a teaching hospital. *Reg Anesth* 1992;17:119-25.
- Uguralp S, Mutus M, Koroglu A, Gurbuz N, Koltuksuz U, Demircan M. Regional anesthesia is a good alternative to general anesthesia in pediatric surgery: Experience in 1,554 children. *J Pediatr Surg* 2002;37:610-3.
- Sener M, Çaliskan E, Bozdoğan N, Baltalı S, Koca D, Ezer SS, et al. Our experiences of paediatric caudal anaesthesia. *Anestezi Dergisi* 2006;14:259-63.
- Ingelmo PM, Fumagalli R. Central blocks with levobupivacaine in children. *Minerva Anestesiol* 2005;71:339-45.
- Congedo E, Sgreccia M, De Cosmo G. New drugs for epidural analgesia. *Curr Drug Targets* 2009;10:696-706.
- Smith RH. Safe dose of levobupivacaine (Chirocaine) in caudal analgesia in children. *Br J Anaesth* 2003;90:400-1.
- Warner MA, Kunkel SE, Offord KO, Atchison SR, Dawson B. The effects of age, epinephrine, and operative site on duration of caudal analgesia in pediatric patients. *Anesth Analg* 1987;66:995-8.
- De Negri P, Ivani G, Tirri T, Favullo L, Nardelli A. New drugs, new techniques, new indications in pediatric regional anesthesia. *Minerva Anestesiol* 2002;68:420-7.
- Förster JG, Rosenberg PH. Clinically useful adjuvants in regional anaesthesia. *Curr Opin Anaesthesiol* 2003;16:477-86.
- Krane EJ, Tyler DC, Jacobson LE. The dose response of caudal morphine in children. *Anesthesiology* 1989;71:48-52.
- Brimacombe J, Richardson C, Keller C, Donald S. Mechanical closure of the vocal cords with the laryngeal mask airway ProSeal™. *Br J Anaesth* 2002;88:296-7.
- Beyaz SG, Tokgöz O. [Laryngeal edema secondary to use of a proseal laryngeal mask airway in a child]. *Genel Tıp Derg* 2010;20:27-30.
- Song D, Hamza M, White PF, Klein K, Recart A. The pharmacodynamic effects of a lower-lipid emulsion of propofol: A comparison with the standard propofol emulsion. *Anesth Analg* 2004;98:687-91.
- Öztürk ÇE, Beyaz SG, Tokgöz O, Şentürk Y. 1% and 2% injection pain of propofol in infusion rates and to intubation comparison of the effects on hemodynamic responses. *Türkiye Klinikleri J Anest Reanim* 2010;8:79-85.
- Beyaz SG, T Fek A, Tokgöz O. The effect of propofol lipuro with and without lidocaine on injection pain in children. *Niger J Clin Pract* 2011;14:60-4.
- Ozyurt G, Moğol EB, Tolunay S, Kerimoğlu B. Tissue coring with spinal needles. *Reg Anesth Pain Med* 2000;25:665-9.
- Guldogus F, Baris YS, Baris S, Karakaya D, Kelsaka E. Comparing tissue coring potentials of hollow needles without stylet and caudal needles with stylet: An experimental study. *Eur J Anaesthesiol* 2008;25:498-501.
- Baris S, Guldogus F, Baris YS, Karakaya D, Kelsaka E. Is tissue coring a real problem after caudal injection in children. *Paediatr Anaesth* 2004;14:755-8.
- Dalens B, Hasnaoui A. Caudal anesthesia in pediatric surgery: Success rate and adverse effects in 750 consecutive patients. *Anesth Analg* 1989;68:83-9.