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Regional Versus General Anesthesia in Pediatric Surgery Patients: A Clinical Perspective

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ABSTRACT

Pediatric surgical procedures require a thoughtful multi modal approach of anaesthesia for perioperative pain management that maximizes both patient comfort and safety. Regional anesthesia (RA) can provide increased anatomic coverage over a longer duration by applying anesthetic medication directly around a targeted peripheral nerve. The primary objective was to assess the effect of regional anaesthesia versus general anaesthesia in pediatric surgery. A retrospective analysis was conducted on 146 cases of caudal blocks and 10 cases of spinal blocks performed in children ranging in age from newborns to 12 years. The study evaluated various anesthesia techniques, including caudal block (CB) alone, CB combined with general anesthesia (GA), GA followed by CB, GA with spinal block and spinal block as a standalone method. Out of the total cases, 142 caudal blocks and 9 spinal blocks were deemed clinically successful. However, in 4 instances, the duration of the caudal block was inadequate, necessitating the use of general anesthesia (GA). Caudal block failure was reported in 11 cases, representing 7.05% of the total. Among the 142 caudal block patients, 26 underwent surgery under GA, with caudal block provided as an adjunct for postoperative pain relief. Caudal anesthesia is recognized as a cost-effective, straightforward and efficient approach that serves both as an independent anesthetic technique and as an adjunct for postoperative pain management. The authors advocate for its broader application across various clinical scenarios involving infra umbilical surgeries in pediatric patients.

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Key Words
Anesthesia, regional, pediatric, surgery

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INTRODUCTION

General anesthesia is defined by the American Society of Anesthesiologists as a "drug induced loss of consciousness during which patients is not arousable, even by painful stimulation"[1]. The indications for general anesthesia are therefore any condition is which the physician needs to completely control a patient's airway, breathing or circulation, to reduce recall and in order to allow the physician adequate time to finish the appropriate operation. Regional anesthesia is an essential part of modern pediatric anesthetic practice, conveying many significant advantages to the patient and to the hospital [2]. The use of anaesthesia in infants and children has raised a great concern regarding its safety and long-term consequences. Experimental research on animals showed that early exposure to anaesthesia is neurologic to the developing brain and can lead to long-term neuro-behaviourial impairment[3,4]. Several studies assessed the effect of exposure to general anaesthesia before the age of 4 years on the development of behavioural and cognitive abnormalities in children[5]. Spinal anesthesia (SA) has the advantage of providing analgesia and total muscle relaxation in a conscious and compliant patient and an uneventful postoperative recovery. it also protects against the potential complications of general anesthesia (GA)[6]. Despite these advantages, regional anesthesia is still preferred only for patients who are at high risk for general anesthesia and the majority of surgeons still prefer doing both procedures under GA. Thus, most of the publications and textbooks on laparoscopic surgery cite GA as the anesthetic option for abdominal laparoscopic surgery. But, lately, occasional reports of laparoscopic surgery being performed under regional anesthesia (spinal or epidural) in selected patients have started coming in[7]. The benefits of combining general and regional anesthesia have not been adequately studied in the pediatric clinical setting. In children, there is a knowledge gap and a paucity of information regarding the relevance and benefits of combining regional and general anesthesia for pediatric hernia repair over general anesthesia alone[8]. This retrospective study aimed to document the outcomes and complications associated with cases of regional anesthesia, with the objective of evaluating their effectiveness in comparison to general anesthesia.

MATERIALS AND METHODS

The study involved a retrospective analysis of 146 caudal and 10 spinal block cases in children aged from newborn to 12 years. Fasting protocols were established based on age: children under 6 months fasted for 4 hours, while older children fasted for 6 hours. Throughout surgery, blood pressure, heart rate, end-tidal CO and arterial oxygen saturation were continuously monitored from the fifth minute following the caudal block. Premeditation with intra nasal midazolam (0.4 mg/kg) was administered 30 minutes prior to surgery in children aged 6 months to 6 years. For children aged 0-6 years, mask induction was performed using a 60%/40% nitrous oxide/oxygen mixture with halothane or sevoflurane, followed by intravenous line placement. Older children were induced intravenously with propofol at a dose of 3 mg/kg. Maintenance of anesthesia in infants aged 0-6 months involved propofol infusion at 2-4 mg/kg/hour, with spontaneous respiration supported by a laryngeal mask. Older children received oxygen via a face mask following propofol infusion. Muscle relaxation, when necessary, was achieved with vecuronium (0.1 mg/kg) before intubation and anesthesia maintenance included a 60% air/40% oxygen mixture and propofol infusion. Caudal block was performed with the patient in the lateral decubitus position. The sacral hiatus was identified and the skin was cleansed with 10% povidone-iodine solution. A 22-gauge needle was inserted at a 70° angle through the sacro-coccygeal ligament into the sacral canal. After a test dose of 1mL of 1% lidocaine with 15µg of adrenaline, 0.25% bupivacaine was injected: 0.7 mL/kg for infants under 6 months and 1mL/kg for older children. For prolonged analgesia, 5µg/mL adrenaline or 50µg/kg morphine was added to bupivacaine. Sedation levels were assessed using Ramsey's sedation score, while analgesia was evaluated physiologically and postoperatively using an objective pain scale. Systolic blood pressure was measured pre-induction via palpation using an appropriately sized pediatric cuff. Anesthesia depth and blood pressure were reassessed 10 minutes after caudal block injection, 20 minutes later and at the operation's conclusion. Anesthesia level was determined using skin pinching with artery forceps. Patients were allowed oral intake 3 hours postoperatively unless morphine had been administered. For spinal anesthesia, 0.5% bupivacaine was injected into the L4-L5 inter space, with dosages tailored to body weight: 0.1mL/kg for infants weighing 2-5kg and 0.08mL/kg for children over 5kg. Post-surgery, patients were monitored in recovery until motor block resolution.

RESULTS AND DISCUSSIONS

(Table 1) presents the distribution of the types of anesthesia administered to patients in the study. The most common type of anesthesia was the Caudal Block (CB), which was used in 74.36% of the cases. The second most frequent combination was General Anesthesia+Caudal Block (GA+CB), which accounted for 16.67%. Other combinations were used less frequently.

Table 1: Distribution of Types of Anesthesia

Type of Anesthesia	n	%
CB	116	74.36
CB+GA	4	2.56
GA+CB	26	16.67
SB	9	5.77
SB+GA	1	0.64
Total	**156**	**100.00**

A majority of patients (39.10%) were aged between 2-12 months. The second most frequent age group was >36 months, comprising 25.64% of the cases. A smaller proportion of patients were between 13-24 months (19.23%) and 25-36 months (9.62%). Only 6.41% of patients were 1 month old (Table 2).

Table 2: Age Distribution of Cases

Age (months)	n	%
1	10	6.41
2-12	61	39.10
13-24	30	19.23
25-36	15	9.62
>36	40	25.64
Total	**156**	**100.00**

(Table 3) shows the types of anesthesia used for different surgeries. High ligation had the highest number of cases (78), predominantly using CB anesthesia (78 cases), with small numbers also receiving GA+CB (17 cases) and SB (6 cases). Archippus, Circumcision and Urethroplasty had lower frequencies of anesthesia combinations. Hydrocelectomy and Cystoscopy were also treated primarily with CB, with one case receiving SB. Laparotomy, Appendectomy, and Adhesiolysis showed fewer cases, often requiring combinations of general anesthesia. Some procedures like Pyeloplasty and Colostomy were administered with combinations involving CB and GA, reflecting the varied anesthetic needs across different types of surgeries.

Table 3: Surgery and Types of Anesthesia

Operation	CB	CB+GA	GA+CB	SB	GA+SB
High ligation	78	1	17	6	1
Orchiopexy	9	1	0	0	0
Circumcision	9	0	2	1	0
Urethroplasty	9	0	2	1	0
Hydrocelectomy	3	0	0	1	0
Cystoscopy	2	0	0	0	0
Rectoscopy	2	1	1	0	0
Laparotomy	2	0	0	0	0
Appendectomy	1	0	1	0	0
Adhesiolysis	1	0	1	0	0
Pyeloplasty	0	0	1	0	0
Colostomy	0	1	1	0	0
Total	**116**	**4**	**26**	**9**	**1**

The complications associated with Caudal Block are summarized in (Table 4). Sacral hiatus abnormality /obesity and subcutaneous infiltration each occurred in 36.36% of cases. Venous puncture was observed in 18.18% of cases. Dural puncture occurred in 9.09% of cases.

Table 4: Types of Caudal Block

Complications	n	%
Sacral hiatus abnormality/obesity	4	36.36
Subcutaneous infiltration	4	36.36
Venous puncture	2	18.18
Dural puncture	1	9.09
Total	**11**	**100.00**

General anesthesia (GA) often leads to hypotension in newborns, particularly when hypovolemia, sepsis, respiratory insufficiency, or cardiovascular immaturity are present. Other complications such as bronchopulmonary dysplasia, hyperglycemia, hypoglycemia, hypothermia and persistent pulmonary hypertension may also arise in neonates[8]. During anesthesia induction or tracheal intubation, abnormal hemodynamic responses like hypotension or hypertension can be triggered in older children. Additionally, hormonal and metabolic alterations, including the release of stress hormones and hyperglycemia, are frequently observed. Neonates may also experience Apnea, central nervous system injuries, metabolic disturbances, post-extubation issues such as subglottic edema and croup, prolonged drug effects, or respiratory depression requiring ventilation[10]. Furthermore, GA can reduce gastrointestinal motility, resulting in delayed oral intake and extended hospitalization. Postoperative pain control often necessitates additional analgesia via caudal anesthesia or oral/rectal analgesic administration in children who have undergone GA. Conversely, regional anesthesia using caudal or spinal blocks exerts minimal impact on hemodynamics, eliminates the need for ventilatory support, allows oral intake within 3 hours, prevents the release of stress hormones and avoids the need for postoperative analgesics. In procedures requiring muscle relaxation, preoperative addition of caudal anesthesia to GA has been shown to reduce stress hormone release and surgical bleeding[11-13]. Complications of caudal block (CB) included dural puncture, vascular puncture, failure to identify the sacral hiatus and toxic reactions to local anesthetics[14]. GA complications are more common in premature or high-risk infants[15]. Out of the total cases, 142 caudal blocks and 9 spinal blocks were deemed clinically successful. However, in 4 instances, the duration of the caudal block was inadequate, necessitating the use of general anesthesia (GA). Caudal block failure was reported in 11 cases, representing 7.05% of the total. Among the 142 caudal block patients, 26 underwent surgery under GA, with caudal block provided as an adjunct for postoperative pain relief. No complications were observed in any of the newborns and CB proved to be a superior and effective alternative to GA, particularly in premature and newborn infants. Caudal epidural anesthesia has become widely accepted as a safe, reliable, cost-effective and appropriate technique for infants and children when administered by skilled anesthesiologists. In our series, the cost of regional anesthesia was approximately one-third that of GA. The treatment costs are considerably higher with GA due to the longer hospital stay required for patients receiving GA compared to those undergoing regional anesthesia. While the onset of block in regional techniques delayed surgery by approximately 10-15 minutes, recovery time was negligible. Moreover, many patients were treated on an outpatient basis after inguinal herniorrhaphy, distal hypospadias surgeries and endoscopic interventions. The low viscosity of epidural fat in younger children makes the

technique particularly effective and easy[16]. A single caudal injection of bupivacaine (2-2.5 mg/kg) provides analgesia for 2-4 hours.14 In our inguinal surgery cases, most patients did not require additional analgesics postoperatively. Adrenaline is commonly used to extend the effect of bupivacaine, although other agents such as fentanyl and clonidine may also be used[17]. Postoperative benefits of effective epidural analgesia include enhanced respiratory function, reduced perioperative cardiac complications, quicker mobilization and return of bowel function and shorter hospital stays. Despite an average anesthetic level at the T5 vertebra, no respiratory difficulties were noted in any infants receiving caudal anesthesia[18]. Epidural anesthesia has also been shown to reduce surgical bleeding in various procedures involving significant blood loss[19,20]. Comparisons between GA patients and regional anesthesia patients revealed that regional anesthesia provided more favorable surgical conditions and reduced bleeding, consistent with findings in the literature. Therefore, regional anesthesia is considered sufficient for hypospadias surgery.

CONCLUSION

Caudal anesthesia offers an inexpensive, straight forward and effective technique, both as a sole anesthetic method and for postoperative analgesia. We recommend its broader use in infraumbilical pediatric surgical procedures.

REFERENCES

1. Ecoffey, C., F. Lacroix and E. Giaufre, et al., 2010. Epidemiology and morbidity of regional anesthesia in children: a follow-up one-year prospective survey of the French-Language Society of Pediatric Anaesthesiologists (ADARPEF). Pediatr Anesth., 20: 1061-1069.
2. Creeley, C., K. Dikranian, G. Dissen, L. Martin, J. Olney and A. Brambrink, 2013. Propofol-induced apoptosis of neurones and oligodendrocytes in fetal and neonatal rhesus macaque brain. Br. J. Anaesth., 45-49.
3. Andreae, M.H. and D.A. Andreae, 2012. Local anaesthetics and regional anaesthesia for preventing chronic pain after surgery. Cochrane Database Syst. Rev., Vol. 0 .10.1002/14651858 .cd007105.pub2.
4. Lennox, P.H., H. Vaghadia, C. Henderson, L. Martin and G.W.E. Mitchell, 2002. Small-Dose Selective Spinal Anesthesia for Short-Duration Outpatient Laparoscopy: Recovery Characteristics Compared with Desflurane Anesthesia. Anesthesia and Analg., 94: 346-350.
5. Sinha, R., A.K. Gurwara and S.C. Gupta, 2009. Laparoscopic Cholecystectomy Under Spinal Anesthesia: A Study of 3492 Patients. J. Laparoendoscopic and Adv. Surg. Tech.s, 19: 323-327.
6. Dahlstrand, U., S. Wollert, P. Nordin, G. Sandblom and U. Gunnarsson, 2009. Emergency Femoral Hernia Repair. Ann. Surg., 249: 672-676.
7. ,J Chang, S., J.Y. ,C Chen, C. ,K Hsu, F. ,C Chuang and S.S. ,D Yang, 2016. The incidence of inguinal hernia and associated risk factors of incarceration in pediatric inguinal hernia: A nation-wide longitudinal population-based study. Hernia, 20: 559-563.
8. Shnider, S.M. and G. Levinson., 1993. Anesthesia and analgesia: Issues for the fetus and newborn. In: Obstetrical anesthesia., In: Friesen, R.H. and editor., (Eds.)., MD: William and Wilkins, Baltimore,, 0 pp: 167-173.
9. Atlee, J.L., 1999. Complications in anesthesia. Pediatrics and Neonatology. In: Nicolson, S.C., M. James and editors., (Eds.)., PA: Saunders, Philadelphia,, 0 pp: 617-193.
10. Benumof, J.L. and J.A. Grass., 2000. Regional anesthesia for ambulatory surgery. In: Anesthesiology Clinics of North America., In: Greengrass, R.A. and editor., (Eds.)., PA: Saunders, Philadelphia,, 0 pp: 341-352.
11. Liu, S.S., R.L. Carpenter and D.C. Mackey., 1995. Effects of Perioperative Analgesic Technique on Rate of Recovery after Colon Surgery. Anesthesiology, 83: 757-765.
12. Gunter, J.B., J.E. Forestner and C.B. Manley, 1990. Caudal Epidural Anesthesia Reduces Blood Loss During Hypospadias Repair. J. Urol., 144: 517-519.
13. Dawkins, C.J.M., 1969. An analysis of the complications of extradural and caudal block. Anaesthesia, Vol. 24 .10.1111/j.1365-2044.1969. tb02909.x.
14. Mayhew, J.F., D.L. Bourke and W.S. Guinee, 1987. Evaluation of the premature infant at risk for postoperative complications. Can. J. Anaesth., 34:627-631.
15. Dalens, B., 1989. Regional anesthesia in pediatrics. Ann Fr Anesth Reanim., 8: 51-66.
16. Constant, I., O. Gall, L. Gouyet, M. Chauvin and I. Murat, 1998. Addition of clonidine or fentanyl to local anaesthetics prolongs the duration of surgical analgesia after single shot caudal block in children. Br. J. Anaesth., 80: 294-298.
17. Gunter, J.B., M.F. Watcha, J.E. Forestner, G.E. Hirshberg, C.M. Dunn, M.T. Connor and J.L. Ternberg, 1991. Caudal epidural anesthesia in conscious premature and high-risk infants. J. Pediatr. Surg., 26: 9-14.
18. Thorud, T., I. Lund and I. Holme, 1975. The Effect of Anesthesia on Intraoperative and Postoperative Bleeding during Abdominal Prostatectomies: A Comparison of Neurolept Anesthesia, Halothane Anesthesia and Epidural Anesthesia. Acta Anaesthesiologica Scand., 19: 83-88.
19. MOIR, D.D., 1968. Blood loss during major vaginal surgery: A Statistical Study of the Influence of General Anaesthesia and Epidural Analgesia. Br. J. Anaesth., Vol. 40 .10.1093/bja/40.4.233.