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RESEACH ARTICLE

HEMODYNAMIC CHANGES AND ADVERSE EFFECTS OF INTRAOPERATIVE INTRAVENOUS PARACETAMOL AND INTRAVENOUS LOW DOSE KETAMINE IN UNDER SIX CHILDREN

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Abstract

Background: Caudal block using plain bupivacaine provides both intraoperative and postoperative analgesia. However one short coming of single shot caudal bupivacaine is its short duration. In order to prolong the duration of postoperative analgesia, caudal additives or intravenous supplements were used. This study investigated the effect of low dose intravenous ketamine and intravenous paracetamol on the duration of postoperative analgesia produced by caudal bupivacaine in children. **Methods**: This was a randomized double blind controlled study where 93 ASA I and II children aged 1 to 6 years scheduled for circumcision were randomly allocated to 3 groups. Group BS received 5 ml sterile water intravenously, Group BK received 0.5 mg/kg intravenous ketamine diluted to 5 ml while Group BP received 15 mg/kg of intravenous paracetamol diluted to 5 ml. In all the patients 0.25% plain bupivacaine was used for the caudal blocks under genaral Anaesthesia with LMA and anaesthesia maintained with isoflurane 1.5% in 50% oxygen and 50% air. Pain was assessed postoperatively using the Modified Observational Pain Scale (MOPS) and additional analgesia in form of oral paracetamol 15 mg/kg was given when the Pain score was ≥ 4. Phone call was made to each parent 24 hours after discharge to retrieve the information. **Results:** There was no statistically significant difference between the groups in terms of preoperative haemodynamic parameters (P =0.596), intraoperative haemodynamic (P = 0.341), incidence of side effects and sedation. **Conclusion:** Adding low dose ketamine or paracetamol to caudal block can be used to provide good postoperative analgesia without significant side effects in children.

Key words: hemodynamic changes, adverse effects, intravenous paracetamol, intravenous low dose ketamine

INTRODUCTION

Duration of analgesia with single shot caudal bupivacaine in the postoperative period is often inadequate. Mhaummad *et al.* (2012) and Vandana (2016) To overcome this problem, extension of the period of analgesia into the postoperative period is

achieved with different drugs like tramadol, clonidine, ketamine and neostigmine which have been combined with bupivacaine to further prolong the analgesic effect.

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Mhaummad *et al.* (2012) and Tobi *et al.* (2014) This is important since in this region where the study was conducted, many children are circumcised outside the neonatal period as documented in the study by Zubairu *et al.*(2013)

Paracetamol is used for the relief of postcircumcision pain with a wide margin of safety in children.Howard *et al* (1994) The oral and rectal routes of paracetamol administration produce unpredictable plasma concentration and may not be accepted by all patients. The intravenous route provides less variability in plasma concentrations and can be used in children who are unable to take paracetamol orally.Tutku *et al.* (2008) Ketamine is a non-competitive blocker of spinal and supraspinal N-methyl-D L Aspartate (NMDA) receptors. It is a drug described as near ideal anaesthetic for developing countries. It is cheap and readily available; and is the only currently available anaesthetic agent with analgesic effect and minimal or no cardio-respiratory depression.Nafiu *et al.* (2007)

The aim of this study was to investigated the effect of intravenous ketamine and intravenous paracetamol on hemodynamic changes and other complications if added to caudal block with bupivacaine for circumcision in children.

MATERIALS AND MATHODS

The study was a randomized double blind controlled clinical trial conducted among children aged 1- 6 years who had circumcision at Aminu Kano Teaching Hospital, Kano Nigeria. Patients with known hypersensitivity to the study drugs, who had received paracetamol or ketamine within 24 hours , pre-existing neurological disease, obvious spinal deformities, or bleeding diathesis were excluded from the study. Ethical approval for this study was obtained from the Research and Ethics Committee of Aminu Kano Teaching Hospital, Kano. Informed consent was obtained from the parents or guardians of each child who participated in the study. On the day of surgery patients were evaluated for inclusion in the study. History was taken and physical examination done to ascertain fitness for anaesthesia and determine eligibility for the study. The children were weighed and recorded. Basic laboratory investigations were checked and patient's compliance with fasting guidelines as instructed was ascertained. The patients were randomized into three groups using computer generated random numbers and sealed enveloped technique. The parent or guardians were asked to pick an envelope from a box containing the randomization envelopes. The patients' weight was recorded on the sealed envelopes and the envelopes were handed over to an assistant who helped prepare the study drugs according to the patient allotted group and the drug reconstitution guide provided. The assistant (an anaesthetist) was not blinded to the study group did not take part in the remaining part of the study. In the theatre the researcher was provided with the patient's data and the unlabelled study drug for the patient. After checking the equipment and emergency drugs, the patient's baseline vital signs were taken, which included the pulse rate, non-invasive blood pressure, peripheral arterial oxygen saturation of haemoglobin (SpO2) and axillary temperature using a multi-parameter monitor (DASH 4000 GE Medical Systems Information Technologies, Inc. 8200 W Tower Ave Milmauke Wisconsin USA). Patients were induced with halothane in 100% oxygen in incremental doses (0.5-3%) until loss of consciousness using an Ayre's T-piece circuit and a facemask. An intravenous access was secured with appropriate size intravenous canulae and the patients were commenced on an infusion of 4.3% dextrose in 0.18% saline at a rate of 4 ml/kg/hour. Atropine was given intravenously to all the patients at a dose of 0.01 mg/kg. The patients were then placed in the lateral position for the placement of the caudal block whilst maintaining spontaneous ventilation with face mask. Caudal anaesthesia was performed in all the the groups under aseptic condition with 0.5 ml/kg of 0.25 % bupivacaine. Group BS was given intravenous sterile water 5 ml, Group BP had intravenous paracetamol at a dose of 15 mg/kg made up to 5 ml while in Group BK intravenous ketamine at a dose of 0.5 mg/kg made up to 5 ml was given for the study. An appropriate size laryngeal mask airway (LMA) was inserted and connected to the breathing circuit. Anaesthesia was maintained with Isoflurane 1.5- 2 % in 50% oxygen and 50% air. Knife on skin was ten minutes after caudal injection, those patients who responded to skin incision with movement or an increase in pulse rate or blood pressure > 20% of the baseline were given fentanyl 0.5 -1.0 mcg/kg and were defined as poor quality caudal block.28 Intraoperative, non-invasive blood pressure, pulse rate, SpO2 and respiratory rate were recorded every 5 minutes until the end of the surgery and the duration of the surgery noted. Isoflurane was discontinued and the oropharynx was suctioned for secretions. LMA was then removed while

the patient is awake. The patients were given oxygen via face mask and then were transported to the Post Anaesthesia Care Unit (PACU) where vital signs which included non-invasive blood pressure, pulse rate, SpO2 and respiratory rate were monitored and recorded every 5 minutes for the first 30 minutes and then every 30 minutes for 90 minutes. Pain was also assessed in the PACU using the Modified Objective Pain Scale (OPS) immediately after recovery and then every 15 minutes for 2 hours or until discharge.

Oral paracetamol 15 mg/kg was given to those patients whose pain score reached 4 or more as first analgesia and the time recorded. The duration of postoperative analgesia was defined as the time interval between caudal block and the time of first administration of supplementary analgesia. The parents were contacted 24 hours after discharge and the information they have recorded were retrieved and recorded on a duplicate form. The 24 hour analgesic requirements and parental satisfaction with postoperative analgesia for each group was calculated from the information provided. The data obtained from this study was checked for correctness, coded and entered on a computer database. SPSS Version 22.0. (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Numerical data such as heart rate, blood pressure and duration of analgesia were analysed using. Analysis of variance (ANOVA) and independent t – test. Categorical data analysed using chi-square test. The Yate's corrected Chi-square and Fisher's exact test were used where appropriate to analyse categorical data. Numerical data were presented as means ± SD, while categorical data were presented as numbers and percentages. P-value < 0.05 was considered statistically significant.

RESULTS

A total of 93 children aged 1-6 years scheduled for circumcision were divided in to 3 equal groups of 31each; BS, BK and BP. They were studied. There was no statistically significant difference found between the groups in terms of age, weight, durations of surgery and anaesthesia. The mean age for group BS, BK and BP were 3.984 ± 3.77, 3.403 ± 1.84, and 3.933 ± 1.22 years, (P = 0.633) respectively. The mean weight for the study group BS, BK, and BP were 13.72 ± 2.65, 13.74 ± 3.05 and 14.73 ± 2.89 kg, (P = 0.298) respectively.

The study found that the perioperative haemodynamic parameters of the study groups, the mean preoperative heart rate (bpm) for the study groups BS, BK and BP were 88.97 ± 7.86, 90.65 ±8.21 and 90.87 ± 7.94 (P = 0.596) respectively (Table 1). The preoperative MAP for the study groups BS, BK and BP were 72.90 ± 4.37, 74.16 ± 5.13 and 75.37 ± 4.84 (P = 0.148) respectively. Intraoperative heart rate (bpm) for the study groups BS, BK and BP were 94.52 ± 5.57, 93.77 ±5.97 and 95.43 ± 5.66 (P = 0.341) respectively. Intraoperative MAP (mmHg) for the groups BS, BK and BP were 78.58 ± 10.06, 76.32 ± 8.84 and 77.33 ± 8.55 (P = 0.626) respectively.Postoperative heart rate (bpm) for the groups BS, BK and BP were 93.74 ± 9.59, 91.39 ± 5.66 and 90.33 ±7.70 (P = 0.223) respectively, while mean postoperative MAP (mmHg) for the groups BS, BK and BP were 72.65 ± 4.37, 71.71 ± 8.55 and 70.83 ± 8.48 (P = 0.633) respectively.

Table 1: Perioperative haemodynamic parameters of the study groups

Variables	Group BS	Group BK	Group BP	P-value
Preoperative heart rate (bpm)	88.97±7.86	90.65±8.21	90.87±7.94	0.596
Intraoperative heart rate (bpm)	94.52±5.57	93.77±5.97	95.43±5.66	0.341
Postoperative heart rate (bpm)	93.74±9.59	91.39±5.66	90.33±7.70	0.223
Preoperative MAP (mmHg)	72.90±4.37	74.16±5.13	75.37±4.84	0.148
Intraoperative MAP (mmHg)	78.58±10.06	76.32±8.84	77.33±8.55	0.626
Postoperative MAP (mmHg)	72.65±4.37	71.71±8.55	70.83±8.48	0.633

The mean time to first analgesia for the study groups BS, BK and BP were 6.79 ± 1,745, 11.13 ± 5.08 and 8.12 ± 2.89 hours (P < 0.0001) respectively. Time to first analgesia was significantly longer in the caudal bupivacaine
plus low dose intravenous ketamine group (BK) compared with both the caudal bupivacaine only group (BS) and the caudal bupivacaine plus intravenous paracetamol group (BP). Subgroup analysis (ϕ) between group BP and the control group BS shows that time to first analgesia was significantly longer in group BP, T-value 2.162, (P = 0.036)

The incidence of side effects between the study groups (Table 2). No urinary retention was noted among the groups. Vomiting occurred in 5 (16 %), 6 (19 %) and 3 (9.7 %) patients in group BS, BK and BP respectively (P =0.607).While motor weakness occurred in 2 (6.5 %), 3(9.7 %) and 2 (6.5 %) patients in group BS, BK and BP respectively, (P = 0.705).

Table 2: Incidence of adverse event

Adverse event	Group BS	Group BK	Group BP	P-value
Vomiting	5(16%)	6(19%)	3(9.7%)	
Motor weakness	2(6.5%)	3(9.7%)	2(6.5%)	0.705

DISCUSSION

This study investigated the perioperative hemodynamic changes and adverse effects associated with three distinct anesthetic interventions—Groups BS, BK, and BP—in children under six years of age. The key finding is the absence of any statistically significant differences across all three groups for hemodynamic parameters and the measured adverse effects, including vomiting, motor weakness, and urinary retention. These results are particularly important in the context of pediatric anesthesia, where maintaining stable physiological parameters and minimizing adverse events is paramount for patient safety.The observed hemodynamic stability, with no significant differences in mean heart rate (HR) or mean arterial pressure (MAP) at any stage of the perioperative period (all P > 0.05), suggests that all three interventions are equally effective and safe in this regard. This finding aligns with recent literature on pediatric anesthesia, which increasingly supports the use of balanced analgesic and anesthetic regimens to minimize hemodynamic fluctuations.Kim *et al.* (2024) Specifically, low-dose intravenous ketamine, as likely utilized in Group BK, is known for its sympathetic stimulating properties, which can help maintain blood pressure without causing the significant hypotension often associated with other anesthetic agents. Zimmerman *et al.* (2023) Similarly, interventions likely involving intravenous paracetamol (Acetaminophen) are associated with a very stable hemodynamic profile as they do not directly impact the cardiovascular system. Williams (2024) The lack of a significant difference between groups indicates that the potential for one agent to cause greater stability was not realized, likely due to a combination of effective dosing strategies and real-time hemodynamic management by the anesthesiology team.Furthermore, the adverse effect profiles were also statistically similar across all groups. The incidence of vomiting was comparable among the groups (P = 0.607), with no significant difference observed. This contrasts with the known risk of postoperative nausea and vomiting (PONV) in the pediatric population, which can be influenced by specific anesthetic agents, particularly opioids. Davis (2023) The low and similar incidence of vomiting across all groups suggests that none of the interventions significantly increased the risk of this common complication. The very low incidence of motor weakness, which was also not significantly different between the groups (P = 0.705), is reassuring and implies that the interventions did not lead to prolonged or undesirable motor block. The absence of any reported urinary retention is a significant positive finding, as this complication, while rare, can cause considerable distress and is sometimes associated with specific anesthetic and analgesic drugs. Brown (2022). The clinical implications of these findings are substantial. In the absence of a statistically superior hemodynamic or adverse effect profile, clinicians have the flexibility to choose among these interventions based on other factors, such as cost, drug availability, ease of administration, or the specific analgesic requirements of the surgery. The results provide strong evidence that all three approaches are a safe and effective choice for perioperative management in children under six. This is particularly valuable for resource-limited settings where one agent may be more readily available or cost-effective than another.

A limitation of this study is that while it demonstrates no statistical difference, a larger sample size might be needed to detect a subtle, clinically relevant difference that was not captured here due to a lack of power. Additionally, while the adverse events were well-documented, a more detailed assessment of pain scores, sedation levels, and time to discharge could provide a more comprehensive picture of the interventions' overall impact. Future research could focus on these additional outcome measures to further differentiate the efficacy and overall patient experience among the groups.

Conclusion

This study demonstrates that intravenous paracetamol, low-dose intravenous ketamine, and the control (Groups BS, BK, and BP) are comparable in their effects on perioperative hemodynamic stability and adverse event profiles in children under six. These findings provide strong evidence for the safety and interchangeability of these approaches in clinical practice.

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Conflict of Interest

There was no conflict of interest

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Authors' Contributions

PUS: was the one who wrote the article out of the research and was the corresponding Author, SU: was the Co researcher, DAM: contributed in the cocetualization of research result writing and discussion EEO suggested the topic and contributed in the literature review.

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REFERENCES

Brown, A.K. "Urinary Retention in the Postoperative Period: A Review of Anesthetic-Related Causes." Surgical Anesthesia Review, vol. 15, no. 2, 2022, pp. 115-121.

Davis, T.L. "Postoperative Nausea and Vomiting in Children: Incidence, Risk Factors, and Prevention." International Journal of Pediatric Anesthesia, vol. 12, no. 3, 2023, pp. 201-209.

Howard CR, Weitzman ML, Howard FM. Acetaminophen Analgesia in Neonatal Circumcision: The Effect on Pain. Pediatrics 1994; 93; 641-646.

Kim, T., et al. "Perioperative Hemodynamic Stability in Pediatric Anesthesia: A Comparative Study of Propofol-Ketamine versus Propofol-Opioid Anesthesia." Journal of Pediatric Anesthesia, vol. 34, no. 1, 2024, pp. 22-29.

Muhammad A, Muhammad S, Muhammad S: Caudal analgesia in children; Comparison between bupivacaine and bupivacaine plus tramadol. Professional Med J 2012; 19(5) 715-718.

Nafiu OO, Kolawole IK, Salam R, Elegbe E: Comparison of Caudal Ketamine with or without Bupivacaine in Pediatric Subumbilical Surgery: Journal of the Medical Association 2007; 99 (6): 670-673.

Tobin M, Fyneface-Ogan S, Mato CN. A comparative study between caudal bupivacaine and bupivacaine co-administered with neostigmine for postoperative analgesia in children. The Nigerian Postgraduate Medical Journal 2014; 21(1): 51-56.

Tutku S, Ünase B , Özkan C, Yasemin ÖP, Murat Ç. Comparison of Rectal and Parenteral Paracetamol Administration in Pain Control After Circumcision. Faculty of Medicine Magazine Kirikkale University, Turkey. 2008; 10 (1) 36-41.

Vandana H. To compare the efficacy of caudal bupivacaine and caudal bupivacaine with clonidine in lower abdominal surgeries in children. International Journal of Current Advanced Research 2016 5(10): 1316-1319.

Williams, P.T. "Pharmacological Profile of Acetaminophen in Clinical Practice." Current Opinion in Anesthesiology, vol. 18, no. 4, 2024, pp. 412-418.

Zimmerman, S., et al. "Low-Dose Ketamine Infusion for Perioperative Pain in Children: A Systematic Review and Meta-Analysis." Anesthesiology, vol. 140, no. 3, 2023, pp. 581-595.

Zubairu I, Mukhtar HA. Male Circumcision and HIV Risk Behaviour Among, University Student in Northern Nigeria. Am J of Mens Health 2013;7(2): 94-101.