

## PAIN RELIEF FOLLOWING DAY CASE PAEDIATRIC INGUINAL HERNIOTOMY: ANALGESIC EFFICACY OF DEXMEDETOMIDINE FOR CAUDAL BLOCK WITH BUPIVACAINE

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### Abstract

**Background:** Many surgical procedures in children are of short duration and are increasingly being performed on day-case basis with consequent need for adequate post-operative pain relief. Caudal analgesia with bupivacaine alone for post-operative pain relief in paediatric day-case herniotomy has been found to be inadequate, hence the need for addition of adjuncts to prolong the analgesia. **Aim:** This study compared the effect of caudal block with bupivacaine alone and bupivacaine combined with dexmedetomidine on post-operative pain in paediatric day case inguinal herniotomy. **Methodology:** In this double-blind randomised controlled study, 80 ASA I or II patients aged between 3 and 8 years scheduled for day case inguinal herniotomy were randomized into two groups (B and BD). After induction of anaesthesia, all patients had caudal block using either 0.5ml/kg of 0.25% plain bupivacaine made up to 20ml with normal saline for group B or 0.5ml/kg of 0.25% plain bupivacaine mixed with 1 $\mu$ g/kg of dexmedetomidine made up to 20ml with normal saline for group BD. Surgery commenced 15 minutes later and anaesthesia was maintained with halothane. In the PACU, pain intensity was assessed on arrival (baseline), at 30 minutes, then every hour until discharge from PACU to the ward using the Objective Pain Scale (OPS). Fentanyl 0.5  $\mu$ g/kg was given when OPS was  $\geq 4$ . Pain assessment continued at home using NRS by parents/guardian for a total of 24hrs. Pain scores and haemodynamic parameters were documented. **Result:** In PACU, the mean baseline OPS in group BD was  $2.00 \pm 0.22$ , compared to  $3.00 \pm 0.17$  in group B ( $p < 0.001$ ). At 240 min post-operatively, the group BD patients had a mean OPS of  $0.40 \pm 0.07$  and group B had a value of  $1.30 \pm 0.14$  ( $p < 0.001$ ). At home, the mean pain score using the numeric rating scale (NRS) was  $3.06 \pm 1.15$  in group BD and  $4.15 \pm 0.86$  in group B ( $p < 0.001$ ).

**Conclusion:** Dexmedetomidine (1 $\mu$ g/kg) in combination with caudal bupivacaine 0.25% reduce postoperative pain scores in day-case paediatric inguinal herniotomy.

**Keys words:** Dexmedetomidine, bupivacaine, caudal block

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## Introduction

It is well recognized that optimal postoperative pain management is essential for children, and that analgesia should be started even before surgery. Postoperative pain is a form of acute pain and it results from tissue destructions associated with surgical procedure.<sup>1,2</sup> Uncontrolled postoperative pain leads to discomfort, suffering, unwanted physical consequences such as risk of developing chronic pain, and increased risk of morbidity. A previous study has shown that postoperative pain management was suboptimal in day-care settings, with 15% of patients contacting the hospital postoperatively reporting pain problems.<sup>3</sup>

Inguinal hernia repair in children is a common minor surgical procedure, usually done as day-case.<sup>4</sup>

Children suffer postoperative pain in the same way as adults, in a study by Faponle and Usang,<sup>5</sup> it was found that in paediatric day case surgeries, post-operative pain constituted 72% of symptoms recorded by parents at home. Surgery-related pain has significant physiological impact. Postoperative pain control following minor surgery in children has been so poorly treated in this environment, untreated acute, recurrent or chronic pain related to disease or medical care may have significant physiological and psychological consequences in children.<sup>6</sup> Multimodal approach is employed for pain management in current practice. In a day-case setting, opioids are often avoided because of potential side effects such as respiratory depression, sedation, nausea, vomiting, pruritus, and reduction in bowel motility leading to ileus which may delay discharge.<sup>7</sup>

Caudal block is a common regional technique used to provide intra and post-

operative analgesia for surgical procedures below the umbilicus in paediatric patients. It has been described as simple, safe and effective in the treatment of acute post-operative pain following minor to moderate infra umbilical surgical procedures in children.<sup>8</sup> This is commonly by the single shot technique using the local anaesthetic agent bupivacaine with reported suboptimal efficacy.

The potent and highly selective  $\alpha_2$  adrenergic agonist, dexmedetomidine may be added as an adjuvant to bupivacaine to improve its efficacy. It has a sedative and sympatholytic effect, however, dexmedetomidine usage is just gaining interest in developing regions of the world and its analgesic effect as adjunct to bupivacaine for caudal block in day case paediatric inguinal hernia surgeries is yet to be evaluated.

This study compares the analgesic effect of addition of dexmedetomidine as adjunct to bupivacaine during caudal epidural block for paediatric patients scheduled for inguinal herniotomy.

## Methodology

This was a prospective, double-blind, randomized study carried out at Aminu Kano Teaching Hospital, a tertiary institution in northwest Nigeria. With Institutional Ethical Committee approval obtained, 80 children aged 3-8 years belonging to the American Society of Anesthesiologists' (ASA) physical status classification I or II and whose parent/guardian had given written consent were recruited into the study. These patients were scheduled for elective hernia surgeries on day-case basis. Patients excluded from this study included patients with known hypersensitivity to the study drugs,

coagulation abnormalities, infection at the caudal injection or sepsis, pre-existing neurological deficits or spinal deformity, children with cardiac problems, respiratory disorders, neurological disorders, gastrointestinal disorders, renal or hepatic impairments.

A detailed history from parent or guardian was obtained and physical examination was performed and documented on every patient on the day of surgery. Routine investigations including full blood count (FBC), electrolyte urea and creatinine (EUCr), and urinalysis were reviewed. Parents/guardian were asked about adherence to routine preoperative fasting guideline of 6 hours for solids and 2 hours for clear fluids before surgery. The patients were randomly allotted to either group B (bupivacaine) or group BD (bupivacaine/dexmedetomidine) after either the parent or guardian was asked to pick uniformly sized sheets of paper representing either of the two study groups from a large box. The patient's file number was written on a sheet of paper bearing the group which the patient belonged to and kept in a sealed separate envelope that was opened after evaluation was completed. Both the investigator and the patient were blinded to the group allocation. All patients were weighed preoperatively.

Nurses in the post anaesthesia care unit (PACU) had been taught the use of the Objective Pain Scale (OPS) as it relates to the study, parameters assessed with OPS include systolic blood pressure, crying, movement, agitation and complaint of pain. Children who could verbalise were taught to report pain or discomfort. Parents/guardians were taught the use of the Numeric Rating Pain Scores (NRS ranging from 0 = no pain to 10 = the worst imaginable pain) so that they were able to assess pain after discharge. The study agents were then prepared under aseptic condition by the research assistant who is a resident doctor in the department

and was not involved in data collection. A multiparameter monitor (GE) to measure heart rate, blood pressure, respiratory rate, and pulse oximetry for arterial oxygen saturation were attached to the patient and baseline readings were obtain and recorded. A precordial stethoscope was placed. Anaesthesia was induced using a stepwise increment of halothane from 0.5% to 5% in 100% oxygen every 60 seconds, the patient was breathing via a Jackson Rees' modified Ayre's T-piece breathing system for patients < 25 kg or Bain Circuit for patients > 25 kg with appropriately sized face mask until consciousness was lost. Intravenous access was then secured with a 22-gauge cannula on the dorsum of the hand when the depth of anaesthesia was deemed adequate by observing the eyes to see if centrally placed, and regular respirations. Dextrose 4.3% in 0.19 saline solution was then set-up to correct the deficit and maintenance. Deficit was calculated with the formula (4:2:1 ml/kg/hr) and administered via a soluset, then an appropriately sized i-gel airway device was inserted based on the weight of the patient for maintenance of general anaesthesia and airway control. Caudal block in all patients was performed by the investigator, who was unaware of the group allocation and blinded to the study drugs. Patients in Group B (Bupivacaine alone) received 0.5ml/kg of 0.25% plain bupivacaine in 20ml syringe made up 20ml with normal saline, while those in Group BD (Bupivacaine plus Dexmedetomidine) received 0.5ml/kg of 0.25% plain bupivacaine mixed with 1 $\mu$ g/kg of dexmedetomidine in 20ml syringe made up to 20ml with normal saline for caudal block. Caudal block was performed by the investigator by placing each patient in the lateral decubitus position with knees drawn towards the chest. The sacral hiatus was identified as the apex of an equilateral

triangle facing inferiorly with a line joining the posterior superior iliac spine as the base. Under sterile condition and draping, the palpating finger was directed caudally from the midpoint of the line joining the posterior superior iliac spines or cranially from the coccyx until a depression was felt. A 22g cannula was inserted into the sacral hiatus at 45 degrees to the skin until a click was felt then it was angulated at 30 degrees with the spine. A 2 ml syringe filled with normal saline as test dose was then used to exclude subcutaneous placement before the local anaesthetic agent bupivacaine in group B or bupivacaine with dexmedetomidine in group BD was injected after a negative aspiration test. Patients were then positioned supine, and surgery allowed to begin 15-20 minutes later with patients breathing spontaneously via the i-gel device.

Observation and monitoring of vital signs was continued at five-minute intervals until the end of surgery. Anaesthesia was maintained with halothane 0.5-1%, adequate anaesthesia was judged by lack of movement and stable vital signs within the baseline values following skin incision. Patients with failed caudal block had their anaesthesia deepened with increased halothane and intravenous fentanyl 1 to 2  $\mu\text{g}/\text{kg}$  was given. Failed caudal block was judged by movement of the limbs to surgical incision, and  $> 20\%$  increase in heart rate compared to baseline values. Patients who received intra-operative analgesia were excluded from the study. At the end of surgery, halothane was discontinued, i-gel removed immediately and oxygen was administered until after emergence from anaesthesia. Patients were managed by a nurse unaware of group allocation in the recovery room (PACU).

Postoperative pain was assessed and recorded on arrival at PACU (0 minute), then at 30, 60, 120, 180 and 240 minutes using the OPS. The observer scored pain

based on points [none/ insignificant pain (1-3), moderate pain (4-6), severe pain (7-10)]. Patients that complain of moderate to severe pain had rescue analgesic of intravenous 0.5  $\mu\text{g}/\text{kg}$  fentanyl given. Oxygen saturation, blood pressure, pulse rate were documented in the recovery room at fifteen-minute intervals.

Patients were discharged to the ward from the PACU after 1 hr according to hospital protocol and when they satisfy the Aldrete score value  $\geq 9$  which is assessed different criteria including patient activity, respiration, circulation, consciousness level and colour. Monitoring of  $\text{SpO}_2$ , PR, and NIBP was continued in the ward hourly. Pain assessment also continued using the OPS as detailed in the study protocol. Patients were discharged home from the ward on oral paracetamol at 20  $\text{mg}/\text{kg}$  when they satisfy the Post Anaesthesia Discharge Scoring System (PADSS) value  $\geq 9$ , this is assessed using different criteria including vital signs, activity and mental status; pain, nausea and vomiting; surgical bleeding; intake and output. After discharge, information regarding the pain intensity (using NRS) and any other complications such as vomiting and irritability was obtained from parents. Pain was assessed at home 4 hourly, for a period of twenty-four hours after the surgery, information about pain score was obtained by the researcher via a telephone call. Patients with an NRS  $\geq 4$  was given paracetamol.

Data on demographic characteristics, haemodynamic variables, pain scores were documented. Quantitative data (age, weight and pain score) were summarized using means and standard deviation. Qualitative data (ASA classification) was summarized using percentage. Test for association for quantitative data was done using student t test and for qualitative data using chi test. A  $p$ -value  $\leq 0.05$  was considered statistically significant and the result processed using the

statistical package for the social sciences (SPSS) version 25 (International Business Machines, IBM, New York, United States of America).

## Results

Eighty patients were recruited for this study; however, three patients were excluded from this study which include one from group BD and two from group B due to failed caudal block. Table I shows the age and weight of patients in each group. The demographic characteristics of the two groups were comparable.

Mean pain score was  $2.01 \pm 0.21$  in the immediate postoperative period for group BD, and  $3.02 \pm 0.15$  for group B ( $p < 0.001$ ) as seen in Table II. At 60 min pain score in Group BD had reduced to  $1.02 \pm 0.17$ , compared to a value of  $2.50 \pm 0.19$  min in group B ( $p < 0.0001$ ). There was also a statistically significant pain score difference between the two groups at 120, 180 and 240min.

The mean pain score (NRS scale) at the time to first analgesic requirement at home was significantly lower in group BD ( $3.06 \pm$

$1.15$ ) compared to group B which was  $4.15 \pm 0.86$  ( $p < 0.001$ ).

Intra operative baseline heart rate was  $106.10 \pm 13.01$  beats per minute in Group B, and  $111.42 \pm 11.48$  beats per minutes for BD,  $p = 0.064$ . A slight increase in heart rate was noticed in group B patients compared to those in group BD at 10 minutes,  $p = 0.243$ . Heart rate values were almost the same at 25 mins in group B ( $101.61 \pm 7.46$  beats  $\text{min}^{-1}$ ) and group BD ( $100.92 \pm 12.21$  beat  $\text{min}^{-1}$ )  $p = 0.723$ . At 35 and 40 minutes intraoperatively heart rate values of both groups BD and B were statistically different with higher values in group B ( $p = 0.027$  and  $0.016$  respectively).

Baseline mean arterial blood pressure were  $70.01 \pm 7.11$  mmHg and  $71.12 \pm 8.10$  mmHg in for groups BD and B respectively,  $p = 0.749$ , a MAP decrease was observed as anaesthesia deepened in both groups. Patients in group BD had lower values compared to group B but the difference was not significant. At 15 minutes intra-operatively, group BD had a value of  $63.03 \pm 7.30$ , compared to  $66.53 \pm 5.35$  in Group B, with  $p = 0.143$ . Mean arterial blood pressure was also not significant at any time point between the groups, with a value of  $50.02 \pm 12.32$  mmHg in group BD and  $54.07 \pm 0.00$  mmHg in group B at the end of surgery ( $p = 0.784$ ).

**Table I: Demographic characteristics of the study groups.**

	Group BD (n=39)	Group B (n=38)	t-value	p-value
<b>Age (years) Mean<math>\pm</math>SD</b>	$5.28 \pm 1.47$	$5.39 \pm 1.69$	-0.311	0.756
<b>Weight (kg) Mean<math>\pm</math>SD</b>	$19.85 \pm 5.70$	$20.63 \pm 4.00$	-0.698	0.487
<b>ASA (%) I</b>	35 (89.7)	32 (84.2)	0.521	0.517
<b>II</b>	4 (10.3)	6 (15.8)		

$\chi^2$

\* p value  $\leq 0.05$  is statistically significant.

**Table II: The Objective pain scale (OPS)**

Time (mins)	Group BD (n=39)	Group B (n=38)	t-value	p-value
<b>0 min pain score</b>	2.01 $\pm$ 0.21	3.02 $\pm$ 0.15	3.32	<0.001*
<b>Mean <math>\pm</math>SD</b>				
<b>30 mins pain score</b>	1.5 $\pm$ 0.17	2.3 $\pm$ 0.11	3.19	<0.001*
<b>Mean <math>\pm</math>SD</b>				
<b>60 mins pain score</b>	1.02 $\pm$ 0.17	2.5 $\pm$ 0.19	4.30	<0.001*
<b>Mean <math>\pm</math>SD</b>				
<b>120 mins pain score</b>	0.80 $\pm$ 0.09	1.5 $\pm$ 0.14	7.19	<0.001*
<b>Mean <math>\pm</math>SD</b>				
<b>180 mins pain score</b>	0.42 $\pm$ 0.50	1.10 $\pm$ 0.55	5.670	<0.001*
<b>Mean <math>\pm</math>SD</b>				
<b>240 mins pain score</b>	0.58 $\pm$ 0.50	1.08 $\pm$ 0.81	3.243	0.002*
<b>Mean <math>\pm</math>SD</b>				

\* p value  $\leq 0.05$  is statistically significant.

**Table III: Time to First Analgesia (TFA) and NRS**

	Group BD (n=39)	Group B (n=38)	t-value	p-value
<b>Pain score at home (NRS)</b>	3.06 $\pm$ 1.15	4.15 $\pm$ 0.86	-5.183	<0.001*
<b>Mean <math>\pm</math>SD</b>				

\* p value  $\leq 0.05$  is statistically significant.

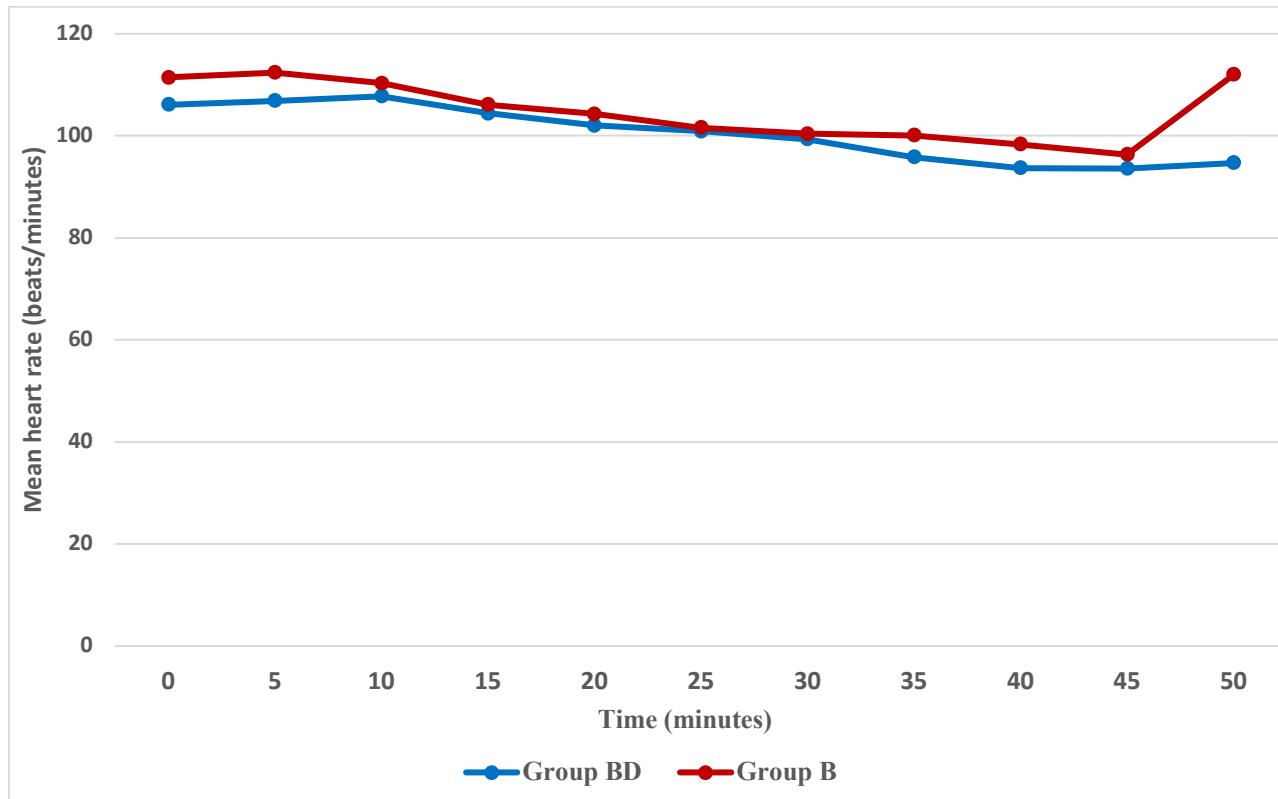


Fig. 1: Pattern of Intra-operative Heart rate

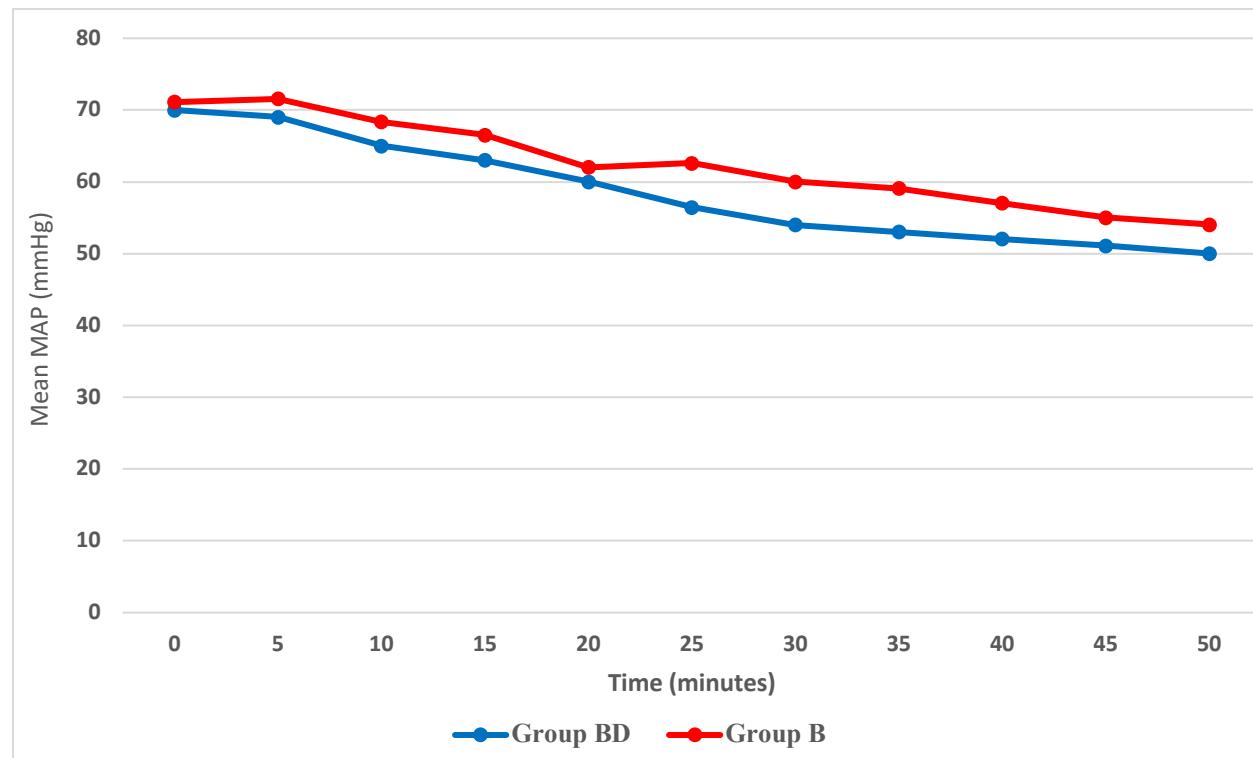


Fig. 2: Pattern of Intra-operative MAP

## Discussion

The results obtained from this study revealed that 0.5ml/kg of 0.25% bupivacaine combined with 1 $\mu$ g/kg of dexmedetomidine when given for caudal epidural in day case paediatric inguinal herniotomy reduces post-operative pain when compared with bupivacaine (0.25%) alone. But haemodynamics and demographic parameters were comparable in the two groups.

The Objective Pain Scale (OPS), a validated pain scoring tool in children was used in the PACU to assess pain in the patients for this study. OPS in the immediate postoperative period were 3 and 2 for groups B and BD respectively. This trend of lower pain intensity score in group BD continued with a score of 1 in group BD and less than 3 for group B at the 60<sup>th</sup> min. It was less than 1 and less than 2 for groups BD and B respectively at 120 180- and 240 min periods of assessment, the differences between the groups were statistically significant. In PACU the initial higher OPS values seen may be due to arousal from Anaesthesia. Hasani et al,<sup>9</sup> in a study of 45 children aged 1 to 9 years scheduled for hypospadias surgery, obtained similar OPS of 2 in the group that had pre-operative caudal bupivacaine anaesthesia compared to the second group that had caudal block after the surgery, the average bupivacaine half-life of 4-6 hr may account for an optimal pain relief at about the 3rd hour seen in their study. Manoj et al,<sup>10</sup> reported similarly low and significant pain score differences in their dexmedetomidine group and control group, Goswami and Hazra<sup>11</sup> and Oruobu-Nwogu A et al<sup>12</sup> also reported lower pain score differences in both study groups using FLACC score in the immediate postoperative period. Effective management of pain in the paediatric patient has been receiving increasing attention over the years due to the

challenging nature of assessing pain in children. Adequate pain management in children depends on correct assessment. In the perioperative period, it is important to distinguish if their perceived pain is due to restlessness from hypotension, thirst, hunger, separation, anxiety, fear of strangers or strange places and desire to void.

Pain assessment in the immediate post-operative period in this study was performed by PACU nurses. The reliability of pain assessment post operatively by nurses was reported in a study by Colwell et al,<sup>13</sup> they examined nurses' use of paediatric pain scale compared with child's self-report of pain. The study concluded that use of paediatric pain scale by nurses reflects the child's exact pain experience.

The NRS was used by parents for pain assessment at home. It is an assessment tool consisting of a line labelled from 0 (no pain) to 10 (worst possible pain) which has been validated for use in the Nigerian child. Eyelade et al,<sup>14</sup> in a study on convergent validity of pain measuring tools among children in Nigeria concluded that the VAS, NRS and Oucher pain scales are valid pain tools that can be used to assess pain in Nigerian children.

The pain score at home using the NRS in this study showed that patients in both study groups had a statistically significant difference in pain with group BD having a pain score of  $3.06 \pm 1.15$  and group B had  $4.15 \pm 0.86$ ,  $p < 0.0001$ .

Haemodynamic variables between groups BD and B were found to be comparable with no statistically significant difference intra and post operatively. The stable hemodynamic state may be as a result of effective caudal block. Haemodynamic stability was also reported in previous studies following caudal block in children that had lower abdominal surgeries.<sup>10,15</sup>

## Conclusion

We conclude that the use of 1 $\mu$ g/kg dexmedetomidine in combination with 0.25% bupivacaine for caudal block reduce postoperative pain scores after inguinal herniotomy. Haemodynamics remained stable and comparable in patients that receive both dexmedetomidine as adjuvant to bupivacaine and those that receive bupivacaine alone throughout the study.

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Nil.

#### Conflicts of interest

There are no conflicts of interest.

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