Original Research Paper

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EVALUATION OF CLONIDINE AS AN ADJUVANT FOR CAUDAL ANAESTHESIA IN CHILDREN

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ABSTRACT **Aims and objectives:** The aim of the study is to analyze and assess the analgesic efficacy of clonidine and duration of action of analgesia given in the dose of 1µg/kg with 0.125% bupivacaine for caudal block in children. The children of the age group from six months to six years are divided into two group as group C and group D, the weight of the children, were in the range from 5kgs up to 20kgs. Group C children should be given 1 ml/kg of 0.125% bupivacaine in caudal epidural space. Group D children are to be given 1 ml/kg of 0.125% bupivacaine with 1µg/kg of clonidine in the caudal epidural space. The parameters to be considered are hemodynamic changes, Duration of post-operative analgesia, Post operative complications. The differences between the two groups were analysed using an independent t-test while meeting normality assumptions for continuous variables and a chi-square test for categorical data. The Mann- Whitney Test was used to analyse non-parametric variables. Statistical significance was determined for all tests with a significance threshold of 0.05 or less. **Results:** In our study we observed Mean duration of the post-operative analgesia in group C patients is 275.2 ± 60.6 minutes and ranges between 190 minutes to 480 minutes. In group D, mean duration is 486.3±90.0 minutes and ranges between 380 minutes to 690 minutes. Mean duration of post-operative analgesia is significantly higher in group D patients compared to groupC. ($p<0.05$; Significant) **Conclusion:** Caudal clonidine in the dose of 1µg/kg in children is a satisfactory and efficacious adjuvant to caudal bupivacaine for producing prolonged postoperative analgesia ,does not compromise haemo dynamics of patients, reduces the number of rescue analgesics in postop period.

KEYWORDS : Post Operative Analgesia, Caudal Anesthesia, Clonidine 0.125%, Bupivacaine

INTRODUCTION

Pain is a defence mechanism that warns the body of potentially harmful stimuli. The incapacity of children to respond and answer to the queries in the same way that adults respond has lead to the misconception that children do not feel pain as much as adults do[1]. Now it is widely accepted that newborns experience nociception as well. Early in foetal development, basic excitatory connections develop, and receptors are extensively distributed[2].

Nociception causes immediate physiological, immunological, humoral, and behavioural responses in the children, resulting in an increase in circulating catecholamines, aldosterone, cortisol, glucagon, and steroid hormones, which can cause adverse effects such as an increase in blood pressure, heart rate, intracranial pressure, and a decrease in transcutaneous partial pressure of oxygen[2]. The above stress response is also evident in children who have insufficient intraoperative and postoperative analgesia, which can be eliminated by delivering appropriate analgesicsto the child.

An anesthesiologist's major concern in a child is postoperative pain management because pain not only affects the patient but also raises anxiety in the parents, which may be alleviated by adequate postoperative analgesia.

Several treatments for paediatric pain alleviation have been tried, with varying degrees of success. One of the most commonly performed regional procedures in paediatric anaesthesia is the caudal epidural block[3]. It has become popular in the recent years, particularly for infraumbilical surgeries, as it is a safe, simple, and reliable technique[4].

Even with long acting local anaesthetic drugs like Bupivacaine, the major disadvantage of a single shot caudal block would be its short duration of action[3]. This results in the child's early identification of pain following surgery, necessitating extra care to achieve effective post-operative analgesia. Various drugs such as Opioids [5, 6, 7,], Midazolam[8], Epinephrine, Ketamine[9], Clonidine[11,12,3], Neostigmine[10], etc., have been used as additives to avoid placement of epidural catheter, while also extending the duration and improving the quality of analgesia of local anaesthetics both intraoperatively and post operatively.Clonidine, which is a α2 adrenergic agonist, acts centrally to cause analgesia[13,14].Though there are various routes of administration for this drug, when used epidurally, it is a more potent analgesic with few side effects[15].

Clonidine is used in caudal block as an adjuvant with local anaesthetics such as Bupivacaine, Lignocaine, and Ropivacaine to improve intra-operative and post- operative analgesia while lowering the dose of local anaesthetic. Clonidine has been known to produce analgesia of variable duration and intensity that is dose dependent. Clonidine was used by many authors as an additive to local anesthetics in dosages ranging from 1µg/kg to 3µg/kg in order to reduce their toxicity[16].

This clinical study was executed to determine the safety and analgesic efficacy of Clonidine as an adjuvant for caudal anesthesia in children undergoing infra umbilical operations at a dose of 1µg/kg to 1ml/kg of 0.125 % bupivacaine

MATERIALS AND METHODS

Source Of The Study:
Patients scheduled for elective and emergency infra umbilical surgeries among paediatric age group from six months to six years at Kurnool Medical College and Hospital. The surgeries were confined to the paediatric surgery department.

Design Of The Study:
Prospective randomized controlled clinical trial.

Period Of The Study:
March 2022- August 2023

Sample Size: 60 patients.

Type Of Surgeries: Infra umbilical surgeries

Inclusion Criteria:
1. ASA - I and II.
2. Patients belonging to age six months – six years.
3. Weight from above 5 kgs to 20 kgs
4. Informed consent from parents.
5. Paediatric patients undergoing elective and emergency sub-umbilical surgeries

Exclusion Criteria:
1. Parental refusal for the procedure.
2. Patients of ASA III & IV having comorbidities like cardiac, respiratory, renal and hepatic dysfunction.
3. Local Infection in the caudal area.
4. Sacral bone abnormalities
5. History of neurological deficits and developmental delay.
6. Bleeding diathesis
7. Patients who had failed block based on hemodynamic parameters and those who developed engorged and vasodilated genital organs, making it less favourable for the surgeon to operate.

Method Of Randomization:

Sealed envelope method

MATERIALS:

1. Bupivacaine hydrochloride injection I.P. local anaesthetic 0.5% - 20 ml vial
2. Clonidine injection I.P. -1ml ampoule - 150µg/ml IM/IV
3. Caudal block

- A tray with a sterile towel, swabs, povidone-iodine 5% solution, sponge holding forceps and bowl.
- 10 ml syringes, 23 G hypodermic needle.
- Drugs
- Appropriate sized Airways and masks.
- Laryngeal Mask Airway (LMA) of appropriate sizes and JacksonRees circuit.

I.V catheter 22 G or 24 G

- Working laryngoscope with appropriate size blades.
- Suction apparatus.
- Drugs essential for resuscitation were ready.

METHODOLOGY:

1. Institutional ethical committee approval was obtained.
2. A detailed history, physical examination, and standard investigations were performed as part of the pre-anaesthetic evaluation.
3. Children of age group of six months to six years of age, ASA physical status I and II posted for elective and emergency infra-umbilical surgeries were listed into the study after getting parental informed consent.
4. Weight of the children in the study was ranging from more than 5 kgs to 20 kgs.

The surgeries considered under this study were appendicectomies (McBurney's incision), herniotomies, orchidopexies, and cystoscopy related procedures. Incidentally, there were no surgeries on the lower limbs.

The patients' age, weight and height, were recorded.

Preoperative Fasting:
Prior to surgery, solid food was prohibited for six hours, breast milk for four hours, and clear fluids for two hours.

Premedication:
Premedication with Intravenous midazolam 0.1mg/kg and injection atropine 0.02mg/kg, 30 minutes before induction of anaesthesia.

Monitoring:
Pre-induction monitors were attached. Monitoring of Electrocardiogram (ECG), Heart rate, Blood Pressure (SBP, DBP, MAP) and Oxygen Saturation (SpO2) were recorded before, during surgery and every 5 mins after the caudal block .The vitals were documented at 0, 5, 10, 15, 30, 45, 60 and 90 mins.

The baseline values were recorded and documented.

Induction:
Inhalation volatile anesthetic induction was done using oxygen 100% and up-to sevoflurane 8%, and an I.V line was secured. Injection fentanyl 1 µg/kg intravenously was given to blunt the intubation responses and aid the induction and intubation process

Airway Management:
Face masks, laryngeal mask airways, and endotracheal tubes were used. As per calculated requirements, a suitable crystalloid infusion was started.

Maintenance Of Anaesthesia:
33% oxygen, 66% nitrous oxide and sevoflurane 1-2%. At the end of surgery patient was placed in lateral position for administration of the caudal block.

Administration Of Caudal Block:
Caudal block was performed at the end of the surgery. The sacral hiatus was detected by moving the thumb up from coccyx towards the sacrum under stringent aseptic circumstances. After identifying the sacral hiatus, a 22 G or 23 G hypodermic needle with bevel facing anteriorly at a 60-70° angle to the skin was inserted until the sacrococcygealmembrane was penetrated, resulting in a characteristic pop. The needle is further advanced so that it hits posterior surface of anterior sacral wall. It was then reduced to an angle of 20° and progressed little further of 2-3 mm so that the entire bevel was within the caudal space.

Space is present between posterior surface of anterior sacral wall and anterior surface of posterior sacral wall. Check for negative aspiration for CSF and blood, to exclude subarachnoid or intravascular placement of the needle. Later the study drug was injected to the allotted group.

Before the administration of the drug, whoosh test was performed by injecting 1-2 ml of air into space by auscultating with a stethoscope to confirm the correct placement of the needle and to avoid subcutaneous injection of the drug. This test even rules out the accidental injection of drug into the rectum in which case the test will be negative.

Group C: Children received 1 ml/kg of 0.125% bupivacaine in the caudal epidural

Group D: Children received 1 ml/kg of 0.125% bupivacaine with 1µg/kg clonidinein the caudal space.

A lax anal sphincter predicts the effectiveness of analgesia after caudal block. After the drug was injected and needle was removed, the child was kept in the supine position.

The patients were observed for any limb movement, tachycardia or increase in mean arterial pressure by 20% more than the baseline values, and presence of any of these parameters was considered a failed caudal block. These children were excluded from the study and managed with additional doses of analgesics.

As sometimes performing caudal block in surgeries involving the penis like urethroplasty, hypospadiasis and chordee correction, may produce extensive vasodilation and subsequent erection leading to priapism and vascular engorgement of these organs, such patients were eliminated from the study to facilitate a quality surgical repair.

Table 2: Table For Defining The Possible Complications Following The Block

Signs	Definition	Treatment
Respiratory depression	SpO2-<93% in pulse oximeter Respiratory rate-<10/min	Oxygen supplementation Assisted ventilation
Bradycardia	Heart rate- less than 20% below the baseline value	Injection atropine 20µg/kg I.V
Hypotension	Systolic blood pressure 20% less than the baselinevalue	Treated with injection ephedrine in fractionated Doses

- Monitoring included heart rate (pulse rate), non-invasive blood pressure measurement, pulse oximetry.
- The recorded parameters were documented every 5 min for 90 min after caudal block.
- After extubation, pain score was assessed using Face, Legs, Activity, Cry, Consolability (FLACC) scale at intervals of 0, 1, 2, 3, 4, 8, 12,16, 20, 24 hours.
- Patients were shifted to the ward after observation in the post-anaesthesia care unit for 3 hours up to 24 hours.

The paediatric observational FLACC pain scale with a score of 0–10 range was used to assess postoperative analgesic efficacy. Every child's pain intensity was measured every hourly until the time of discharge from the PACU.

FLACC score 0 = no pain 1-3 = mild pain
4-7=moderate pain 8-10=severe pain
If the FLACC pain scale score was found to be 3 or more at any time, it was considered moderate pain and rescue analgesia was provided in the form of a paracetamol suppository 30 mg/kg rectally or oral paracetamol 15 mg/kg.

The time interval between the injection of caudal block and the first need for supplementary analgesia was defined and recorded as the duration of action of caudal analgesia.

Category	Scoring		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to; distractable	Difficult to console

Each of the five categories is scored from 0 – 2, resulting in total range of 0 – 10, FLACC = Face, Leg, Activity, Cry, Consolability

Figure 7: FLACC SCORING

Statistical Methods

MS Excel 2007 was used to enter data, and SPSS version 21.0 was used to analyse the results. Continuous variables were expressed as mean and standard deviation (SD), whereas categorical variables were expressed as frequency (percent). The differences between the two groups were analysed using an independent t-test while meeting normality assumptions for continuous variables and a chi-square test for categorical data. The Mann-Whitney Test was used to analyse non-parametric variables. Statistical significance was determined for all tests with a significance threshold of 0.05 or less.

OBSERVATIONS AND RESULTS

Table 3: Age wise distribution of the study participants (n=30 in each group)

Group	Mean age (In months)	Standard deviation	t-value	p-value
Group C	32.9	12.58	0.277	0.783 (NS)
Group D	33.8	12.55		

Mean age in group C patients was 32.9 ± 12.58 months, ranges from 8 to 59 months and group D were 33.8 ± 12.55 months, age ranges from 10 to 60 months. The difference in mean age of the patients between two groups was not significant statistically. (t=0.277; p>0.05; Not significant)

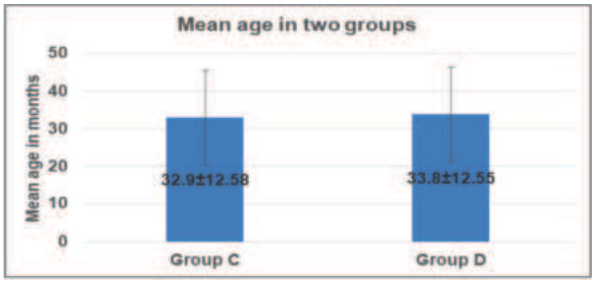

Chart 1: Bar diagram showing Age wise distribution of patients in two groupsTable 4: Gender wise distribution of the study participants

□²-value with Yate's correction = 0; df = 1; p>0.05; Not significant

In group C, out of 30 patients 25 (83.3%) were males and 5 (16.7%) were females. In group D, out of 30 patients 26 (86.7%) were males and 4 (13.3%) were females. No significant difference was found between the groups with respect to gender. (□²-value with Yate's correction = 0; degree of freedom (df) = 1; p>0.05; NS)

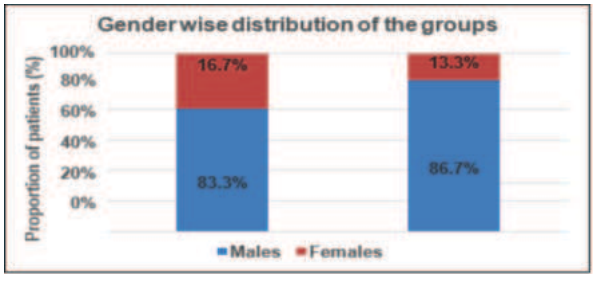

Chart 2: Bar diagram showing the Gender comparison between two groups

Table 5: Distribution of the study participants by weight

Group	Weight (in kilograms)		t-value	p-value
	Mean	Standard deviation		
Group C	13.7	2.62	1.542	0.129 (NS)
Group D	14.7	2.40		

Mean weight in group C patients was 13.7 ± 2.62 kilograms and in group D was 14.7 ± 2.40 kilograms. The mean weight of the patients in two groups were not showing any significant difference statistically. (t=1.542; p>0.05; Not Significant)

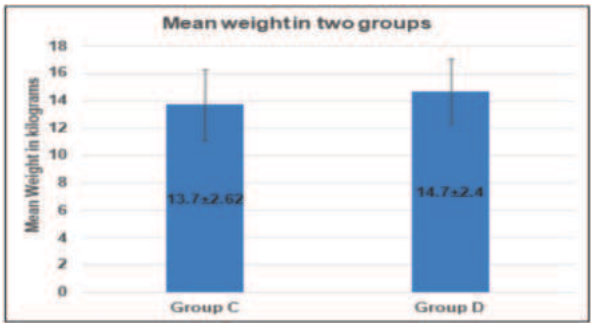

Chart 3: Bar diagram showing comparison between groups by mean weight

Table 6: Distribution of the study participants by ASA classification

ASA classification	Group C	Group D	p-value
I	20 (66.7%)	19 (63.3%)	0.787 (NS)
II	10 (33.3%)	11 (36.7%)	

□²-value = 0.073; df = 1; p>0.05; Not significant

In group C, around 20 (66.7%) patients are in level I by ASA classification and 10 (33.3%) patients are in level II by ASA classification. In group D, around 19 (63.3%) patients are in level I by ASA classification and 11 (36.7%) patients are in level II by ASA classification. There is no significant difference between two groups with respect toASA classification. (□²value=0.073; df=1; p>0.05)

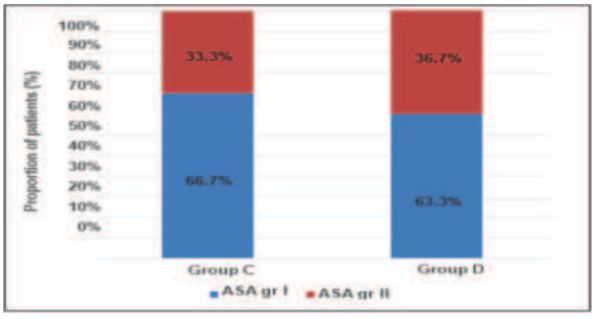

Chart 4: Bar diagram showing the comparison of groups by ASA classification

Table 7: Distribution of the patients by type of the surgery

Type of the surgery	Total (n) (%)	Group C (n) (%)	Group D (n) (%)	p-value
Herniotomy	31 (51.7%)	15 (50%)	16 (53.3%)	1.000; NS
Appendicectomy	17 (28.3%)	9 (30%)	8 (26.7%)	
Cystoscopy	7 (11.7%)	4 (13.3%)	3 (10%)	
Orchidopexy	5 (8.3%)	2 (6.7%)	3 (10%)	
Total	60 (100%)	30 (100%)	30 (100%)	

p-value obtained by chi-square test with Yate's correction; NS = Not significant

Out of 30 group C patients, majorly 15 (50%) patients have undergone herniotomy, followed by appendicectomy in 9 (30%) patients, cystoscopy in 4 (13.3%) patients, and orchidopexy in 2 (6.7%) patients.

Out of 30 group D patients, majorly 16 (53.3%) patients have undergone herniotomy, followed by appendicectomy in 8 (26.7%) patients, cystoscopy and orchidopexy in 3 (10%) patients each.

No significant difference was found between the groups with respect to type of surgery they undergone. (p>0.05; NS)

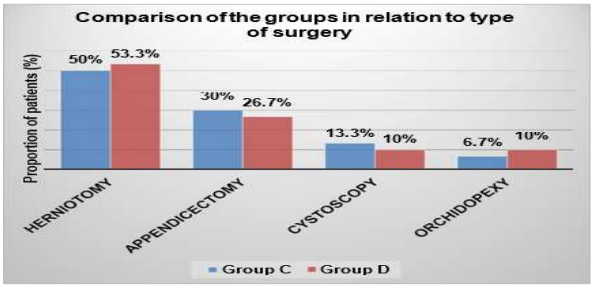

Chart 5: Bar diagram showing the comparison by type of surgery

Table 8: Comparison of the heart rate changes (in beats per minute) between groups

Heart rate (in beats per minute)	Group C		Group D		p-value
	Mean	SD	Mean	SD	
Baseline	103.3	7.02	104.3	7.38	0.593; NS
5 mins	100.2	7.94	101.9	7.84	0.407; NS
10 mins	99	7.41	102.3	7.50	0.092; NS
15 mins	99.2	6.69	102.1	7.44	0.118; NS
30 mins	99.1	6.86	101.8	7.88	0.162; NS
45 mins	99.5	6.06	101.2	7.48	0.337; NS
60 mins	99.3	6.31	100.1	7.64	0.660; NS
90 mins	99.1	6.57	100	7.46	0.622; NS

In both the groups, mean heart rate changes equally with time. At any point of time the difference in heart rate between two groups were not significant statistically. (p>0.05)

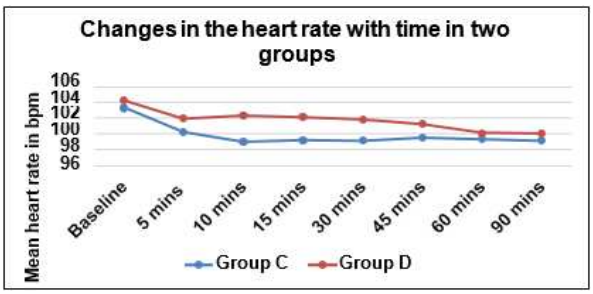

Chart 6: Line diagram showing the trends of heart rate change in two groups

Table 9: Distribution of the groups by mean SBP (systolic blood pressure)

Systolic Blood Pressure (SBP in mm of Hg)	Group C	Group D	p-value
Baseline	93±3.64	93.9±2.83	0.307; NS
5 mins	93.2±3.26	93.9±3.16	0.425; NS
10 mins	93.5±2.83	93.5±2.91	0.993; NS
15 mins	82±3.30	82.1±3.99	0.888; NS
30 mins	86.2±2.26	86.2±2.73	0.997; NS
45 mins	90.2±2.16	91.3±2.88	0.121; NS
60 mins	87.4±2.63	88.3±2.80	0.222; NS
90 mins	86.9±2.35	88±2.70	0.108; NS

In either of the groups mean SBP changes equally with time. At any point of time the difference between the two groups was not significant statistically. (p>0.05)

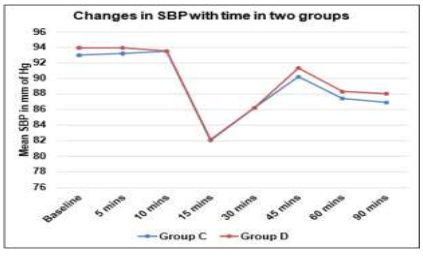

Chart 7: Line diagram showing the systolic blood pressure changes

Table 10: Distribution of the groups by mean DBP (diastolic blood pressure)

Diastolic Blood Pressure (DBP in mm of Hg)	Group C	Group D	p-value
Baseline	63.1±3.33	62±3.31	0.204; NS
5 mins	53.6±3.78	55±3.43	0.139; NS
10 mins	56.7±2.82	56.3±2.60	0.602; NS
15 mins	59.5±2.71	60±2.72	0.479; NS
30 mins	62±3.31	61±3.36	0.266; NS
45 mins	61±3.36	61.5±3.22	0.585; NS
60 mins	62±3.29	62.3±3.38	0.758; NS
90 mins	61.1±3.35	61.8±3.24	0.437; NS

In both the groups mean DBP changes equally with time. At any point of time the difference was not significant statistically. (p>0.05)

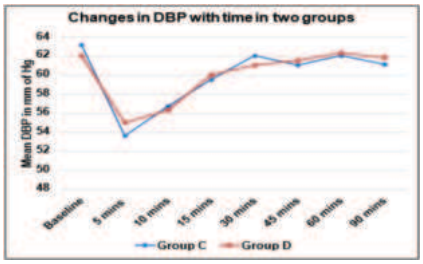

Chart 8: Line diagram showing the changes in DBP

Table 11: Distribution of the groups by MAP (mean arterial pressure)

Mean Arterial Pressure (MAP in mm of Hg)	Group C	Group D	p-value
Baseline	73.1±3.28	72.6±2.53	0.511; NS
5 mins	66.8±2.71	68.0±2.88	0.102; NS
10 mins	69.0±2.22	68.7±1.94	0.579; NS
15 mins	67.0±2.21	67.4±2.14	0.479; NS
30 mins	70.1±2.53	69.4±2.76	0.310; NS
45 mins	70.8±2.38	71.4±2.15	0.310; NS
60 mins	70.5±2.77	70.9±2.69	0.573; NS
90 mins	69.7±2.59	70.5±2.48	0.227; NS

In both the groups mean arterial pressure changes equally with time. At any pointof time the difference was not significant statistically. (p>0.05)

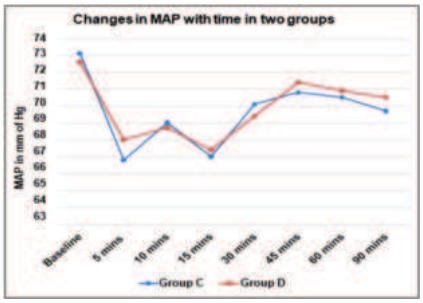

Chart 9: Line diagram showing the changes in MAP

Table 12: Distribution of the groups by mean oxygen saturation (SpO2)

Oxygen saturation (SpO2)	Group C	Group D	p-value
Baseline	98.7±0.99	98.9±0.96	0.430 (NS)
5 mins	98.9±0.94	98.8±0.99	0.690 (NS)
10 mins	99.1±0.88	98.7±1.02	0.109 (NS)
15 mins	99±0.98	98.8±0.96	0.428 (NS)
30 mins	99.4±0.86	99±1.02	0.106 (NS)
45 mins	99±1.17	98.8±0.89	0.459 (NS)
60 mins	99.5±1.01	99±1.02	0.061 (NS)
90 mins	99.3±1.23	99.2±0.91	0.722 (NS)

In either of the groups mean oxygen saturation changes equally with time. At any point of time the difference between the two groups were not significant statistically. (p>0.05)

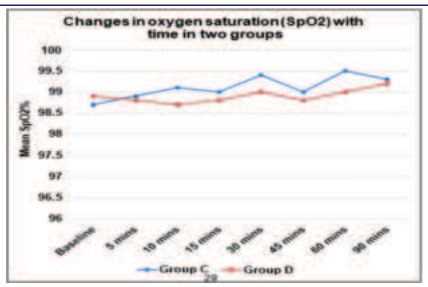

Chart 10: Line diagram showing the SpO2 changes of the groups

Table 13: Distribution by the FLACC pain scores of patients in two groups

FLACC pain scores		Group C			Group D			Mann Whitney test p-value
		N	%	Mean Rank	N	%	Mean Rank	
0 hour	0	30	100%	30.5	30	100%	30.5	1.000; NS
	1-3	0	0%		0	0%		
	≥4	0	0%		0	0%		
1 hour	0	24	80%	32.0	27	90%	29.0	0.282; NS
	1-3	6	20%		3	10%		
	≥4	0	0%		0	0%		
2 hours	0	14	46.7%	33.08	17	56.7%	27.92	0.200; NS
	1-3	16	53.3%		13	43.3%		
	≥4	0	0%		0	0%		
3 hours	0	1	3.3%	40.50	12	40%	20.50	<0.001; S
	1-3	28	93.4%		18	60%		
	≥4	1	3.3%		0	0%		
4 hours	0	1	3.3%	39.27	3	10%	21.73	<0.001; S
	1-3	23	76.7%		27	90%		
	≥4	6	20%		0	0%		
8 hours	0	1	3.3%	35.73	1	3.3%	25.27	0.016; S
	1-3	19	63.4%		27	90%		
	≥4	10	33.3%		2	6.7%		
12 hours	0	1	3.3%	33.4	2	6.7%	27.60	0.185; NS
	1-3	22	73.3%		24	80%		
	≥4	7	23.4%		4	13.3%		
16 hours	0	8	26.7%	27.15	0	0%	33.85	0.116; NS
	1-3	21	70%		27	90%		
	≥4	1	3.3%		3	10%		
20 hours	0	1	3.3%	28.33	2	6.7%	32.67	0.321; NS
	1-3	21	70%		20	66.6%		
	≥4	8	26.7%		8	26.7%		
24 hours	0	3	10%	33.73	0	0%	27.27	0.134; NS
	1-3	19	63.3%		26	86.7%		
	≥4	8	26.7%		4	13.3%		

At zero hour, all the patients in both groups have FLACC score of 0 and their mean ranks are 30.5. The difference in mean ranks is not significant statistically. (p>0.05; NS)

At the end of first hour, 24 (80%) group C patients have FLACC score of 0 and remaining 6 (20%) patients have FLACC score between 1 to 3. In group D, 27 (90%) patients have FLACC score of 0 and remaining 3 (10%) patients have FLACC score between 1 to 3. Mean ranks of FLACC scores in group C patients and group D are 32.0 and 29.0 respectively. The difference in mean ranks is not significant statistically. (p>0.05; NS)

At the end of second hour, 14 (46.7%) group C patients have FLACC score of 0 and remaining 16 (53.3%) patients have FLACC score between 1 to 3. In group D, 17 (56.7%) patients have FLACC score of 0 and 13 (43.3%) patients have FLACC score between 1 to 3. Mean ranks of FLACC scores in group C patients and group D are 33.08 and 27.92 respectively. The difference in mean ranks is not significant statistically. (p>0.05; NS)

At the end of third hour, as many as 28 (93.4%) group C patients have FLACC score between 1 to 3, 1 (3.3%) patient have FLACC score of 0 and 1 (3.3%) patienthave FLACC score ≥4. In group D, 12 (40%) patients have FLACC score of 0 and 18 (60%) patients have FLACC score between 1 to 3. Mean ranks of FLACC scores of group C patients and group D are 40.50 and 20.50 respectively. Mean ranks of the scores is significantly higher in group C when compared to group D patients. (p<0.05; S)

At the end of 4th hour, as many as 23 (76.7%) group C patients have FLACC score between 1 to 3, 1 (3.3%) patient have FLACC score of 0 and 6 (20%) patients have FLACC score ≥4. In group D, 3 (10%) patients have FLACC score of 0 and 27 (90%) patients have FLACC score between 1 to 3. Mean ranks of FLACC scores in group C patients and group D are 39.27 and 21.73 respectively. Mean ranks of the scores is significantly higher in group C compared to group D patients. (p<0.05; S)

At the end of 8th hour, as many as 19 (63.4%) group C patients have FLACC score between 1 to 3, 1 (3.3%) patient have FLACC score of 0 and 10 (33.3%) patients have FLACC score ≥4. In group D, 1 (3.3%) patient have FLACC score of 0, 27 (90%) patients have FLACC score between 1 to 3 and 2 (6.7%) patients have FLACC score≥4. Mean ranks of FLACC scores in group C patients and group D are 35.73 and 25.27 respectively. Mean ranks of the scores is significantly higher in group C when compared to group D patients. (p<0.05; S)

At the end of 12th hour, as many as 22 (73.3%) group C patients have FLACC score between 1 to 3, 1 (3.3%) patient have FLACC score of 0 and 7 (23.4%) patients have FLACC score ≥4. In group D, 2 (6.7%) patients have FLACC score of 0, 24 (80%) patients have FLACC score between 1 to 3 and 4 (13.3%) patients have FLACC score ≥4. Mean ranks of FLACC scores in group C patients and group D are 33.4 and 27.60 respectively. The difference in the mean ranks of the scores is not significant statistically. (p>0.05; NS)

At the end of 16th hour, as many as 21 (70%) group C patients have FLACC score between 1 to 3, 8 (26.7%) patients have FLACC score of 0 and 1 (3.3%) patient have FLACC score ≥4. In group D, none of the patients (0%) have FLACC score of 0, 27 (90%) patients have FLACC score between 1 to 3 and 3 (10%) patients have FLACC score ≥4. Mean ranks of FLACC scores in group C patients and group D are 27.15 and 33.85 respectively. The difference in mean ranks of the scores is not significant statistically. (p>0.05; NS)

At the end of 20th hour, as many as 21 (70%) group C patients have FLACC score between 1 to 3, 1 (3.3%) patient have FLACC score of 0 and 8 (26.7%) patients have FLACC score ≥4. In group D, 2 (6.7%) patients have FLACC score of 0, 20 (66.6%) patients have FLACC score between 1 to 3 and 8 (26.7%) patients have FLACC score ≥4. Mean ranks of FLACC scores in group C patients and group D are 28.33 and 32.67 respectively. The difference in mean ranks of the scores is not significant statistically. (p>0.05; NS)

At the end of 24th hour, as many as 19 (63.3%) group C patients have FLACC score between 1 to 3, 3 (10%) patients have FLACC score of 0 and 8 (26.7%) patients have FLACC score ≥4. In group D, none of the patients (0%) have FLACC score of 0,26 (86.7%) patients have FLACC score between 1 to 3 and 4 (13.3%) patients have FLACC score ≥4. Mean ranks of FLACC scores of the patients in group C and group D are 33.73and 27.27 respectively. The difference in the mean ranks of the scores is not significant statistically. (p>0.05; NS)

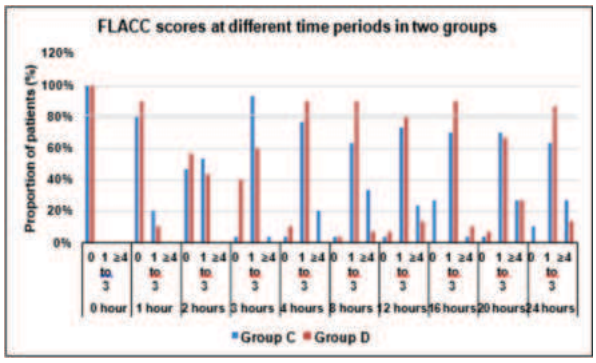

Chart 11: Comparison of FLACC pain scores of patients in two groups

Table 14: Distribution by duration of the post-operative analgesia in two groups

Duration of the postoperative Analgesia (in minutes)				
Group	Mean	Standard deviation	Range	p-value
Group C	275.2	60.6	190-480	<0.001; S
Group D	486.3	90.0	380-690	

Mean duration of the post-operative analgesia in group C patients is 275.2 ± 60.6 minutes and ranges between 190 minutes to 480 minutes. In group D, mean duration is 486.3±90.0 minutes and ranges between 380 minutes to 690 minutes. Mean duration of post-operative analgesia is significantly higher in group D patients compared to group C. (p<0.05; Significant)

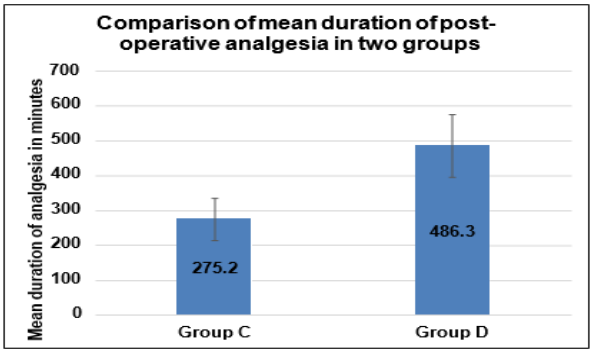

Chart 12: Comparison of duration of post- operative analgesia in two groups

Table 15: Distribution of the groups by number doses of rescue analgesia given

Number of doses of Rescue Analgesia	Group C (n=30)	Group D (n=30)	Total (n=60)
0 doses	0 (0%)	2 (6.7%)	2 (3.3%)
1 dose	2 (6.7%)	14 (46.7%)	16 (26.7%)
2 doses	20 (66.7%)	10 (33.3%)	30 (50%)
3 doses	8 (26.6%)	4 (13.3%)	12 (20%)

² value with Yate's correction = 11.513; df = 3; p-value = 0.009 (Significant)

In group C, majority of the patients (66.7%) needed 2 doses of rescue analgesia, followed by 8 (26.6%) patients needed 3 doses and 2 (6.7%) patients needed one dose of rescue analgesia. In group D, most of the patients (46.7%) needed only one dose of rescue analgesia, followed by 10 (33.3%) patients needed 2 doses, 4 (13.3%) patients needed 3 doses and 2 (6.7%) patients doesn't needed any rescue analgesia. Group C patients needed significantly higher number of doses compared to patients of group D. (p<0.001; Significant)

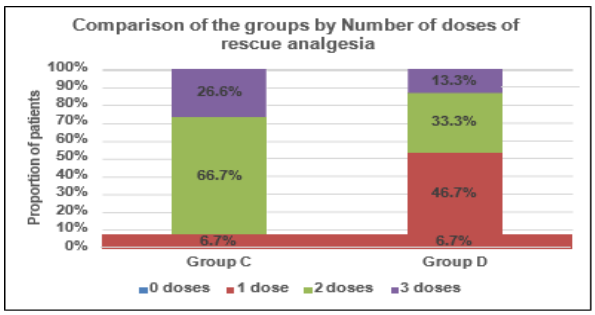

Chart 13: Comparison of the groups by doses of rescue analgesia given

Table 16: Distribution of the groups by incidence of Adverse events

Adverse events	Group C (n=30)	Group D (n=30)	p-value
Nausea & Vomiting	3 (10%)	1 (3.3%)	0.604; NS*
Bradycardia	2 (6.7%)	1 (3.3%)	1.000; NS*

***p-value obtained by chi-square test with Yate's correction**

In group C, a total of five adverse events occurred. Among them 3 (10%) patients had nausea and vomiting and 2 (6.7%) patients had bradycardia. In group D, only two adverse events occurred. Among them 1 (3.3%) patient had nausea and vomiting and 1 (3.3%) patient had bradycardia. In these two adverse events, two groups don't show any significant difference. (p>0.05; Not Significant)

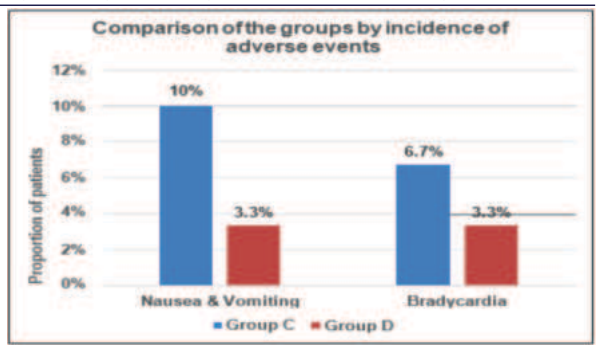

Chart 14: Comparison of the groups by incidence of Adverse events

DISCUSSION

Pain is defined as unpleasant sensory and emotional experience associated with actual or potential tissue damage or explained in terms of such damage, by the International Association for the Study of Pain. Children have really been undertreated for pain due to the incorrect belief that they do not suffer or feel pain, nor do they react to or remember painful experiences in the similar way that adults do.

Many advancements have been made in the study and management of pain in children during the last decade. In paediatric surgery, caudal analgesia is the most popular and also widely utilized regional block

Because of its long duration of action, bupivacaine is the preferred local anaesthetic.

Despite using long-acting local anaesthetics such as Bupivacaine the major disadvantage of single shot caudal epidural analgesia is its shorter duration of action. Intermittent or continuous infusion of analgesics using caudal catheters or adjuvants, can extend postoperative analgesia. Due to a high probability of infection and a higher prevalence of technical issues, use of the caudal catheters is restricted. As a result, adjuvants are a better option for extending the duration of analgesia.

Clonidine In Caudal Block:

Clonidine is known to enhance the quality and also duration of local anaesthetics when given caudally in children. Clonidine was shown to have analgesic properties when delivered through the epidural method. It was later demonstrated to extend analgesia in children when it was administered in paediatric caudal blocks.

In 1998 Constant et al[11] and Yildiz et al[12] in 2006 found Clonidine to be the drug of choice to prolong caudal analgesia duration in children.

Several mechanisms have been postulated. Clonidine combines with alpha 2 adrenoceptors at spinal and supraspinal sites, after crossing the BBB and produces analgesia. Secondly, it causes a direct suppression of the spinal cord nociceptiveneurons. Also, the peripheral sensory A delta and C nerve fibre neurotransmission, is suppressed by clonidine. The last mechanism suggested is related to its pharmacokinetics: by inducing vasoconstriction through α -2b adrenoceptors which are located at the peripheral vascular smooth muscles.

Caudal Block And Genital Surgeries:

Despite the many advantages of caudal epidural analgesia, certain technical concerns with the types of surgeries for which it was utilised had to be addressed. The use of regional procedures like spinal or caudal anaesthesia in surgeries involving penis like urethroplasty, hypospadiasis, and chordee repair is not recommended due to the considerable vasodilation, erection and vascular engorgement. When these complications arise, surgeons may become sceptical about the surgical procedure's success. As the tissues recover to their preoperative state after the regional block wears off, the sutures may become slack and imperfect, lowering the quality of surgical repair. *As a result, procedures such as urethroplasty and chordee correction were excluded from our research*

The study using caudal block with 0.125% plain bupivacaine and 0.125% bupivacaine with clonidine combination, was carried out in sixty children aged six months to six years, weighing between 5kgs to 20 kgs, belonging to ASA I and II posted for elective and emergency

infraumbilical surgeries. Caudal clonidine was used in a dose of 1 µg/kg without any neurological deficits. A careful study design was used in this clinical trial, with a low dose of clonidine (1µg/kg) to avoid side effects such as hypotension, bradycardia, and PONV after anaesthesia.

Age Distribution
Identifying the caudal epidural space is simple in children under the age of 7, but it becomes more difficult as the children grow because the sacral vertebrae fuses and also the sacral hiatus decreases in size.

Children aged 6 months to 6 years were chosen for this study. There was no significant difference between the two groups with respect to age, weight, or sex.

Males outnumbered females in both groups (> 80%). This may be due to the fact that our study included surgeries like herniotomy and orchidopexy.

Concentration and dosage of the drug :
In this study, 0.125% bupivacaine 1ml/kg was used for all patients in each of the two groups (group C and group D) along with 1µg/kg of clonidine in group D as an additive.

In our study also, we have used 0.125% bupivacaine (1ml/kg). Higher concentration may produce motor block in the initial postoperative period and thereby delaying the discharge of the patient. Because all of the patients were monitored in the hospital for 24 hours after surgery, 0.125 percent bupivacaine was utilised, which provided better analgesia.

Hemodynamic Parameters:
Heart Rate:
Clonidine due to its action on the alpha 2 receptors causes a fall in the heart rate and blood pressure.

In this study, heart rate and blood pressure of all the patients were recorded at 5 minutes interval. The mean baseline heart rate was similar in both groups. *Baseline heart rate was 103.3±7.02 per minute in the Bupivacaine group and 104.3 ± 7.38 per minute in the clonidine group; the difference was found to be statistically insignificant.*

After performing caudal block at the end of the surgery, the heart rate was stable in the two groups and the differences were statistically insignificant. The patients who had a heart rate less than 20 % from the baseline, were treated with injection atropine.

Blood Pressure:
Similarly, at any time interval, *there was no significant difference in systolic and diastolic blood pressure between the two groups.* In group C, the mean baseline SBP was 93±3.64 mm Hg, while in group D, it was 93.9±2.83 mm Hg. After 15 minutes, there was a slight fall in the SBP to 82± 3.30 mm Hg and 82.1 ± 3.99 mm Hg which might indicate onset of caudal block and it was statistically insignificant. Later at any point of time, there was no much difference between the groups in SBP. The mean baseline DBP was 63.1 ± 3.33 mm of Hg in group C and 62 ± 3.31 mm of Hg in group D. It was recorded for 90 min. At any point of time the difference between the groups were not significant statistically.

The baseline mean arterial blood pressure was 73.1 ± 3.28 mm of Hg in group Cand 72.6± 2.53 mm of Hg in group D. The difference between the groups was not statistically significant.

OXYGEN SATURATION OF HAEMOGLOBIN (SpO2):
The baseline oxygen saturation (SpO2) was 98.7± 0.99 % in the bupivacaine group and 98.9±0.96% in the clonidine group. At 5, 10 and 30 minutes, the SpO2 values were 98.9% ± 0.94, 99.1% ± 0.88 and 99% ± 0.98 respectively in group C and 98.8% ± 0.99, 98.7% ±1.02 and 98.8% ±0.96 respectively in group D. *The differences were statistically insignificant.*

There were no desaturation events at any point of time.
Duration of Postoperative analgesia :
The most fundamental and crucial aspect of pain management is pain evaluation. Assessing and measuring pain in the children is a complex task, owing to the lack of a reliable, universal approach for assessing and quantifying children's pain.

The postoperative analgesia duration in bupivacaine group in 275.2± 60.6 minutes and clonidine group is 486.3± 90.0 minutes as per our study. ***This difference between the two groups is statistically highly significant.***

The mean duration of analgesia produced by combining clonidine and bupivacaine varied significantly in the clinical studies. The reason is due to a variety of factors, including the different doses of clonidine administered, changes in premedication and different volatiles used, surgery type rescue analgesia indications, pain evaluation, and statistical analysis.

To measure postoperative, the **FLACC Pain Scale** was used in this study. For children aged 2 months to 7 years, the FLACC Pain Scale is a reliable and established behavioural and observational pain assessment score[71].

The FLACC pain score was statistically insignificant during the first two hours. The difference in the pain scores between the groups C and D was statistically significant from third hour to eight hour.

Group C had 22 (73%) patients with a pain score of 3 and 7patients with pain score of 4(23.4%)while group D had 24 (80%) with pain score of 3 and 4 (13.3%) patients with a pain score of 4 in the 12thhour. The pain scores in both groups were similar. Statistics show that the difference is insignificant.

Group C had 21(70%) patients with a pain score of 3 and 1 (3.3%)patient with 4while group D had 27(90%) and 3 (10%)with a score of 4 in the 16th hour. Statistics show that the difference is insignificant.

Group C had 19(63.3%) patients with a pain score of 3 and 8 patients with a pain score of 4(26.7%) and group D had 26(86%) with score of 3 and 4 (13.3%) patients with score of 4 at the end of 24th hour. Both the groups had similar pain score respectively, the difference being statistically insignificant. Paracetamol 30mg/kg per rectally or 15mg/kg orally was given rescue analgesics if FLACC score was ≥3.

Rescue Analgesia:
In plain bupivacaine group 20 (66.7%), 8(26.6%) children were given 2 and 3 doses of rescue analgesics respectively. Whereas in the clonidine group 10(33.3%), 4 (13.3%) children had 2 and 3 doses of rescue analgesics respectively**.** *The difference was found to be statistically highly significant.*

Complications
Almost all the studies are associated with complications but most of them are within the acceptable range. The ultimate goal is to reduce the severity and number of complications as far as possible.

In this study, Two (6.7%) children in the bupivacaine group C, and one (3.3%) child in the clonidine group D, developed bradycardia, that was treated with inj. atropine 20 µg/kg. Nausea and vomiting were reported in 3 (10%) of the children in the Bupivacaine plain (group C) group, compared to 1 (3.3%) in the clonidine with bupivacaine group, and were treated with inj. ondansetron 0.1 mg/kg. *There were no statistically significant differences between the groups.*

SUMMARY
This clinical study titled as Evaluation of clonidine as an adjuvant in caudal anesthesia in children. A prospective, randomized study was carried to evaluate the effects of the caudal clonidine as an adjuvant to bupivacaine children The study comprised sixty children aged 6 months to 6 years who were ASA grade I and II and were undergoing various infraumbilical operations. They were categorized into two groups of 30 each. Caudal bupivacaine 0.125% (1ml/kg) was given to the group C patients and caudal bupivacaine 0.125% (1 ml/kg) with clonidine (1µg/kg) were given to the group D patients. Hemodynamic changes, total duration of analgesia, postoperative rescue analgesics and incidence of side-effects are the parameters studied. Demographic parameters like age, weight and sex were comparable in the two groups. The paediatric observational FLACC pain scale was used to measure post operative pain and rescue analgesics were given if the score was ≥3. Haemodynamic parameters like MAP,heart rate and oxygen saturation was comparable with no significant difference.

The mean total duration of analgesia was 275.2 ± 60.6 minutes in plain

bupivacaine group and 486.3±90 minutes in the clonidine group, thereby indicating a reduced need for the postoperative rescue analgesics in the clonidine group. There was no significant difference in the incidence of complications like bradycardia and nausea and vomiting between the two groups**.** Finally, this study demonstrated that addition of clonidine 1µg/kg to bupivacaine 0.125% caudally resulted in increased duration of analgesia and less postoperative rescue analgesic needs compared with 0.125% bupivacaine plain 1ml/kg, without any significant difference with respect to hemodynamic parameters and side-effects in children scheduled for infra umbilical surgeries.

Hence, clonidine safely prolongs the total duration of postoperative analgesia when it is added to bupivacaine for the caudal block for infra-umbilical paediatric surgeries.

CONCLUSION

- Caudal clonidine in the dose of 1µg/kg in children is a satisfactory and efficacious adjuvant to caudal bupivacaine for producing prolonged postoperative analgesia.
- Addition of clonidine to caudal bupivacaine does not compromise the hemodynamics of the patients.
- Caudal clonidine to bupivacaine also reduces the number of rescue analgesics in the postoperative period .
- Caudal clonidine in the lesser doses like 1µg/kg has no significant adverse effects like bradycardia, hypotension and PONV.

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