

Clonidine or Tramadol Added to Bupivacaine for Prolonging Post Operative Caudal Epidural Analgesia in Children

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Abstract

Background and Objectives: Caudal epidural analgesia is most popular and commonly performed regional blocks in paediatric anaesthesia. To prolong post operative analgesia local anesthetics have to be combined with adjuvants. Adjuvants like narcotics, alpha-2 agonists, epinephrine, tramadol, neostigmine, and s-ketamine have been studied. Of these clonidine and tramadol are drugs with minimal side effects. Hence study performed with the primary objective being, comparing the two drugs when combined with bupivacaine regarding prolongation of the post operative analgesia **Methods:** The study was conducted among Ninety children in the age group of 2 to 8 years posted for elective sub-umbilical surgical procedures lasting less than one hour, after obtaining ethical committee clearance. They were divided into 3 groups, 30 each. Group C received 0.5ml/kg of 0.25% Bupivacaine with 0.1ml/kg of normalsaline, Group BC 0.5ml/kg of 0.25% Bupivacaine with 1µg/kg of Clonidine(0.1ml/kg) and Group BT 0.5ml/kg of 0.25% Bupivacaine with 1mg/kg of tramadol (0.1ml/kg). The various parameters studied were duration of post operative analgesia, haemodynamic changes and incidence of side-effects. **Results:** The mean duration of analgesia was 539.83±19.32 minutes in clonidine group which was significantly longer than 412.00±26.05 minutes in tramadol group. The requirement of rescue analgesic was also lesser in the clonidine group. Incidence of post-operative nausea and vomiting was slightly higher in the tramadol group. **Conclusion:** Addition of clonidine in the dose of 1µg/kg and tramadol 1 mg/kg to 0.25% bupivacaine (0.5ml/kg) increased the duration of postoperative analgesia and clonidine provided a longer duration with less side-effects than tramadol.

Keywords: Caudal; Bupivacaine; Clonidine; Tramadol.

Introduction

Caudal epidural analgesia is one of the most popular and commonly performed regional blocks in paediatric anaesthesia. It is a reliable and a safe technique that can be used with general anaesthesia for intraoperative and postoperative analgesia in patients undergoing abdominal and lower limb surgeries [4].

Local anaesthetics used alone do not have prolonged post operative analgesia and hence they have to be combined with adjuvants. Various adjuvants like narcotics, alpha-2 agonists (clonidine, dexmedetomidine), epinephrine, sodium bicarbonate,

tramadol, neostigmine, and s-ketamine have been studied and used to prolong and improve the efficacy of the caudal block in children [18,4]. Of these adjuvants clonidine and tramadol are the most popular drugs used nowadays, as they have minimal side effects. Studies have found that both clonidine and tramadol when combined with bupivacaine for caudal epidural have prolonged post operative analgesia [9,11]. After searching the literature we could not find any study comparing the efficacy of caudal clonidine and tramadol as adjuvants. Hence the present study was undertaken with the primary objective being, comparing the two drugs when combined with bupivacaine regarding prolongation of the post operative analgesia.

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Methodology

Ninety children in the age group of 2 to 8 years with American Society of Anaesthesiologists (ASA) class I posted for elective sub-umbilical surgical procedures, lasting for less than one hour. They were selected for the study and randomly divided using shuffled sealed opaque envelop method, into three equal groups after obtaining ethical and scientific committee clearance - Group C: 0.5ml/kg of 0.25% Bupivacaine with 0.1ml/kg of normal saline, Group BC: 0.5ml/kg of 0.25% Bupivacaine with 1micro g/kg of Clonidine (0.1ml/kg) and Group BT: 0.5ml/kg of 0.25% Bupivacaine with 1mg/kg of Tramadol (0.1ml/kg).

Pre-operative assessment was done for each patient and written informed consent taken from parents. EMLA cream was applied on the dorsum of both hands one hour prior to surgery. Oral midazolam 0.5 mg/kg was given one hour prior to surgery. An intravenous line was secured with 22G intravenous cannula. Injection (Inj) Ramosetron 6micro g/kg and Inj. Dexamethasone 0.1mg/kg were given intravenously (IV) as premedications. Vital parameters like heart rate (HR), Non-Invasive Blood Pressure (NIBP), arterial pulse saturation (SpO₂) and Electrocardiography (ECG) were monitored with EDAN iM80 multiparameter monitor. Pre-oxygenation done with 100% oxygen for 3 minutes. Induction was done with Inj. Thiopentone 5mg/kg body weight. Endotracheal intubation was done using appropriate sized tube after giving Inj. Atracurium 0.5mg/kg IV. General anaesthesia was maintained using controlled ventilation with 50% O₂ + 50% N₂O + Sevoflurane 1%. Inj. Atracurium 0.05mg/kg IV was given when required.

Under strict asepsis, caudal block was performed using 23G, 2.5cm hypodermic needle in lateral decubitus position before surgical incision. Heart rate (HR), mean arterial pressure (MAP) and SpO₂ were recorded before induction, after intubation, 10 min after caudal block i.e., at the time of surgical incision and at extubation.

The test drugs were prepared by a senior anaesthesiologist who was not involved in the study and the observer and patients were thus blinded for the study drugs. The study drugs were prepared as follows: 0.5ml of Inj. Clonidine (Cloneon, Neon laboratories) with 1ml containing 150µg diluted to 7.5ml (1ml=10µg) with normal saline and 0.1ml of this used per kg body weight for the study. Likewise, 1ml of Inj. Tramadol (Tramazac, Zydus Cadila) (50mg/ml) diluted to 5ml (1ml=10mg) with normal saline and 0.1ml of this used per kg body weight for the study. The children were reversed with Injection Neostigmine 0.05mg/kg and Injection Atropine 0.02mg/kg IV after the completion of surgery.

During surgery, adequate analgesia was defined by haemodynamic stability, as indicated by the absence of increase in MAP or HR more than 15% of the baseline (value just before the surgical incision) during skin incision. If HR or MAP increased by more than 15%, analgesia was considered inadequate (failed caudal) and subsequent data obtained from those children were no longer considered and hence excluded from the study. Pain score, haemodynamic parameters, respiratory rate, oxygen saturation, sedation score, motor block and side-effects were assessed in the post-operative room hourly for first six hours and every sixth hourly for 24 hours.

The analgesic effect of caudal block was evaluated using the FLACC scale (Table 1) hourly for first six hours and every sixth hourly for 24 hours. When the FLACC score 48 was greater than or equal to 4, syrup paracetamol 15mg/kg orally was given as rescue analgesic and time was noted. Assessment

Of the duration of analgesia was performed by comparing the time from caudal block to administration of the first dose of rescue analgesic. Assessment of number of doses of rescue analgesic in 24 hours in each group was also done. Sedation was assessed using 4 point sedation score and motor blockade using modified Bromage scale soon after extubation and for first six hours and every sixth hourly for 24 hours. Motor blockade was assessed using modified Bromage scale.

Table 1: Definitions (Pain was assessed by FLACC scale [12])

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; distractible	Difficult to console

Definitions

0 = No pain, 1-3 = Mild pain, 4-7 = Moderate pain, 8-10 = Severe pain

Sedation was assessed by 4 point sedation score [16]

1. Asleep, not arousable by verbal contact.
2. Asleep, arousable by verbal contact
3. Drowsy not sleeping.
4. Alert/Awake.

Assessment of motor block was done by using Modified Bromage Scale [2]

0. Patient is able to move the hip, knee and ankle.
1. Patient is unable to move the hip but able to move the knee and ankle.
2. Patient is unable to move the hip and knee but able to move the ankle.
3. Patient is unable to move the hip, knee and ankle.

Statistical Methods

Data analysis was performed using SPSS for Windows (Version 20, IBM-SPSS Inc. Armonk, New York) the primary outcome of this study was the duration of post-operative analgesia. The mean duration of post-operative analgesia was 4-6 hours with Bupivacaine based on a previous study. A power analysis of 25 patients was required to detect an increase in the duration of post-operative analgesia by 20%. 5 more patients in each group were allowed to compensate for drop-outs during the study period. The significance was determined by paired 't' test and analysis of variance (ANOVA). The results were compared at 0.05 levels of significance for the corresponding degrees of freedom, P<0.05 (Significant), P>0.05 (Not Significant). The severity if any was evaluated by using the

percentages and Z-Test. Case Fatality Rate was used to calculate the severity of the side-effects.

Results

There was statistically no significant difference among the three groups regarding the demographic criteria, the duration of surgery and anaesthesia (Table 2) Regarding the per operative and postoperative haemodynamic status, there was no significant difference among the three groups (Table 3). Regarding the duration of postoperative analgesia Group C was 293 minutes, Group BC 539 minutes and Group BT was 412 minutes (Table 5). This was statistically significant with p value 0.000. Comparing the groups BC and BT the postoperative analgesia was statistically significant (p value 0.000). Nine children in Group C required 3 doses of rescue analgesics compared with 3 children in Group BT and none in Group BC respectively which is statistically significant (p value <0.05) (table 6). Majority of the children in all the 3 groups required 2 doses of rescue analgesics. None of the children in all the 3 groups had any motor weakness or any side effects like pruritis or urinary retention and all of them were alert in the postoperative period.

Demographic Data (Table 2)

shows the age, sex, weight and height distribution of patients among the three groups.

The mean age is 4.56 years in normal saline(control) group, 4.43 years in the clonidine group, and 4.53 years in tramadol group with a p value of 0.946.

There is no significant difference in sex distribution in all three groups.

The mean weight is 14.63 kg in control group, 15.06 kg in clonidine group, and 15.16 kg in tramadol group with a p value of 0.812.

Table 2: Demographic Data

Groups	Bupivacaine+Normalsaline (C)	Bupivacaine+Clonidine (BC)	Bupivacaine+Tramadol (BT)	P value
Mean ± SD Age (in years)	4.5667 ± 1.56873	4.4333 ± 1.61210	4.5333 ± 1.67607	0.946
SEX distribution	Male-86.7% Female-13.3%	Male -86.7% Female -13.3%	Male -83.3% Female - 16.7%	>0.05
Mean ± SD Weight (in kg)	14.6333 ± 3.06800	15.0667 ± 3.70399	15.1667 ± 3.39455	0.812
Mean ± SD Height (in cm)	100.7667 ± 9.89142	101.2000 ± 9.49918	101.1000 ± 9.28978	0.983
Duration of Surgery Mean (in minutes)	23.8333	26.5000	26.0000	0.135
Duration of Anaesthesia Mean (in minutes)	39.0000	41.1667	40.8333	0.184

Table 3: Haemodynamic Stability

	Groups	Preoperative	After Intubation	Post Operative	P Value
Mean Blood Pressure Mean+SD (in mm Hg)	C	79.72 ± 4.40	87.41 ± 4.14	79.50 ± 4.43	0.262
	BC	78.20 ± 3.63	86.75 ± 3.40	78.13 ± 3.54	
	BT	78.40 ± 3.53	86.83 ± 4.26	77.86 ± 3.61	
Saturation Mean+SD (%)	C	100.00 ± 0.00	100.00 ± 0.00	99.00 ± 0.37	0.811
	BC	100.00 ± 0.00	100.00 ± 0.00	99.00 ± 0.37	
	BT	100.00 ± 0.00	100.00 ± 0.00	99.00 ± 0.37	
Heart Rate Mean+SD(beats/min)	C	110.80 ± 8.62	132.0 ± 7.19	109.96 ± 8.44	0.841
	BC	113.06 ± 8.30	134.53 ± 7.30	110.26 ± 7.75	
	BT	112.06 ± 7.65	131.26 ± 8.18	109.06 ± 8.39	

The mean height is 100.7 cm in control group, 101.2 cm in clonidine group, and 101.1 cm in tramadol group with a p value of 0.983

The mean duration of surgery is 28.8 min in control group, 26.5 minutes in clonidine group and 26 minutes in tramadol group with a p value of 0.135

The mean duration of anaesthesia is 39 minutes in control group, 41.1 minutes in clonidine group and 40.8 minutes in tramadol group with a p value of 0.184.

Haemodynamic Stability (Table 3)

shows the mean preoperative, post extubation and post operative blood pressure, saturation and heart rate The mean MAP in control group are 79.7, 87.4, 79.5 mmHg preoperatively, after intubation, post operatively respectively.

The mean MAP in clonidine group are 78.2, 86.7, 78.1 mmHg preoperatively, after intubation and post operatively respectively.

The mean MAP in tramadol group are 78.4, 86.8, 77.8 mmHg preoperatively, after intubation and

post operatively respectively. The mean heart rate in control group are 110.8, 132.1, 109.9 beats per minute preoperatively, after intubation, post Operatively respectively.

The mean heart rate in clonidine group are 113, 134.5, 110.2 beats per minute preoperatively, after intubation, post Operatively respectively.

The mean heart rate in tramadol group are 112, 131.2, 109 beats per minute preoperatively, after intubation, post operatively respectively.

Postoperative Haemodynamic Parameters (Table 4)

The mean MAP in the control group is 79.1, 79.5, 79.5, 79.5, 79.63, 80.93, 80.66, 79.43, 79.46, 79.43 mm of Hg after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively. The mean MAP in the tramadol group is 80.1, 78.13, 78.13, 78.13, 78.13, 80.2, 81.76, 78.1, 78.1, 78.1 mm of Hg after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively. The mean MAP in the

Table 4: Postoperative Haemodynamic Parameters

Parameters	Group	Mean Arterial Pressure (Mean + SD)		Heart Rate (Mean + SD)		Respiration Rate (Mean + SD)	
		Mean + SD	P value	Mean + SD	P value	Mean + SD	P value
After Extubation	C	79.13 ± 3.79	.391	121.23 ± 4.83	.136	21.26 ± 2.74	.563
	BT	80.17 ± 2.95		123.90 ± 9.12		21.90 ± 3.03	
	BC	79.41 ± 3.38		125.26 ± 8.88		22.03 ± 3.06	
1 HRS	C	79.50 ± 4.43	.224	109.96 ± 8.44	.841	19.83 ± 2.66	.134
	BT	78.13 ± 3.54		110.26 ± 7.75		21.00 ± 2.81	
	BC	77.86 ± 3.61		109.06 ± 8.39		21.16 ± 2.84	
2 HRS	C	79.50 ± 4.43	.104	110.13 ± 8.54	.823	19.66 ± 2.70	.286
	BT	78.13 ± 3.54		110.66 ± 7.55		20.53 ± 2.76	
	BC	77.33 ± 3.75		109.36 ± 8.19		20.73 ± 2.79	
3 HRS	C	79.50 ± 4.43	.097	110.16 ± 8.48	.870	19.53 ± 2.48	.505
	BT	78.13 ± 3.54		110.63 ± 7.58		20.10 ± 2.55	
	BC	77.30 ± 3.73		109.53 ± 8.21		20.26 ± 2.57	
4 HRS	C	79.63 ± 4.44	.102	110.26 ± 8.56	.894	19.63 ± 2.39	.754
	BT	78.13 ± 3.54		110.73 ± 7.53		19.96 ± 2.51	
	BC	77.53 ± 3.54		109.73 ± 8.34		20.10 ± 2.50	

5 HRS	C	80.93 ± 4.44		111.56 ± 8.38		19.50 ± 2.48	
	BT	80.20 ± 3.69	.286	112.13 ± 7.67	.598	19.93 ± 2.47	.653
	BC	79.33 ± 3.57		110.06 ± 8.32		20.06 ± 2.47	
6 HRS	C	80.66 ± 4.42		111.30 ± 8.53		19.60 ± 2.49	
	BT	81.76 ± 3.69	.075	112.83 ± 7.34	.409	19.90 ± 2.52	.792
	BC	79.43 ± 3.57		110.03 ± 8.29		20.03 ± 2.52	
12 HRS	C	79.43 ± 4.37		110.26 ± 8.12		19.50 ± 2.52	
	BT	78.10 ± 3.52	.294	110.93 ± 7.20	.805	19.93 ± 2.61	.654
	BC	78.03 ± 3.69		111.60 ± 8.10		20.10 ± 2.64	
24 HRS	C	79.43 ± 4.36		110.23 ± 8.49		19.53 ± 2.44	
	BT	78.10 ± 3.52	.305	111.20 ± 7.43	.813	19.83 ± 2.58	.796
	BC	78.10 ± 3.58		111.50 ± 7.89		19.96 ± 2.59	

Table 5: Duration of Post Operative Analgesia

Group	Mean (in min)	STD. Deviation	P value
C	293.6667	22.62640	.000
BC	539.8333	19.31960	
BT	412.0000	26.05035	

Table 6: Number of Doses of Supplementary Analgesics Over 24 Hours

Groups	No. of Doses		
	1	2	3
C	0	1	9
BC	1	0	0
BT	0	0	3

clonidine group is 79.4, 77.86, 77.33, 77.3, 77.53, 79.33, 79.43, 78.1, 78.1 mm of Hg after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean heart rate in the control group is 121.2, 109.96, 110.13, 110.16, 110.26, 111.56, 111.3, 110.26, 110, 110.23 beats per minute after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean heart rate in the tramadol group is 110.26, 110.66, 110.63, 110.73, 112.13, 112.83, 110.93, 110.96, 111.2 beats per minute at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean heart rate in the clonidine group is 109.06, 109.36, 109.53, 109.73, 110.06, 110.03, 111.6, 111.5, 111.5 beats per minute at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The difference in the mean heart rates in the three groups is not statistically significant.

The mean respiratory rates in control group are 21.26, 19.83, 19.66, 19.53, 19.63, 19.5, 19.6, 19.5 and 19.53 at extubation, 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs and 24hrs postoperative respectively.

The mean respiratory rates in clonidine group are 22, 21.16, 20.73, 20.26, 20.1, 20.06, 20.03, 20.1 and 19.96 at extubation, 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs and 24hrs postoperative respectively.

The mean respiratory rates in tramadol group are 21.9, 21, 20.53, 20.1, 19.96, 19.93, 19.9, 19.93 and 19.83 at extubation, 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs and 24hrs postoperative respectively.

Duration of Post Operative Analgesia (Table 5)

Duration of postoperative analgesia Group C was 293 minutes, Group BC 539 minutes and Group BT was 412 minutes. This was statistically significant with p value 0.000. Comparing the groups BC and BT the postoperative analgesia was statistically significant (p value 0.000)

Number of Doses of Supplementary Analgesics Over 24 Hours (Table 6)

Nine children in Group C required 3 doses of rescue analgesics compared with 3 children in Group BT and none in Group BC respectively which is statistically significant (p value <0.05). Majority of the children in all the 3 groups required 2 doses of rescue analgesics.

Discussion

Caudal analgesia used for infra umbilical surgeries in children with only local anaesthetics will produce a shorter duration of postoperative analgesia. Hence nowadays an adjuvant is always added to local anaesthetic. The most popular local anaesthetic agent being used is bupivacaine [4]. The most common adjuvants used to prolong the postoperative analgesia are opioids and alpha2 agonists [4,17]. Since morphine produces more side effects like respiratory depression, nausea and vomiting, tramadol a weak opioid analgesic with less postoperative side effects is becoming more popular as a caudal analgesic [4,15]. Alpha 2 agonists like clonidine and dexmedetomidine have been found to prolong postoperative analgesia when used along with local anaesthetics as adjuvants. It was found that addition of dexmedetomidine as adjuvant was not superior to clonidine, though dexmedetomidine is much costlier than clonidine [8]. Hence clonidine is a more popular caudal analgesic than dexmedetomidine. Individual studies using clonidine and tramadol as adjuvants to bupivacaine for caudal analgesia have been found to produce prolonged postoperative analgesia. After searching through the literature, no study comparing these 2 drugs was found. Neuraxial placement of clonidine inhibits spinal substance P release and nociceptive neuron firing produced by the noxious stimulation. Alpha 2 afferent terminals are situated centrally and peripherally, in the superficial laminae of spinal cord and several brain stem nuclei. This suggests that analgesic effects of clonidine are more pronounced after neuraxial administration [1,13]. Tramadol is a centrally acting analgesic with multimodal action. It acts on serotonergic and noradrenergic nociceptors, while its metabolite O - desmethyl tramadol acts on the mu opioid receptors. Its analgesic potency is claimed to be about 1/10th of morphine [6,7]. It is considered to be a relatively safe analgesic but its main concern is the increased incidence of postoperative nausea and vomiting [13,6]. The dose of clonidine used by many authors is 1µg/kg body weight along with bupivacaine 0.25% [4,12]. Clonidine [12] when used as 2µg/kg body weight dose did not enhance the analgesic efficacy but increased the incidence of side effects like respiratory depression, bradycardia and hypotension [3,10]. Tramadol when used in the dose of 1 mg/kg body weight along with bupivacaine produced prolonged postoperative analgesia [5,7]. Tramadol when used as 2 mg/kg body weight did not prolong the analgesia but increased the

incidence of post operative nausea and vomiting [9,5]. In our study we found that the duration of postoperative analgesia with tramadol 1mg/kg body weight was 412 minutes, when compared with clonidine 1µg/kg body weight which was 512 minutes and this was highly statistically significant. Both the drugs produced prolongation of the analgesia compared with the group where only bupivacaine 0.25% was used. Similar findings were found with studies conducted by Shreshta SK et al [15], Parmeshwari A et al [12] and Doda M et al [15]. In our study, the number of doses of rescue analgesics was also more in the control group compared to the tramadol and clonidine group. We did not find any increase in the side effects, especially PONV with tramadol, as a combination of ramosetron, which has a prolonged effect and dexamethasone was used as premedicant for all the children in our study.

Hence we conclude that both clonidine and tramadol when used as adjuvants along with bupivacaine for caudal analgesia in children are effective in producing prolonged postoperative analgesia with minimal side effects. Clonidine produces more prolonged analgesia compared to tramadol and hence can be the preferred adjuvant for caudal analgesia in children.

Table 1: Pain was assessed by FLACC scale [12]

Table 2: Demographic Data shows the age, sex, weight and height distribution of patients among the three groups.

The mean age is 4.56 years in normal saline(control) group, 4.43 years in the clonidine group, and 4.53 years in tramadol group with a p value of 0.946 There is no significant difference in sex distribution in all three groups.

The mean weight is 14.63 kg in control group, 15.06 kg in clonidine group, and 15.16 kg in tramadol group with a p value of 0.812.

The mean height is 100.7 cm in control group, 101.2 cm in clonidine group, and 101.1 cm in tramadol group with a p value of 0.983

The mean duration of surgery is 28.8 min in control group, 26.5 minutes in clonidine group and 26 minutes in tramadol group with a p value of 0.135

The mean duration of anaesthesia is 39 minutes in control group, 41.1 minutes in clonidine group and 40.8 minutes in tramadol group with a p value of 0.184.

Table 3: Haemodynamic Stability shows the mean preoperative, post extubation and post operative blood pressure, saturation and heart rate

The mean MAP in control group are 79.7, 87.4, 79.5 mmHg preoperatively, after intubation, post operatively respectively.

The mean MAP in clonidine group are 78.2, 86.7, 78.1 mmHg preoperatively, after intubation and post operatively respectively.

The mean MAP in tramadol group are 78.4, 86.8, 77.8 mmHg preoperatively, after intubation and post operatively respectively.

The mean heart rate in control group are 110.8, 132.1, 109.9 beats per minute preoperatively, after intubation, post. Operatively respectively.

The mean heart rate in clonidine group are 113, 134.5, 110.2 beats per minute preoperatively, after intubation, post Operatively respectively.

The mean heart rate in tramadol group are 112, 131.2, 109 beats per minute preoperatively, after intubation, post operatively respectively.

Table 4- Postoperative Haemodynamic Parameters: The mean MAP in the control group is 79.1, 79.5, 79.5, 79.5, 79.63, 80.93, 80.66, 79.43, 79.46, 79.43 mm of Hg after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean MAP in the tramadol group is 80.1, 78.13, 78.13, 78.13, 78.13, 80.2, 81.76, 78.1, 78.1 mm of Hg after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean MAP in the clonidine group is 79.4, 77.86, 77.33, 77.3, 77.53, 79.33, 79.43, 78.1, 78.1 mm of Hg after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean heart rate in the control group is 121.2, 109.96, 110.13, 110.16, 110.26, 111.56, 111.3, 110.26, 110, 110.23 beats per minute after extubation, at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean heart rate in the tramadol group is 110.26, 110.66, 110.63, 110.73, 112.13, 112.83, 110.93, 110.96, 111.2 beats per minute at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The mean heart rate in the clonidine group is 109.06, 109.36, 109.53, 109.73, 110.06, 110.03, 111.6, 111.5, 111.5 beats per minute at 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs, 18hrs and 24hrs postoperative respectively.

The difference in the mean heart rates in the three groups is not statistically significant.

The mean respiratory rates in control group are 21.26, 19.83, 19.66, 19.53, 19.63, 19.5, 19.6, 19.5 and 19.53 at extubation, 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs and 24hrs postoperative respectively.

The mean respiratory rates in clonidine group are 22, 21.16, 20.73, 20.26, 20.1, 20.06, 20.03, 20.1 and 19.96 at extubation, 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs and 24hrs postoperative respectively.

The mean respiratory rates in tramadol group are 21.9, 21, 20.53, 20.1, 19.96, 19.93, 19.9, 19.93 and 19.83 at extubation, 1 hr, 2hrs, 3hrs, 4hrs, 5hrs, 6hrs, 12hrs and 24hrs postoperative respectively.

There is no statistically significant difference in respiratory rates in the three groups ($p > 0.05$).

Table 5 duration of postoperative analgesia Group C was 293 minutes, Group BC 539 minutes and Group BT was 412 minutes. This was statistically significant with p value 0.000. Comparing the groups BC and BT the postoperative analgesia was statistically significant (p value 0.000).

Table 6- Nine children in Group C required 3 doses of rescue analgesics compared with 3 children in Group BT and none in Group BC respectively which is statistically significant (p value < 0.05). Majority of the children in all the 3 groups required 2 doses of rescue analgesics.

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