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Comparison of Recovery Following Two Different Anaesthetic Techniques in Term Neonates Undergoing Emergency Colostomy: A Prospective Randomised Controlled Study

Aavula Muralidhar[1], Y. Ravinaga Prasad[2], M. Damodara Rao[3], N. Srinivas Reddy[4], Ch Sunil Kumar[5]

[1-5]Associate Professor, Department of Anaesthesiology, Niloufer Hospital, Osmania Medical College, Hyderabad, Telangana State 500004, India.

Abstract

Introduction: The risk of apnea after surgery is significant in neonates regardless of anaesthetic agents used. A prospective randomized study done at our institute to explore the hypothesis "post-operative neonatal recovery is better with sevoflurane and caudal block with spontaneous ventilation compared to a technique with muscle relaxants." *Aim:* To study neonatal recovery after sevoflurane and caudal block with spontaneous ventilation in comparison with the addition of Muscle relaxants. *Materials and Methods:* Study done in 100 term neonates, undergoing emergency colostomy were studied for a period of 2 years. Group I patients induced and intubated with sevoflurane maintained spontaneous ventilation. Group II patients induction and intubation by sevoflurane and atracurium. Caudal block given in both groups with 1.25ml/kg volume of bupivacaine. Blinded observers recorded emergence timings and monitored postoperative apnea for 12 hours. *Results:* Statistically no significant difference in the vital parameters recorded intraoperatively and post-operatively between the 2 groups. Median value of $EtCO_2$ was different with p value < 0.05. Median time to first movement, eye opening, tracheal extubation and first cry was less in group I (150, 150, 180, 210 seconds) than in group II (300, 330, 360 and 420 seconds). Post-operative incidence of apnea is lesser in group I (3/50) than group 2 (11/50), Chi-square static is 6.3529. p value is 0.012 (<0.05). No rescue airway interventions were required in both groups. *Conclusion:* Post-operative apnoeic spells are less and neonates wake faster with sevoflurane and caudal block with spontaneous ventilation compared to muscle relaxant group with IPPV. Sevoflurane and caudal block with spontaneous ventilation is preferable to other techniques for newborn lower abdominal surgeries.

Keywords: Neonate; Sevoflurane; Caudal Blockade; Spontaneous Ventilation; Muscle Relaxants and Post-Operative Recovery.

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Introduction

The risk of life threatening apnea after surgery is significant in neonates regardless of the anesthetic techniques used by the pediatric anesthesiologists. Regional blocks especially Caudal block appears to be more safe in this age group, reduces the risk of Respiratory dysfunction. Inhalents also appears to be more safe especially Sevoflurane which is having rapid induction and recovery. Combination of both with endotracheal intubation protects airway, rapid recovery and reduces post-operative apnea spells. Increasing number of day care procedures are performed in children due to availability of short acting anaesthetic agents. Inhalational anaesthetics are one such easily titratable agents in availability. Sevoflurane, a polyfluorinated methyl isopropyl ether is a non pungent inhalational agent making

Corresponding Author: Y. Ravinaga Prasad, Associate Professor, Department of Anaesthesiology, Niloufer Hospital, Osmania Medical College, Hyderabad, Telangana 500004, India.
E-mail: aavulaklmn@gmail.com

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easier to deliver anaesthesia to paediatric population [1]. Sevoflurane with a blood gas partition coefficient of 0.65 (@ 37^0C) is easily titratable achieving faster induction and recovery in children. The MAC of sevoflurane decreases with age ranging from 3.3% in neonates to 2.5% in infants and young adults [2]. Neonates and preterm infants are especially susceptible to ventilatory depressant effects of anaesthetics.

Sevoflurane attenuates bronchial smooth muscle constriction by histamine or acetylcholine release and is safe to use in children for mask induction as well as maintenance [3]. At clinical concentrations, it maintains cardiac output and preserves coronary blood flow in neonates and children [4]. The safety profile is also extended to children with uncommon conditions like acute intermittent porphyria, muscular dystrophies, myotonic dystrophy [9]. Sevoflurane based anaesthesia resulted in excitation/emergence phenomenon reported in some earlier studies [5]. However, this becomes infrequent with adequate pain control and avoiding associated risk factors [6]. Reliable pharmacodynamics and pharmacokinetic properties together with absence of major side effects have made sevoflurane a safe and reliable agent for clinical practice.

H(a):Alternate Hypothesis: There is variation in Neonatal recovery after Sevoflurane and Caudal block anaesthesia in comparison with others

H(o)Null Hypothesis: There is no variation in Neonatal recovery.

Our aim of study is neonatal recovery after sevoflurane and caudal block with spontaneous ventilation in comparison with the addition of Muscle relaxants

Materials and Methods

Post-operative Randomized pilot study that reflects both clinical practice at our institution and explore hypothesis that "Neonatal recovery after sevoflurane and caudal block with spontaneous ventilation is much better than other techniques."

After obtaining ethical committee approval and informed parental consent of 100 patients undergoing "emergency pelvic loop colostomy making"with in 48 hrs of birth, in the period of 30 months i.e. from January 2013 to jun 2015.

Inclusion Criteria

Term neonates weighing between 2.5 kgs to 3.5 kgs.

Exclusion Criteria

Preexisting cardiac, respiratory, neuromuscular, metabolic diseases and other any associated congenital abnormalities, very low birth weight and premature babies.

We studied total 100 patients 50 in each group.Using random number tables patients were allocated randomly to receive either sevo and caudal or sevo, atracurium and caudal.

Patients were allocated randomly to two groups. All patients received Inj. Atropine 0.1 mg IV and Inj. Fentanyl 1 mcg/kg IV and Caudal epidural block with 1.25ml/kg volume of bupivacaine.

GROUP 1 neonates induced and intubated with a 2 MAC value of Sevoflurane in 100% Oxygen (1 MAC =3.2% in neonates), maintained with spontaneous ventilation with end tidal sevoflurane concentration of 0.5-1.0 MAC in N_2O:O_2 mixture with paediatric circuit. GROUP 2 neonates induced with 1 to 1.5 MAC of Sevoflurane in 100% Oxygen, intubation facilitated by Inj. Atracurium 0.5 mg/kg, lungs were ventilated with an end tidal Sevoflurane concentration of 0.5 to 1.0 MAC in N_2O:O_2 mixture with paediatric circuit.

All neonates in both groups received Caudal epidural block in left lateral position, with a single injection of 1.25ml/kg volume of Bupivacaine (2 – 3 mg/kg) with 23 G hypodermic needle, to ensure that both groups were comparable to one another in terms of the duration and intensity of analgesia provided in the initial post-operative period. Induction to Incision and Incision to skin closure times (anaesthesia time) were recorded for both groups. After skin closure vitals recorded – Heart Rate, SpO_2, Blood Pressure, $EtCO_2$ and End tidal Sevoflurane. After completion of skin closure, Sevoflurane administration discontinued in both groups and residual neuromuscular block antagonized with Neostigmine 60 mcg/kg and Glycopyrollate 10 mcg/kg in Group 2.

Blinded observer (senior/junior residents) was admitted to the operating room once anaesthesia was discontinued and timed the undisturbed patient to the following end points – First gross movement, Eye opening, Tracheal extubation (decided by the anaesthesiologist on clinical grounds) and the first cry. Any adverse events in the recovery period such as Laryngospasm and cough recorded.

Blinded Observer was Admitted into Post Operative Room to Record

- Bradycardia (clinical significance if HR is less than 100),
- A haemoglobin O_2 Saturation (SpO_2) of less than 90% for more than 10 Sec
- Apnoea (defined as sustained respiratory pause of 15 sec or longer than 15 sec if accompanied by an SPO2 less than 90% or Bradycardia).

Patient characteristics were comparable. Median values p Value > 0.05.

Results

Hundred neonates were allotted equally to Group 1 and 2, both groups were comparable in age, Birth weight, Pre op Hb% and Anaesthetic time (induction to skin closure) P value >0.05, there was no statistically significant difference in between groups (Table 1).

Median values recorded for Heart Rate, Blood pressure and SpO_2 in Group 1 were comparable to values recorded in Group 2 at the time of skin closure, p value>0.05, not significant statistically. Comparison of $EtCO_2$ is significant p Value<0.05 (Table 2).

Median time to first gross movement in group-1 occurred in half time of the group-2, 150 seconds compared with 300 seconds . Standard deviation in group-1 is 23.23 where as in group-2 is 55.54, p Value is <0.05 (Graph 1).

Mean time to eye opening occurred in group-1 is under half of the time of the group-2 neonates, 150 seconds compared to 330 seconds. Standard deviation in group-1 is 25.71 where as in group-2 is 58.8, p Value<0.05 (Graph 2).

Median time to tracheal extubation occurred in group-1 in half of the time of the group-2 neonates, 180 seconds compared to 360 seconds. Standard deviation in group-1 is 25.29 where as in group-2 is 58.84, p Value<0.05 (Graph 3).

Median time to first cry in group-1 in half of the

Table 1: Neonatal Characteristics in present study,

Neonatal Characteristics	Group 1, n =50	Group 2, n = 50	P-Value
Neonate Weight in kgs	2.8	2.9	>0.05
Neonate Age in days	1	1	>0.05
Haemoglobin gm/dl	12.6	12.0	>0.05
Induction to Incision time in min.	7	7	>0.05
Incision to skin closure time in min	38	38.5	>0.05

All Characteristics are insignificant in comparison.

Table 2: Comparison of Median cardiorespiratory changes at the time of skin closure

Cardiorespiratory changes	Group 1, n = 50	Group 2, n = 50	P-Value
Herat rate	138 per min	140 per min	>0.05
Blood pressure	80/48 mmHg	78/49 mm Hg	>0.05
Spo2	96%	99%	>0.05
EtCO2 (Mean+SD)	39.97±40	45.14±45	<0.05

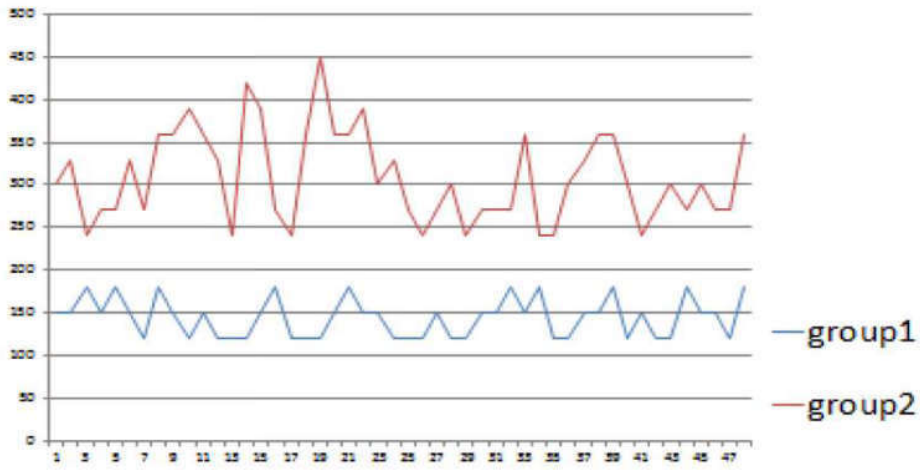

Fig. 1: Comparision of first gross movement in 2 groups

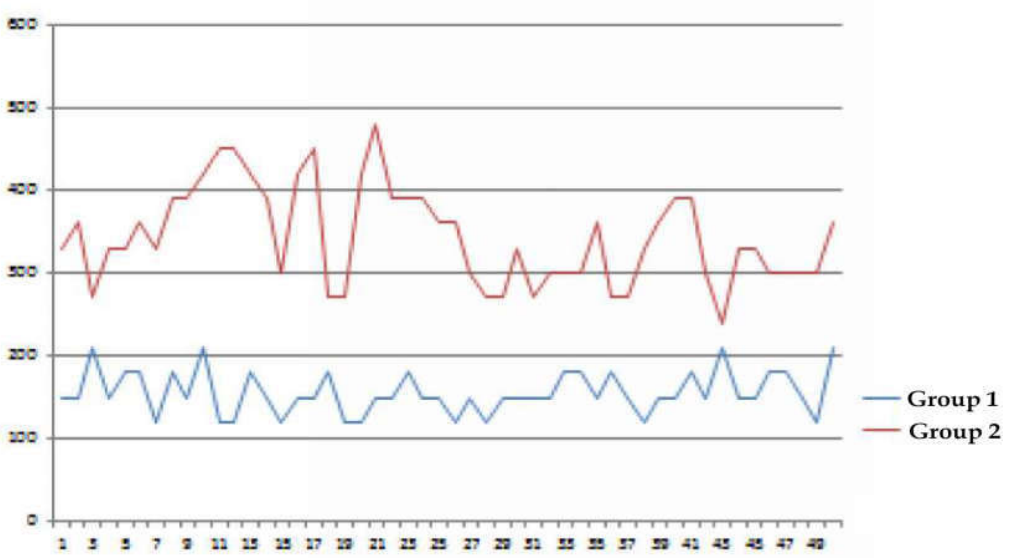

Fig. 2: Comparision of Eye opening in 2 groups

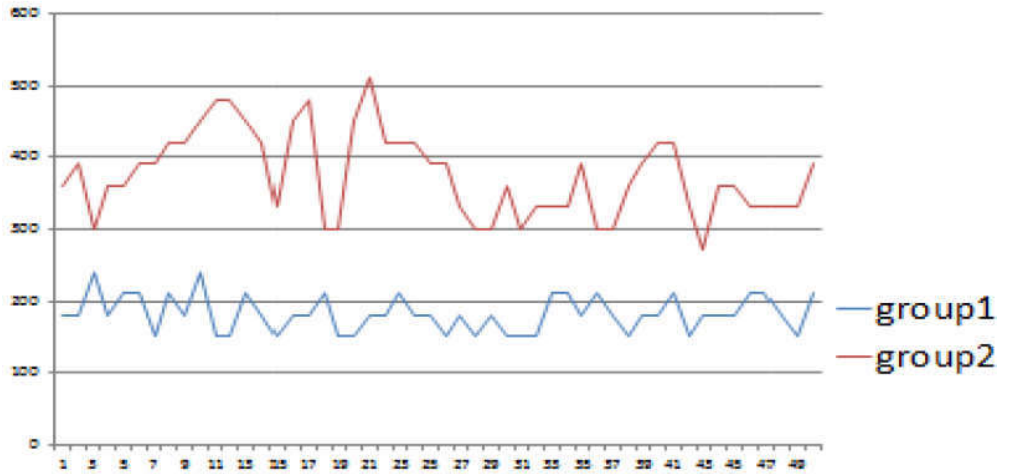

Fig. 3: Comparision of tracheal extubation in 2 groups

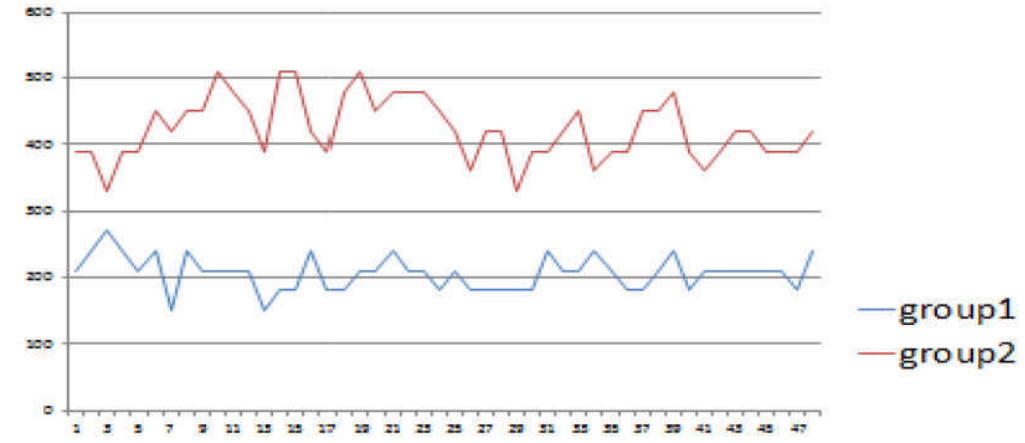

Fig. 4: Comparision of Frist cry in 2 groups

Table 3: Post operative findings in study

	YES	NO
Post-operative incidence of Apnoea		
Group 1	3	47
Group 2	12	38
SPo2 <90% for >10Sec & Bradycardia <100		
Group 1	3	47
Group 2	4	46

time of the group-2 , 210 seconds compared to 420 seconds. Standard deviation in group-1 is 28.2 where as in group-2 is 47.8 p Value<0.05 (Graph 4).

Comparison of post-operative incidence of Apnoea. There was clear statistical significance in between two groups, Post-operative incidence of apnoea is lesser in group I (3/50) than group 2 (11/50). The Chi-Square statistic is 6.3529. The p Value is 0.011719. The result is significant as p <0.05. These patients required O_2 therapy. The Chi-square statistic is 6.3529. The P value is 0.011719. This result is significant at p < 0.05. statistically significant (Table 3).

Comparison of SpO_2 <90% for >10sec and Bradycardia <100 per min. There was no statistical significance between two groups in the incidence of postoperative bradycardia and oxygen desaturation. p Value is 0.69, is more than 0.05, not significant. These patients are part of apnoeic spells patients, required O_2 therapy with bag mask ventilation. No rescue airway interventions were required in either of the groups. No patient required mechanical ventilation.

Discussion

We have designed a study that reflects clinical practice at the Niloufer hospital for women and children in Hyderabad. Anaesthesia with sevoflurane and caudal epidural block has been the preferred technique for those newborns, who are thought to be at risk for postoperative cardio respiratory complications, requiring lower abdominal surgery. This approach provides anaesthesia of sufficient quality and duration to permit the completion of colostomy making.The dosing regimen (Bupivacaine 2-3mg/kg) in caudal has been used without untoward sequale at our institution for the last 10 years. It is less than the 3.8mg/kg dose used by Gunter and collegue to establish single injection caudal epidural anaesthesia and compares favourably with mean total dose of bupivacaine 2.8mg/kg (range 2.5 -3.7 mg/kg) used by Peutrell and Hughes in their study of a combined spinal- epidural technique.

Proposed etiological factors for this include the hangover effect of residual anesthetic agents combined with an elevated plasma level of circulating endorphins. By attempting to ensure that both groups were comparable in terms of the duration and intensity of analgesia provided , we hoped to be able to detect in the initial postoperative period any excess cardiorespiratory complications attributable to residual anaesthesia alone.We designed our study to reflect as closely as possible the current practice at our institution. We used 2.0 MAC sevoflurane for induction and 0.75 – 1.0 MAC for maintenance of anaesthesia. So, Sevoflurane being low blood-gas solubility, rapid induction, and rapid emergence characteristics, coupled with its nonirritating airway properties and stable patient hemodynamic characteristics, is desirable for use in children. Although low soluble anesthetics allow for faster emergences, they have also been associated with higher incidences of emergence agitation [7-16]. Consequently, the advantage of a rapid emergence may be more than offset by the quality of the anesthetic emergence. In pediatric studies of desflurane and halothane emergence, excitement was noted to be more common in patients anesthetized with desflurane than in patients anesthetized with halothane [13,14,16]. In a study of pediatric ambulatory patients undergoing a variety of surgical procedures, Lerman et al. [7] noted that emergence excitement was 3 times more common in sevoflurane-anesthetized patients than in those patients receiving halothane. Aona et al. [9] also noted that the incidence of emergence excitement was greater with sevoflurane than with halothane. Not all studies have demonstrated an increase in emergence agitation with sevoflurane. Wellborn et al. [15] compared the emergence and recovery characteristics of desflurane, halothane, and sevoflurane in children undergoing outpatient adenoidectomy with BMT who had also received

intraoperative opioids. Although the addition of opioids attenuates emergence agitation, the incidence of emergence excitement was similar for both the halothane- (25%) and sevoflurane- (10%) anesthetized patients but was markedly greater in the desflurane-anesthetized children (55%).

In addition to the choice of anesthetics, other factors can influence the incidence of emergence agitation [12,17]. Pain, patient temperament, age, and developmental maturity are all factors that can affect emergence agitation. Pain, especially in preverbal children, can be difficult to quantify and may mimic the signs of emergence agitation from anesthesia.Lerman et al. [18], has noted that the intraoperative administration of opioids or the placement of regional blocks profoundly reduced the incidence of emergence agitation in patients anesthetized with both sevoflurane and halothane.

Except the neonates who had apnoeic spells, no other neonates required O_2 therapy, in addition to their preoperative requirement. None had airway irritation such as coughing or laryngospasm. Patients who had apnoeic spells with SpO_2 <90% and/or Bradycardia required active intervention with bag and mask ventilation. No patients required intubation and mechanical ventilation.In our study, none of the children suffered any excitation during sevoflurane induction that could possibly contribute to the emergence agitation. Naito et al. [19] compared emergence after sevoflurane and halothane anaesthesia in children, and described a greater incidence of restlessness and agitation in children anaesthetised with sevoflurane. The reason for this remains unclear. A central nervous system excitatory effect of sevoflurane has been proposed [3]. S.M. Sale, et al. [20] reported sevoflurane followed by maintenance with desflurane utilizes, to the most benefit, as it is less soluble volatile anaesthetic agents and results in the fastest recovery and may be of particular benefit in high-risk formerly premature infants.

Conclusion

In conclusion we suggest that Sevoflurane induction and intubation with spontaneous ventilation and caudal epidural block is the current best technique for new born surgeries under going lower abdominal surgeries, even preferable in very high risk newborns and premature babies.

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