

## Comparison Between Intravenous Fentanyl and Dexmedetomidine to Decrease Sevoflurane - Induced Agitation in Paediatric Patients Undergoing Lower Abdominal Surgery: A Prospective Randomized Observational Study

Puneeth J<sup>1</sup>, Mahantesh S Mudakanagoudar<sup>2</sup>

<sup>1</sup>Senior Resident, Dept. of Anesthesiology and Critical Care, Kempegowda Institute of Medical Sciences, Bengaluru, Karnataka 560004, India. <sup>2</sup>Associate Professor, Dept. of Anaesthesiology, SDM College of Medical Sciences and Hospital, Sattur, Dharwad, Karnataka 580009, India.

### Abstract

**Introduction:** Sevoflurane is widely used in paediatric anesthesia. It has a rapid induction and rapid recovery profile. It is pleasant, non-pungent and non-irritant to the respiratory airways. Emergence agitation (EA) in children early after sevoflurane anesthesia is a common postoperative problem, with incidence up to 80%. Fentanyl and  $\alpha_2$ -agonists like Dexmedetomidine have been shown to be effective measures in decreasing the incidence of EA. **Aims and Objectives:** To compare the incidence of intravenous dexmedetomidine and fentanyl to decrease the post operative agitation after sevoflurane anesthesia in paediatric patients undergoing lower abdominal surgery. **Material and methods:** Sixty ASA physical status I and II children aged 2-9 years were included in this study. After inhalation induction with sevoflurane, patients were randomly assigned to receive either Saline (group N, n=20), fentanyl 1 mic/kg IV (group F, n=20) or dexmedetomidine 0.3 mic/kg IV (group D, n=20) 10 minutes before discontinuation of anesthesia. **Results:** The incidence of agitation was significantly higher in group N compared with other two groups, the incidence of agitation was 60% in Group N, 45% in Group F and 20% in Group D. There was no significant difference ( $p > 0.05$ ) between the three groups in modified Aldrete recovery scores, but emergence time was more in dexmedetomidine when compared with other groups which was statistically significant. **Conclusion:** Fentanyl 1 mic/kg iv or dexmedetomidine 0.3 mic/kg iv that is administered 10 minutes before the termination of anesthesia reduces the postoperative agitation in children.

**Keywords:** Agitation; Dexmedetomidine; Fentanyl; Sevoflurane.

### How to cite this article:

Puneeth J, Mahantesh S Mudakanagoudar. Comparison Between Intravenous Fentanyl and Dexmedetomidine to Decrease Sevoflurane - Induced Agitation in Paediatric Patients Undergoing Lower Abdominal Surgery: A Prospective Randomized Observational Study. Indian J Anesth Analg. 2019;6(4):1387-1397.

### Introduction

Sevoflurane is an inhalational agent of choice in paediatric anesthesia practice since many years. The relative lack of airway irritation, non-pungency, low blood gas partition coefficient with rapid induction and rapid recovery as well as limited

cardio-respiratory depression made it a suitable inhalational agent in children.

Emergence agitation (EA) following general anesthesia in children is an evolving problem since sevoflurane has become a popular anesthetic for pediatric anesthesia.<sup>1</sup> Although EA is self-limited and occurs within the first 30-minutes of recovery

**Corresponding Author:** Mahantesh S Mudakanagoudar, Associate Professor, Dept. of Anaesthesiology, SDM College of Medical Sciences and Hospital, Sattur, Dharwad, Karnataka 580009, India.

**E-mail:** drmontygoudar@yahoo.co.in

**Received on** 24.05.2019, **Accepted on** 11.07.2019



This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0.

in Post Anesthesia Care Unit (PACU), but it can last up to 2 days and end up in causing physical injuries to the child and mental trauma to parents.<sup>2</sup>

Apart from sevoflurane several other factors can lead to EA such as rapid awakening in an unfamiliar environment, painful events like surgical wounds, agitation on induction, airway obstructions, environmental disturbances, the duration of anesthesia, hyperthermia, hypothermia, type and site of operation, premedication.<sup>2</sup> Among these postoperative pain and inhalation induced agitation are commonly seen in our practice. Various medications and procedures like caudal block will combat postoperative pain induced agitation.

However, the exact etiology of agitation after Sevoflurane anesthesia is still not known. There being a possibility that it exerts an irritant effect on the central nervous system.<sup>3</sup>

Various medications, including opioids, sedatives and alpha-2 agonists have been tried with various success.

Fentanyl is a potent opioid receptor agonist with sedative and analgesic effects. It is routinely used in the practice of pediatric perioperative medicine. Some clinical trials have shown that fentanyl can prevent EA under sevoflurane anesthesia in children.<sup>4</sup>

Dexmedetomidine is the latest addition to the Group of  $\alpha_2$ -adrenergic receptor agonist approved by FDA in 1999 for use in humans for analgesia and sedation. It is a highly selective adrenergic receptor agonist, exhibits sympatholytic, sedative, and analgesic effects.

Dexmedetomidine has several advantages over traditional medications such as narcotics and benzodiazepines. Owing to its sedative and analgesic action, no respiratory depression, better haemodynamic stability, minimal or no significant adverse effect profile has led to its use in paediatric anesthesia. It can be used as premedication, sedative for invasive procedures, anti-shivering agent and reduction of emergence agitation.

We decided to undertake this study to compare the effect of the selective  $\alpha_2$ -adrenergic receptor agonist Dexmedetomidine with Fentanyl to reduce emergence agitation and also observe the recovery characteristics after Sevoflurane anesthesia in children aged 3-10 years undergoing lower abdominal surgeries

## Materials and Methods

Clearance for this prospective randomized double blind study was obtained from the institutional

ethical committee. After thorough preoperative evaluation, written and informed consent from the patient's parent/guardian was taken. Nil by mouth status of the child was confirmed and Midazolam 0.5 mg/kg orally as a premedication was given half an hour before surgery.

The patients were randomly allocated into either of the three groups:-

1. Group N: to receive normal saline 10 ml i.v. 10 minutes before the end of anesthesia, (n=20)
2. Group F: to receive Fentanyl 1 mcg/kg diluted to 10 ml of normal saline i.v. 10 minutes before the end of anesthesia, (n=20)
3. Group D: to receive Dexmedetomidine 0.3 mcg/kg diluted to 10 ml of normal saline i.v. 10 minutes before the end of anesthesia, (n=20) by using envelope method.

In the operation theatre, standard monitoring with electrocardiogram, noninvasive oscillometric blood pressure (NIBP) and pulse oximetry was initiated and baseline values were recorded and continuous monitoring was done during the whole study. Patients were induced with inhalation induction via transparent face mask after saturating the breathing system (Jackson-Rees modification of Ayer's t-piece) with a mixture of sevoflurane 8% with N<sub>2</sub>O 60% in O<sub>2</sub>. After loss of consciousness, intravenous line was inserted and when adequate depth of anesthesia was reached, a Proseal laryngeal mask airway (PLMA) of appropriate size for the age and weight of the child was placed and patient was allowed to breath spontaneously. Ventilation was assisted if the patient becomes apneic or if the end-tidal carbon dioxide increased to  $\geq 55$  mmHg.

After PLMA insertion and before the start of surgery, Caudal block with 1.0 ml/kg of 0.25% bupivacaine was performed in all patients. Failure of caudal block was defined as increase in heart rate and or mean arterial blood pressure (MAP) > 10% than pre-incisional value at the start of surgery. Sevoflurane was reduced to 2% with 60% N<sub>2</sub>O in O<sub>2</sub>. The anesthetic agents were delivered in a concentration that maintained a stable heart rate, blood pressure and respiratory rate (base line  $\pm$  20%).

Ten minutes before the end of anesthesia, Group N: received Normal saline 10 ml i.v., Group F: received Fentanyl 1 mcg/kg diluted in 10 ml of normal saline i.v., Group D: received Dexmedetomidine 0.3 mcg/kg diluted in 10 ml of normal saline i.v., slowly over ten minutes.

At the end of the procedure anesthetic gases were discontinued and maintained on O<sub>2</sub> 100% > 5L/min. PLMA was removed when patient showed adequate recovery from anesthesia. Then the patient was transferred to the post anesthesia care unit (PACU) for monitoring of vital signs and scoring of various scales used in our study at regular intervals.

The following parameters were recorded: duration of anesthesia (time from the start of induction till discontinuation of anesthetics) in min., duration of surgery (from skin incision to final skin sutures) in min., time of emergence (time from the discontinuation of anesthesia till first response/eye opening to command/stimuli) in min., Emergence scoring was done using watcha scale scoring (Table 1). Paediatric Anesthesia Emergence Delirium Score (PAEDS) and Objective pain scale (Table 2 & 3) was used to differentiate delirium from pain behavior and vital parameters like heart rate, mean arterial pressure, respiratory rate, end tidal carbon dioxide, oxygen saturation and MAC of sevoflurane were monitored.

In PACU parents/gaurdian were allowed to be at the child's bed side immediately upon admission along with one trained nurse and the junior resident, to stay with the patient until discharge to the ward and recorded each score of different scales at regular intervals.

Patients were kept in PACU until they attained an Aldrete score of 9 (Table 4) or more and free from vomiting. The time to meet these criteria was also

recorded as recovery time in minutes. Patients who had vomiting were given ondansetron 0.1 mg/kg i.v. Patients who had pain were given morphine 0.1 mg/kg. i.v.

### Statistical Analysis

All the data obtained were presented in mean ± SD form and analysis of their significance was done by using the p values obtained through Student t- test. The ANOVA test (analysis of variance) was used for continuous variables and chi-square test for discrete variables. The software used for statistics is SPSS 20.00. *p* < 0.05 was considered to be statistically significant.

### Results

Demographic data (gender, age, weight) and type of surgery were comparable in all the groups Tables 5-7. Duration of Anesthesia and duration of surgery were also comparable in all the three groups Table 8. The duration of emergence was more in Dexmedetomidine group when compared with other two groups Figure 1. There was no significant difference in heart rate and mean arterial pressure in between each groups. But there was a decrease in heart rate and mean arterial pressure in Dexmedetomidine group when compared with other two groups after administration of the study drug but was not significant statistically Figures 2 and 3.

**Table 1:** The Watcha scale scoring.

Behaviour	Score
Asleep	0
Calm	1
Crying, but can be consoled	2
Crying, but cannot be consoled	3
Agitated and thrashing around	4

Scores of zero, one and two were considered as absence of EA, and scores of three and four as presence of EA.

**Table 2:** The Paediatric Anesthesia Emergence Delirium (PAED) Scale scoring.

Behaviour	Not at all	Just a little	Quite a bit	Very much	Extremely
Makes eye contact with caregiver	4	3	2	1	0
Actions are purposeful	4	3	2	1	0
Aware of surroundings	4	3	2	1	0
Restless	0	1	2	3	4
Inconsolable	0	1	2	3	4

The scores are summed and the total correlates positively with the degree of ED.

Figure 4 shows the number and percentage of patients in whom agitation was present according to Watcha Scale. The incidence of agitation was 60% in Group N, 45% in Group F and 20% in Group D on arrival to PACU which was significant. The number of patients who had agitation was comparable by the end of 20 minutes in all the three groups.

According to the PAED scale scoring, the scores were higher in Group N when compared with Group F, and group F scores was higher when compared with Group D on arrival and gradually decreased over time Table 9. Hence in our study we found that

the degree of agitation was less in Group D when compared with other two groups and that in Group F was less when compared with Group N.

According to the Objective Pain Scale scoring Table 10, the scores were higher in Group N when compared with Group F, and Group F scores was higher when compared with Group D on arrival and gradually decreased over time. This showed that the groups which were having higher degree of agitation also had a higher Objective Pain Scale score. The difference in duration of recovery time in three groups was not significant Table 11.

**Table 3:** Objective Pain scale scoring.

Parameter	Finding	Points
Systolic blood pressure	Increase < 20% of preoperative blood pressure	0
	Increase 20-30% of preoperative blood pressure	1
	Increase > 30% of preoperative blood pressure	2
Crying	Not crying	0
	Responds to age appropriate nurturing (tender loving care)	1
	Does not respond to nurturing	2
Movements	No movements relaxed	0
	Restless moving about in bed constantly	1
	Thrashing (moving wildly) or rigid (stiff)	2
Agitation	Asleep or calm	0
	Can be comforted to lessen the agitation (mild)	1
	Cannot be comforted (hysterical)	2
Complains of pain	Asleep or states no pain	0
	Cannot localize pain	1
	Localizes pain	2

Total score = SUM (points for all scorable parameters)

### Interpretation

- Minimum Score: 0
- Maximum Score: 10
- Maximum Score if too young to complain of pain 8.
- The higher the score the greater the degree of pain.

**Table 4:** Aldrete Recovery Scoring.

Criteria	Points
<i>Color</i>	
Pink	2
Pale or dusky	1
Cyanotic	0
<i>Respiration</i>	
Can breathe deeply and cough	2
Shallow but adequate exchange	1
Apnea or obstruction	0

*Circulation*

BP +/- 20% of normal	2
BP +/- 20-50% of normal	1
BP > 50% of normal	0

*Consciousness*

Awake, alert and oriented	2
Arousable but readily drifts back to sleep	1
No response	0

*Activity*

Moves all extremities	2
Moves two extremities	1
No movement	0

Patients were kept in PACU until they attained an Aldrete score of  $\geq 9$ .

**Table 5:** Distribution of male and female in three study groups (Dexmedetomidine, Fentanyl and Normal saline).

Sex	Dexmedetomidine	%	Fentanyl	%	Normal saline	%	Total
Male	19	95.00	19	95.00	18	90.00	56
Female	1	5.00	1	5.00	2	10.00	4
Total	20	100.00	20	100.00	20	100.00	60

The difference in distribution of male and female samples in three groups was not significant (Chi-square=0.5357) ( $p$  value=0.765017).

**Table 6:** Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with respect to mean age and weight by one way ANOVA.

Groups	Age		Weight		Gender
	Mean	SD	Mean	SD	
Dexmedetomidine	4.10	2.59	13.35	6.49	
Fentanyl	3.95	2.33	13.40	5.54	
Normal saline	4.00	2.18	13.75	5.10	
F-value	0.0207		0.0288		
P-value	0.9795		0.9716		

The difference in distribution of samples by age and weight in three groups was not significant (P value=0.9795 and 0.9716 respectively).

**Table 7:** Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with respect to type of surgery.

Types of surgery	Dexmedetomidine	%	Fentanyl	%	Normal saline	%	Total
Circumcision	10	50.00	12	60.00	11	55.00	33
Herniotomy	8	40.00	6	30.00	8	40.00	22
Orchidopexy	2	10.00	2	10.00	1	5.00	5
Total	20	100.00	20	100.00	20	100.00	60

Chi-square=0.4820,  
 $p=0.9740$

The difference in distribution of samples by types of surgery in three groups was not significant (Chi-square=0.4820) ( $p$  value=0.9740).

**Table 8:** Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with respect to mean Anesthesia and Surgery duration by one way ANOVA.

Groups	Anesthesia duration		Surgery duration	
	Mean	SD	Mean	SD
Dexmedetomidine	56.90	8.87	31.25	8.72
Fentanyl	54.90	8.73	30.50	8.72
Normal saline	54.55	9.20	31.00	8.97
F-value	0.4027		0.0376	
P-value	0.6704		0.9631	

The difference in duration of anesthesia and surgery in three groups was not significant ( $p$  value=0.6704 and 0.9631 respectively).

\* $p < 0.05$  indicates significant at 5% level.

**Table 9:** Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with PAED scale scores at different intervals by one way ANOVA test.

Time points	Summary	Dexmedetomidine	Fentanyl	Normal saline	Total	F-value	$p$ -value
On arrival	Mean	9.60	12.35	13.80*	11.92	4.4245	0.0164*
	SD	3.98	4.86*	4.72	4.79		
15 min	Mean	8.00	9.70	10.40	9.37	4.2668	0.0188*
	SD	2.45	2.81	2.74	2.82		
30 min	Mean	3.90	4.15	4.35	4.13	0.9839	0.3801
	SD	0.79	1.09	1.14	1.02		
45 min	Mean	3.00	3.00	3.00	3.00	0.0000	1.0000
	SD	0.00	0.00	0.00	0.00		
60 min	Mean	2.20	2.45	2.60	2.42	3.5946	0.0339*
	SD	0.41	0.51	0.50	0.50		

\* $p < 0.05$  indicates significant at 5% level.

**Table 10:** Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with OP scale scores at different intervals by one way ANOVA test.

Time points	Summary	Dexmedetomidine	Fentanyl	Normal saline	Total	F-value	$p$ -value
On arrival	Mean	2.75*	4.00	4.50	3.75	5.9091	0.0047*
	SD	1.86	1.69*	1.40	1.79		
15 min	Mean	2.65*	3.75	4.15	3.52	5.5090	0.0065*
	SD	1.73	1.48	1.18	1.59		
30 min	Mean	0.15	0.35	0.45	0.32	2.2075	0.1193
	SD	0.37	0.49	0.51	0.47		
45 min	Mean	0.00	0.00	0.00	0.00	0.0000	1.0000
	SD	0.00	0.00	0.00	0.00		
60 min	Mean	0.00	0.00	0.00	0.00	0.0000	1.0000
	SD	0.00	0.00	0.00	0.00		

\* $p < 0.05$  indicates significant at 5% level.

**Table 11:** Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with mean recovery time

Groups	Mean	SD
Dexmedetomidine	57.0	10.8
Fentanyl	61.0	11.7
Normal saline	66.3	14.1
F-value	1.8561	
$p$ -value	0.1681	

Comparison Between Intravenous Fentanyl and Dexmedetomidine to Decrease Sevoflurane - Induced Agitation in Paediatric Patients Undergoing Lower Abdominal Surgery: A Prospective Randomized Observational Study

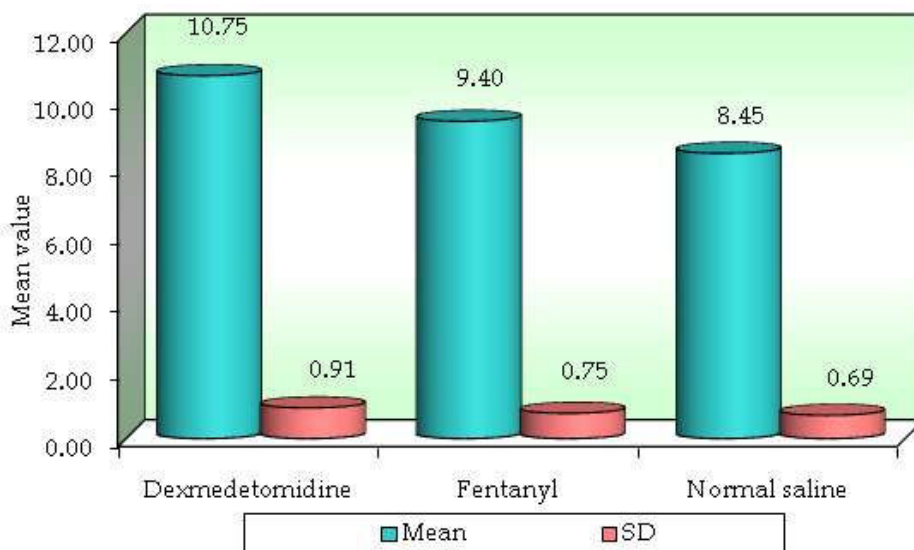


Fig. 1: Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with respect to mean emergency time.

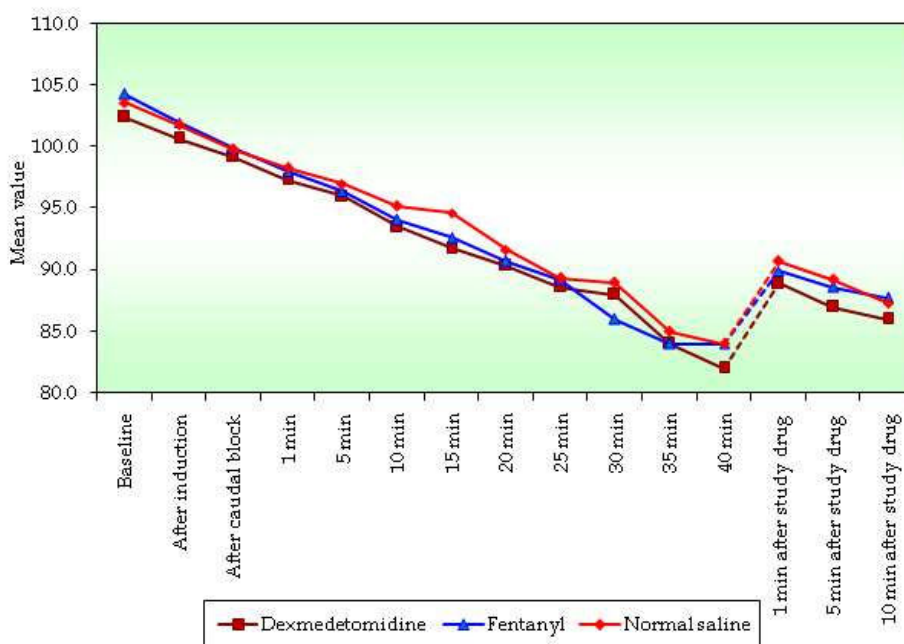


Fig. 2: Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with respect to heart rate at different intervals.

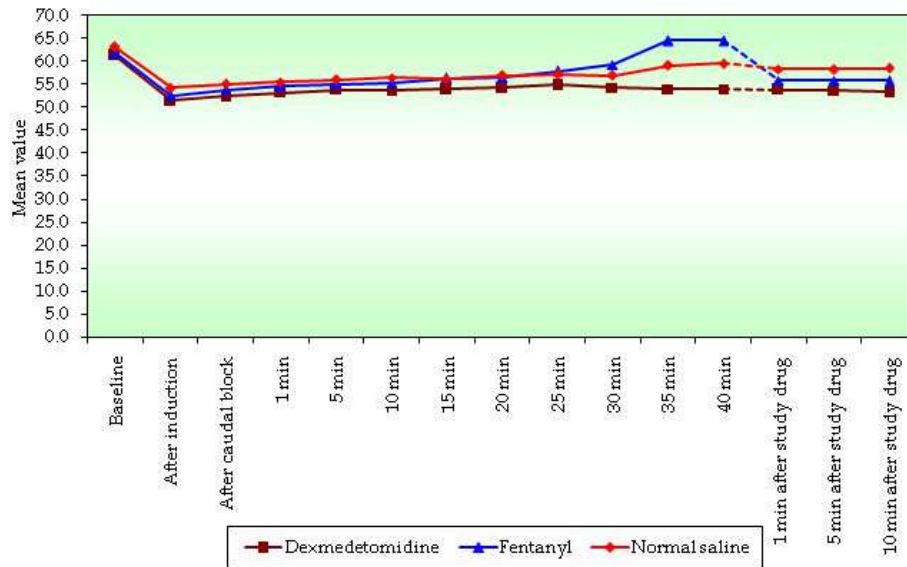


Fig. 3: Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with respect to mean arterial pressure at different intervals.

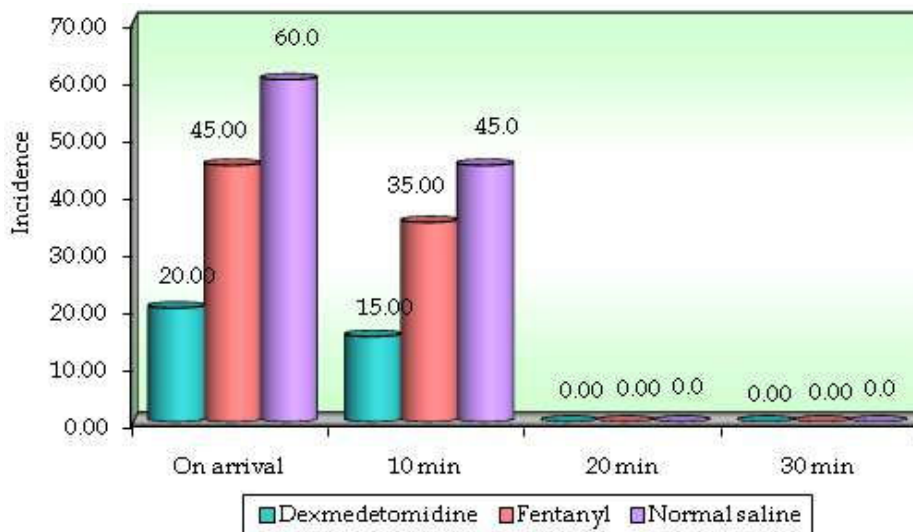


Fig. 4: Comparison of three study groups (Dexmedetomidine, Fentanyl and Normal saline) with Watcha scale at different intervals for presence of agitation.

**Discussion**

Emergence Agitation is identified as one of the significant problems in children recovering from anesthesia. It usually occurs in the first 30 minutes post operatively but may last upto two days.<sup>2</sup>

EA can be dangerous to patients, particularly to young children. Patients suffering from emergence agitation may harm themselves and dislodge the drains, catheters or intravenous cannulae which affect the result of surgery. They may inflict

a bodily injury on the nursing staff or cause a paranoiac accident, which makes the management and monitoring of patients at the post anesthesia care unit difficult. This may lead to an increased length of stay in the post anesthesia care unit, resulting in patient discomfort and increased perioperative costs.

In our study, we chose Sevoflurane as the inhalational anaesthetic agent to observe the incidence of EA. Kulka *et al.*<sup>1</sup> stated that Sevoflurane is associated with higher incidence of emergence



agitation in upto 80% in children. Singh *et al.*<sup>5</sup> found a higher incidence of emergence agitation associated with Sevoflurane (40%) than with Desflurane (26%) and Isoflurane (18%) in children. Two unique intrinsic characteristics of Sevoflurane were speculated by Holzki *et al.*<sup>5</sup> that might account for the development of emergence agitation.

First, this anaesthetic agent exerts an irritating side effect on the central nervous system. Second, epileptiform activity has been reported during the use of Sevoflurane anesthesia. Agitation may be related to the similar CNS effects of these anesthetics, which may affect brain activity by interfering with the balance between neuronal synaptic inhibition and excitation in the CNS.

Davis *et al.*<sup>6</sup> suggested that inadequate pain relief may be the cause of agitation, particularly after short surgical procedures for which peak effects of analgesics may be delayed until the child is completely awake. Postoperative pain has been the next probable factor when assessing a child's behaviour upon emergence because of the overlapping clinical picture with emergence agitation. The children in all the three groups in our study were given Caudal block with 1.0 ml/kg of 0.25% bupivacaine after PLMA insertion and before the start of surgery to exclude pain as the confounding factor.

Intense preoperative anxiety, both in children and their parents has also been associated with an increased likelihood of restless recovery and agitation from anesthesia. The children in all the three groups in our study were premedicated with midazolam 0.5 mg/kg orally half an hour before surgery. Kain *et al.*<sup>7</sup> determined the relationship between preoperative anxiety, ED, and postoperative maladaptive behaviours. He found a higher incidence in children who were not premedicated and underwent surgery and general anesthesia using Sevoflurane.

However, the aetiology of Sevoflurane induced EA is still unknown and a clear-cut strategy for its prevention has not been developed.

The decision of whether to treat emergence agitation with additional pharmacological medication depends upon the severity and duration of symptoms.

Various pharmacological agents are used to combat sevoflurane induced agitation in Paediatric age group. Use of opioids like Fentanyl, which serve as sedatives and analgesics have been tried and used widely for control of agitation.<sup>8,9,10</sup> Use of analgesics like Ketorolac, paracetamol have

been used to decrease emergence agitation.<sup>11</sup> Use of alpha 2 adrenoreceptor agonists like Clonidine and Dexmedetomidine have been recommended to eliminate pain as a potential source of agitation.<sup>12,13</sup> Use of benzodiazepines like Midazolam, owing to their sedative property have been suggested to calm the post operative agitation.<sup>14</sup>

Among them opioids like Fentanyl and alpha 2 adrenoreceptor agonist like Dexmedetomidine have sedative and analgesic effects and both are known to reduce emergence agitation. Thus we selected these two drugs in our study.

Matin *et al.*<sup>15</sup> suggested that Fentanyl premedicated children experienced less anxiety and strain during surgery and had better recovery. Manaa *et al.*<sup>9</sup> and Cravero *et al.*<sup>8</sup> in their studies observed a significant reduction in emergence agitation in children receiving Fentanyl. In our study, we chose Inj. Fentanyl in the dose of 1 mic/kg i.v. which was in consensus with the dose chosen by Manaa *et al.*<sup>9</sup>, Cravero *et al.*<sup>8</sup>.

Because of its sedative and analgesic effects,  $\alpha_2$  adrenoreceptor agonists like Clonidine and Dexmedetomidine have been used safely and effectively for the management of Sevoflurane agitation in paediatric patients. Cravero *et al.*<sup>8</sup> and Kulka *et al.*<sup>1</sup> found a reduction of agitation with Clonidine 2 mcg/kg i.v. in children undergoing surgery under Sevoflurane anesthesia. Dexmedetomidine a recent addition to the  $\alpha_2$  adrenoreceptor agonist group has also been studied extensively in the reduction of emergence agitation.

Dexmedetomidine owing to its sedative and analgesic action, no respiratory depression, better haemodynamic stability, minimal or no significant adverse effect profile has lead to its use in paediatric anesthesia. It can be used as a premedication, sedative for invasive procedures, shivering and reduction of emergence agitation.

Isik *et al.*<sup>16</sup> and Guler *et al.*<sup>17</sup> observed that Dexmedetomidine 0.5 mic/kg or 1 mic/kg reduced post Sevoflurane agitation significantly but it also prolonged to early phase of post anesthesia recovery.

Backache *et al.*<sup>13</sup> used Dexmedetomidine i.v. after induction of anesthesia in the dose of 0.15 mic/kg and 0.3 mic/kg. He observed that incidence of postoperative agitation was 37% in the control group, 17% in children receiving 0.15 mic/kg and 10% in children receiving 0.3 mic/kg. In our study, we used Inj. Dexmedetomidine 0.3 mic/kg i.v.; this was in accordance with the dose chosen by Manaa *et al.*<sup>9</sup>, Masami *et al.*<sup>12</sup>.

We have given the study drug 10 minutes before the end of anesthesia, our study was in consensus with the study conducted by Manaa *et al.*<sup>9</sup>.

Thus, we decided to conduct our study with Dexmedetomidine 0.3 mcg/kg and comparing it with Fentanyl 1 mcg/kg on reduction of emergence agitation after Sevoflurane anesthesia in children aged 2-9 years of ASA physical status I or II undergoing elective lower abdominal surgery.

Post operative scales used for agitation scoring and pain scoring were the Watcha scale<sup>18,19</sup> and The Paediatric Anesthesia Emergence Delirium (PAED) Scale<sup>20</sup>. The PAED scale is validated but is difficult to use in the routine clinical practice. It is better to use a simple scale like watcha scale to detect delirium and then use the PAED scale to measure its degree<sup>21</sup>.

Agitation due to pain is a significant confounding factor for the evaluation of the presence or measurement of the degree of ED.

The patient can be agitated even if they have pain, hence we used objective pain scale, so that we can differentiate if the patient was agitated due to pain or due to general anesthesia with sevoflurane. The total score in objective pain scale is 10, But since the patient in our study was in the age group of 2 to 9 years, not all the patient were able to complaint of pain. Hence, that parameter was removed from the objective pain scale for all the patients and then the maximum score had become 8. Among other parameters like systolic blood pressure, crying, movements and agitation except for systolic blood pressure other parameters were overlapping to an extent with the parameters used in the PAED scale. Hence in our study we observed that the groups which were having higher degree of agitation according to PAED scale also had a higher objective pain scale score.

In our study we observed that the patients in the Group N showed higher scores of agitation in comparison to Group F, and Group F showed higher scores of agitation in comparison to Group D.

The difference between Group D and Group F was significant, suggesting that Dexmedetomidine is more effective in reduction of the emergence agitation after Sevoflurane anesthesia compared to Fentanyl.

We also observed that the agitation scores were higher in the first ten minutes post operatively and by the end of 30 minutes, patients in all the three groups were comparable with regard to agitation scorings. This was in consensus with the observation made by Vljakovic *et al.*<sup>14</sup>.

Erdil *et al.*<sup>10</sup> observed that Dexmedetomidine proved to be better than Fentanyl in reducing the agitation; however the difference was not significant.

In contrast to Manaa *et al.*<sup>9</sup> who proved that Fentanyl was slightly better than Dexmedetomidine. In our study 60% of the children in Group N showed presence of agitation as against 45% in Group F and 20% in Group D on arrival in post anesthesia care unit.

Aldrete Recovery Score was used to assess recovery of patient in PACU and those patients who attained an aldrete recovery score of  $\geq 9$  were discharged from the PACU to the ward and the time taken to achieve this score was noted<sup>22</sup>.

None of the patients showed any adverse effects or intraoperative event of significance or post operative complications like nausea/vomiting, hypotension, bradycardia, hypoxemia, hypoventilation, apnoea, and respiratory depression.

## Conclusion

The dose of fentanyl 1 mcg/kg i.v. or dexmedetomidine 0.3 mcg/kg i.v. that is administered 10 minutes before the discontinuation of anesthesia reduced the postoperative agitation in children.

Dexmedetomidine was more effective when compared with fentanyl in attenuation of sevoflurane-induced agitation in paediatric patients undergoing lower abdominal surgery.

## References

1. Emergence agitation in paediatric patients. Masui 2007 May;56(5):554-9.
2. Masoumeh BS, Fatemeh F. Postanesthetic Emergence Agitation in Pediatric Patients under General Anesthesia. Iran J Pediatr. 2014 Apr;24(2):184-190.
3. Singh R, Kharbanda M, *et al.* Comparative evaluation of incidence of emergence agitation and postoperative recovery profile in paediatric patients after isoflurane, sevoflurane and desflurane anesthesia. Indian J Anaesth. 2012;56(2):156-161
4. Shi F, Xiao Y *et al.* Effects of Fentanyl on Emergence Agitation in Children under Sevoflurane Anesthesia: Meta-Analysis of Randomized Controlled Trials. PLoS One. 2015 Aug 14;10(8).
5. Holzki J and Kretz FJ. Changing aspects of sevoflurane in paediatric anesthesia: 1975-99. Pediatr Anesth. 1999;9:283-86.

6. Davis PJ, Greenberg JA, Gendelman M, Recovery characteristics of sevoflurane and halothane in preschool-aged children undergoing bilateral myringotomy and pressure equalization tube insertion. *Anesth Analg.* 1999;88:34-8.
7. Kain Z, Caldwell-Andrews AA, Weinberg ME, *et al.* Sevoflurane versus Halothane: postoperative maladaptive behavioral changes. *Anesthesiology.* 2005;102:720-26.
8. Cravero JP, Beach M, Thyr B, *et al.* The effect of small dose fentanyl on the emergence characteristics of paediatric patients after sevoflurane anesthesia without surgery. *Anesth Analg.* 2003;97:364-7.
9. Manaa EM, Abdelhaleem AA, Mohamed EA. Fentanyl versus dexmedetomidine effect on agitation after sevoflurane anesthesia. *Saudi J Anaesth.* 2007;1:57-61.
10. Erdil F, Demirbilek S, Begec Z *et al.* The effects of Dexmedetomidine and Fentanyl on emergence characteristics after adenoidectomy in children. *Anaesth Intensive Care.* 2009 Jul;37(4):571-6.
11. Johannesson GP, Floren M, Lindahl SG. Sevoflurane for ENT - surgery in children : a comparison with halothane. *Acta Anaesthesiol Scand.* 1995;39:546-50.
12. Masami S, Gotaro S, Misako T *et al.* Effect of single-dose Dexmedetomidine on emergence agitation and recovery profiles after Sevoflurane anesthesia in pediatric ambulatory surgery. *Japanese journal of anesthesia.* 2010;26:675-682.
13. Ibacache ME, Muñoz HR, Brandes V. Single does Dexmedetomidine reduces agitation after Sevoflurane anesthesia in children. *Anesth Analg* 2004;98:60-3.
14. Vljakovic GP, Sindjelic RP. Emergence Delirium in Children: Many Questions, Few Answers. *Anesth Analg.* 2007 Jan;104(1):84-91.
15. Matin, Abdul M, *et al.* Fentanyl as a premedication for anesthesia in paediatric surgery. *Journal of Chittagong Medical College Teachers' Association.* 2008;19(1):23-27.
16. Isik B, Arslan M, Tunga AD, *et al.* Dexmedetomidine decreases emergence agitation in pediatric patients after Sevoflurane anesthesia without surgery. *Pediatr Anesth.* 2006;16:748-53.
17. Guler G, Akin A, Tosun Z, *et al.* Single dose Dexmedetomidine reduces agitation and provides smooth extubation after pediatric adenotonsillectomy. *Pediatr Anesth.* 2005;15:762-66.
18. Kim NY, Kim SY, Yoon HJ, *et al.* Effect of Dexmedetomidine on Sevoflurane Requirments and Emergence Agitation in Children Undergoing Ambulatory Surgery. *Yonsei Med J.* 2014;55(1): 209-15.
19. Watcha MF, Ramirez-Ruiz M, White PF, *et al.* Perioperative effects of oral ketorolac and acetaminophen in children undergoing bilateral myringotomy. *Can J Anaesth.* 1992;39:649-54.
20. Bajwa SA, Costi D, Cyna AM. A comparison of emergence delirium scales following general anesthesia in children. *Pediatr Anaesth.* 2010;20: 704-11.
21. Pieters BJ, Penn E, Nicklaus P. *et al.* Emergence delirium and postoperative pain in children undergoing adenotonsillectomy: a comparison of propofol vs sevoflurane anesthesia. *Paediatr Anaesth.* 2010;20:944-50.
22. Aldrete JA, Kroulik D. A post-anesthetic recovery score. *Anesth Analg.* 1970;49:924-34.

