

## RECOVERY STATUS IN CHILDREN AFTER GENERAL ANAESTHESIA : ROLE OF PRE-EMPTIVE LOCAL ANAESTHETIC INFILTRATION

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### SUMMARY:

*This prospective clinical study was carried out in the dept. of Anaesthesia, Analgesia and Intensive Care Medicine, BSMMU, Dhaka during the period of January 06 to September 06. The study was done to emphasize the importance of giving analgesics preemptively instead of waiting for the children to complain or express their pain and to improve post operative recovery status and associated response by reducing the immediate post operative pain with simple local anaesthetic infiltration. The children scheduled for elective herniotomy operation through a hernial incision under general anaesthesia were recruited in this study. Immediate recovery status in children was compared with preemptive (group-1) and without preemptive (group-II) local infiltration of 0.25% bupivacaine in herniotomy operation. No. of patients was 20 in each group pulse, systolic, diastolic and mean pressure, oxygen saturation, pain [scored by Toddler Preschooler Postoperative Pain Scale (TPPPS)], anaesthetic recovery (scored by Steward recovery system) and mental status of the children were observed postoperatively at different time interval up to one hour.*

*Pulse, systolic, diastolic, mean pressure were stable in group-I than in group-II. Oxygen saturation in both the groups were in clinically acceptable range but in group-II, 5 mins after extubation there was fall more than that of group-I which was statistically significant. Pain score (TPPPS) in group-I was lower all the time period but in group-II the score was high; all the children required rescue pethidine within 10 mins after extubation, mean dose required, in group-II was 23.6+3.6mg. Steward recovery score in both groups were not significant at early period but after 10 mins, p value became significant. The mental state of group-I was calm & quite ; only 3 were excited, on the other hand in group-II all children were excited & irritable and required rescue pethidine. So preemptive local infiltration of 0.25 % bupivacaine improved the recovery status in children by reducing the immediate postoperative pain and thereby decrease in postoperative morbidity.*

**Keywords : Pre-emptive analgesia, Local Infiltration, Recovery Status**

### Introduction

Recovery constitutes the transition state from general anaesthesia to the baseline state.<sup>1</sup> The definition of recovery is difficult because some drowsiness may persist for many hours. The period of recovery is the end of surgery to when the patient is alert and physiologically stable.

Pain is the major cause of distress during the emergence and immediate postoperative period; this is also true for infants & young children, even premature infants at 28 weeks of gestation show marked endocrine responses (epinephrine, nor epinephrine, glucagons, lactate and pyruvate) to surgically induced stress.<sup>2</sup>

The goal of preemptive analgesia is to prevent the establishment of central sensitization, which amplifies postoperative pain; post injury analgesia usually has a reduced effect because central sensitization already has been established.<sup>3</sup>

The physiological basis of preemptive analgesia is complex and involves modification of pain pathways.

There are many methods for suppression of pain pathways eg. central neural block, local infiltration, NSAIDs, opioid etc for management of postoperative pain<sup>4</sup> but the local anaesthetics are most potent in relieving pain and which have also different mode of administration.<sup>5</sup>

Analgesic effect after topical application of local anaesthetics are due to both local effect caused by nerve block at incision site and systemic effect due to absorption at raw surface and followed by central modulation mechanism.<sup>6</sup>

There are several scoring systems used to quantify recovery from Anaesthesia.<sup>1</sup> The most useful are Aldrete recovery score and Steward recovery score. The Aldrete scale is oriented toward adults; Steward developed a more suitable scale for children.<sup>1</sup> The Steward Recovery scale scores airways, consciousness, and movement from 0-2 points, maximum points is-6.

This study was performed to see the immediate recovery profile in paediatric patients after preemptive wound infiltration with 0.25% Bupivacaine.

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## Materials and methods

This randomised, prospective clinical study was carried out in the Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangabandhu Sheikh Mujib Medical University Hospital, Dhaka during the period of January 06 to September 06.

Children aged between 3 and 5 years with ASA grade 1 & II and scheduled for herniotomy under general anaesthesia were recruited in this study. The children who were having Physical or mental retardation, hormonal balance, any other congenital abnormality other than congenital inguinal hernia, drug allergy, and hepatic/ cardiac/ haemorrhagic diathers were excluded from the study.

After recruitment, the children were randomly divided into two groups, 20 in each by card sampling. Group-I - received Infiltration 0.25% bupivacaine (2 mg/kg) around the incision site and Group- II – received Infiltration with distilled water of same volume at around the incision site.

All children were examined preoperatively and baseline (pulse, blood pressure, oxygen saturation) were recorded. Measuring tools for pulse, blood pressure and oxygen saturation were Multi Parameter Monitor. All children were given general anaesthesia. After pre-oxygenation for 2-3 min. with 100% oxygen, induction of anaesthesia was done with thiopentone sodium 3 mg/kg -1 IV and tracheal intubation was done after giving atracurium besylate 0.5 mg/kg IV. Maintenance of anaesthesia was with N<sub>2</sub>O 70%, O<sub>2</sub> 30% and halothane 0.5 % with long acting muscle relaxant atracurium besylate and IV opioid analgesic: Pethidine 0.70 mg-1kg. Local infiltration with inj. 0.25% bupivacaine (2 mg/kg) was given in group-I & distilled water of same volume was given in group-2 around the incision site 5 min. before incision.

Peroperative parameters (pulse, BP, O<sub>2</sub> saturation etc.) were recorded accordingly. Peroperative fluid balance was done by 0.45 % NaCl with 5 % dextrose solutions at a rate of 4 ml-1kg-1hr. Residual effect of neuromuscular blocking drug was antagonised by Inj. neostigmine 50 µg/kg with atropine 20 µg-1kg and then tracheal extubation was accomplished.

In the postoperative period heart rate, blood pressure, Oxygen saturation, mental status( excitable or calm, quite), Steward recovery score, pain score (TPPPS), requirement of rescue pethidine, any complication like nausea, vomiting etc were recorded in prescribed data sheet. In the postoperative period patients were monitored at least one hour. Inj pethidine (1.50 mg/kg) was given to the patients who had TPPPS >3.

## Results

### Baseline characteristics of the patients:

Table 1 describes the baseline characteristics of the patients participated in the study. The table shows that all the demographic variables like age and sex as well other parameters of interest were identical in both the groups.

Characteristics	Group		P-value
	Gr-1 (n = 20)	Gr-2 (n = 20)	
Age (months)	49.60±7.88	50.40±8.00	0.752*
Sex (Male/Female)	14/6	14/6	0.634
Weight (Kg)	15.55±2.45	15.72±2.40	0.826
Preoperative Pulse/m	93.70±7.69	92.30±7.87	0.573
Preoperative Systolic BP	91.75±7.00	91.15±8.92	0.814
Preoperative Diastolic BP	56.00±4.58	56.15±5.77	0.928
Preoperative mean pressure	67.92±5.13	67.82±6.64	0.958
Preoperative Saturation (%)	100.15±2.37	99.75±.44	0.462

Data are expressed as **mean ± SD** or is frequency as applicable. Sex is expressed as **male-female ratio**.

\* ANOVA statistics was used to analyse the data and level of significance was 0.05. Any p-value <0.05 was considered as significant

Monitoring of *pulse* at different time intervals in postoperative ward:

Figure-1 depicts the changes in pulse at different time intervals (immediately, 5, 10, 20, 40 and 60 minutes after extubation) during recovery stage from GA in postoperative ward. The table shows that pulse rates of the Group-1 were comparatively uniform throughout the 1<sup>st</sup> 1 one hour period while the pulse rates of the group-2 were somewhat higher than the former group for the 1<sup>st</sup> 20 minutes).

### Monitoring of *systolic BP* at different time intervals:

Fig. 2, 3 and 4 depict the levels of systolic diastolic and mean BPs at different time intervals (immediately, 5, 10, 20, 40 and 60 minutes after extubation) during recovery stage from GA in postoperative ward. From the table it is seen that systolic diastolic and mean BPs of the Group-I were with in normal ranges throughout the 1<sup>st</sup> 60 minutes, while the BPs of the group group-2 were somewhat higher

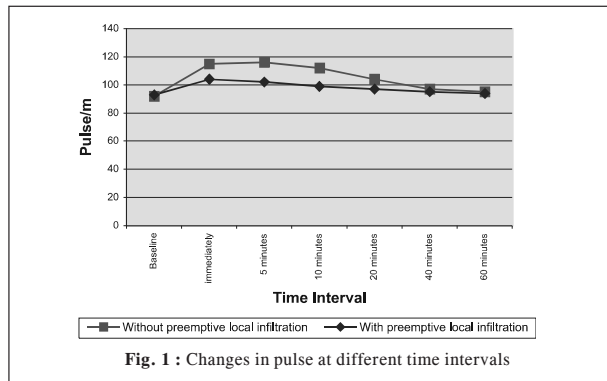


Fig. 1 : Changes in pulse at different time intervals

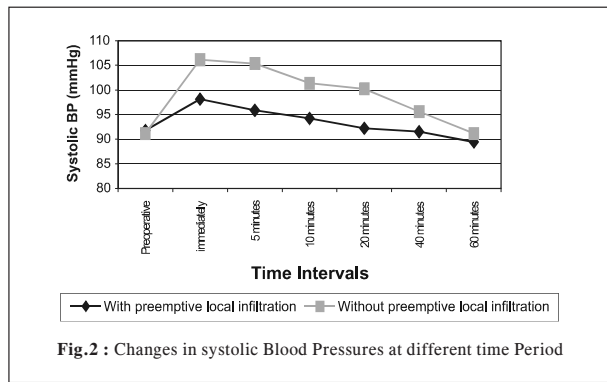


Fig. 2 : Changes in systolic Blood Pressures at different time Period

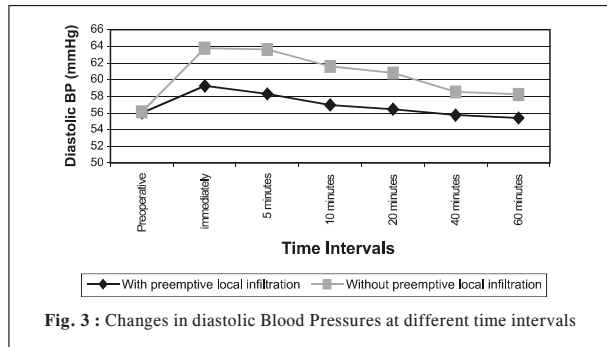


Fig. 3 : Changes in diastolic Blood Pressures at different time intervals

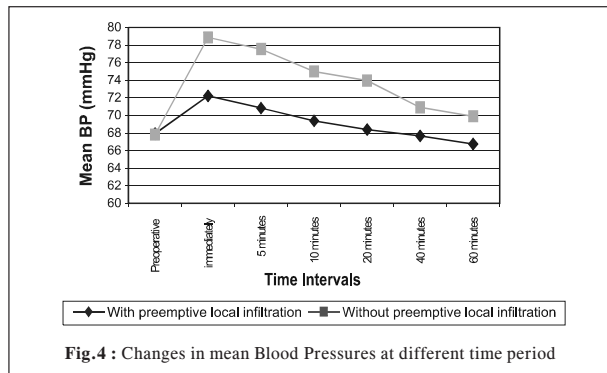


Fig. 4 : Changes in mean Blood Pressures at different time period

than the former group for the 1<sup>st</sup> 20 minutes. However the BPs came down to normal levels at 40 minutes interval following rescue analgesic administration (p-values are <0.05, <0.05, <0.05, <0.05, >0.05 and >0.05 respectively).

**Monitoring of oxygen saturation at different time intervals**

Fig. 5 explains the changes in oxygen saturation of the patients at different time intervals (immediately, 5, 10, 20, 40 and 60 minutes after extubation) while recovering from GA. The table shows that there was no difference in the two groups with respect to oxygen saturation at any of the above intervals, except at 5 minutes, during the 1<sup>st</sup> one-hour period (p>0.05). The mean oxygen saturation at 5 minutes interval in Group-1 was (100 ± 0.31)%, where as in Group-II was (99 ± 0.79)% and the difference between the two groups was found to be statistically significant (p<0.001).

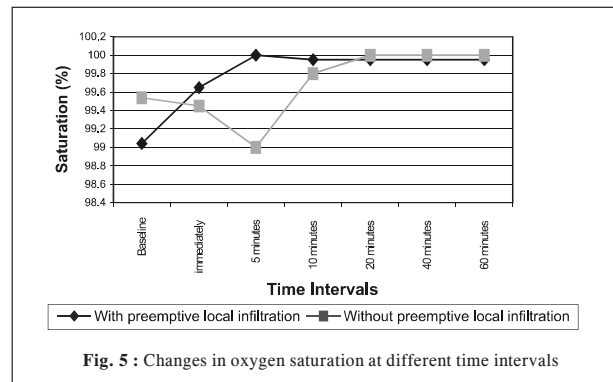


Fig. 5 : Changes in oxygen saturation at different time intervals

**Monitoring of Steward recovery score at different time intervals:**

Table 2 explains the Steward recovery score of the patients at different time intervals (immediately, 5, 10, 20, 40 and 60 minutes after extubation) while getting recovered from GA. The table shows that Steward recovery scores immediately and at 5 minutes after extubation for both the groups were exactly equal (so significance level was undefined). But the two groups were significantly different at 10, 20, 40 and 60 minutes intervals with respect to the same variables. (p-values <0.05, <0.05, <0.05, <0.05, respectively).

**Changes in TPPPS at different time intervals:**

Figure-6 shows the changes in TPPPS at different time intervals during recovery from GA. The TPPPS was always found to be staggeringly higher in Group-II compared to Group-1 (p<0.001), except at interval of 60 minutes.

**Mental state at different time intervals**

Fig. 7 shows the mental state of the patients of II groups at different intervals after extubation. From the figure it is seen that out of 20 patients in Group-1, only 3 were excitable immediately after extubation, but none was excitable thereafter. Whereas in the Group-II - 17, 20, 16 and 3 patients were excitable at immediately, 5 minutes, 10 minutes and 20 minutes after extubation respectively. However at 40 minutes interval all the patients of the latter group became calm and quite as rescue analgesic (pethidine) was administered. The difference between the 2 groups in respect of mental state after extubation was found to be significant ( $p < 0.05$ ).

	Group		P-values
	Gr-1	Gr-2	
<b>Steward recovery score</b>	<b>(n = 20)</b>	<b>(n = 20)</b>	
Immediately <sup>#</sup> after extubation	6.00 ± 0.0	6.00 ± 0.0	Undefined*
5 minutes after extubation	6.00 ± 0.0	6.00 ± 0.0	Undefined
10 minutes after extubation	6.00 ± 0.0	5.80 ± 0.41	0.036**
20 minutes after extubation	6.00 ± 0.0	5.85 ± 0.37	0.075
40 minutes after extubation	6.00 ± 0.0	5.80 ± 0.41	0.036
Steward score 60 minutes after extubation	6.00 ± 0.0	5.95 ± 0.22	0.324

# All the variables are expressed as mean ± SD as ANOVA statistics was used to analyse the data.

\*\* Level of significance was 0.05. Any p-value < 0.05 was considered as significant

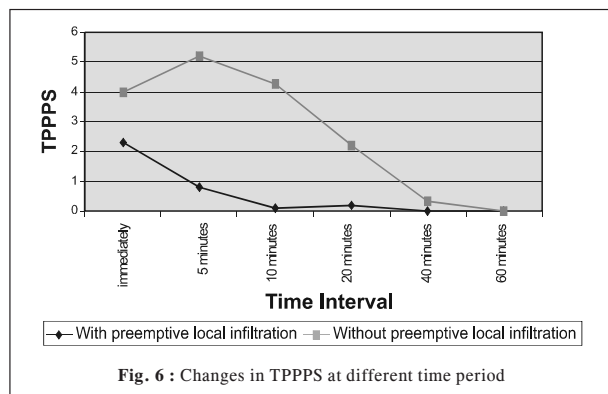


Fig. 6 : Changes in TPPPS at different time period

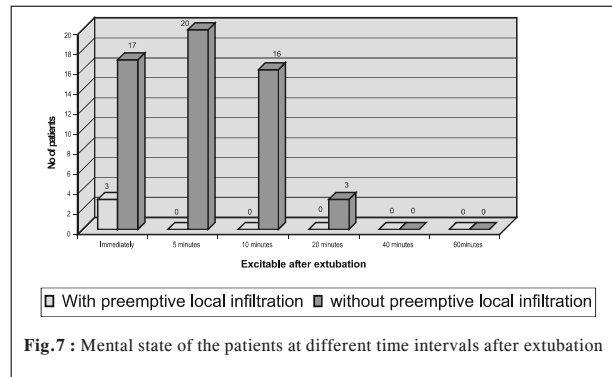


Fig. 7 : Mental state of the patients at different time intervals after extubation

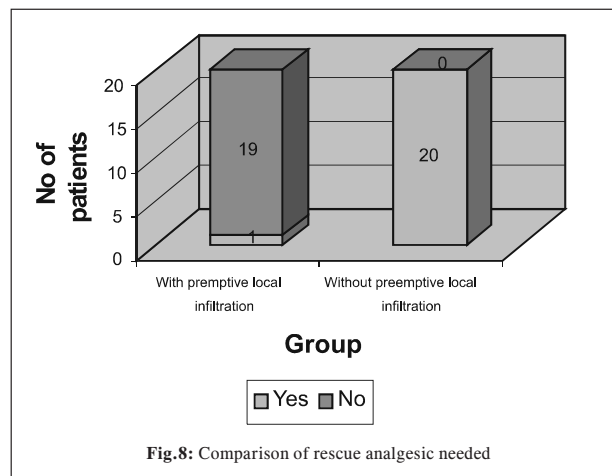


Fig.8: Comparison of rescue analgesic needed

**Rescue analgesic (pethidine):**

Fig. 8 describes the rescue analgesic (pethidine) needed by the patients of the two groups. All 20 cases in Group-II needed rescue analgesic whereas only 1 needed the same in Group-I. The difference between the two groups was statistically significant ( $p < 0.005$ ).

The mean dose of pethidine needed in Gr-II to bring the patients to calm and quite condition was  $23.6 \pm 3.6$  mg, the minimum and maximum doses being 18mg and 30mg respectively. The dose of pethidine needed by the patients in Gr-I was 24 mg.

**Incidence of complications**

Table 3 shows the incidence of complications between the 2 groups. A total of 10 patients developed complications like nausea and vomiting. Of them 7 (35%) developed in the Group-2 and the rest 3 (15%) developed in the Group-1. The association between the group and complications was statistically significant ( $p = 0.001$ ).

Table - 3 : Type of complications			
Complications	Group		Total
	Gr - 1	Gr - 2	
Nausea	02 (33.3%)	04 (66.7%)	06
Vomiting	01 (25.0%)	03 (75.0%)	04
Total	03 (30.0%)	07 (70.0%)	10

Table 3 also shows the type of complications in the two groups. Of the total 10 complications 6 (4 in Gr-1 and 2 in Gr-II) were nausea and 4 (3 in Gr-1 & 2 in Gr-2) were vomiting.

### Discussion

There are many factors that make the child unstable during the recovery stages. Amongst them the most important is surgical pain. Due to this pain the associated surgical or trauma there is increased sympathetic activity, hormonal changes (elevation of serum catecholamine, glucocorticoid, glucagon, growth hormone concentration<sup>1</sup>) that elevate the blood pressure, metabolic changes, making the patient restless, disoriented ultimately unstable and finally the recovery status of the child, is disturbed

Pain is the major cause of distress during the emergence and immediate postoperative periods.<sup>2</sup> Doxon and others, 1984 proved that pain causes prolonged disruption of behavioral development.<sup>7</sup> Patient outcome become worse if pain is not adequately treated.<sup>8</sup>

Preemptive analgesia is an antinociceptive treatment that prevents establishment of altered central processing of afferent input from sites of injury.<sup>9</sup> The most important condition for establishment of an effective preemptive analgesia is the establishment of an effective level of antinociception before injury and the continuation of this effective analgesic level well into the post injury period to prevent central sensitization during the inflammatory phase. The concept of preemptive analgesia was formulated by Crile at the beginning of previous century on the basis of clinical observation.<sup>10</sup> Later revival of this idea was associated with a series of animal studies started by Wolf.<sup>11,12</sup>

There are lot of studies using preemptive analgesia with different drugs alone or in combination and thus reducing the postoperative pain and improved the postoperative recovery status.

In our study we randomly selected the patients in two groups. Preemptive local infiltration was given in

group—I & preemptive local infiltration of distilled water of same volume was given in group—II before surgical incision. Then we observed & compared the immediate recovery status within one hour, specially the pain, mental status, cardiovascular variables (Pulse, Blood pressure), oxygen saturation, requirements of analgesics and other vital functions etc. It was observed that the group—I had improved recovery status after general anaesthesia.

Badner and colleagues demonstrated that administration of 0.5% bupivacaine in knee surgeries resulted in reduced morphine requirements.<sup>13</sup> Preemptive blockade of peripheral nerves with local anesthetics can have a beneficial effect on pain after hernia repair, outlasting the duration of the nerve block even when the repair is performed under spinal anesthesia.<sup>14</sup> Eriksson –Mjoberg-M and his colleagues also have shown significantly reduced morphine consumption in preincisional subcutaneous infiltration with 0.25% bupivacain than in placebo infiltration.<sup>15</sup> As against these positive outcomes of preincisional infiltration with bupivacaine, Bourget JL and his colleagues have shown no difference between preincisional and postincisional infiltration with 0.25% bupivacaine in relation to pain score or morphine consumption.<sup>16</sup> Cobby-TF also has shown no difference in pain score or in morphine consumption with bupivacaine infiltration between study and control group after abdominal hysterectomy.<sup>17</sup>

In non- surgical cases, topical opioid administration has been used successfully by Krajnik and his colleagues with rapid relief of pain and analgesia lasteing for 7-8 hours.<sup>18</sup> Wound irrigation with dexamethasone acetate<sup>19</sup> and with triamcinolone<sup>20</sup> after lumbar surgery reduces pain score and 24 hours morphine consumption significantly.

Analgesic effects of topical local anaesthetics are due to nerve blocks and anti inflammatory effects at incisional areas and systemic effect due to absorption from raw surfaces and then by central modulatory mechanisms in the dorsal horn by activation of the endogenous opioid system.<sup>21</sup>

In our study it was shown that cardiovascular parameters (pulse, systolic, diastolic and mean pressure) were higher in group-II compared to group-I. Significant result was found before 40 minutes after extubation. After 40 minutes p-values became insignificant, due to control of pain in group II by administration of IM pethidine. It is well established that in response to pain there is increased concentration of serum catecholamine (sympathetic activity) and other stress hormones like glucocorticosteroid, glucagons, growth hormone,<sup>1</sup> which ultimately causes increased blood pressure (systolic, diastolic, and mean) and pulse. Hypertention, tachycardia and other pain-related

behaviors are almost always due to pain and the treatment is administration of analgesic agents.<sup>1</sup>

Oxygen saturation difference between the groups in our study was found to be insignificant at all time interval except at 5 minute where the p-value was significant. Although the O<sub>2</sub> saturation in both the groups at all time intervals were maintained with in clinically acceptable range but at 5 minute interval in group-II, O<sub>2</sub> saturation fell more in comparison with group-I (p < 0.001).

There are several scoring systems used to quantify recovery from anaesthesia, the most useful are Aldrete recovery score and Steward recovery score.<sup>1</sup> The Aldrete recovery score is oriented towards adult, Steward developed a more suitable scale for children.<sup>22</sup> In the group-I as patients were awake at all the time period, so that higher score was found, where as in group-II after giving rescue pethidine the score gradually became less. In this study at immediately and 5 minutes after extubation p-values were undefined but there after the values became significant.

Clare McCarthy and his colleagues investigated & found TPPPS to be suitable for the assessment of pain in children.<sup>23</sup> TPPPS (Toddler Preschooler Postoperative pain scale) is an observation scale and is suitable for children because the parameter does not depend on the patient comment. Preschool children usually like to use the verbal and cognitive skills to describe their feeling of pain or physical discomfort.<sup>24</sup> At different time intervals TPPPS is highly significant. In group-II initially the score was higher but gradually became lower due to rescue pethidine, but in group-I there was least pain and the TPPPS was lower in comparison with group-II. There are many studies which proved that the preemptive local infiltration reduces the postoperative pain score & less analgesic requirement, Huang-SJ and his colleagues have shown significantly less pain score at rest and with cough in lower abdominal operations in female; in their study, 0.125 % bupivacaine was used for infiltration before incision. Morphine consumption was also less in study group from 6<sup>th</sup> hour to 24<sup>th</sup> than in control group.<sup>25</sup>

Pain at awakening is the major cause of postoperative agitation and excitement; adequate analgesia minimizes the incidence of excitement in the recovery period.<sup>2</sup> In our study, these parameters were compared between the two groups at different time periods and it was found to be significant. In group-I only 1 patient was excited at immediately after extubation but in group-II all patients were excited & agitated at different time periods, which gradually reduced after giving pethidine.

Rescue pethidine was given IM when patients showed higher TPPPS (> 3), excited and or pain related response.

In group-II all the patients needed rescue pethidine within 10 minutes after extubation, 5 patients(25%) at immediately, 10 patients (50%) at 5 minutes and no.5 patients(25%) at 10 minutes after extubation but in group-I most (19) of the patient needed no rescue pethidine, only one patient needed pethidine at immediately after extubation. The difference between the two groups is statistically significant. The mean dose of pethidine needed to bring the patients to calm & quitestate in group-II was 23.6 ± 3.6 mg, whereas in group-I all patients were calm & quitestate without any rescue pethidine except one case. Total duration of analgesic effect of bupivacaine is generally long and Karsten Hannibal & his colleagues documented with 0.25% bupivacaine infiltration with late request of analgesic at 345 minutes (5.65 hrs) after incision.<sup>26</sup> Another study of Meena N Cherian et al colleagues has shown the request for first dose of analgesic at 807.7 minute (13.45 hrs) after operation with 0.375% bupivacaine infiltration.<sup>27</sup>

Preemptive local and regional anaesthesia leads to smoother emergence; the incidence of nausea and vomiting is decreased, since narcotics are avoided.<sup>28</sup> In our study nausea and vomiting was seen in both the groups, but higher incidence (> double) 35% was found in group-II (Nausea-4, vomiting-3) where as in group-I the incidence was 15% (nausea-2, vomiting-1), which is statistically significant. Nausea and vomiting is a relatively frequent & unpleasant complication of anaesthesia in children at recovery room.<sup>2</sup> In this study group-I developed less complications (15%) as compared with group-II (35%). In our study except nausea & vomiting there was no other complication in both the groups.

## Conclusion

It is concluded that preemptive local infiltration with 0.25% bupivacaine in children produces no or insignificant pain and pain related responses. There is no or less requirement of analgesics, improved comfort ness of the patients and also reduced incidence of postoperative complications. Thus preemptive local infiltration reduces immediate postoperative morbidity which is turn improved immediate recovery status of the children.

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