Original Research Article

A comparative study of efficacy of different doses of fentanyl in the prevention of incision related tachycardia in children

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Abstract

Background: Pain is a subjective sensation and assessment of pain during general anaesthesia is a difficult preposition. It can only be assessed indirectly by noting the features of a stress response like tachycardia and hypertension after a surgical stimulus. Skin is a very painful structure and skin incision is invariably associated with tachycardia. **Objectives:** We tried to determine the optimal dose of fentanyl that can provide adequate analgesia in paediatric patient. We have studied efficacy of two doses of Fentanyl, 1 and 2 mcg/Kg body weight on prevention of incision related tachycardia in children undergoing lower abdominal surgeries. **Materials and Methods:** Children of age group 1-5 years were randomly allocated into two groups, Group A and B. children in Group A received 1 mcg/kg of Fentanyl and those in Group B received 2 mcg/kg of Fentanyl. After induction with thiopentone sodium, all the children were given inhalational anesthesia with nitrous oxide, oxygen and halothane mixture. Heart rate was noted at different periods during surgery. **Results:** In both groups heart rate increased immediately after incision and the increase in heart rate was less in group B compared to group A. But this was not significant statistically. The rise in heart rate could be suppressed only partially by Fentanyl, 2 mics/Kg of body weight. Incision related tachycardia could not be suppressed entirely by either of the two doses. **Conclusions**: We conclude that incision related tachycardia cannot be suppressed altogether by either 1 mcg or 2 mcg/Kg dose. For adequate analgesia it is better to give 2 mcg Fentanyl per Kg body weight in children.

Key Words: Heart rate, Fentanyl, Lower abdominal surgeries incision related tachycardia.

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INTRODUCTION

The utmost responsibility of the Anesthesiologist is to provide adequate pain relief during surgery. Unfortunately, we do not have adequate yardstick to assess pain. Hence we have to monitor other indirect variables like heart rate and blood pressure as markers of pain. Pain produces a sympatho adrenal response secondary to hypothalamic activation of the sympathetic autonomic system and release of norepinephrine. This increased sympathetic activity results in tachycardia and hypertension[1]. Skin incision in children results in a stress response and produces increase in heart rate and blood pressure[2]. This stress response can be modified by administration of narcotics[3]. Tachycardia in children immediately before surgery maybe because of anxiety and stress in children. But increase in heart rate immediately after incision can be taken as an indicator of pain. We have studied whether Fentanyl as a supplementary analgesic during gas oxygen inhalational anesthesia can suppress this tachycardia, Fentanyl is a short acting opioid and high doses of Fentanyl will be used during cardiac anesthesia and for induction. But as a supplementary analgesic during inhalational anesthesia it is given at a dose of 1-3 mcg/kg [4] We compared two doses of Fentanyl 1 mcg/kg and 2 mcg/kg on suppression of incision related tachycardia in pediatric patients. Our primary aim during this study was to know whether we are providing adequate analgesia to the child during nitrous oxide, oxygen, halothane anesthesia. We have taken incision related tachycardia as a yardstick of pain

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and we studied whether Fentanyl can suppress this tachycardia at the selected doses.

MATERIALS AND METHODS

Forty children of the age group 1 – 5 years undergoing nitrous oxide, oxygen, halothane anesthesia for routine lower abdominal surgeries were randomly allocated into two groups. We used a computer generated random table for this. All the even numbers in the table were included in Group – A. Those with odd numbers were included in Group – B. Children other than ASA grade l are excluded from the study. Children undergoing long surgeries(>45 minutes) were also excluded from the study. Group – A patients received 1 mcg/kg body weight of Fentanyl and Group – B patients received 2 mcg/kg body weight of Fentanyl intravenously at the time of premedication. A routine pre anesthetic checkup was done before taking the child inside. Their NBM status was checked. Most of the children come to the operation theater with an IV line inserted in the pediatric ward. We simply check the patency of IV line by flushing with normal saline and give premedication glycopyrrolate 6 mcg/kg body weight IV. We observed that giving glycopyrolate well in advance makes the Airway dry by the time of intubation and there will be decreased need for endotracheal suction. Then the child is shifted inside and the calculated dose of Fentanyl is given. Ondansetron 80 mcg/kg body weight was also given intravenously. Preoxygenation and induction are done simultaneously because it is difficult to restrain the child on operation table for a long period. Patient is induced with 5mg/kg of thiopentone and 2 mg/kg of suxamethonium. After this patient is connected to pulse oximeter. Immediately after the child is induced we started mask ventilation with oxygen. Child is intubated after one minute and connected to Boyle's machine via Jackson Ree's circuit and IPPV started with N_2O + O_2 + halothane. For relaxation Injection vecuronium 80mcg/kg intravenous was given after recovery from suxamethonium in all patients. We recorded pulse rate immediately after induction. For this we took the reading of heart rate on the pulse oximeter. We took this as base line value because before induction it would be difficult to connect the pulse oximeter probe to a struggling child. Hence we took the value after induction as base line value. Then we recorded the pulse rate at 1 minute and 3 minutes after intubation. The surgeon is allowed to start the surgery usually 5 minutes after intubation. We recorded pulse rate just before incision and again at 1 minute and 3 minutes after incision. During surgery we also recorded highest heart rate and lowest heart rate throughout the procedure. We recorded the pulse rate after surgery but before recovery. This we did, to have comparative values at different times during the surgical procedure. At the end of surgery after respiratory efforts started, usually after 30 minutes child was given 50 mcg/kg body weight of neostigmine and 10 mcg/kg body weight of glycopyrolate. Once respiratory efforts were adequate and the child is awake, the patient was extubated. 1 minute after reversal and extubation, child was assessed by Steward Recovery Score[5]. This was to check whether we were compromising on recovery by increasing dose of Fentanyl. After satisfactory recovery children were shifted to postoperative ward and monitored periodically till complete recovery. We also looked for side effects of Fentanyl in each case. we looked for nausea, vomiting, chest wall rigidity or post operative respiratory depression.

RESULTS

1 minute after intubation tachycardia was less in Group – B compared to Group-A. In Group – A increase in heart rate varied from 6 to 29 with a mean of 13.5 whereas increase in heart rate one minute after intubation in group – B varied from 4 to 31 with a mean of 6.7. But this was not significant statistically ($p>0.05$) Three minutes after intubation the heart rates started settling down and returned to almost base line values in both groups. When the heart rates in both groups were compared there was no statistically significant difference. There was increase in heart rate one minute after skin incision in both the groups. Increase in heart rate in Group – A varied from 6 to 19 with a mean of 10.6 in Group – B increase in heart rate varied from 2-11 with a mean of 5.6. Again this was not significant statistically. Three minutes after incision tachycardia was still there in both groups but comparatively less. When heart rates in both groups were compared it was observed that the increase in heart rate was more in group B. This was clinically irrelevant in relation to our study but statistically significant. Steward Recovery Score was 5 – 6 in both the groups. The maximum possible score is 6. That means we did not compromise on recovery by increasing Fentanyl dose from 1 mcg/kg to 2 mcg/kg body weight. One patient in Group – B had a recovery score of 3 but improved to 5 after 5minutes. None of the patients in either group, had nausea, vomiting and chest wall rigidity. No respiratory depression was observed in any of the patient in the post operative ward.

Statistical Analysis

Both the groups were similar in characteristics like age, ASA grade and site of surgery. The difference of age between both the groups was statistically not significant. But the mean duration of surgery in group B was more, and this difference was found to be statistically significant. But this is not relevant to our study.

RESULTS

Table 1: Demographic table

	Group – A	Group – B	T value	P value	Significance
Age	5 ± 2 Years	6 ± 2 Years	1.5811	0.1221	Not significant
ASA	Grade I	Grade I	-	-	-
Duration of Surgery	20 ± 5 minutes	25 ± 5 minutes	3.1623	0.0031	Significant
Site of Surgery	Lower Abdominal	Lower Abdominal	-	-	-

Table 2:

		NORMAL SCORE
Consciousness	Awake	2
	Responding to stimuli	1
	Not Responding	0
Airway	Coughing on command or crying	2
	Maintaining good airway	1
	Airway requires maintenance	0
Movement	Purposeful Movement	2
	Non purposeful movement	1
	No movement	0

Table 3: Comparison of effect of different doses of fentanyl on heart rate

Heart rate	Group A (N = 20)	Group B (N = 20)	T value	P value	Significance
At induction	119.1±17.6	129.5±13.43	2.1008	0.0423	Significant
1 min. after induction	130.65±13.25	136.35±14.17	1.3140	0.1967	Not significant
3 min. after induction	119.35±14.56	124.4±13.58	1.1343	0.2638	Not significant
Before incision	112.65±15.46	119.45±15.69	1.3806	0.1755	Not significant
1 min. after incision	123.35±16.55	124.55±16.22	0.2316	0.8181	Not significant
3 min. after incision	113.9±12.9	124±16.11	2.1886	0.0348	Significant

Fentanyl in doses of 1 and 2 mcg/Kg body weight did not affect the heart rate 1 minute and 3 minute after induction or before incision and 1 minute after incision ($p < 0.05$). The heart rate was significantly more 3 minutes after incision ($p < 0.05$). But this is clinically irrelevant. Hence we can conclude that there is no statistically significant difference between the two groups ($p > 0.05$)

Table 4: Master Chart

	GROUP A, (FENTANYL 1 MCG / KG BODY WEIGHT)						GROUP B (FENTANYL 2 MCG / KG BODY WEIGHT)					
Sr. No.	Induction	After Intubation 1 min.	After Intubation 3 mins.	Before incision	After incision 1 min.	After incision 3 mins.	Induction	After intubation 1 min.	After intubation 3 mins.	Before incision	After incision 1 min.	After incision 3 mins.
1.	130	120	110	98	117	112	120	125	123	119	130	123
2.	120	128	124	124	140	126	160	170	153	157	162	166
3.	130	142	140	138	132	128	150	125	110	107	115	120
4.	143	134	116	109	128	124	122	140	118	107	112	110
5.	80	126	110	90	108	98	128	134	140	146	149	138
6.	95	97	77	83	79	79	135	142	134	115	120	123
7.	91	115	114	100	112	97	122	117	118	117	126	130
8.	130	133	121	120	134	121	120	115	111	116	118	128
9.	107	136	128	117	129	115	120	128	115	111	116	118
10.	155	163	144	140	154	125	120	138	130	120	130	128
11.	110	125	118	100	108	114	132	127	117	83	83	92
12.	130	141	135	130	141	130	138	143	138	136	130	125
13.	110	135	130	128	138	125	135	148	116	115	124	133
14.	123	143	125	120	133	123	128	132	120	113	120	101
15.	120	128	110	101	110	105	140	154	98	114	120	113
16.	110	120	105	100	108	101	154	151	145	135	146	149
17.	130	140	130	120	130	115	121	152	129	128	130	124
18.	120	126	110	105	116	110	120	141	138	125	131	130
19.	118	125	120	115	124	110	115	125	120	115	111	109
20.	130	136	120	115	126	120	110	120	115	110	118	120

DISCUSSION

Children will have fast heart rate, when they were separated from the parents and brought into operation theatre. This stress will cause raised catecholamine levels in the blood and the heart rate will increase. This increase in heart rate continues even after induction for some time. Surgical incision causes increase in heart rate by two ways. One because of surgical stress and two, because of pain. But in general, incision related tachycardia can be taken as a marker of pain. Because skin is a very painful structure, immediately after skin incision the heart rate will increase and slowly it settles down to lower level. The same thing happened in our study. Immediately after incision the heart rate rose and settled down to a lower level after 5 minutes. This stress response to surgical stimulus can be modified by narcotics like fentanyl[6]. H.P. Duncan *et al* compared efficacy of different doses of fentanyl in reducing stress response in children undergoing cardiac surgeries. They used doses like 2,5,25,50 and 150 mcg/Kg. They concluded that attenuation of stress response is better with higher doses of fentanyl[7]. Iyer V and Russel WJ investigated different doses of fentanyl to attenuate the stress response to intubation. They concluded that minimum 10 mcg/ Kg body weight should be given to keep heart rate below 100/ minute[8]. Bruder N *et al* concluded that attenuation of stress response to intubation starts with administration of fentanyl at a dose of 2 mcg/Kg body weight[9]. Chung *et al* concluded that 2 and 5 mcg / Kg bodyweight of fentanyl along with esmolol will attenuate stress response best[10]. Gurulingappa *et al* found that fentanyl at a dose of 4 mcg/Kg produced persistent, reliable, effective attenuation of stress response during endotracheal intubation[11.] Abhijit mohite and others compared two doses of fentanyl 1 and 2mcg/Kg body weight on attenuation of haemodynamic response during laryngoscopy and intubation. They concluded that 2 mcg/kg is a better dose to attenuate the response[12]. Neither of the two doses of Fentanyl could suppress incision related tachycardia entirely in our study. But the rise in heart rate in Group B (Fentanyl 2 mcg/kg body weight) was less when compared to that in Group- A. Mean increase in heart rate in Group – A was 10.6 and it was 5.6 in Group – B. But this was not significant statistically ($p>0.05$). Many of the above studies have shown that the higher is the dose of Fentanyl the better is the attenuation of stress response. Hence a higher dose of fentanyl may be required to suppress the incision related tachycardia entirely. Whether to go for higher doses of fentanyl or stop at 2 mcg/Kg as a supplementary analgesic is a big dilemma. Steward Recovery Scores were the same in both groups. That means Fentanyl at a dose of 2 mcg/kg body weight will not effect recovery much in a child anesthetized with nitrous oxide, oxygen, halothane and relaxant technique.

CONCLUSION

We conclude that Fentanyl at a dose of 2 mcg/kg body weight suppresses incision related tachycardia better than 1 mcg/kg body weight dose. At the same time fentanyl at this dose will not attenuate tachycardia entirely to surgical stimulus. Hence minimum 2 mcg/kg body weight of Fentanyl has to be given to provide adequate analgesia to children. At this dose none of the children had any side effects. Recovery scores were same in both groups.

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