European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 10, Issue 02, 2023

Original Research Article

Epidural fentanyl for post-operative analgesia in lower limb orthopaedic surgeries: A comparative study with epidural tramadol

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Abstract

Aims and Objective: To compare the efficacy of epidural FENTANYL and TRAMADOL for post-operative analgesia in lower limb surgeries in terms of onset of analgesia, duration of analgesia, quality of analgesia and undesirable effect.

Material Method: This prospective randomized study was conducted to compare the analgesic efficacy and side effects of epidural fentanyl and that of epidural tramadol and included sixty (60) patients of either sex in the age range of 18-65 years, undergoing lower limb surgeries under Combined Spinal Epidural anaesthesia (CSE) with ASA physical status I & II. These were divided into two groups of 30 patients each. Group F- Fentanyl group and Group T- Tramadol group. Patients of Group F received 50 mcg of Fentanyl + 8ml of 0.125% Bupivacaine (9 ml) and that of Group T received 50 mg of Tramadol and 8ml of 0.125% Bupivacaine(9 ml).The patients were randomly given epidural fentanyl or epidural tramadol when patient complained of pain post operatively with Visual analog score 3 or above. Patients were closely monitored in the post-operative period till they had pain relief. Quality of pain relief was measured using visual analogue scale and occurrence of side effects like nausea and vomiting, pruritis, respiratory depression were noted. A detailed clinical history and physical examination of the patients was done and all vital parameters were recorded well in advance. An informed and written consent was taken from the patient for the study.

Result: Mean Time of onset of analgesia after epidural injection was 5.42 ± 1.18 minutes in Group F and 12.80 ± 1.62 minutes in Group T and the difference was found to be statistically significant. Mean Duration of analgesia was 240.22 ± 36.53 in Fentanyl group and 360.52 ± 24.83 in Tramadol groups respectively which was also statistically significant. Pruritis was significantly higher in Fentanyl group whereas nausea and vomiting was higher in tramadol group. Quality of analgesia was better following administration of epidural Fentanyl.

Conclusion: Both epidural Fentanyl and Tramadol are effective in relieving post-operative pain; however Fentanyl produced better patient satisfaction compared to tramadol but the duration of action was short.

Keywords: Epidural, analgesia, tramadol, fentanyl

Introduction

The crucial component of anaesthesia is postoperative pain management. Every surgery needs to have appropriate and efficient post-operative pain management. Even though postoperative pain management and its implications have received a lot of attention in the previous three decades, it is still a serious concern [1].

Effective post-operative analgesia is necessary and critical not only for facilitating rapid

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recovery but also for minimising patient costs, increasing patient satisfaction, and enhancing the patient's sense of wellbeing. It also ensures quick patient mobilisation and rehabilitation, reduces post-operative complications, shortens hospital stays with rapid discharge, and fosters stronger doctor-patient rapport [2].

The use of neuraxial methods, in particular epidural analgesia, is now well established. Epidural analgesia is a quick, effective, and affordable method of reducing postoperative pain [3].

Drugs commonly used for epidural based analgesia techniques include local anaesthetics, Opioids, local anaesthetic-opioid combinations and other adjuvants: like clonidine, epinephrine, ketamine, sodium bicarbonate, magnesium etc. It has been demonstrated that combination of the local anaesthetic agents and other adjuvants improves the onset & intensity of the epidural block [4].

To ensure efficient, appropriate postoperative pain management, it is essential to have extensive planning and evaluation, which involves a full pain history and physical examination. Good patient interaction and proactive analgesic control are desirable components of a successful treatment plan [5].

Tramadol is a synthetic 4-phenyl-piperidine analog of codeine and is a racemic mixture of two enantiomers. The positive enantiomer has moderate affinity for the opioid μ receptor and inhibits serotonin uptake while negative enantiomer is a potent norepinephrine synaptic release inhibitor. It has a peculiar quality of potent analgesic effect without any significant respiratory depression [6].

Fentanyl is a synthetic opioid substance which acts by targeting specific Mu-receptor and has an agonist effect. It also has agonist effect on other opioid system receptors such as the delta, and potentially the kappa-receptors. Activation of Mu receptor is the primary mechanism by which Fentanyl produces analgesic effect. Fentanyl is a derivative of phenyl piperidine with a quick onset and lesser duration of action [7].

Aim and Objectives

Two drugs *viz* Fentanyl and Tramadol administered via Epidural route for postoperative pain relief in Lower Limb orthopaedic Surgery in regards to:

(a) Onset of analgesia
(b) Duration of action
(c) Quality of analgesia in accordance to VAS
(d) Undesirable effects

Materials and Methods

Study design: Prospective, Randomized.

Selection of patients: Sixty (60) patients of either sex in the age range of 18-65 years, undergoing lower limb Orthopaedic surgery under Combined Spinal Epidural anaesthesia with ASA physical status I & II formed the study groups.

Exclusion criteria

1. Patient denial for epidural analgesia or subarachnoid block.
2. ASA> II
3. <18 year & > 65 years.
4. Patients with known allergic history to Fentanyl, Tramadol and local Anaesthetics.
5. Patient requiring general anaesthesia.
6. Failed or partial effect of subarachnoid block.
7. Any contraindication to spinal/combined spinal epidural.

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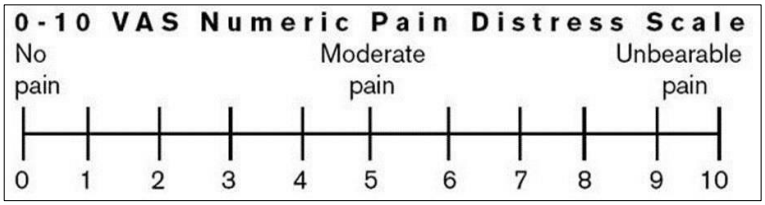
All the patient were made familiar with visual analog scale preoperatively



Patients were informed about anaesthetic procedure and peri-operative sequence in a simple and supportive language
Informed and written consent was taken.
Preservative free Injection Tramadol and Injection Fentanyl was used in this study
The patients were randomly divided into two groups by simple random selection technique. Each group contained 30 patients.

Patient group	No. of patients	Epidural drug	Dose
F	30	Inj. Fentanyl citrate	50 mcg as a single bolus dose
T	30	Inj. Tramadol hydrochloride	50 mg as a single bolus dose

Method

Tablet Pantoprazole 40 mg and Tablet alprazolam 0.25 mg were prescribed night before surgery and on the morning of surgery (at-least 2 hours prior to surgery) with a sip of water. Patients were be kept nil orally for 8 hours.
On the day of surgery, vitals in the form of heart rate, systolic, diastolic and mean arterial pressure and Spo_2 were recorded in the pre-operative area. A wide bore intravenous cannula was inserted for giving intravenous fluid. On the operating table multichannel monitor was attached and vitals in the form of heart rate and rhythm, systolic, diastolic and mean arterial pressure and Spo_2 were recorded. Preloading was done over a period of 20 minutes before spinal anaesthesia with injection ringer lactate. All patient were planned under Combined Spinal Epidural anaesthesia. After sitting position and under all aseptic precaution L3-L4 space was identified and local anaesthesia was infiltrated in the identified space and then 18G Tuohy's needle was introduced in the identified space using loss of resistance technique. Epidural catheter was presented through the Tuohy's needle and was progressed 4-6 cm in the epidural space. A test dose of 3ml of 2% lidocaine with adrenaline [1:200000] was injected to check the right placement of epidural catheter. Under all aseptic precaution subarachnoid block was given one space below using 25G quincke needle with 2.5-3ml of hyperbaric 0.5% bupivacaine after free flow of clear CSF. Sensory & motor block was assessed before proceeding with the surgical procedure and allowed only after adequate effect was attained. In the postoperative period patients were observed for post-operative pain and once Visual Analog Score was 3 or above. Post-operative analgesia was administered as under through epidural catheter according to group of patients adjusted.
After epidural administration following parameters were closely monitored in all patients at 15 min, 30 min, 45 min, 1 hour (60 minute), 2 hour (120 minute), 4 hour (240 minute) and 6 hour (360 minute)

1. Onset of analgesia
2. Duration of analgesia
3. Quality of analgesia in accordance to VAS score
4. Occurrence of side effects like nausea and vomiting, pruritis, respiratory depression.

Onset of analgesia: The time from administration of the drug to reduction in Visual analog scale score <3.

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Duration of analgesia: The time between onset of analgesia and Visual analog scale score >3**.**

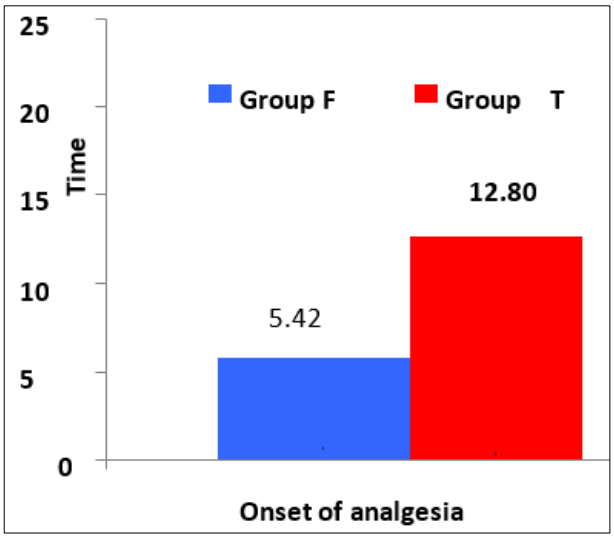
When visual analog scale >3, findings were recorded and it mark the end of study period and then subsequent dose were given through epidural catheter. When patient asked for rescue analgesia or Visual Analog Scale score 3 or above or no decrease in Visual Analog scale Score within 30 minutes of epidural administration, then rescue analgesia was given assuming epidural catheter is kinked or misplaced and the patient was excluded from the study.
Injection diclofenac 75 mg I.V was used as rescue analgesia.

Statistical analysis

Data captured on the physical performa were entered in the excel to make a master chart. Statistical analysis was performed by the SPSS program for windows, version 28.0(SPSS, Chicago, illinois). Continuous variables are presented as mean± SD, median (IQR) and minimum and maximum values. Categorical variables are presented as absolute no. and percentage. Data were checked for normality before statistical analysis.
Normally distributed continuous variables were compared using unpaired t test, whereas the Mann-Whitney U test was used for those variables that were not normally distributed. Categorical variables were analysed using either the chi square test or fisher's exact test. For all statistical tests, a p value less than 0.05 is considered statistically significant.

Observation and Results

	Group F	Group T	p value
	Mean ± SD	Mean ± SD	
Onset of analgesia min	5.42 ± 1.18	12.80 ± 1.62	<0.001
Analgesia duration min	240.22 ± 36.53	360.52 ± 24.83	<0.001



It was observed that under Group F, mean onset of analgesia was 5.42 ± 1.18 min while in Group T, mean onset of analgesia being 12.80 ± 1.62 min. Further it was observed that there was a significant mean difference in Onset of analgesia with onset being faster in fentanyl as compared to tramadol with a p value of <0.001.

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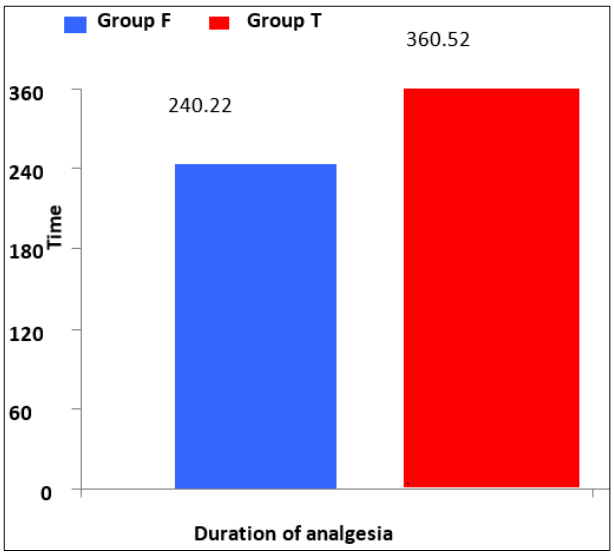
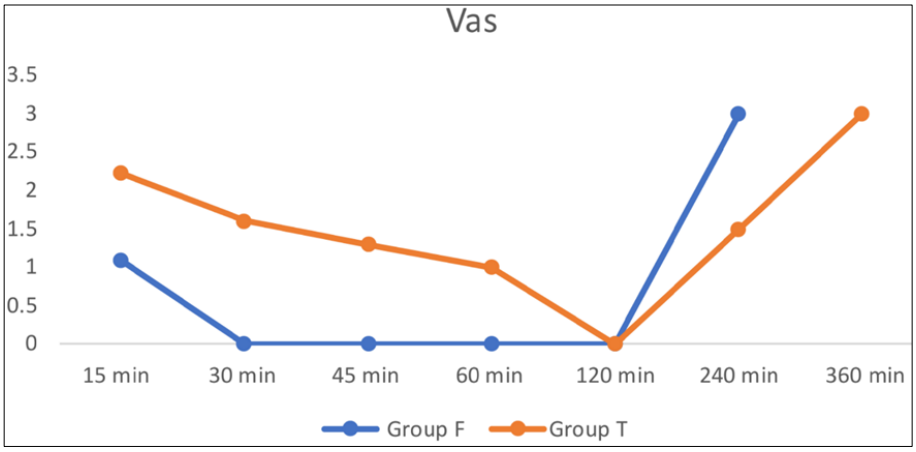


It was observed that under Group F, mean duration of analgesia was 240.22 ± 36.53 min while in Group T, mean duration of analgesia being 360.52 ± 24.83 min. Further it was observed that there was a significant mean difference in duration of analgesia when Group F compared to Group T (p value <0.001).

	Group F			Group T			p value
	Mean ± SD	Min - Max	Median (IQR)	Mean ± SD	Min - Max	Median (IQR)	
15 min vas	1.09 ± 0.32	0 - 2	1 (0 - 2)	2.22 ± 0.25	1 - 3	2 (1 - 3)	<0.001
30 min vas	0.00 ± 0.00	0 - 0	0 (0 - 0)	1.60 ± 0.12	0 - 2	1 (0 - 2)	<0.001
45 min vas	0.00 ± 0.00	0 - 0	0 (0 - 0)	1.30 ± 0.20	0 - 2	1 (0 - 2)	<0.001
60 min vas	0.00 ± 0.00	0 - 0	0(0 - 0)	1.00 ± 0.30	0 - 2	1 (0 - 2)	<0.001
120 min vas	0.00 ± 0.00	0 - 0	0 (0 - 0)	0.00 ± 0.00	0 - 0	0 (0 - 0)	>0.005
240 min vas	3.00 ± 0.00	3 - 3	3 (3 - 3)	1.50 ± 0.30	1 - 2	1 (1 - 2)	<0.001
360 min Vas				3.00 ± 0.00	3-3	3(3 - 3)	



The table and chart above show the comparison of VAS at various time points between the two groups. It was observed that there was a significant mean difference in VAS at 15 min, 30 min, 45 minute, 60 minute and 240 minute (p value <0.001) respectively. While there was no significant mean difference observed in VAS at 120 minute (p value >0.05) of Group F compared with Group T.

VAS pain score was 1.09±0.32 in group F and 2.22± 0.25 in group T 15 minute after epidural administration of study drug which was statistically highly significant. VAS pain score at 30 min, 45 min and 60 min was 0.00 in fentanyl group and in tramadol group 1.60±0.12 at 30 min, 1.30±0.20 at 45 min, 1.00 ± 0.30 at 60 minute with p value <0.001. VAS at 120 minute in Group F and in group T was 0.00 ± 0.00 with p value >0.05. At 240 minute in group F was

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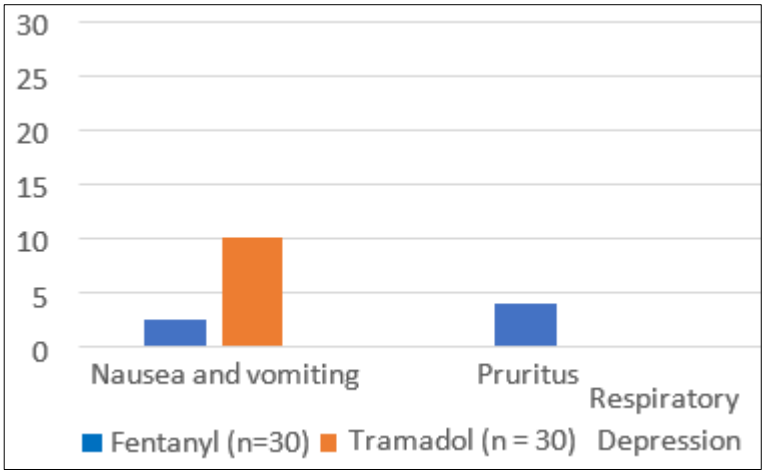
3.00 ± 0.00 and in group T was 1.50 ± 0.30 (p <0.001) which were statistically highly significant.

Incidence of side effects

Side effects	Group F (n=30)	Group T (n=30)	P value
Nausea and vomiting	2 (6.8%)	10 (33.33%)	<0.001
pruritis	4 (13.33%)	0(0%)	<0.001
Respiratory depression	0 (0%)	0 (0%)	



Incidence of nausea and vomiting (33.33%) was significantly higher in tramadol (p value <0.001). Incidence of pruritis (13.33%) was more in fentanyl group (<0.001). none of the patient in both group had episode of respiratory depression.

Discussion

Acute postoperative pain is a complex physiological reaction to illness, visceral distension, or tissue damage. In addition to providing subjective comfort, postoperative pain management also aims to decrease the nociceptive impulse brought on by surgery and to ease autonomic and somatic pain reflexes and the discovery of opioid receptors has opened up new horizon in post-operative pain management [8].

The central neuraxial blockade is a useful tool in the anaesthesiologist's arsenal because the change in physiology and biochemistry, and consequently the morbidity and mortality, it causes are small compared to general Anaesthesia [9].

Overall the incidence of cardiac and pulmonary morbidity and mortality may be decreased significantly with effective post-operative pain management [10].

The present study was done to assess the efficacy and adverse effect of 8ml 0.125% bupivacaine + 50 mcg of Fentanyl in comparison to 8ml 0.125% bupivacaine + 50 mg Tramadol through epidural route for postoperative pain in lower limb orthopaedic surgeries.

Onset of analgesia

In the present study mean time of onset of analgesia was quicker with epidural fentanyl 5.42±1.18 min than epidural tramadol 12.80±1.62 min (p value <0.001).

Rutter DV *et al*. in 1981 reported that after epidural administration of 100 mcg fentanyl, mean pain score reduced by 50% within 5 minutes and concluded that it had rapid onset of action. Naulty JS *et al*. in 1985 used different doses of epidural fentanyl in parturient after caesarean delivery and observed that 100 mcg fentanyl produced pain score 0 within 3-6 minute. Ujjwala BK *et al*. in 2016 observed that mean onset of analgesia in fentanyl group was faster 5.79±0.65 minutes when compared to 13.08 ±2.6 minutes in tramadol group. Naik GL, *et al*. observed that onset of analgesia was faster in fentanyl group 3.79 ± 0.36 minutes followed by tramadol group 7.76 ± 0.65.

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Result of the present study was in concordance to above studies, from this it is concluded that onset of analgesia was faster with fentanyl than tramadol. This rapid onset is attributable to high lipid solubility and high affinity of fentanyl group for opioid receptors compared to that of tramadol.

Duration of Analgesia

In the present study mean duration of analgesia was longer with epidural tramadol 360.52 ± 24.83 when compared to epidural fentanyl 240.22 ± 36.53 min (p value <0.001).

Jitendra R, *et al*. in 2016 observed that mean duration of analgesia in tramadol group was 4.92 ± 0.74 hours and was significantly longer when compared with fentanyl group 3.06 ± 0.38 hours. Tejash H.S, *et al*. 2021 observed that mean duration of analgesia was prolonged with epidural tramadol 8.06 ± 12.5 hours when compared with epidural fentanyl 5.5±0.97. Fu Y.P *et al*. in 1991 used 75 mg tramadol for post-operative analgesia and observed that mean duration of analgesia to be 12 ± 5 hours.

Similar studies utilising epidural tramadol and fentanyl demonstrated some variation in the duration of analgesia compared to the current study. Epidural fentanyl's analgesic effect lasted between two and six hours in several studies; in our study, it lasted about four hours. According to studies, tramadol's analgesic effect lasted between 5 and 12 hours when given by epidural route; in our study, it lasted for 6 hours. In every study, tramadol provided analgesia for a longer period of time than fentanyl.

Quality of analgesia in accordance to vas score

In our study VAS score of both group were recorded at 15 min, 30 min, 45 min, 60 min, 120 min, 240 minute, 360 minute and compared between two study group.

Reduction in vas score was seen in both study group but Mean vas score at 15, 30, 45 and 60 minute after administration of epidural study drug was significantly lower in fentanyl group (p value <0.001) and was statistically highly significant. At 2 hour both groups vas score were 0.00 (p value >0.05) and was statistically not significant.

This data shows that quality of analgesia in fentanyl group was significantly better when compared to tramadol group during its duration of analgesia.

Ujjwala B.K, *et al*. in 2016 observed that VAS score was significantly lower in fentanyl group than tramadol group and concluded that quality of analgesia was better in fentanyl group.

Sudhir P, *et al*. in 2018 observed that epidural 50 mcg fentanyl when compared to 50 mg of epidural tramadol had significantly lower vas score for 12 hours.

Tejash H.S, *et al*. in 2021 observed that pain control in fentanyl group was significantly better than tramadol group.

Side Effects

In our study group T, 10 patients (33.33%) of patients had nausea and vomiting and none of the patient had episode of puritis or respiratory depression on comparing with group F, 4 patients (13.33%) of patients had nausea and vomiting and 4 patients (13.7%) had episode of puritis and none had episode of respiratory depression.

In a study conducted by Lytle SA *et al*. 1991 using fentanyl 50 mcg authors observed that 4% of the patient reported pruritis.

Kaur J, *et al*. in 2014 observed that incidence of pruritis was higher in patients receiving epidural fentanyl affecting 25% of the study group.

Raghunath J *et al*. found that incidence of nausea and vomiting was 43% with tramadol and 10% with fentanyl and 13.33% patient had incidence of pruritus who received fentanyl and none of the patient had episode of pruritus with tramadol.

L. Giridhar *et al*. observed that 6 out 20 patients with tramadol and 4 out of 20 patients with fentanyl had incidence of nausea & vomiting.

In a study conducted by more P *et al*. 2016 observed that 13.3% of the patient had nausea and vomiting in tramadol group.

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Our study had a similar result with above studies. Nausea and vomiting was higher in case of tramadol whereas incidence of pruritus was significantly high with fentanyl than tramadol.

Conclusion

From the present study following conclusion are made:

1. Epidural fentanyl provides a rapid & better but shorter duration of analgesia as compared to Epidural tramadol.
2. Epidural Tramadol provides longer duration of analgesia compared to Epidural fentanyl.
3. Undesirable side effects like nausea & vomiting were seen in both group but more often after Epidural Tramadol whereas incidence of pruritis was only seen with fentanyl. There were no serious side effect in both the groups.

From the present study we conclude that Epidural fentanyl 50mcg provides better quality of analgesia of rapid onset but of shorter duration.

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