Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07, 2024

Original research article

A comparative study between epidural butorphanol and epidural buprenorphine for postoperative pain relief in patients undergoing lower abdominal and lower limb surgeries

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Abstract

This study, titled "A Comparative Study Between Epidural Butorphanol and Epidural Buprenorphine for Postoperative Pain Relief in Patients Undergoing Lower Abdominal and Lower Limb Surgeries," involved 100 ASA I and II patients aged 20-60 years. Ethical committee approval was obtained before starting the study. Patients were randomly divided into two groups: Group A (n=50) received 1 mg of Butorphanol tartrate, and Group B (n=50) received 300 mcg of Buprenorphine hydrochloride. In the postoperative period, the study drug was administered via an epidural catheter when patients first reported pain. The mean duration of analgesia for Butorphanol was 5.19±0.747 hours, with a rapid onset and excellent pain relief, though some experienced nausea, vomiting, and pruritus. No motor blockade or other complications were noted. For Buprenorphine, the mean duration of analgesia was 9.85±1.49 hours, with a slower onset compared to Butorphanol. Despite excellent pain relief, there were higher incidences of nausea (14%) and vomiting (20%) compared to Butorphanol (8% and 10%, respectively), while pruritus was less frequent (4% vs. 10%). Two patients (4%) in the Buprenorphine group experienced hypotension, with no motor blockade reported.

Keywords: Epidural, butorphanol, buprenorphine, postoperative pain relief, lower abdominal surgery, lower limb surgery

Introduction

Narcotic analgesics are very frequently being used for epidural analgesia neuraxial regional techniques. Epidural administration of morphine (μ-receptor opioid agonists) was regarded as “gold -standard” single -dose neuraxial opioid by many due to its postoperative analgesic efficacy and prolonged duration of action. But because of various side effects associated with morphine use [1, 2], other narcotic analgesics were studied.

Buprenorphine is a semisynthetic opioid having strong agonistic activity at μ receptor and antagonistic activity at κ-receptor [3]. Studies shows that buprenorphine behavior is typical of μ agonist but its partial agonistic property at μ receptor is responsible for respiratory depression [4].

Butorphanol is a lipid soluble narcotic with strong κ -receptor agonistic activity and weak μ-receptor agonistic/antagonistic activity [5].

This present study was conducted to compare the efficacy and complication of epidural butorphanol and epidural buprenorphine for postoperative analgesia.

Aims and Objectives

1. To compare the efficacy of epidural butorphanol and epidural buprenorphine for post-operative analgesia.
2. To evaluate the onset and duration of analgesia of both the study drugs.
3. To evaluate and compare the side effects of both the study drugs.
4. To study the number of epidural doses required postoperatively in each of the two study groups.
5. To assess sedation based on Ramsay sedation score between the two groups.

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Materials and Methods

The study was undertaken at a tertiary care referral hospital from July 2016 to June 2017 after obtaining institutional ethical committee clearance and written informed consent from patients.

Inclusion criteria

1. Patients of ASA I & ASA II grade.
2. Age group between 20 to 60 years of both gender.
3. Patients posted for various elective lower abdominal and lower limb surgeries.

Exclusion criteria

1. Patients of ASA grade III and IV.
2. All contraindications for epidural anesthesia.

a) Uncooperative patient/patient refusal.
b) Severe hemorrhage or shock.
c) Coagulation defects or patients on anticoagulation therapy.
d) Local inflammation.

3. History of opioids abuse.
4. Allergy to any drug used in the study.

The study was conducted on 100 patients who were randomly divided into 2 groups of 50 each. Group A received postoperatively 10ml of epidural inj. Butorphanol 1mg diluted in normal saline and Group B received postoperatively 10ml of epidural inj. Buprenorphine 300 micrograms diluted in normal saline.

Pre-anesthetic evaluation was done on the day before surgery. Basic laboratory investigations such as complete blood count, fasting blood sugar, blood urea, serum creatinine were done routinely for all patients. Chest X-ray and ECG was done only when indicated. All patients were given tablet alprazolam 0.5mg orally on the night before the surgery.

Patients' body weight and height were measured and recorded and then shifted to the operating table. All routine monitors (ECG, NIBP, pulse oximetry) were connected and baseline readings of all vital parameters were taken.

An intravenous access was established with 18 G cannula and preloading done with 500ml of ringer lactate solution was done. Patients were instructed about Visual Analogue Scale (VAS), a scale of 10 cm length with 0 on the scale corresponding to 'No Pain' and 10 'Maximum Intolerable Pain Experienced'.

Under aseptic precautions L3-L4 interspace was identified, with the highest point of iliac crest as anatomical landmark (Tuffier's Line). Epidural space was identified by loss of resistance of technique. Epidural catheter passed through epidural needle, thereafter needle was removed and catheter secured. 2% xylocaine with adrenaline was given as a test dose.

All cases were done under general anaesthesia. For GA, patients were premedicated and preoxygenated with 100% O_2 for 3 minutes.

The premedication's used were:

1. Inj. Ondansetron i.v. stat (4 mg).
2. Inj. Ranitidine hydrochloride 1 standard ampoule i.v.
3. Inj. Glycopyrrolate 0.2 mg i.v. stat
4. Inj. Tramadol 1-2 mg/kg body wt i.v.

Patients were induced with i.v. propofol 2mg/kg body wt. and following loss of response to verbal command, intubating dose of inj. Rocuronium given 1.2 mg/kg was given. Control ventilation was done for 1 minute and then laryngoscopy and intubation was done with appropriate size endotracheal tube and the tube was secured after confirmation of correct placement of tube. $ETCO_2$ sensor was connected to the tube for intraoperative monitoring of $ETCO_2$. Anaesthesia was maintained with N_2O:O_2 mixture in the ratio of 2:1 and inj. Rocuronium at 0.1mg/kg body wt. was used for maintenance. Nitrous oxide was discontinued after the patients were fully awake. Neuromuscular reversal was done with neostigmine 50µg/kg and glycopyrolate 10µg/kg body weight and then extubation done after confirming the patient's response to verbal command.

After completion of surgery, patient complaining of pain clinically correlating with visual analog score of 3 and above, the study drug was administered via the epidural catheter and onset, duration of analgesia, vital parameters like Pulse rate, blood pressure, respiratory rate, Spo2 was recorded at 0 min, 15mins, 30mins, 1hr, 2hr, 4hr, 8hr, 12hr, 18 hr and 24 hr respectively.

The level of sedation provided by each drug was assessed on the basis of Ramsay Sedation Score till the administration of rescue analgesia. Patients were given rescue analgesia with the same drug when they complained of pain and VAS score was more than 5.

Duration of analgesia was calculated after injecting the drug through epidural catheter and patient was asked to point out scores on scales. VAS score was calculated in the postoperative period at 1, 2, 4, 8, 12, 18 and 24 hours respectively to know the duration of analgesia provided by each drug respectively.

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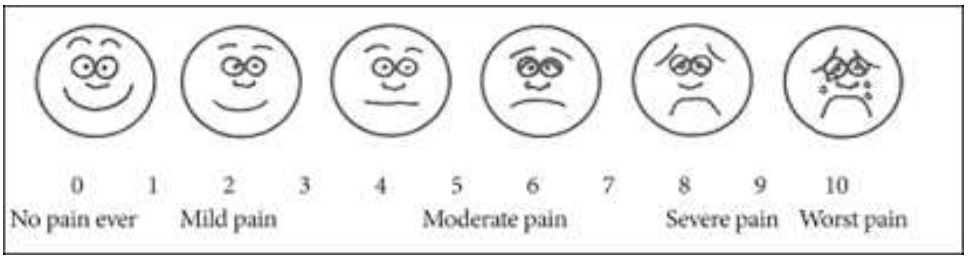
The duration of analgesia was calculated from administration of 1st dose of the drug till the requirement of second dose and then the study was abandoned.
Onset time of analgesia is the time from administration of drug to symptomatic relief (VAS score less than initial score at the time of study drug administration).
Analgesia was scored by Visual Analog Scale.



0-no pain
1,2,3-mild pain
4,5,6-moderate pain
7,8,9-severe pain
10-worst pain ever.
All the patients were observed for the following side effects throughout the study period-nausea, vomiting, pruritus, respiratory depression, hypotension.

Definitions

1. Hypotension (defined as a decrease in systolic BP >20% of the baseline value or SBP < 90 mm Hg) was treated with IV boluses of 6 mg ephedrine.
2. Bradycardia is defined as a pulse rate of < 50 beats/min, treated with IV boluses of 0.3–0.6 mg atropine.
3. Respiratory depression (respiratory rate < 8 or saturation of peripheral oxygen < 95%) was treated with oxygen supplementation and respiratory support if required.

Statistical Analysis

The data compiled were analysed with GraphpadInstat® 3 statistical software. For qualitative data, Chi-square test was used. Quantitative data were analyzed using two tailed unpaired student t-test.

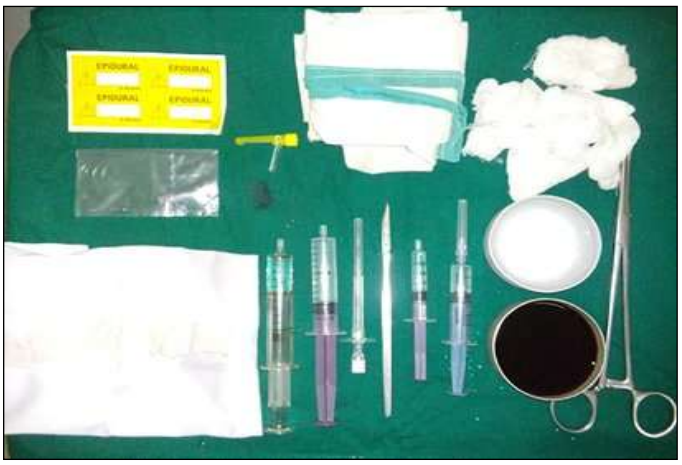


Photo of epidural trolley

Results and Observations

The present study consists of 100 adult patients posted for elective lower abdominal and lower limb surgical procedures and were divided into two groups of 50 each.
Group A received Injection butorphanol and Group B received Injection buprenorphine hydrochloride epidurally postoperatively.
In the post-operative period following parameters were recorded: pulse, SBP, DBP, MAP, SpO_2, respiratory rate, VAS along with documentation of any side effects like hypotension, nausea, vomiting, etc.

Demographic profile

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Table 1: Comparison of Age Distribution

Age Group (in yr)	Group A		Group B		P Value
	No. of Patients	Percentage	No. of Patients	Percentage	
20-30	18	36%	13	26%	
31-40	18	36%	15	30%	
41-50	09	18%	12	24%	0.1701
51-60	5	10%	10	20%	
Mean ± SD (yrs)	35.88±10.59		39.06±12.35		

On comparing the two groups statistically using unpaired student t test, no significant difference was found (p value =0.1701).

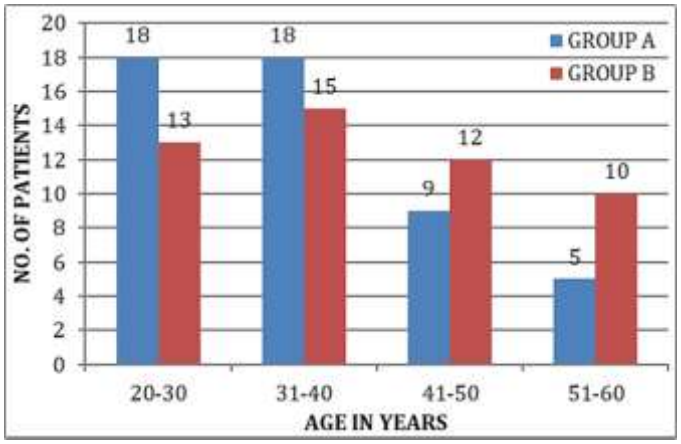

Fig 1: Bar diagram showing age distribution in between the two groups

Table 2: Sex Distribution

Sex	Group A		Group B		P value
	No. of Patients	Percentage	No. of Patients	Percentage	
Male	18	36%	17	34%	0.8339
Female	32	64%	33	66%	
Total	50	100%	50	100%	

On statistical analysis using chi square test, no statistical significant difference was found (p=0.8339).

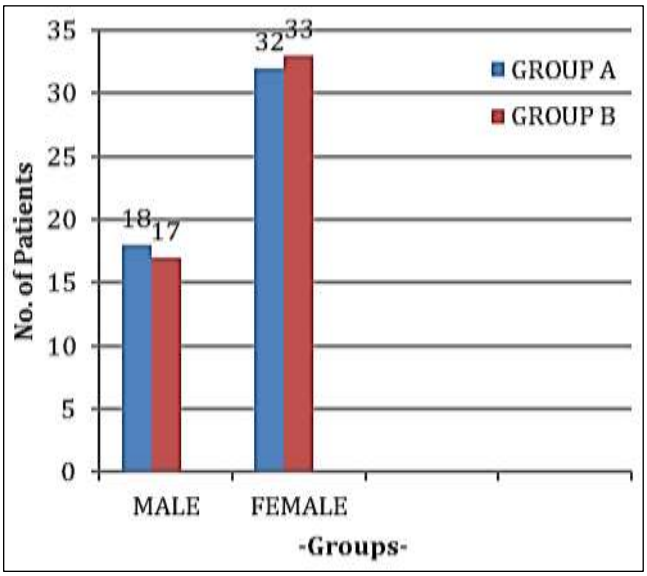

Fig 2: Bar diagram showing sex distribution between the groups

Table 3: Comparison of Asa Status Between Two Groups

ASA Status	Group A(N=50)		Group B(N=50)		P Value
	No of patients	Percent (%)	No of patients	Percent (%)	
I	43	86	45	90	0.7583

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II	7	14	5	10	

On statistical analysis using chi square test, no statistical significant difference was found (p=0.7583).

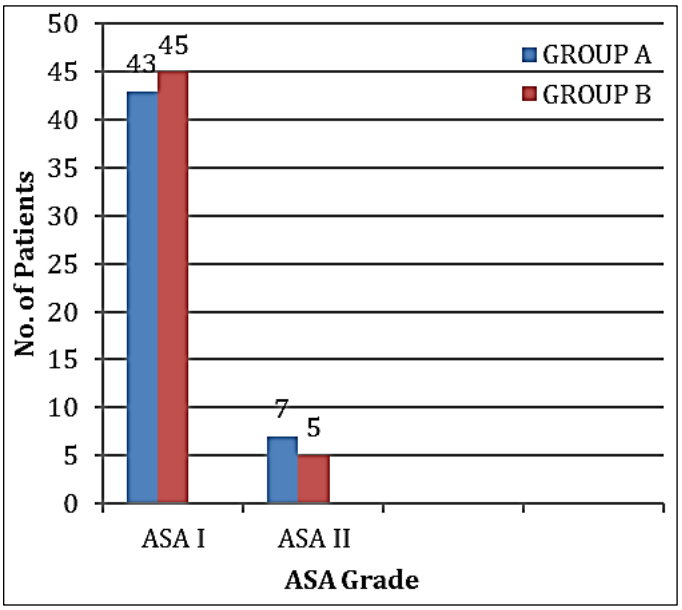

Fig 3: Bar diagram showing ASA distribution between the groups

Table 4: Comparison of Weight between Two Groups

Weight in KG	Group A		Group B		P value
	No of Patient	Percent	No of Patient	Percent	
40-49	3	6%	0	00	0.2206
50-59	22	44%	20	40%	
60-69	17	34%	21	42%	
70-78	8	16%	9	18%	
Mean ± sd	62.48±7.30		61.64±7.25		

On statistical analysis using unpaired student t test, no statistical difference was found (p=0.2206).

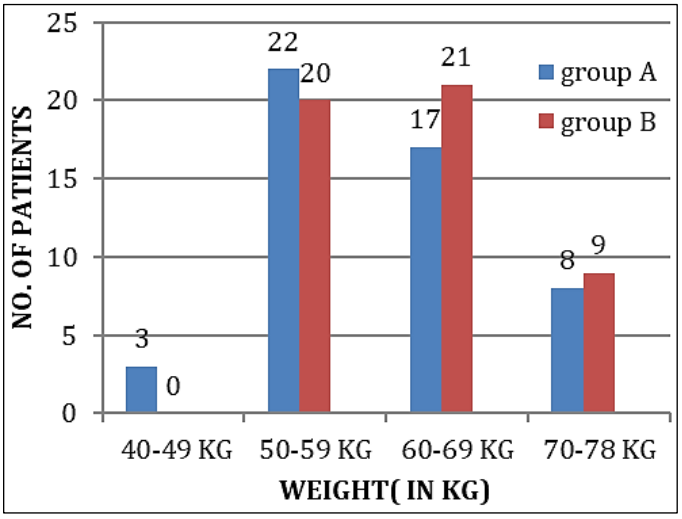

Fig 4: Bar diagram showing weight distribution between two groups

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Table 5: Comparison of Mean Height Between Two Groups

Height	Group A	Group B	P Value
Mean	164.48	165.30	0.2664
SD	3.52	3.81	

On statistical analysis using unpaired student t test, no statistical difference was found (p=0.2664).

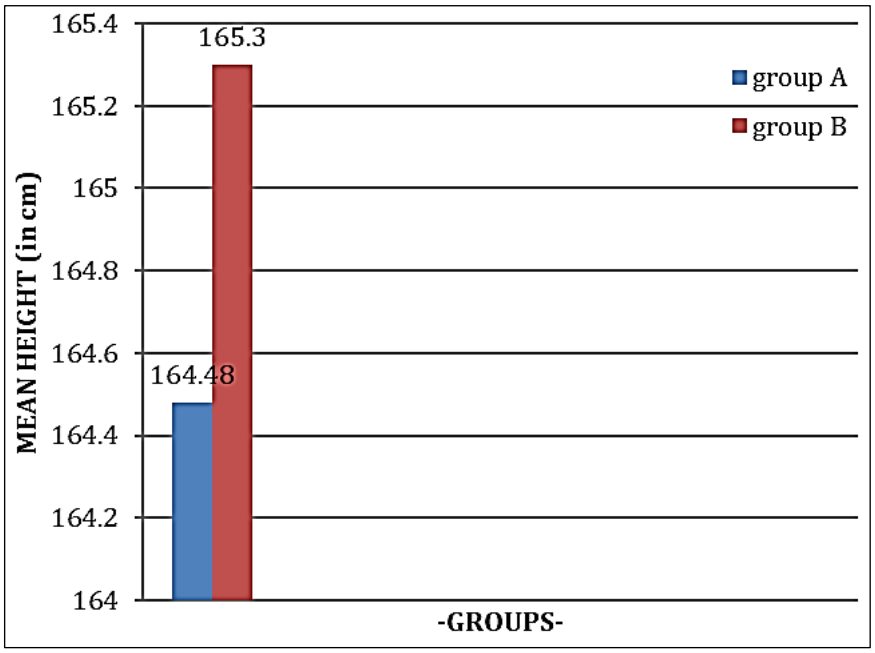

Fig 5: BAR Diagram Showing Mean Height Distribution between Two Groups

Table 6: Comparison of Type of Surgery between Two Groups

Type of Surgery	Group A (INJ. Butorphanol)	%	Group B (INJ. Buprenorphine)	%	Total
Total Abdominal Hysterectomy	15	30	18	36	33
Exploratory Laparotomy	20	40	21	42	41
Laparotomy + Myomectomy	08	16	04	8	12
Internal Fixation of Fracture shaft of femur	05	10	03	6	08
Internal fixation of fracture tibia	02	4	04	8	06
	50		50		100

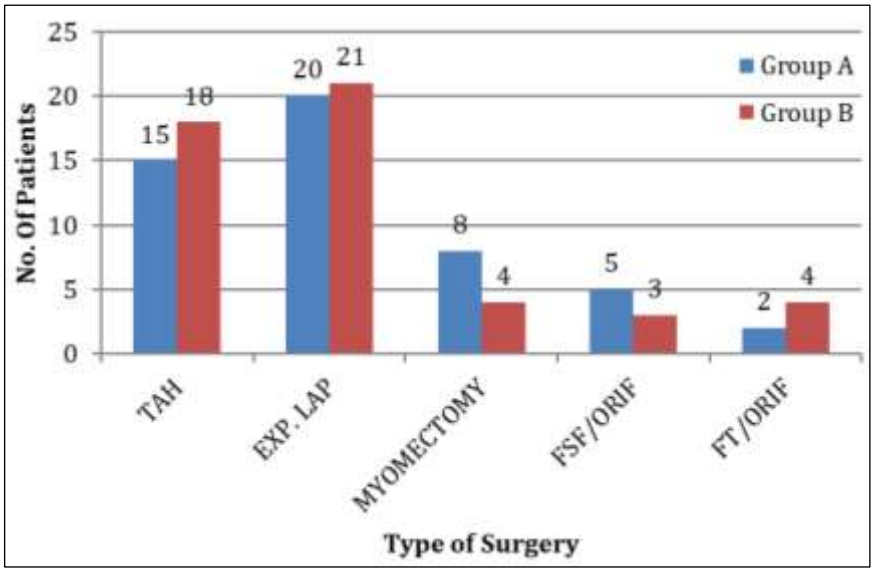

Fig 6: Bar diagram showing distribution of patients based on surgical procedures in two groups

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Onset of Analgesia

Inj. Butorphanol group, the minimum time required for the onset of analgesia was 5 minutes and maximum time was 13 minutes. The percentage wise distribution within butorphanol group showed that in maximum number of patients (30%) the time required for the onset of analgesia was 10 minutes.

Table 7: Showing Onset of Analgesia in Butorphanol Group

Time (in minutes)	Number of cases	Percentage of cases %
5	8	16
6	9	18
8	9	18
10	15	30
12	8	16
13	1	2

In buprenorphine group, the minimum time required for the onset of analgesia was 8 minutes and the maximum time required was 20 minutes. The onset of analgesia in 17 patients out of 50(34%) was 10 minutes.

Table 8: Showing Onset of Analgesia in Buprenorphine Group

Time (in minutes)	Number of cases	Percentage of cases
8	3	6%
10	17	34%
14	10	20%
15	9	18%
18	8	16%
20	3	6%

Table 9: Showing Comparison of Mean Onset Analgesia between Two Groups:

Group	No. of Patients	Mean	SD	P Value
Butorphanol	50	8.50	2.483	<0.0001
Buprenorphine	50	13.46	3.494	

Table 10: Comparison of Duration of Postoperative Analgesia

Duration of Analgesia	group A	Group B
In minutes	No of patients (%)	No of patients (%)
120-180	-	-
180-240	-	-
240-300	30 (60%)	-
300-360	16(32%)	-
360-420	4 (8%)	-
420-480	-	-
480-600	-	35 (70%)
600-720	-	12 (24%)
720-840	-	3 (6%)

The duration of postoperative analgesia when compared between two groups it was found that inj. buprenorphine was comparatively longer acting as compared to inj. Butorphanol. In buprenorphine group duration of analgesia was found to be in the range of 8-14hrs while in butorphanol group the duration of postoperative analgesia was found to be in range of 4-7 hrs.

Table 11: Comparison of Mean Duration of Postoperative Analgesia

Group	Number of Samples	Mean (hrs)	SD
Butorphanol	50	5.19	0.747
Buprenorphine	50	9.85	1.490

The mean duration of postoperative analgesia in butorphanol group was 5.19±0.747 hrs, whereas in buprenorphine group it was 9.85±1.490 hrs. Longer duration of post-operative analgesia was found in buprenorphine group.

The tailored p value being <0.0001 which is extremely significant.

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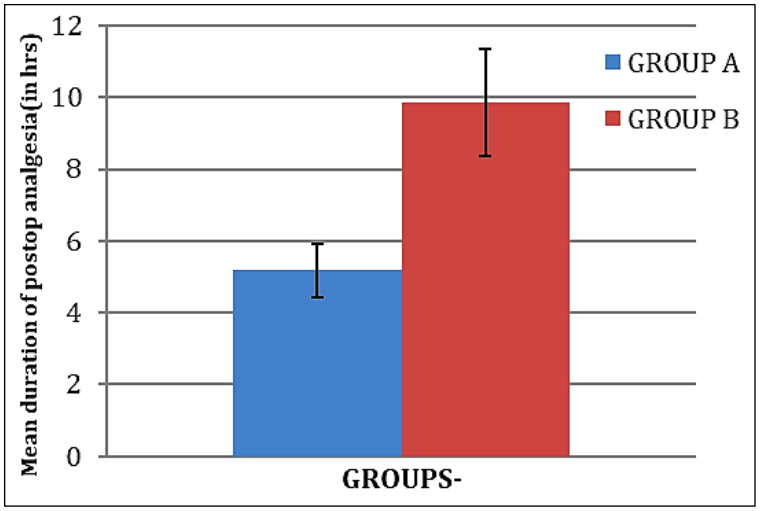

Fig 7: Showing Comparison of Mean Duration of Analgesia between Two Groups

The above bar diagram represents the difference between the duration of analgesia provided by each drug of the study group. It has been found maximum duration of postoperative analgesia with buprenorphine was 14 hrs while with that of butorphanol was 7 hrs.
Hence, inj. buprenorphine provided comparatively longer duration of postoperative analgesia than inj. Butorphanol.

Vital Parameters

Table 12: Comparison of Heart Rate between Two Groups

Study period	Heart Rate (beats/min)				p-value
	Group A		Group B		
	Mean	SD	Mean	SD	
0 min	82.18	3.70	81.26	2.86	0.1674
15 min	81.74	2.91	81.48	2.24	0.6178
30 min	83.70	2.98	83.32	2.81	0.5153
1 hour	83.10	2.61	83.94	4.43	0.2508
2 hour	84.76	2.09	85.00	4.77	0.7452
4 hour	80.14	3.03	80.86	5.26	0.4037
8 hour	88.90	5.53	89.38	6.50	0.6917
12 hour	84.90	1.75	85.38	3.39	0.3758
18 hour	80.88	4.50	81.74	6.10	0.4244
24 hour	85.10	2.07	84.26	4.74	0.8887

This chart comparing the heart rate of both groups using two tailed unpaired t test shows no statistical significance during the entire study period (p>0.05).

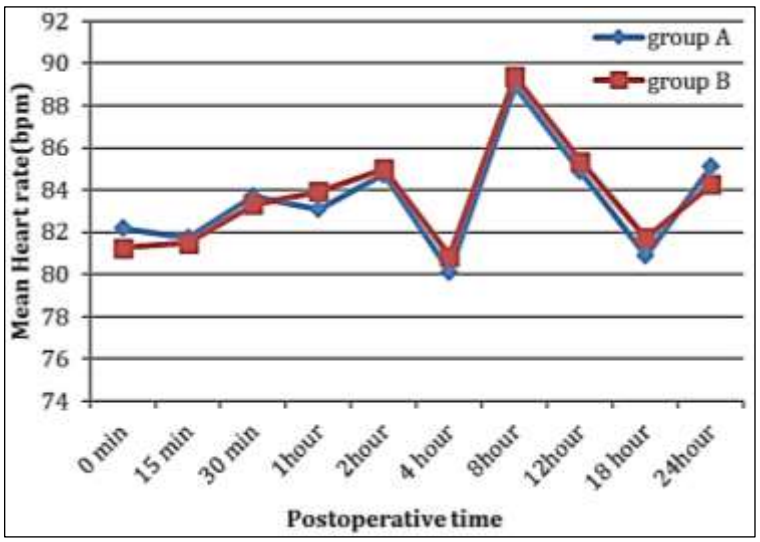

Fig 8: Line Diagram Showing Comparison of Mean Heart Rate between Two Groups

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Table 13: Comparison of Systolic Blood Pressure between Two Groups

Study Period	Systolic Blood Pressure (mm/hg)				P value
	Group A		Group B		
	Mean	SD	Mean	SD	
0 min	126.72	2.31	125.66	4.29	0.1272
15 min	124.14	2.91	125.10	3.87	0.1641
30 min	121.46	1.81	122.48	5.32	0.2024
1hour	125.06	3.28	126.02	3.48	0.1589
2hour	123.20	2.88	122.32	4.94	0.2792
4 hour	125.56	1.84	124.16	4.68	0.0518
8hour	128.76	5.19	129.54	2.49	0.3404
12hour	125.04	3.11	125.84	2.73	0.1748
18hour	122.78	3.18	123.26	4.06	0.5120
24hour	123.40	1.97	123.80	4.22	0.5450

This chart comparing the systolic blood pressure (SBP) of both groups using two tailed unpaired t test shows no statistical significance during the entire study. (p >0.05).

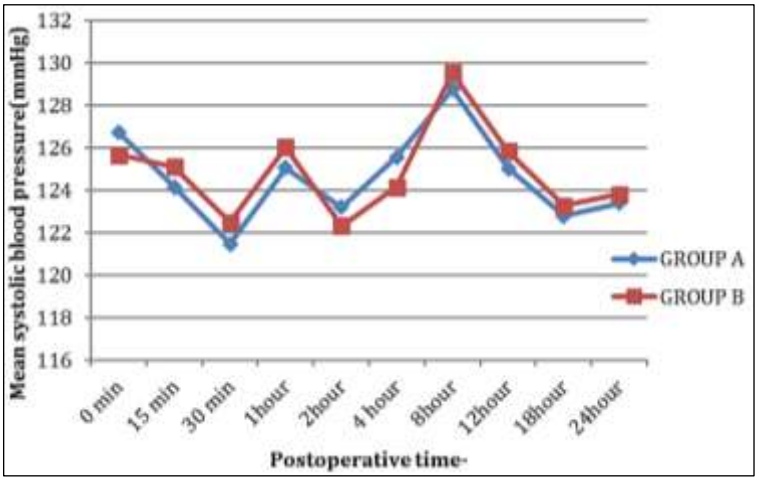

Fig 9: Line Diagram Showing Comparison of Mean Systolic Blood Pressure between Two Groups

Table 14: Comparison of Diastolic Blood Pressure between Two Groups

Study Period	Diastolic Blood Pressure (mm hg)				P Value
	Group A		Group B		
	Mean	SD	Mean	SD	
0 min	78.68	5.38	78.54	4.29	0.8859
15 min	77.70	2.46	78.52	4.18	0.2348
30 min	77.96	2.28	78.84	3.59	0.1427
1 hour	80.84	3.58	81.34	4.30	0.5289
2 hour	79.88	3.78	80.76	1.27	0.1219
4 hour	78.42	2.59	79.38	4.56	0.1986
8 hour	86.32	5.31	87.30	4.22	0.3095
12 hour	85.00	4.22	86.18	2.92	0.1072
18 hour	85.26	4.85	84.14	3.98	0.2098
24 hour	86.74	3.95	85.74	3.86	0.2035

This chart comparing the diastolic blood pressure (DBP)of both groups using two tailed unpaired t test shows no statistical significance during the study (p>0.05).

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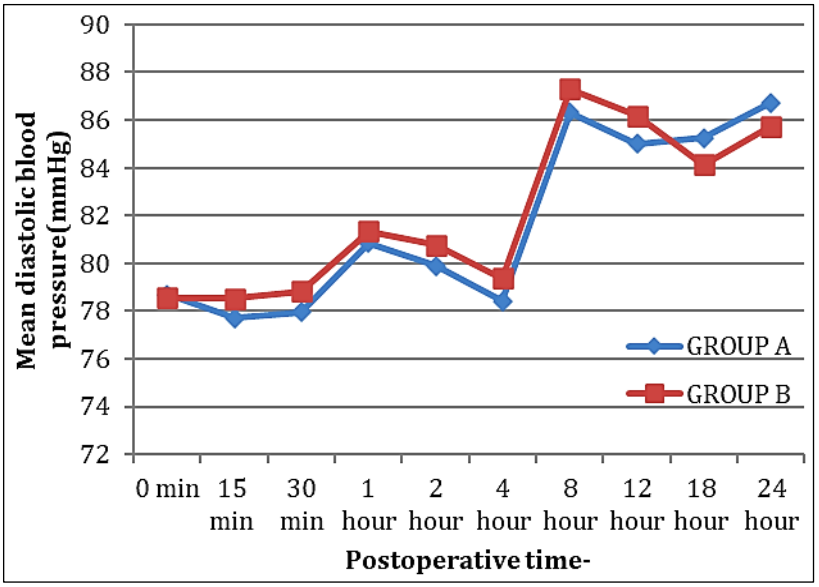

Fig 10: Line Diagram Showing Comparison of Mean Diastolic Blood Pressure between Two Groups

Table 15: Comparison of Respiratory Rate between Two Groups

Study Period	Respiratory Rate (Breaths/Min)				P value
	Group A		Group B		
	Mean	SD	Mean	SD	
0 min	18.72	2.32	18.10	1.88	0.1453
15 min	18.54	2.39	18.04	1.44	0.2081
30 min	18.78	2.13	18.14	1.56	0.0897
1 hour	17.92	2.43	17.44	1.73	0.2580
2 hour	17.60	2.19	17.68	1.85	0.8440
4 hour	18.60	2.28	18.14	1.93	0.2130
8 hour	17.72	2.38	18.10	1.78	0.3735
12 hour	17.82	1.86	18.32	1.52	0.1495
18 hour	19.18	1.77	19.20	1.28	0.9485
24 hour	19.98	2.50	19.22	1.30	0.0594

This chart comparing the respiratory rate (RR) of both groups using two tailed unpaired t test shows no statistical significance during entire study period (p value>0.05).

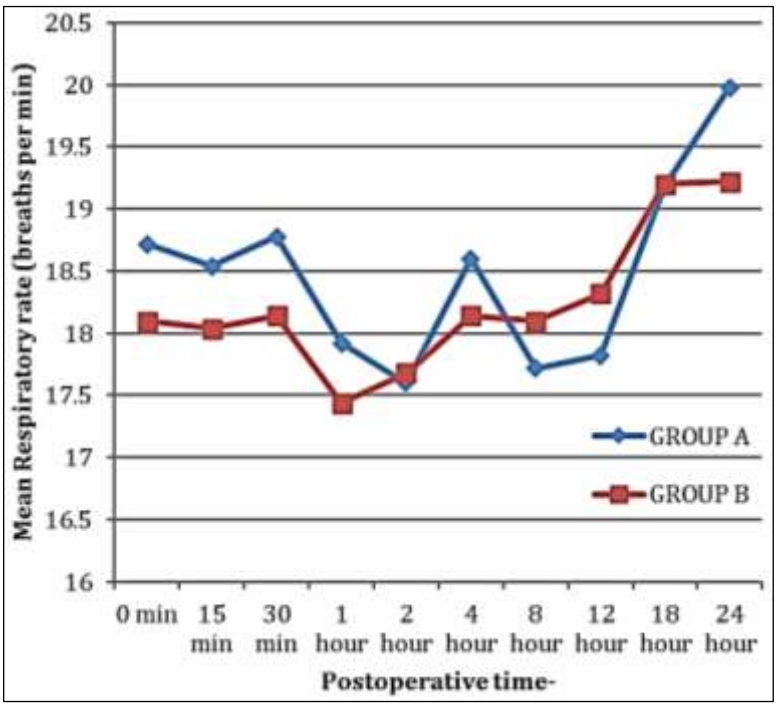

Fig 11: Line Diagram Showing Comparison of Mean Respiratory Rate between Two Groups

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Table 16: Comparison of SPO 2% between Two Groups

Study Period	SPO2%				P Value
	Group A		Group B		
	Mean	SD	Mean	SD	
0 mins	97.14	1.41	97.44	1.08	0.2352
15 mins	97.40	1.28	97.70	0.83	0.1675
30 mins	97.38	1.24	97.58	0.80	0.3402
1 hour	97.64	1.27	97.86	0.84	0.3095
2 hour	97.88	1.12	98.10	1.10	0.3242
4 hour	98.04	0.99	98.42	1.11	0.0739
8 hour	97.60	1.11	97.88	1.12	0.2122
12 hour	97.94	1.06	98.16	1.06	0.3019
18 hour	97.86	1.05	97.98	1.19	0.5941
24 hour	97.68	1.13	97.90	1.08	0.3242

SPO2 comparison between two groups shows no statistically significant variation (p>0.05).

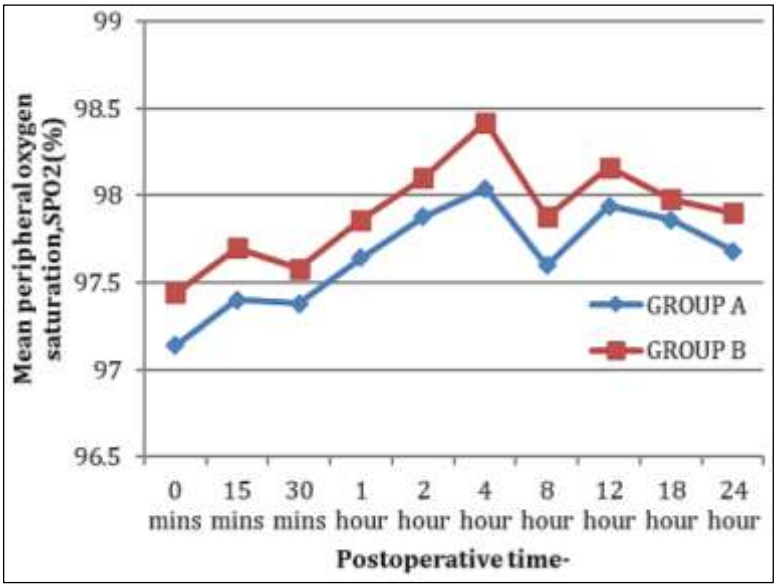

Fig 12: Line Diagram Showing Comparison of Peripheral Oxygen Saturation (SPO2) between Two Groups

On comparing SPO2, no statistical difference was found between two groups (p>0.05).

Table 17: Comparison of Visual Analog Pain Score between Two Groups

Study Period	Visual Analog Pain Score				P Value
	Group A		Group B		
	Mean	SD	Mean	SD	
1hour	0.26	0.43	0.38	0.48	0.1910
2 hour	0.32	0.507	0.40	0.48	0.4164
4 hour	2.70	0.67	1.52	0.67	<0.0001
8 hour	3.70	0.75	5.04	0.72	<0.0001
12 hour	3.62	0.89	4.64	0.81	<0.0001
18 hour	3.96	0.69	3.98	0.83	0.8960
24 hour	3.86	0.74	3.70	0.78	0.2953

On comparing the VAS score between two groups, extremely significant statistical difference was noted at 4th, 8th and 12th hour of the study. At 4th hour of study postoperatively, VAS score was higher in group A than group B (extremely statistically significant, p<0.0001) as analgesic effects of butorphanol started to wear off from this period onwards. At 8th and 12th hour of study VAS score was extremely significant in group B compared to group A(p <0.0001) as analgesic effects of buprenorphine started to wear off from this period onwards. During rest of study, VAS score was not statistically significant (p>0.05).

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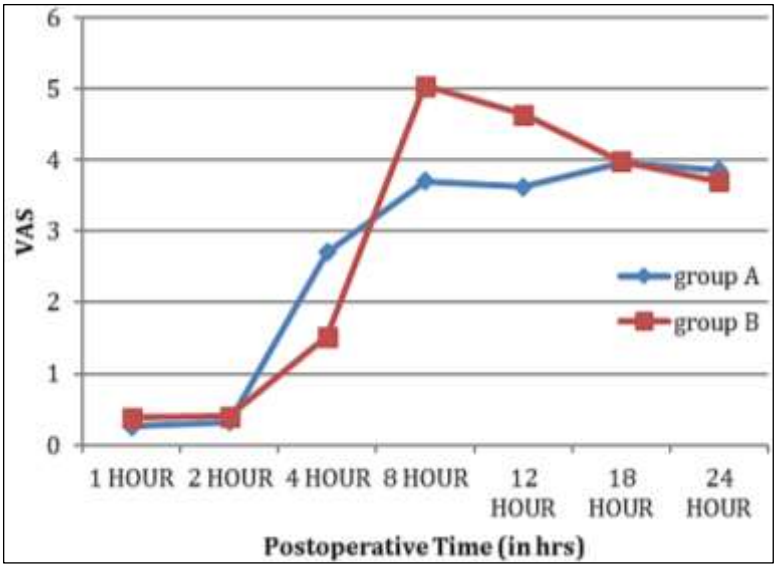

Fig 13: Line Diagram Showing Comparison of Vas between Two Groups

Table 18: Comparison of Ramsay Sedation Score between Two Groups

Study Period	Sedation Score (RSS) Group A		Sedation Score (RSS) Group B	
	Mean	SD	Mean	SD
O Min	1.90	0.30	1.88	0.32
15 Min	1.88	0.32	1.90	0.30
30 Min	2.20	0.40	2.20	0.40
1 HR	2.0	0.0	2.18	0.38
2 HR	2.0	0.0	2.02	0.14
4 HR	2.0	0.0	2.0	0.0
8 HR	2.0	0.0	2.0	0.0
12 HR	2.0	0.0	2.0	0.0

On comparing Ramsay Sedation Score between two groups at different time intervals, no statistical significant difference was found (p>0.05).

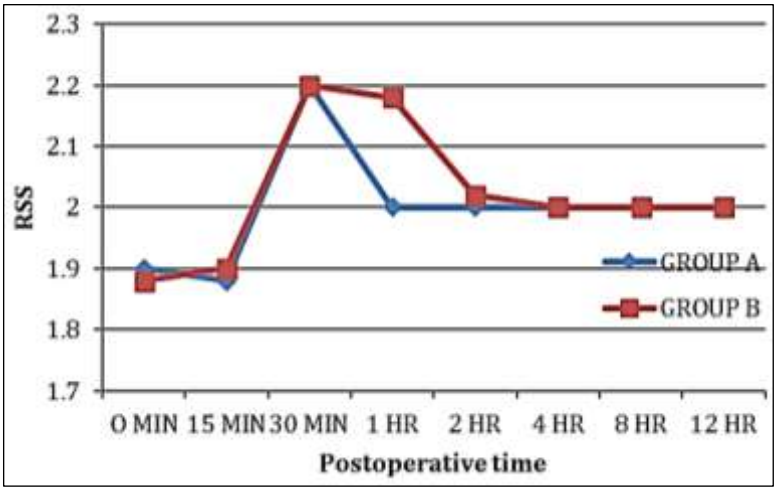

Fig 14: Line Diagram Showing Comparison of RSS Between two groups

Table 19: Showing Comparison of Side Effects between Two Drugs

Side Effects	Group A (N=50) (%)	Group B (N=50) (%)	P Value
Respiratory depression	0	0	
Pruritus	5(10%)	2(4%)	<0.05
Nausea	4(8%)	7(14%)	<0.05
Vomiting	5(10%)	10(20%)	<0.05
Hypotension	0	2(4%)	>0.05

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When side effects of drugs between two groups were compared it was found that the incidence of nausea and vomiting were found to be more with inj. Buprenorphine (Group B). Also there was occurrence of pruritus in 2 patients and hypotension in 2 patients belonging to Group B.

In Group A the incidence of nausea and vomiting was comparatively lesser as compared to Group B, nausea was seen in 4 patients and vomiting in 5 patients out of 50 in Group A while in Group B nausea seen in 7 patients and vomiting seen in 10 patients out of 50. Pruritus was seen in 5 patients (10%) in group A. None of patients in group A shows hypotension. Respiratory depression was not seen in both groups.

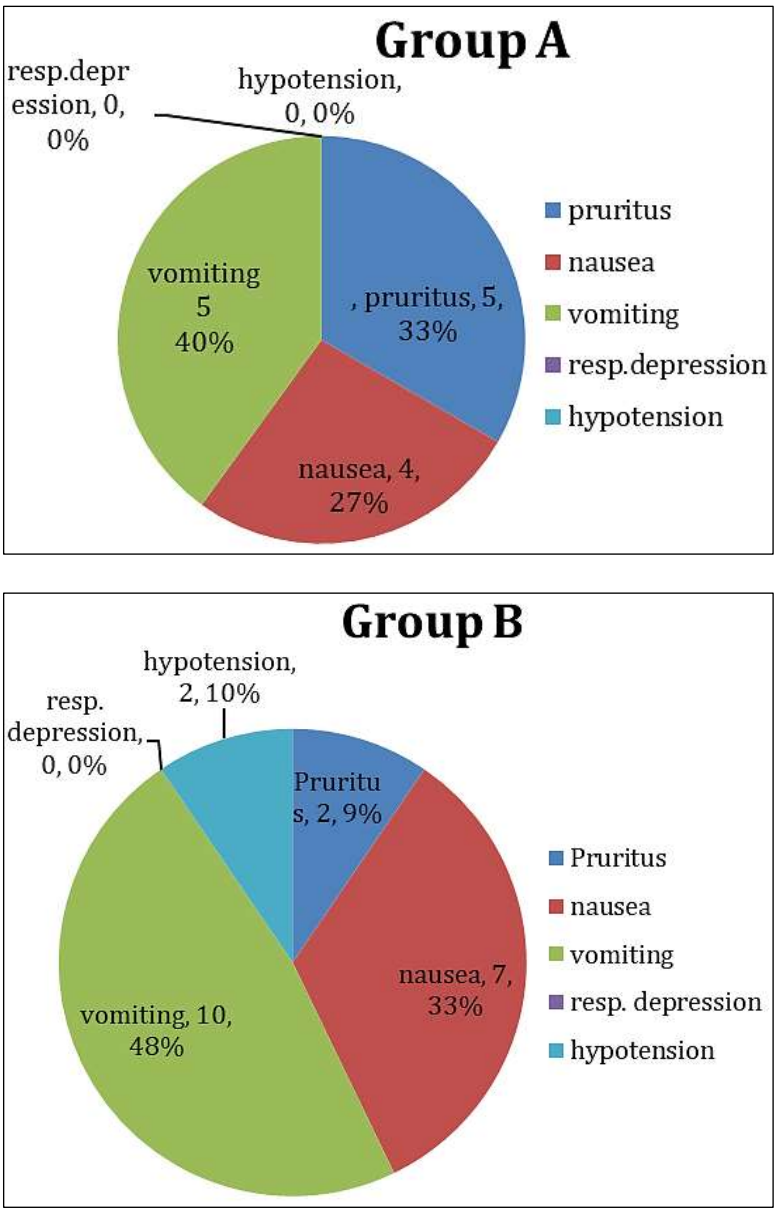

Fig 15A, B: Showing Distribution of Side Effects of Study Drugs between the Two Groups

Table 20: Comparison of No. of Epidural doses in First 24 Hours Post-Operatively

No. of epidural doses in first 24 hours.	Group A			Group B	
	No. of patients	%		No. of patients	%
1	0	0		0	0
2	0	0		40	**80
3	8	16		10	20
4	42	84**		0	0
Total no. of patients	50		100	50	100
Total no. of epidural doses consumed	192			110	
Mean± SD	**3.84±0.37**			**2.20±0.40**	
p< 0.0001					

**- highly significant (p<0.001)

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The above chart shows the difference in the requirement of rescue analgesics between the two groups in the first 24 hours postoperatively. Most of the patients in group A required 4 doses of analgesics in the first 24 hours postoperatively, whereas most patients in group B required 2 dose of analgesic in the first 24 hours postoperatively. 1 dose of analgesic was not sufficient for any patient in both the groups and none of the patients in group B required 4 doses of analgesics. Total number of analgesic doses needed by group A was 192 with a mean and standard deviation of 3.84±0.37 and total number of analgesic doses needed by group B was 110 with a mean and standard deviation of 2.20±0.40. The difference was extremely statistically significant (P<0.0001).

Discussion

Postoperative pain is a major concern for the anaesthesiologists which is one of the most prevalent forms of acute pain. Pain is defined as a complex physiologic reaction to tissue injury or visceral distension which is subjective and results in unpleasant, unwanted sensory, and emotional experience. Adequate pain control is must for surgical patients, as pain in the postoperative period is the most important aspect of their sufferings.

The technique of epidural analgesia for postoperative analgesia was first described by Cleland (1949) [6]. Different epidural opioids have been used to reduce anxiety and pain associated with surgery. Three classes of opioid receptors, mu, delta and kappa receptors (μ, δ, and κ) have been found in central and peripheral nervous system to which opioids bind.

The pharmacodynamic response depends upon to which receptor the opiods bind, the affinity of binding and whether it is an agonist or an antagonist.

Various studies done in the past on epidural narcotics for postoperative analgesia and it was concluded that analgesia produced by epidural route was better than by intravenous route and was relatively free of side effects. Behar *et al*. (1979) was the first person who used morphine for postoperative analgesia via epidural route [7]. After morphine, different drugs were studied and used for epidural analgesia.

The present study was comprised of 100 patients of ASA class I or II, aged 20-60 years, weight between 40-80 kgs and undergoing elective lower abdominal and lower limb orthopaedic surgery. All patients were randomly assigned to one of the two groups of 50 patients each. Group A-Comprised of 32 females and 18 male patients of mean age 35.88±10.59 years, mean weight 62.48 ± 7.30 kg and height of 164.48 ± 3.52 cm who received 1mg of inj. Butorphanol diluted upto 10 ml of normal saline and given epidurally. Group B-Comprised of 33 females and 17 male patients of mean age 39.06±12.35years, mean weight 61.64 ± 7.25 kg and height of 165.30 ± 3.81 cm who received 0.3mg of injection Buprenorphine diluted upto 10 ml of normal saline and given epidurally.

Buprenorphine a semi-synthetic opioid is a partial μ-receptor agonist, partial or full δ-receptor agonist and competitive antagonist at the κ-receptor. It has long half-life and it is 25-40 times more potent than morphine. It is available in a preservative free solution and has high lipid solubility. Butorphanol tartrate is a synthetic morphine derivative having partial agonist and antagonistic activity at μ-receptor and agonistic activity at the κ-receptor. As seen with other opioids, central nervous system effects (sedation, confusion and dizziness) are also seen with butorphanol.

Therefore, this study was undertaken to evaluate the efficacy of epidural butorphanol and epidural buprenorphine for postoperative analgesia in lower abdominal and lower limb surgery.

Onset of Action

Tan PH *et al*. [8] compared epidural butorphanol plus clonidine with epidural butorphanol for postoperative analgesia. They found that onset of analgesia with butorphanol (0.5mg) began at 5 min and peaked at 20-30 min.

Parikh GP *et al*. [9] conducted a study to compare epidural butorphanol with morphine for postoperative analgesia. They found that average onset of analgesia with butorphanol(0.04mg/kg) was 26.5 +/- 7.61 minutes.

Praveen kumardevullapalli *et al*. [10] conducted a study to compare epidural butorphanol 2mg with epidural morphine 2.5mg both diluted with normal saline to make final epidural volume of 10ml. They found that mean onset of analgesia with epidural butorphanol (2mg) was 14.66 + 4.34 (S. D) minutes.

Krishna Chaithanya *et al*. [11] compared epidural Bupivacaine (0.125%) versus epidural Bupivacaine (0.125%) and Butorphanol (2mg) for post-operative analgesia. They found that in group BB (2mg butorphanol + 0.125% bupivacaine) the onset of analgesia was 2-4 minutes (mean 2.69).

Swathi N *et al*. [12] compared epidural bupivacaine with butorphanol and bupivacaine with tramadol for postoperative analgesia. They found that onset of action (8.44 ± 1.158 min in Butorphanol group and 12.80 ± 1.354 min in Tramadol group) was faster in butorphanol group.

Pokharel K *et al*. [13] did a study where group 1 received epidural 0.125% bupivacaine while group 2 and 3 received an additional 0.5 mg and 0.75 mg butorphanol respectively for postoperative analgesia. The found that onset of analgesia in group 2 (4.1+/-2.6 min.) and group 3 (4.0+/-2.5 min) were significantly different (P≤0.01) from group 1 (6.6+/-2.7 min).

Arun Kumar Gupta *et al*. [14] compared epidural Fentanyl and Buprenorphine for post Operative

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Analgesia. Group I(n=30) received 200 µg of fentanyl dissolved in 10 ml of normal saline and Group II(n=30) received 60µg of buprenorphine dissolved in 10 ml of normal saline. They found that mean onset of analgesia in buprenorphine group was 13.70±3.24 minutes.
In our study the mean onset of analgesia with epidural butorphanol(1mg) was 8.50±2.483 minutes whereas with epidural buprenorphine it was 13.46 ±3.49 minutes.
We found that epidural Butorphanol has rapid onset of analgesia when compared to epidural Buprenorphine and the observations of our study correlates with above studies.

Duration of analgesia
Dona Elsa Jose *et al*. [15] compared epidural buprenorphine and butorphanol for postoperative analgesia and found that buprenorphine has longer duration of postoperative analgesia when compared to butorphanol (586.17 ± 73.64 vs. 342.53 ± 47.42 [P ≤ 0.001]).
Praveen kumardevullapalli *et al*. [10] found that mean duration of postoperative analgesia with epidural butorphanol (2mg) ranged from 4-8 hours with a mean ± SD of 5.20±0.71 hours.
Ruchi Gupta *et al*. [16] compared epidural butorphanol with epidural tramadol for postop analgesia. Group I (n=30) received 2mg butorphanol as bolus epidurally, 1 mg for top up dose. Group II (n=30) received 100mg tramadol as bolus, 50 mg for top up. The duration of analgesia in Butorphanol group was found to be 5.35±0.29 hr and in Tramadol groups 6.25±1.58 hrs. Sanjeev B. Birajdar *et al*. 176 compared different doses of epidural butorphanol for postop analgesia in orthopedic patients. Study comprised of Group A & B of 30 patients each, receiving 1mg & 2mg of butorphanol respectively, diluted upto 10ml of normal saline and given by epidural catheter. The mean duration of analgesia ingroup A (1mg) was 187 ± 29.14 minutes and in group B(2mg) was 201± 33.56 minutes. The difference between the two was statistically not significant (p≥0.05).
Krishna Chaithanya *et al*. [11] compared epidural Bupivacaine (0.125%) versus epidural Bupivacaine (0.125%) and Butorphanol (2mg) for post-operative pain relief. The duration of analgesia lasted for 2-4 hours (mean 2.98) in bupivacaine group where as in bupivacaine-butorphanol group (2mg butorphanol + 0.125% bupivacaine) duration of analgesia lasted for 6-8 hours (mean 6.98) (p≤0.0001).
Swathi N *et al*. [12] compared epidural bupivacaine with butorphanol and bupivacaine with tramadol for postoperative pain relief in abdominal surgeries and they concluded that duration of analgesia was longer with tramadol group (5.92 ± 0.76 h with butorphanol vs. 7.68 ± 0.76 h with tramadol).
Bharti N, Chari P *et al*. [17] compared epidural butorphanol with epidural butorphanol-bupivacaine for postoperative pain relief. Patients were divided in 3 groups:
Group 1: Received two mg of butorphanol in 10 mL of normal saline.
Group 2: Received two mg of butorphanol in 10 mL of 0.125% bupivacaine.
Group 3: Received two mg of butorphanol in 10 mL of 0.25% bupivacaine.
They found that the duration of analgesia was prolonged in patients receiving butorphanol with bupivacaine combination (8.68 +/- 0.82 hrs, 9.82 +/- 0.54 hrs) as compared with butorphanol alone (4.35 +/- 0.66 hrs; P ≤ 0.05).
Egon Lanz *et al*. [18] studied postoperative analgesia and side effects of epidural buprenorphine and found that the postoperative analgesic effect of 0.3 mg buprenorphine lasts for about 12 hr.
J. Wolff *et al*. [19] compared epidural buprenorphine (0.3 mg) with epidural morphine (4mg) for postoperative analgesia in the first 24 hours. They found that mean duration of analgesia was 620 minutes with epidural buprenorphine (0.3mg).
Kumar D *et al*. [20] did a comparative study of epidural buprenorphine and ketamine for postoperative pain relief. They observed that the mean duration of analgesia with buprenorphine was 13.1 hours (range 8-24 hours).
R.Y. Gundersen *et al*. [21] did a double-blind study on postoperative pain relief with high-dose epidural buprenorphine. One group received 0.3 mg and the other 0.9 mg of buprenorphine epidurally to abolish postoperative pain. They concluded that both epidurally administered buprenorphine in doses of 0.3 and 0.9 mg produced excellent and long-lasting (8-9 h) postoperative analgesia in the majority of their patients.
G.P. Wilde *et al*. [22] did a study on epidural buprenorphine for pain relief after spinal decompression. The mean duration of post-operative analgesia was more than 10 hours in the buprenorphine group (0.3mg).
In our study, the mean duration of post operative analgesia obtained with epidural Butorphanol (1mg) was 311.40±44.82 minutes (range 4-7.0 hours) and with Buprenorphine was 591±89.40mins. (range 8-14 hrs). The observations of our study correlates with above mentioned studies and thus proves the longer duration of action of epidural Buprenorphine compared to butorphanol.

Side effects
Dona Elsa Jose *et al*. [15] found that both groups did not show respiratory depression. The incidence of nausea, vomiting (13% vs. 10%) and headache (20% vs. 13%) was more in buprenorphine group however the incidence of pruritus (3% vs. 6%) was found to be more with butorphanol group. No other complications were observed.

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Sanjeev B. Birajdar *et al*. [23] compared different doses of epidural butorphanol for postop analgesia in orthopedic patients. Study comprised of Group A; B of 30 patients each, receiving 1mg; 2mg of butorphanol respectively, diluted upto 10ml of normal saline. They found that postoperatively, nausea and vomiting was observed in 1 patient in both group A and group B. Pruritis was observed in 1 patient in group B & not observed in any patient in group A. No patient had urinary retention and respiratory depression in either group.

H K Sale *et al*. did a randomized study to evaluate effectiveness of Buprenorphine for post-operative analgesia in terms of duration, quality and side effects by different routes of administration. After surgery, patients received buprenorphine 300 mcg by various routes of administration. They found that side effects due to buprenorphine considering whole population as study sample were urinary retention in 3 patients (4%), nausea in 5 patients (6.67%), vomiting in 2 patients (2.66%). None of the patients shows respiratory depression.

J. Wolff *et al*. [19] compared Epidural buprenorphine (0.3 mg) with epidural morphine (4mg) for postoperative analgesia in the first 24 hours. They found that in the buprenorphine group, none of patients shows respiratory depression, 3 (out of 20) patients had nausea, 2 patients (out of 20) had vomiting.

Arun Kumar Gupta *et al*. [14] did a comparative study of epidural Fentanyl and Buprenorphine for post operative analgesia in lower abdominal and lower limb surgeries. They found that incidence of nausea and vomiting was very common with epidural buprenorphine as compared to fentanyl. Pruritus was seen in 6.6% of patients in the fentanyl groups but none had in buprenorphine group. None of the patients in either group had respiratory depression.

William E. Ackerman *et al*. [24] did a comparison of the incidence of pruritus following epidural opioid administration in the parturient and found that both buprenorphine and butorphanol had very low incidence of pruritus (butorphanol comparatively shows more incidence than buprenorphine) compared to other opioids.

In our study, the incidence of nausea and vomiting found to be more in Buprenorphine group i.e. 14% and 20% respectively compared to Butorphanol group where the incidence of nausea and vomiting were found to be 8% and 10% respectively and the difference found to be statistically significant ($p \leq 0.05$). The finding of our study correlates with the observation of Dona Elsa Jose *et al*. (15).; Sanjeev B. Birajdar *et al*. [23].

The incidence of pruritus in our study was found to be relatively higher in Butorphanol group compared to buprenorphine group (5% vs 2%) and difference found to be statistically significant ($p<0.05$). The findings correlate with the observation of Dona Elsa Jose *et al*.; William E. Ackerman *et al*. [24]; Arun Kumar Gupta *et al*. [14]. None of the patients in the study shows respiratory depression.

Hemodynamic Changes

Sanjeev B. Birajdar *et al*. [23] found that on comparing the VAS scores of two groups, there was no statistical significant difference in VAS scores at varying time intervals in patients receiving 1mg and 2 mg of epidural butorphanol. They also reported that pulse rate, systolic blood pressure and diastolic blood pressure remained stable in the entire study period and difference between two groups was not statistically significant.

Praveen kumardevullapalli *et al*. [10] reported that hemodynamic stability was well maintained during the entire study in the butorphanol group.

Ruchi Gupta *et al*. [25] conducted a study by comparing epidural butorphanol with epidural tramadol for postop analgesia and found that on intergroup comparison the difference in mean pulse rate, systolic and diastolic blood pressure were not found statistically significant. The mean VAS score between the groups was highly significant ($p \leq 0.001$) at 0.5, 1, 1.5, 2 hrs; significant ($p \leq 0.05$) from 4 to 8 hours and at 12, 24 hours it was insignificant statistically ($p \geq 0.05$).

Taguchi T. *et al*. [26] studied effect of buprenorphine on cancer pain-a single-blind crossover comparison with pentazocine and found that hemodynamic stability was well maintained, suggesting little effect of buprenorphine on the respiratory and cardiovascular system.

J. Wolff *et al*. [19] compared Epidural buprenorphine (0.3 mg) with epidural morphine(4mg) for postoperative analgesia in the first 24 hours and reported only minor changes in blood pressure, heart rate and respiratory rate during the entire study period.

Arun Kumar Gupta *et al*. [14] did a comparative study of Epidural Fentanyl and Buprenorphine for post operative analgesia in lower abdominal and lower limb surgeries. They found that in the buprenorphine group the mean pulse rate showed a tendency to decrease at all the recorded timings, but this was statistically significant only from 20 minutes to 6 hours ($p \leq 0.05$). Between the two groups there was a statistically significant decrease in the pulse rate at 20 minutes, 30 minutes,1 hour and 2 hours ($p \leq 0.05$). Between the two groups, a significant fall in systolic blood pressure was observed at 20 minutes 30 minutes and 1 hour ($p \leq 0.05$). Between the two groups, no significant differences was observed at any time in diastolic blood pressure ($p \geq 0.05$) The respiratory rate (RR) did not show any significant changes in any group, statistically not significant ($p \geq 0.05$). The oxygen saturation (SPO_2) was maintained above

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98% in all the patients in both the groups.
In our study intergroup comparison of systolic and diastolic blood pressure, heart rate, respiratory rate, oxygen saturation was done using two tailed unpaired student t test and no statistically significant difference was found between the two groups during the entire study but two cases of hypotension noted in buprenorphine group (fall ≥20% of baseline value). The findings of our study correlates with the observations of Sanjeev B. Birajdar *et al.*; Praveen Kumardevullapalli *et al*. [10]; Ruchi Gupta *et al*. [25]; J. Wolff *et al*. [19]; Arun Kumar Gupta *et al*.
In our study, on comparing the VAS score between two groups, there was extremely significant statistical difference ($p \leq 0.0001$) noted at 4th, 8th and 12th hour of the study. At 4th hour of study postoperatively, VAS score was higher in group A than group B ($p \leq 0.0001$) as analgesic effects of butorphanol initial epidural dose started to wear off from this period onwards. At 8th and 12th hour of study VAS score was significantly higher in group B compared to group A($p \leq 0.0001$) as analgesic effects of buprenorphine initial epidural dose started to wear off from this period onwards. During rest of study, VAS score comparison was not statistically significant ($p \geq 0.05$). The finding of our study correlates with observations of Ruchi Gupta *et al*.
On assessing and comparing sedation between the two groups by Ramsay sedation score (RSS), no statistically significant difference was found at different time intervals (p value ≥ 0.05).

Rescue Analgesia
Ruchi Gupta *et al*. 174 reported that in butrophanol group majority of the patients required 4 epidural dosages while in tramadol group 3 dosages were required for pain relief postoperatively in first 24 hours and this difference was highly significant ($p \leq 0.001$).
Egon Lanz, *et al*. [27] reported that patients who received 0.3mg epidural buprenorphine requested fewer additional analgesics during the postoperative period than did patients who received 0.15 mg buprenorphine or no epidural reinjection.
In our study, in butrophanol group majority of the patients required 4 epidural dosages while in Buprenorphine group majority of patients required 2 epidural dosages for pain relief postoperatively in first 24 hours and this difference was extremely significant ($p \leq 0.0001$). The observations of our study correlates with findings of Ruchi Gupta *et al*. [25], Egon Lanz, *et al*. [27].

Conclusion
Epidural analgesia is a well-accepted modality that effectively attenuates postoperative pain. The choice of drug to provide analgesia should balance the efficacy of analgesia against the frequency of side effects indicating the safety profile.
Butorphanol and Buprenorphine both were found to be effective for postoperative analgesia when used epidurally in patients undergoing lower abdominal and lower limb surgeries. It was found that epidural buprenorphine in comparision to epidural butorphanol provides better quality of analgesia with longer duration of action however epidural butorphanol found to have faster onset of action compared to buprenorphine. The incidence of nausea and vomiting found to be more with epidural buprenorphine whereas incidence of pruritus was more with epidural butorphanol. Respiratory depression was not seen in any patient. In both the groups, hemodynamic stability was well maintained throughout the study. In buprenorphine group, lesser rescue analgesia was required postoperatively in first 24 hours. Thus, we conclude that epidural buprenorphineis a better analgesic than epidural butorphanol for providing postoperative pain relief.

Conflict of Interest: None.

Funding statement: None.

List of Abbreviations
ASA-American Society of Anesthesiologists.
ASA I-ASA Physical Status Classification I.
ASA II-ASA Physical Status Classification II.
ECG-Electrocardiogram.
NIBP-Non-invasive Blood Pressure.
$ETCO_2$-End-tidal carbon dioxide.
SBP-systolic blood pressure.
DBP-diastolic blood pressure.
MAP-mean blood pressure.
SpO2-Oxygen saturation.
O2-Oxygen.
N2O-Nitrous oxide.
L3-L4-L3 third lumbar spine, L4 forth lumbar spine.

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GA-General Anaesthesia.
VAS-Visual Analogue Scale.
Min-minutes.
Kg-Kilogram
S.D-Standard Deviation.
TAH-Total abdominal hysterectomy
EXP.LAP-Exploratory laparotomy
FSF-Fracture shaft of femur.
FT-Fracture of tibia.
ORIF-Open reduction and internal fixation.

References

1. Sultan P, Gutierrez MC, Carvalho B. Neuraxial morphine and respiratory depression: Finding the right balance. Drugs. 2011;71:1807-19.
2. Bromage PR, Camporesi EM, Durant PA, Nielsen CH. Nonrespiratory side effects of epidural morphine. Anesth Analg. 1982;61:490-5.
3. Gudin J, Fudin J. A Narrative Pharmacological Review of Buprenorphine: A Unique Opioid for the Treatment of Chronic Pain. Pain Ther. 2020 Jun;9(1):41-54. Doi: 10.1007/s40122-019-00143-6. Epub 2020 Jan 28. PMID: 31994020; PMCID: PMC7203271.
4. Mégarbane B, Hreiche R, Pirnay S, Marie N, Baud FJ. Does high-dose buprenorphine cause respiratory depression? possible mechanisms and therapeutic consequences. Toxicol Rev. 2006;25(2):79-85. Doi: 10.2165/00139709-200625020-00002. PMID: 16958555.
5. Ji J, Lin W, Vrudhula A, Xi J, Yeliseev A, Grothusen JR, *et al*. Molecular Interaction Between Butorphanol and κ-Opioid Receptor. Anesth Analg. 2020 Sep;131(3):935-942. Doi: 10.1213/ANE.0000000000005017. PMID: 32701545; PMCID: PMC7668422.
6. Waurick K, Waurick R. Epiduralanästhesie-Geschichte und Technik der Epiduralanästhesie [History and Technique of Epidural Anaesthesia]. Anasthesiol Intensivmed Notfallmed Schmerzther. 2015 Jul;50(7-8):476-82; quiz 483. German. doi: 10.1055/s-0041-100845. Epub 2015 Jul 31. PMID: 26230893.
7. Behar M, Magora F, Olshwang D, Davidson JT. Epidural morphine in treatment of pain. Lancet. 1979 Mar;1(8115):527-9. doi: 10.1016/s0140-6736(79)90947-4. PMID: 85109.
8. Tan PH, Chou AK, Perng JS, Chung HC, Lee CC, Mok MS. Comparison of epidural butorphanol plus clonidine with butorphanol alone for postoperative pain relief. Acta Anaesthesiol Sin. 1997 Jun;35(2):91-6. Erratum in: Acta Anaesthesiol Sin 1997 Sep;35(3):191. PMID: 9293649.
9. Parikh B, Joshi A. Comparison of epidural butorphanol versus epidural morphine in postoperative pain relief. Middle East J Anaesthesiol. 2014 Feb;22(4):371-6. PMID: 25007690.
10. Praveen Kumar Devulapalli, Hemanth Raj Verma. A Comparative Study of Epidural Butorphanol and Epidural Morphine for the Relief of Postoperative Pain. Journal of Evolution of Medical and Dental Sciences. 2015 April;4(30):5161-5171. DOI: 10.14260/jemds/2015/754
11. Krishna Chaithanya, Narasimha Reddy, Sangamitra Gandra, Sujith TR, Venkateswar Rao. A Comparative Study of the Effect of Epidural Bupivacaine (0.125%) versus Epidural Bupivacaine (0.125%) and Butorphanol (2mg) for Post-Operative Pain Relief in Lower Abdominal and Lower Limb Surgeries. Journal of Evolution of Medical and Dental Sciences. 2014 Aug;3(35):9243-9249. DOI: 10.14260/jemds/2014/3193
12. Swathi N, Ashwini N, Shukla MI. Comparative study of epidural bupivacaine with butorphanol and bupivacaine with tramadol for postoperative pain relief in abdominal surgeries. Anesth Essays Res. 2016 Sep-Dec;10(3):462-467. Doi: 10.4103/0259-1162.177522. PMID: 27746533; PMCID: PMC5062192.
13. Pokharel K, Rahman TR, Singh SN, Bhattarai B, Basnet N, Khaniya S. The efficacy and safety of low dose epidural butorphanol on postoperative analgesia following cesarean delivery. JNMA J Nepal Med Assoc. 2008 Apr-Jun;47(170):57-61. PMID: 18709032.
14. Arunkumar R, Nimi G, Sandhya K. A comparative study on the effect of intrathecal nalbuphine and buprenorphine as an adjuvant to 0.5% hyperbaric bupivacaine in elective infraumbilical surgeries. Indian J Clin Anaesth 2024;11(2):159-166.
15. Jose DE, Ganapathi P, Anish Sharma NG, Shankaranarayana P, Aiyappa DS, Nazim M. Postoperative pain relief with epidural buprenorphine versus epidural butorphanol in laparoscopic hysterectomies: A comparative study. Anesth Essays Res. 2016 Jan-Apr;10(1):82-7. doi: 10.4103/0259-1162.173612. PMID: 26957696; PMCID: PMC4767084.
16. Gupta R, Kaur S, Singh S, Aujla KS. A comparison of Epidural Butorphanol and Tramadol for Postoperative Analgesia Using CSEA Technique. J Anaesthesiol Clin Pharmacol. 2011 Jan;27(1):35-8. PMID: 21804703; PMCID: PMC3141111.
17. Bharti N, Chari P. Epidural butorphanol-bupivacaine analgesia for postoperative pain relief after abdominal hysterectomy. J Clin Anesth. 2009;21:19-22.

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18. Lanz E, Simko G, Theiss D, Glocke MH. Epidural buprenorphine-a double-blind study of postoperative analgesia and side effects. Anesth Analg. 1984 Jun;63(6):593-8. PMID: 6375465.
19. Wolff J, Carl P, Crawford ME. Epidural buprenorphine for postoperative analgesia. A controlled comparison with epidural morphine. Anaesthesia. 1986;41:76-9.
20. Kumar D, Dev N, Gupta N. Comparative study of epidural Buprenorphine and Ketamine for post-operative pain relief. Ind. J Anaesth. 1997;(41):38.
21. Gundersen RY, Andersen R, Narverud G. Postoperative pain relief with high-dose epidural buprenorphine: a double-blind study. Acta Anaesthesiol Scand. 1986 Nov;30(8):664-7. doi: 10.1111/j.1399-6576.1986.tb02497.x. PMID: 3544649.
22. Wilde G, Whitaker A, Moulton A. Epidural buprenorphine for pain relief after spinal decompression. J Bone Joint Surg Br. 1988;70-B(3):448-450. doi:10.1302/0301-620X.70B3.3286657
23. Sanjeev B. Birajdar, *et al*. Comparative Study of Different Doses of Epidural Butorphanol for Postoperative Analgesia in Orthopaedic Patients Int J Cur Res Rev; 2014 April, 06(08).
24. William E. Ackerman TM, Mushtaque M. Juneja, David M. Kaczorowski, George W. Colclough. A comparison of the incidence of pruritus following epidural opioid administration in the parturient. Can J Anaesth. 1989;36(4):388-91.
25. Gupta Ruchi, Kaur Simmerpreet, Singh Saru, Aujla KS. A comparison of Epidural Butorphanol and Tramadol for Postoperative Analgesia Using CSEA Technique. Journal of Anaesthesiology Clinical Pharmacology. 2011 Jan-Mar;27(1):35-38.
26. Taguchi T. [Effect of a long-acting analgesic, buprenorphine on cancer pain-a single-blind crossover comparison with pentazocine]. Gan To Kagaku Ryoho. 1982 Feb;9(2):250-7. Japanese. PMID: 7184401.
27. Lanz E, Simko G, Theiss D, Glocke MH. Epidural buprenorphine-a double-blind study of postoperative analgesia and side effects. Anesth Analg. 1984 Jun;63(6):593-8. PMID: 6375465