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Original Research Article

A comparative study of epidural bupivacaine with dexmedetomidine and epidural bupivacaine with fentanyl for postoperative analgesia in lower limb orthopaedic surgeries

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Abstract

Introduction: Multimodal analgesia through different techniques is associated with superior pain relief. Opioids as epidural adjunct to local anesthetics have been in use for long and α2 agonists are being increasingly used for same. The present study aims at comparing the hemodynamic, sedative and analgesic effects of epidurally administered fentanyl and dexmedetomidine when combined with bupivacaine.
Methods: A comparative randomized double-blind study consisting 60 patients with ASA physical status I and II of either sex between 20 and 50 years scheduled for lower limb orthopedic surgeries under epidural block were randomly divided into two Groups (n = 30) D and F. After epidural block with 15 ml of 0.5% Bupivacaine, Group D received 1 µg/kg of Dexmedetomidine and Group F received 1 µg/kg of Fentanyl. Time to request for the first postoperative analgesia were recorded.
Results: Mean duration of analgesia was 340.8 minutes with SD of 13.098 in dexmedetomidine group and 263.97 minutes with SD of 10.778 in fentanyl group Duration of sensory and motor blockade were prolonged in group D compared to group F.
Conclusion: Dexmedetomidine seems to be a better alternative to fentanyl as an epidural adjuvant due to prolonged postoperative analgesia and lower consumption of rescue analgesia.

Keywords: Epidural, bupivacaine, dexmedetomidine, fentanyl, postoperative pain relief

Introduction

Inadequately controlled pain negatively affects quality of life, function, and functional recovery, the risk of post-surgical complications and the risk of persistent post-surgical pain. Use of epidural analgesia for major surgeries provides effective pain relief with minimal side effects and high levels of patient satisfaction. It also obtunds central sensitization and pain

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induced organ dysfunction, leading to improved outcome [1]. Epidural being the volume dependent technique require larger doses of bupivacaine to achieve analgesic effects. Opioids such as Fentanyl are commonly used as an adjuvant to Bupivacaine to reduce the dose, to increase the onset and prolong the duration of analgesia [2]. Fentanyl an opioid analgesic provides a dose sparing effect of local anaesthetic to achieve a desired anaesthetic effect. Opioid does provide a dose sparing effect of local anaesthetic and superior analgesia but there is always a possibility of an increased incidence of pruritis, urinary retention, nausea, vomiting and respiratory depression [3]. Alpha 2-agonists such as dexmedetomidine is also being used as adjuvant to local anaesthetic in place of opioids. The alpha 2-adrenergic agonists provide sedation, anxiolysis, hypnosis, analgesic, antihypertensive and sympatholytic effect [4]. Alpha 2-agonists such as dexmedetomidine is also being used as adjuvant to local anaesthetic in place of opioid. Keeping the benefits of epidural adjunct to bupivacaine in consideration, our study is designed to compare the efficacy of dexmedetomidine versus fentanyl in combination with bupivacaine for postoperative analgesia in lower limb orthopedic surgery. With primary objective being to compare the efficacy of epidural bupivacaine with dexmedetomidine and fentanyl for postoperative analgesia, and secondary objectives pointing towards the comparison of time required for first epidural analgesia top up after bolus dose and to assess hemodynamic parameters in perioperative period.

Methodology

A comparative, randomised, double blinded study was carried out on 60 ASA physical status grade I and II patients of either sex between 20-50 years of age, scheduled for elective lower limb orthopaedic surgeries. The study was conducted in department of Anesthesiology, BMCH, Chitradurga. After the approval by the Institutional Ethical Committee on 16th January 2021 numbered 2020-2021/96, written informed consent was obtained from all the patients before being included in the study. Patients refusal, patients with known drug allergies to local anesthetics, bleeding and clotting disorders, patients with spinal deformities such as kyphoscoliosis, neurological deficits, previous spinal injuries and surgeries, patients with both local and systemic sepsis were excluded from the study.

The sample size was calculated from the data obtained by the previous study Paul A. (A comparative study of dexmedetomidine and fentanyl as an adjuvant to epidural bupivacaine in lower limb surgeries). Sampling was done by Simple Random Sampling using computer generated table. Sample size was calculated using Open-epi software considering 95% confidence interval, 80% power of study and assumed standard deviation of 3.57. Sample size obtained was 30 in each group.

Sixty adult patients with ASA physical status I and II and between 20 and 50 years of age were allocated randomly into two groups (30 patients each). Group I received Epidural bupivacaine with dexmedetomidine 1µg/kg and Group II received Epidural bupivacaine with fentanyl 1 µg/kg. Preoperative evaluation of all the patients were performed with detailed history, physical examination including weight, height and airway examination. baseline investigations were done and all the patients kept nil per oral as per ASA fasting guidelines. Premedicated with Inj. Ranitidine 150mg IV (intravenous) and Inj. Alprazolam 0.25mg IV. On arrival of patient to operating theatre, they were monitored by continuous electrocardiogram (ECG), noninvasive blood pressure (NIBP) monitor and pulse oximeter. The patient's baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), oxygen saturation by pulse oximetry (SpO2) were documented by an anaesthesiologist who was blinded to the study.

A large bore 18G intravenous (IV) cannula was secured at non-diseased site for drugs and continuous intravenous fluid administration. Standard monitors were attached after that

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patients were made to sit and under strict aseptic precautions 18G Tuohy's needle was inserted into L2-L3 interspinous epidural space. Epidural space was confirmed by loss of resistance to air method and epidural catheter was threaded 3-4cm inside the epidural space and fixed after institution of test dose with 3ml Inj. lidocaine 0.2% with adrenaline. Once catheter placed in epidural space confirmed then study drug was administered according to randomly selected group. Hemodynamic parameters were recorded intraoperatively following injection of epidural at every 5 minutes for first 45 minutes.

If adequate sensory and motor blockade was not achieved by study drug then anaesthesia modality was switched on to Subarachnoid block or General anesthesia and not considered for this study anymore.

Later continuously monitored with standard monitors. After completion of surgery patients were shifted to postoperative ward; hemodynamic parameters were recorded at every 30 minute interval. Pain relief was assessed with both subjective and objective parameters. Subjective parameter assessed by using 10-point visual analog scale in which a score of 0 indicated no pain and a score of 10 indicates worst pain imaginable. Duration of analgesia was recorded as the first complaint of pain that is VAS>4 in the postoperative period and rescue analgesic was administered.

Once patient complained of pain 10ml of 0.125% bupivacaine injected epidurally.

Objective parameters were heart rate, systolic blood pressure, diastolic blood pressure.

Results

The present study was conducted at the Department of Anesthesiology, BMCH, Chitradurga. After the approval by the Institutional Ethical Committee on 16th January 2021 numbered 2020-2021/96, written informed consent was obtained from all the patients before being included in the study, to study the efficacy of epidural dexmedetomidine with bupivacaine versus epidural fentanyl with bupivacaine for postoperative pain relief in lower limb orthopedic surgery.

A total of 60 patients of lower limb orthopedic surgery fulfilling the inclusion criteria were included in the group. Difference in age of both the groups was not found to be statistically significant (P= 1.73) Out of 60 patients recruited in the study, (46.7%) were females and rest (53.3%) were males. Difference in gender of patients in both the groups was not found to be statistically significant.

The first analgesic requirement in Group F was earlier (263.87 min) as compared to Group D (340.8 min). Difference in time of first analgesic requirement between the above two groups was found to be statistically significant (p<0.001).

Table 1: Distribution of study subjects based on mean age, weight, height and BMI

	Group	N	Mean	Std. Deviation	Std. Error Mean	P
Age	D	30	44.17	4.526	0.826	1.73
	F	30	42.6	4.264	0.778	
Weight (kgs)	D	30	159.2	11.8	2.2	0.59
	F	30	160.7	8.4	1.5	
Height (in M)	D	30	56.6	6.9	1.3	0.37
	F	30	58.2	7.6	1.4	
BMI	D	30	22.3	2.0	0.4	0.71
	F	30	22.6	2.5	0.5	

D=Dexmedetomidine, F=Fentanyl, BMI=Body Mass Index.

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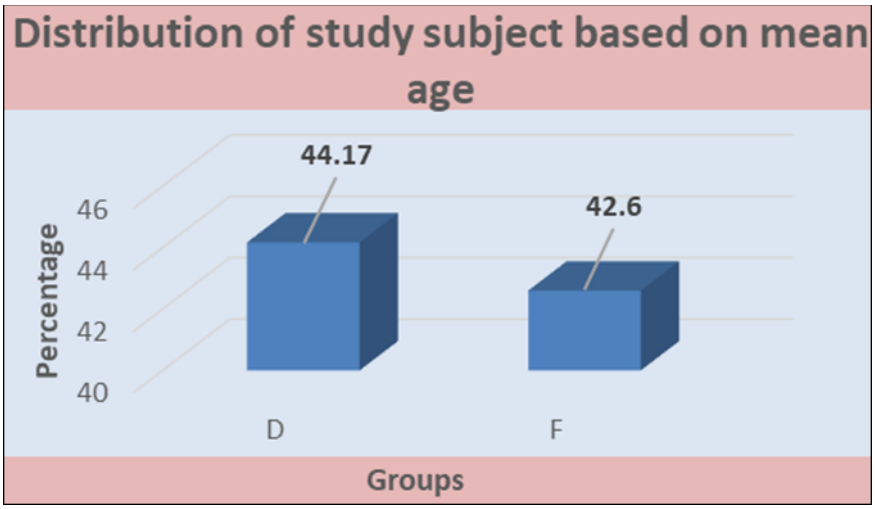

Fig 1: Mean Age

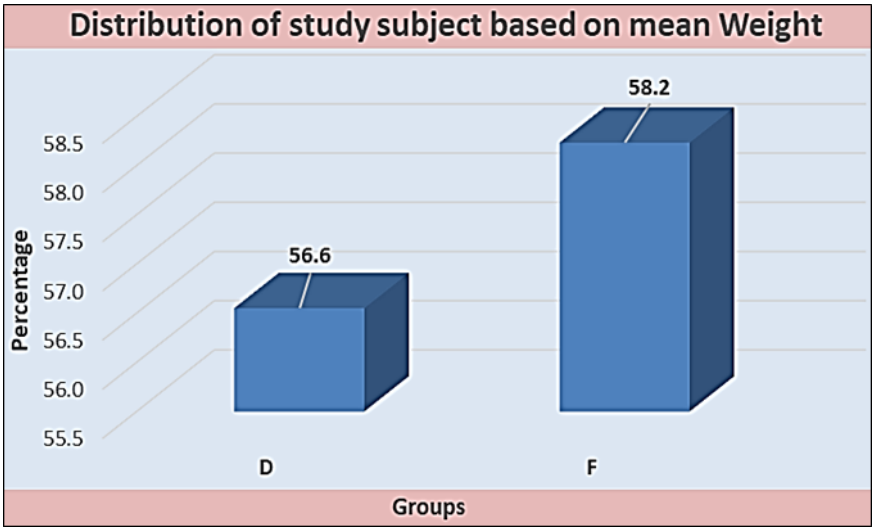

Fig 2: Mean Weight

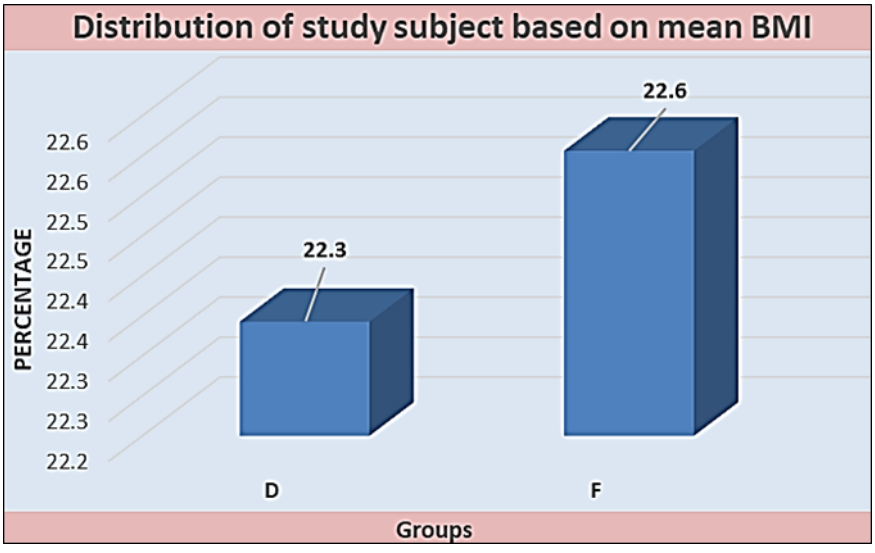

Fig 3: Mean BMI

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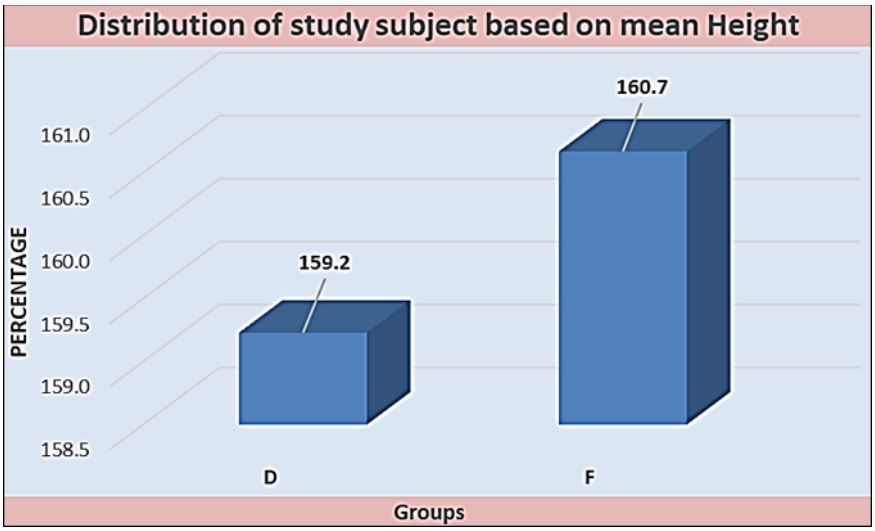

Fig 4: Mean Height

Table 2: Distribution of study subjects based on Gender

Gender	Group D		Group F	
	Frequency	Percentage	Frequency	Percentage
Female	14	46.7	11	36.7
Male	16	53.3	19	63.3

Group D= Dexmedetomidine, Group F= Fentanyl

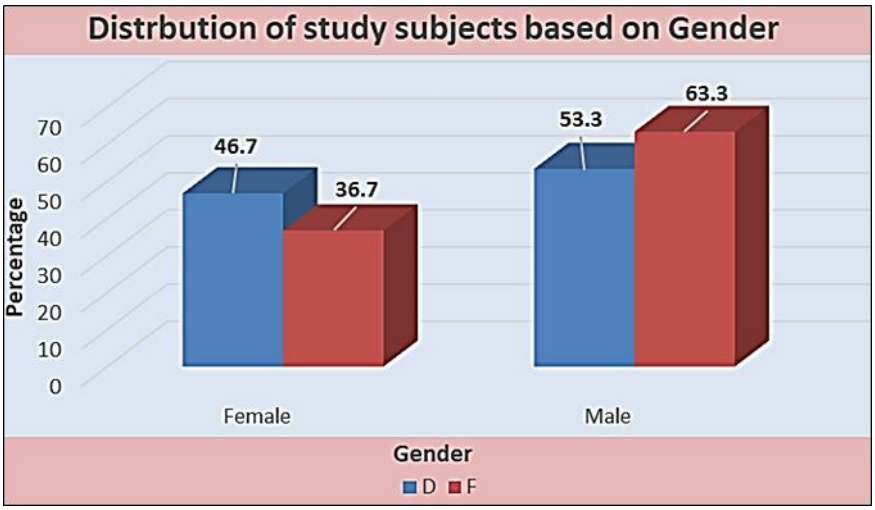

Fig 5: Gender

Table 3: Distribution of study subjects based on ASA Grading

ASA Grade	Group D		Group F	
	Frequency	Percentage	Frequency	Percentage
I	12	40.0	16	53.3
II	17	60.0	13	46.6

Group D=Dexmedetomidine, Group F=Fentanyl, ASA=American Society of Anaesthesiology.

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Table 4: Distribution of study subjects based on Duration of Anaesthesia

	Group	N	Mean	Std. Deviation	Std. Error Mean	P
Duration of Analgesia	D	30	340.8	13.098	2.391	<0.001*
	F	30	263.97	10.778	1.968	

p<0.001* statistically significant, D= Dexmedetomidine, F= Fentanyl

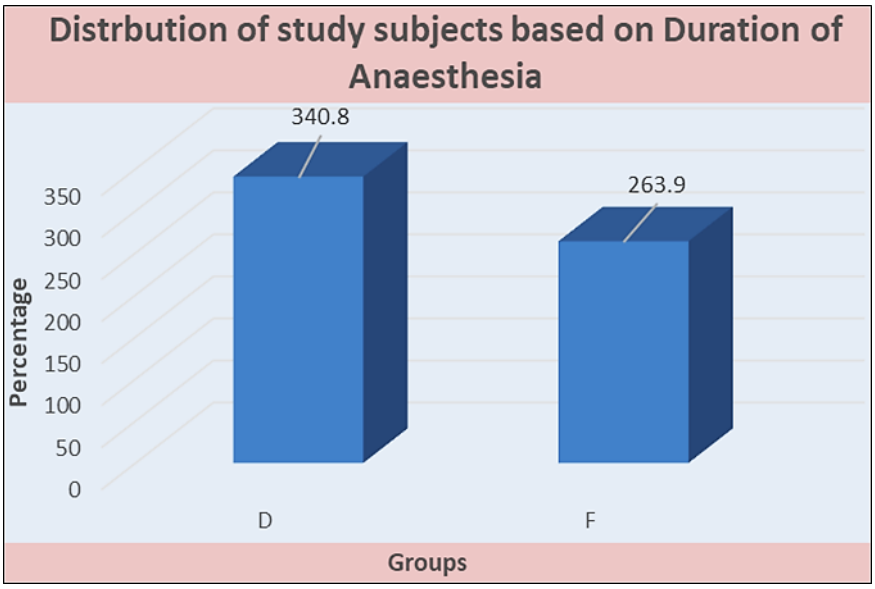

Fig 6: Duration of Anaesthesia

Discussion

Lower limb surgeries may be performed under local, regional (spinal or epidural) or general anesthesia, but neuraxial blockade is the preferred mode of anesthesia.
In recent years, use of adjuvants during epidural anesthesia has gained popularity with the aim of prolonging the duration of block, better success rate, patient satisfaction, decreased resource utilization compared with general anesthesia, and faster recovery. Dexmedetomidine is a new addition to the class of α2 agonist which has got numerous beneficial effects when used through epidural route. It acts on both pre-and post-synaptic sympathetic nerve terminals and central nervous system, thereby decreasing the sympathetic outflow and norepinephrine

release causing sedative, antianxiety, analgesic, sympatholytic and hemodynamic effects. Dexmedetomidine causes a manageable hypotension and bradycardia, but the striking feature of this drug is the lack of opioid-related side effects such as respiratory depression, pruritus, nausea and vomiting. Both dexmedetomidine (α2 agonist) and fentanyl (opioid) are being used as adjunct with bupivacaine to increase duration of regional anesthesia. Sukhminder J S B *et al*., in 2011 compared dexmedetomidine and fentanyl for epidural analgesia in lower limb orthopedic surgeries concluded that dexmedetomidine seems to be better epidural adjuvant to fentanyl as it provides prolonged postop analgesia, lower consumption of LA for epidural analgesia. Prolonged analgesia and motor block can be explained by the fact that epidural dexmedetomidine has greater selectivity for α-2 receptors and lipid solubility. Paul A, Nathroy A, Paul T compared dexmedetomidine and fentanyl as an adjuvant to epidural bupivacaine in lower limb surgeries concluded that dexmedetomidine as an adjuvant to epidural bupivacaine is a better alternative to fentanyl as it shows prolonged duration of analgesia (380±35.93min). Sarkar A *et al*., in 2018 compared the analgesic efficacy of epidural bupivacaine and dexmedetomidine with bupivacaine and fentanyl in lower limb orthopaedic surgeries concluded that dexmedetomidine group has much more efficacy than fentanyl when given epidurally for postoperative pain relief, the first analgesic requirement in Group fentanyl was earlier (212.20 + 10.91 min) as compared to Group Dexmedetomidine (329.90 + 16.11 min). Difference in time of first analgesic requirement between the above two groups was found to be statistically significant (p<0.001). Gill R S *et al*., in 2016 compared addition of fentanyl and dexmedetomidine to ropivacaine for epidural analgesia in lower abdominal and lower limb orthopaedic surgeries concluded that dexmedetomidine seems to be better alternative to fentanyl as an epidural adjuvant as it provides stable hemodynamics, prolonged postop analgesia, lower consumption of postop LA for epidural analgesia.

Conclusion

The present study was conducted to study the efficacy of epidural dexmedetomidine with bupivacaine versus epidural fentanyl with bupivacaine for postoperative pain relief in lower limb orthopedic surgery. Dexmedetomidine seems to be a better alternative to fentanyl as an epidural adjuvant as it provides comparable stable hemodynamics, prolonged post-op analgesia, lower consumption of post-op LA for epidural analgesia.

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