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Original Research Article

Effect of addition of 8 mg of dexamethasone to 15 ml of 0.25% levobupivacaine in ultrasound guided adductor canal block for postoperative analgesia in patients undergoing knee surgeries

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Abstract

Background: Adductor canal block (ACB) has recently been considered as a promising method for providing analgesia after knee surgeries with sensory blockade. ACB blocks the sensory innervation of the knee via the saphenous nerve [1]. ACB preserves quadriceps muscle strength better than Femoral Nerve Block, minimizing weakness during knee extension and thus functional recovery is improved within the first 24 hrs post‐operative period and the risk of developing Deep Vein Thrombosis is reduced [1]. Addition of Dexamethasone to local anaesthetics improves the quality and duration of peripheral nerve block [2]. We evaluated the effect of adding dexamethasone to levobupivacaine on the duration of postoperative analgesia in patients undergoing knee surgery using ultrasound-guided adductor canal block.

Methods: The study was a prospective double blinded randomized comparative study. Sixty patients scheduled for knee surgery were randomly allocated into two groups to receive adductor canal block. The control group L received 15 mL levobupivacaine 0.25% + 2 mL normal saline, and the dexamethasone group D received 15 mL levobupivacaine 0.25% + 2 mL dexamethasone (8 mg). Measurements included duration of sensory blockade, hemodynamic stability, visual analog score, time to first analgesic requirement and analgesic consumption.

Results: Postoperative analgesia was better in Group D patients. The mean VAS score increased with time and the magnitude of increase was more in the Group L than in group D. Duration of analgesia was significantly prolonged in Group D (14 ± 2.25 hours) when compared to Group L (10.57 ± 1.65 hours) with significant P value (<0.05). There was no significant difference between two groups in terms of age, sex, ASA grading and type of surgery. Both the groups maintained hemodynamic stability, which was statistically insignificant (P value >0.05).

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Conclusion: The addition of 8 mg of dexamethasone to 0.25% levobupivacaine in adductor canal block provides prolonged postoperative analgesia and less postoperative analgesic consumption than levobupivacaine alone in knee surgery.
Keywords: Adductor canal block, post-operative analgesia, levobupivacaine, dexamethasone, knee surgeries

Introduction

Peripheral nerve block is used to provide anaesthesia, or analgesia, or both by infiltration of local anaesthetic solution perineurally. When compared with intravenous analgesia alone, Peripheral nerve block for intraoperative and postoperative pain management provides improved analgesia, fewer opioid- related adverse events, earlier ambulation, and shorter hospital stay.

A limitation to postoperative analgesia with peripheral nerve blocks is that the analgesic effect lasts only a few hours and the patient might experience moderate to severe pain at the surgical site thus resulting in the need for alternative analgesic therapy. Various adjuvants can be used to prolong the duration of analgesia in peripheral nerve block. Dexamethasone can be used intravenously or perineurally to prolong the duration of analgesia [2]. Steroids produce vasoconstriction, thereby reduces the absorption of local anesthetic. Dexamethasone acts on the glucocorticoid receptors and increases the activity of inhibitory potassium channels on nociceptive C-fibers, thus decreasing their activity [3]. Extra fascicular injection of dexamethasone does not produce any damage to the nerve. Intrafascicular injection causes very minimal damage when compared other steroids like hydrocortisone and triamcinolone[4]. Thus, it is safe to use dexamethasone as an adjuvant to local anesthetics for peripheral nerve block.

Racemic Bupivacaine which is a mixture of dextro and levobupivacaine is most commonly used local anesthetic for peripheral nerve blocks. But it has a potential to cause serious cardiovascular side effects. Levobupivacaine is the s-isomer of Bupivacaine. It is equally potent local anaesthetic, but less cardio, neurotoxic when compared to its racemic mixture [5]. It causes less depression of myocardial contractility. Hence, levobupivacaine comparatively safer in this respect.

Methodology

After approval of Institutional Human Ethical committee, a prospective double blinded randomized comparative study was conducted on patients underwent knee surgery under Spinal anaesthesia. Patients were assessed preoperatively for physical status, medical history, general examination and systemic examination. Age group between 18-60 years with physical status American society of Anesthesiology grading ASA I and II were divided into two equal groups. Written Informed consent obtained from all the patients and the procedure was clearly explained.

Inclusion criteria

1. ASA grade I & II.
2. Age-18-60 years.
3. Body Mass Index (BMI)-18-35 kg/m^2.

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Exclusion criteria

1) ASA >III.
2) Age >60 years.
3) BMI > 35 kg/m^2.
4) Patients refusal.
5) Bleeding diathesis.

The patients allocated for the study were randomly divided into two groups of 30 patients each.

Group D (levobupivacaine with dexamethasone) (n=30) received Adductor canal block with 15 ml of levobupivacaine 0.25% + 2 ml dexamethasone (8 mg).

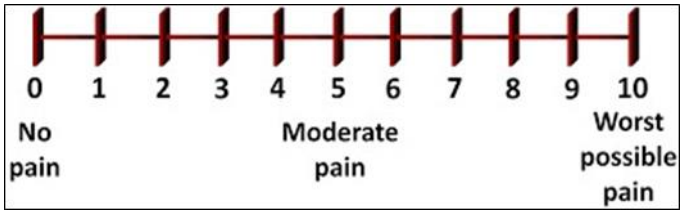
Group L (levobupivacaine without dexamethasone) (n=30) received Adductor canal block with 15 ml of levobupivacaine 0.25% + 2 ml normal saline.

Patient's ECG, NIBP, Heart Rate, Respiratory Rate were recorded preoperatively. After performing the surgery under spinal anaesthesia, ultrasound‑guided adductor canal block was performed with patient in supine position. Under aseptic precautions, linear ultrasound transducer (10-12) Hz was placed at the mid‑thigh level. The superficial femoral vessels were identified, deep to the sartorius muscle. Then, 22G needle was advanced (using the in‑plane technique from lateral to medial) toward the adductor canal where, the study drug was injected.

Parameters monitored

1. 5 lead ECG
2. NIBP
3. Heart Rate
4. Respiratory Rate
5. VAS score
6. Time of rescue analgesia

The duration of analgesia was recorded according to visual analogue score (VAS)



When the patients experienced pain (VAS >4) Inj. Paracetamol 1 gram IV infusion was given.

Statistical analysis

The data collected were entered into Microsoft excel 360 in order to create a master chart. The master chart was then loaded into statistical package for social sciences (SPSS) version 26 for further statistical analysis. Both quantitative and qualitative variables were present in the master chart. Both descriptive and inferential statistics were used for analysis.

For describing the qualitative variables, frequency and percentages were used. For describing the quantitative data, mean and standard deviation were used. In order to find out difference in distribution of qualitative variable between the experimental arms, chi-square test was

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applied. To find out the difference in mean between two groups, independent samples T test was applied. To find out the difference in change of mean between the groups for a repeatedly measured variables, Repeated measures analysis of variance (RM-ANOVA) was used. A P value of less than 0.05 was considered to be statistically significant.

Results

Table 1: Comparison of mean age between the groups

Groups	Age in years		t*	P value
	Mean	SD		
D	34.10	7.05	1.205	0.233
L	36.40	7.72		

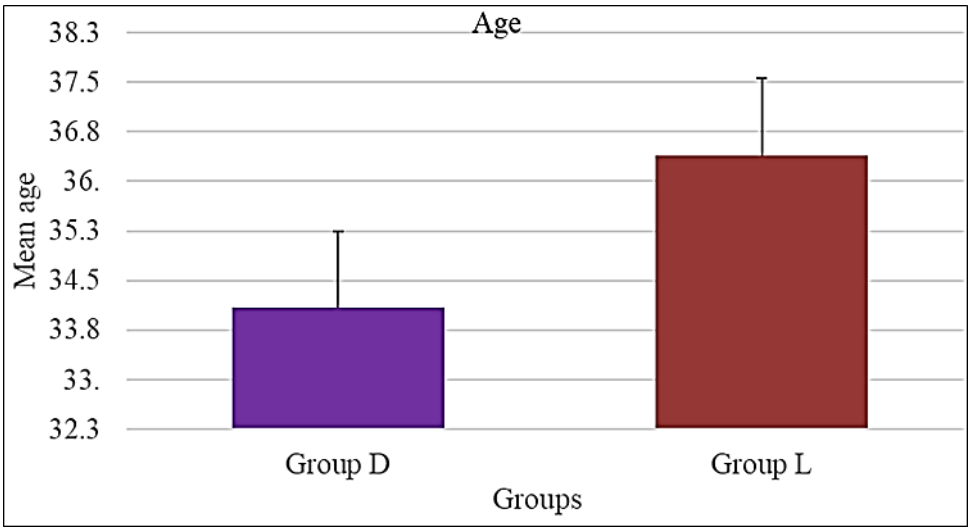

Fig 1: Bar chart showing difference in mean age between the groups

The mean age among the participants in the D group was 36.10 ± 7.05 years and that of the L group was 36.40 ± 7.72 years. The mean age of both the groups were found to be similar with P value of more than 0.05.

Table 2: Distribution of sex between the groups

Variables		Group D		Group L		X^{2*}	P value
		N	%	N	%		
Sex	Male	27	90	26	86.7	0.162	0.688
	Female	3	10	4	13.3		

*Chi square test was applied.

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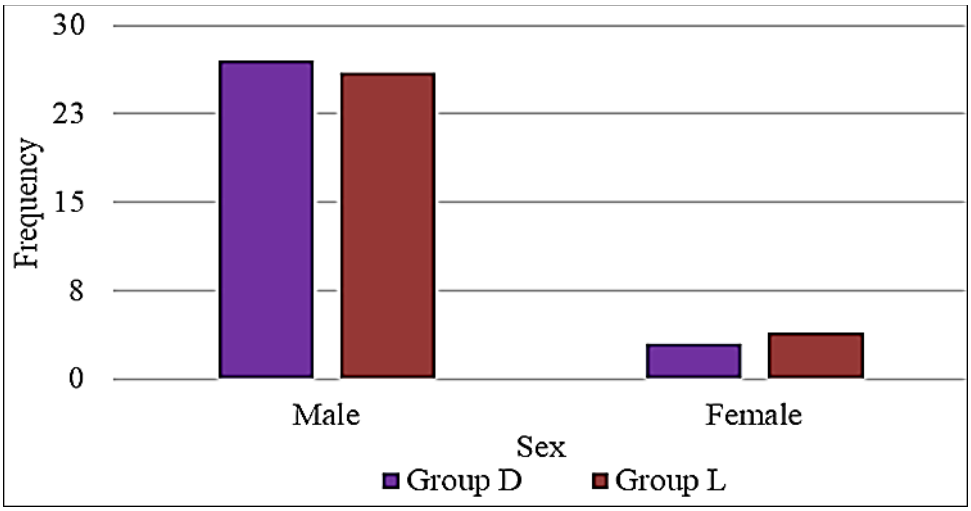

Fig 2: Compound bar chart showing distribution of sex between the groups

Among the participants in group D, 90% were males and among those in group L, 86.7% were males. The distribution of sex was found to be similar between the groups with P value of more than 0.05.

Table 3: Distribution of ASA between the groups

Variables		Group D		Group L	
		N	%	N	%
ASA	I	26	86.7	26	86.7
	II	4	13.3	4	13.3

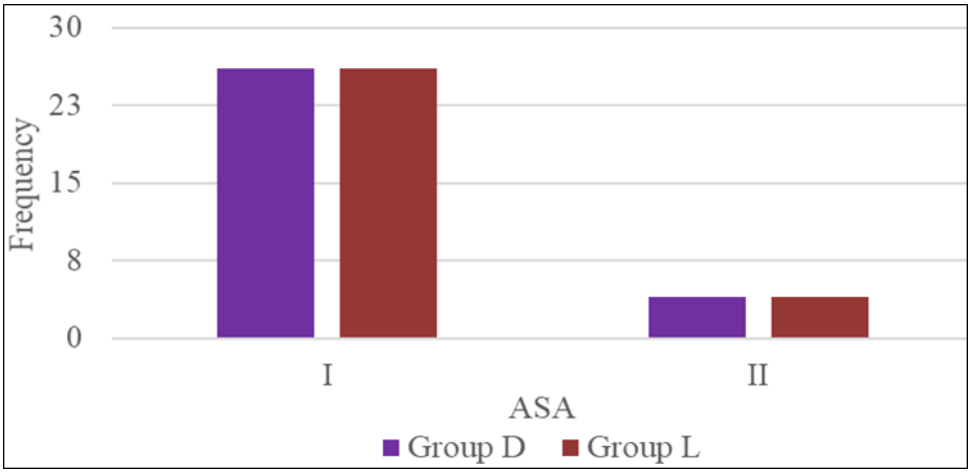

Fig 3: Compound bar chart showing distribution of ASA between the groups

In both the groups, the proportion of ASA I was 86.7% and that of ASA II was 13.3%.

Table 4: Distribution according to type of surgery between the groups

Variables		Group D		Group L		X^{2*}	P value
		N	%	N	%		
Type of surgery	Arthroscopic meniscal repair	0	0	3	10	3.960	0.266
	Implant exit	9	30	8	26.7		
	ORIF	6	20	8	26.7		
	Tension band wiring	15	50	11	36.7		

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*Chi square test was applied.

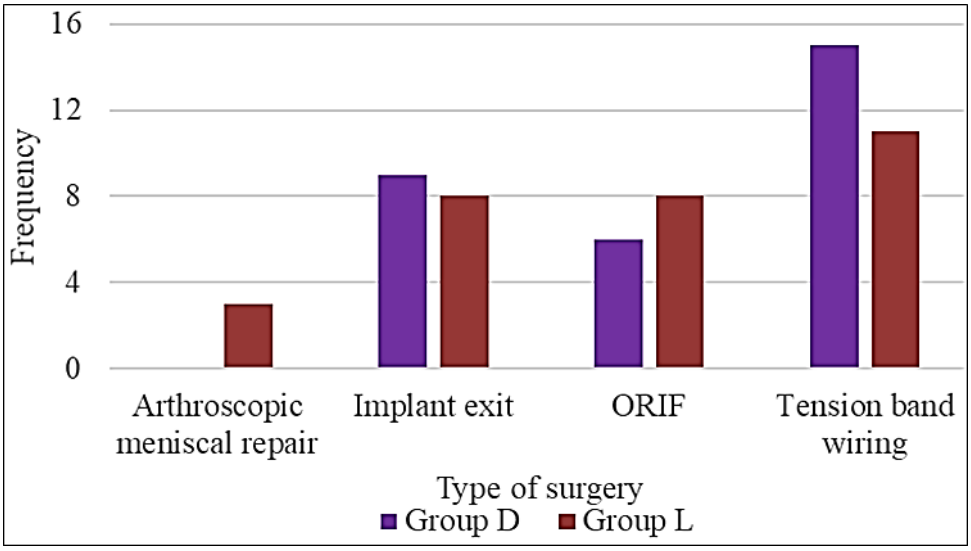

Fig 4: Compound bar chart showing distribution of type of surgery between the groups

Among the participants in group D, 50% had undergone tension band wiring and among the participants in group L, 36.7% had undergone tension band wiring. Both the groups were similar with regard to distribution of type of surgery with P value more than 0.05.

Table 5: Mean change in VAS between the groups over the timeline

Timeline	Group D		Group L		P value*	
	Mean	SD	Mean	SD	Within	Between
0	0	0	0	0	0.001$	0.001$
15 mins	0	0	0	0		
30 mins	0	0	0	0		
45 mins	0	0	0	0		
60 mins	0	0	0	0		
1.5 hrs	0	0	0	0		
2 hrs	0	0	0	0		
2.5 hrs	0	0	0.2	0.48		
3 hrs	0.17	0.04	1.53	0.68		
6 hrs	1.03	0.81	2.80	0.71		
9 hrs	2.60	0.93	3.93	0.25		
12 hrs	3.66	0.66	4.00	0.37		
18 hrs	3.96	0.41	4.20	0.37		
24 hrs	4.03	0.41	4.20	0.40		

*Repeated measures ANOVA was applied.
$ Statistically significant

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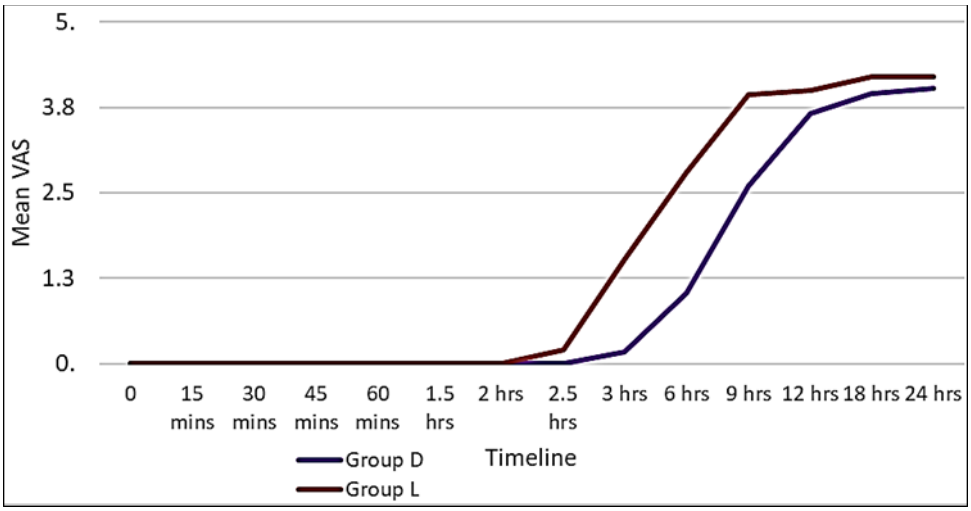

Fig 5: Line diagram showing trend in VAS between the groups

Over the follow up period the mean VAS was found to be increasing in both the groups with P value of less than 0.05. The trend was also found to be different between the groups with P value of less than 0.05.

No participant in either group had reported pain till 2 hrs of follow up. The mean VAS score was statistically more in the Group L than in group D at 2.5, 3, 6, 9, 12, 18 and 24 hours. The mean VAS score increased with time and the magnitude of increase was more in the Group L than in group D.

Table 6: Comparison of mean time for rescue analgesia between the groups

Groups	Time of rescue analgesia		t*	P value
	Mean	SD		
D	14	2.25	6.71	0.001
L	10.57	1.65		

The mean time for rescue analgesia among the participants in the D group was 14 ± 2.25 hours and that of the L group was 10.57 ± 1.65 hours. The mean duration was more in group D than in group L with P value of less than 0.05.

Table 7: Comparison of mean analgesic consumption between the groups

Groups	Analgesic consumption (in g)		t*	P value
	Mean	SD		
D	1.63	0.43	6.86	0.001
L	2.36	0.39		

*Independent samples t test was applied.

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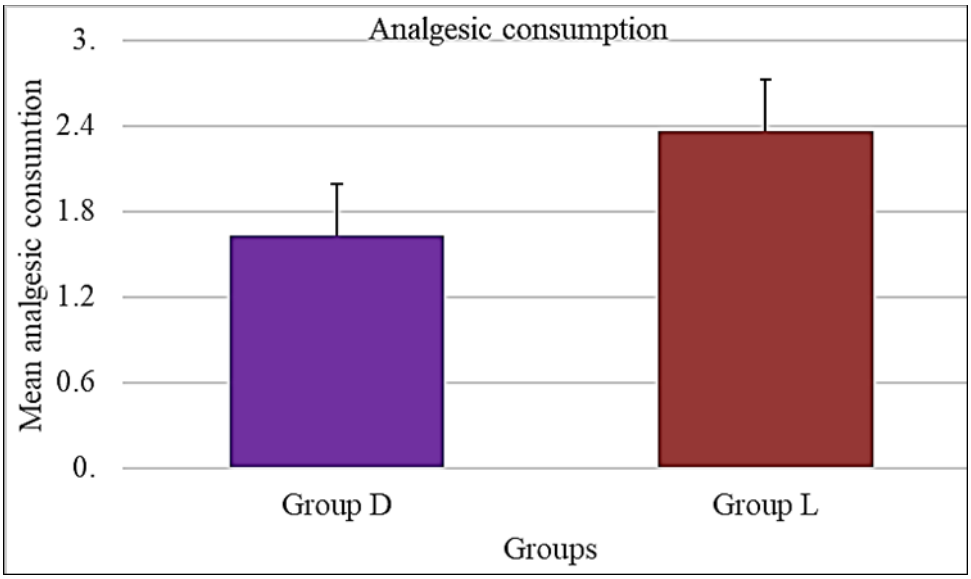

Fig 6: Bar chart showing difference in mean analgesic consumption between the groups

The mean analgesic consumption among the participants in the D group was 1.63 ± 0.43 grams and that of the L group was 2.36 ± 0.39 grams. The mean analgesic consumption was more in the L group than in the D group with P value of less than 0.05.

Discussion

The aim of the study was to determine whether addition of dexamethasone to levobupivacaine improves the efficacy of ACB in patients undergoing knee surgery. The results revealed that addition of 8 mg dexamethasone to 0.25% levobupivacaine solution during ACB improved the duration and the quality of post-operative analgesia based on the time of first analgesic requirement and analgesic consumption. The use of dexamethasone reduced the consumption of analgesics during the post-operative period.

Increasing the duration of action of local anesthetics during nerve blocks improves the quality of surgical anesthesia and prolongs post-operative analgesia. Various additives have been studied in order to prolong the duration of nerve blockade. Among that Dexamethasone has shown promising outcomes in post-operative analgesia. The use of dexamethasone at doses of 4-12 mg via intravenous and perineural routes has been studied and the most common dose used perineurally was 8 mg [6].

Corticosteroid-mediated neurotoxicity is usually associated with the vehicle polyethylene glycol and the preservative benzyl alcohol, sometimes insoluble steroid particulate matter in the solution [7]. Studies have demonstrated that when corticosteroids administered perineurally has no long-term effect on structure, electrical properties or function of the nerves. Extra fascicular injection of dexamethasone caused no damage to the nerve and intrafascicular injection might cause very minimal damage when compared to other steroids like hydrocortisone and triamcinolone [4]. Thus, Dexamethasone proves to be a safer adjuvant and the adverse effects with a single dose of dexamethasone is extremely rare and minimal [8].

Surgical trauma produces tissue damage leading to an inflammatory state which causes the release of pro-and anti-inflammatory proteins. Pro-inflammatory cytokines causes local inflammation as well as systemic responses. Post-operative elevation in serum CRP and IL-6 levels were reported [9]. Dexamethasone being a long-acting glucocorticoid with potent anti-inflammatory properties reduces the inflammatory response. Post-operative serum CRP levels were found to be lower in patients when Dexamethasone is used as an adjuvant [10].

In this study, duration and quality of Postoperative analgesia was better in Group D patients where Dexamethasone is used as an adjuvant. The VAS score has been recorded for 24 hours

postoperatively. The mean VAS score increased with time and the magnitude of increase was more in the Group L than in group D. Duration of analgesia was significantly prolonged in Group D (14 ± 2.25 hours) when compared to Group L (10.57 ± 1.65 hours) with significant P value (<0.05). When the patients experienced moderate pain (VAS >4) 1 gram paracetamol IV infusion was given. The time of first analgesic requirement was also studied. The mean time for rescue analgesia among the participants in the D group was 14 ± 2.25 hours and that of the L group was 10.57 ± 1.65 hours. The analgesic consumption was also studied. The mean amount of analgesic consumption among the participants in the D group was 1.63 ± 0.43 grams of paracetamol and that of the L group was 2.36 ± 0.39 grams with significant P value (<0.05). Thus reducing the consumption of analgesics during post-operative period. This reduction may be due to the ability of dexamethasone in reducing inflammation and pain during early post-operative period.

Conclusion

The addition of 8 mg of dexamethasone to 0.25% levobupivacaine in adductor canal block provides prolonged postoperative analgesia and less postoperative analgesic consumption when compared to levobupivacaine alone in knee surgery. Thus providing better recovery in immediate post-operative period.

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