Section: Anaesthesia

Original Research Article

COMPARISON OF INTRATHECAL DEXMEDETOMIDINE AND FENTANYL AS ADJUVANT TO LEVOBUPIVACAINE FOR POSTOPERATIVE ANALGESIA IN KNEE SURGERIES

Pallapothu Rajesh[1], Venkata Ramesh Pativada[2]

[1]Associate Professor, Department of Anaesthesia, PSP Medical College Hospital and Research Institute, Oragadam, Panruti, Sriperumbudur (Taluk), Kanchipuram, Tamilnadu India
[2]Assistant Professor, Department of Anesthesiology, Andhra Medical College, Visakhapatnam Visakhapatnam(dt), Andhra Pradesh. India.

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Corresponding Author:
Dr. Venkata Ramesh Pativada,
Email: drrameshpv@gmail.com

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ABSTRACT

Background: Although spinal anaesthesia technique for knee surgery is very economical and easy to administer, postoperative pain control is a major problem. Hence, an ideal adjuvant anaesthesia which prolongs the action of anaesthesia for a longer time with minimal side effects is mandatory for successful surgery. **Materials and Methods:** Out of 90 (ninety) patients, 45 (Group F) were administered isobaric levobupivacaine (0.5%, 2.8 ml) and fentanyl (25 mcg, 0.5 ml), total volume: 3.3 ml. 45 (Group D) were administered isobaric levobupivacaine (0.5%, 2.8 ml) and dexmedetomidine (10 mcg, diluted in normal saline), for a total volume of 3.3 ml. The analgesic effects of both drugs were monitored postoperatively. The VAS score for both drugs was noted and compared. **Result:** Comparison of time to give first rescue analgesia, time to reach peak sensory level, total duration of motor blockade, time to 2 sensory level regression, and haemodynamic parameters between the two groups had a significant p-value ($p<0.001$), and the least side effects were noted in group D. **Conclusion:** It is concluded that intrathecal dexmedetomidine with levobupivacaine has a longer prolonged motor and sensory block than fentanyl with levobupivacaine.

INTRODUCTION

Spinal anaesthesia is an established technique used for knee joint surgeries. It is very economical and easy to administer. However, the pain that occurs post-operatively is the major problem because the spinal anaesthesia used has a short duration of action. Hence, early analysis intervention is needed to control the post-operative pain period.[1] Many adjuvants are available, such as midazolam, clonidine and others, which prolong the effect of anaesthesia. The common problems observed during lower limb (or knee) surgeries are visceral pain, nausea, and vomiting. The addition of dexetomidine and fentanyl to levobupivacaine improves the quality of intraoperative and early postoperative spinal block.[2] Dexmedetomidine, a new highly selective α-2 agonist, is under evolution as a neuroaxial adjuvant, as it provides haemodynamic stability and prolonged postoperative analgesia with minimal side effects. It is hypothesised that spinal anaesthesia with 5 mcg dexmedetomidine would produce a more post-operative analgesic effect with levobupivacaine with minimal side effects.[3] It acts on α-2 receptors on the dorsal horn cells and reduces the sympathetic neurotransmitter release. The duration of the motor block may be increased when it binds to the motor neurones in the spinal cord.[4] Hence, adding dexmedetomide and fentanyl to levobupicaine in two groups of knee surgery patients separately. The duration of post-operative anaesthesia and side effects were evaluated.

MATERIALS AND METHODS

90 (ninth) patients aged between 18 and 70 years admitted at PSP Medical College, Hospital and Research Institute, Oragadam, Kanchipuram (Dist)-631604, Tamil Nadu, India, were studied.

Inclusive Criteria

Patients having ASA-I-III physical status and elective lower limb surgeries who gave their written consent were selected for the study.

Exclusion Criteria

Patients with hypersensitivity to amide and ester local anesthesia, having absolute contraindications to spinal anesthesia, patients with bleeding disorders,

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hypertension, cardiac problems, or head injuries, and pregnant females were excluded from the study.

Method: The patients undergoing knee surgery were classified into two groups by virtue of a lottery system. Group F-45 patients were given 0.5% isobaric levobupivacaine 2.8 mL + 25 mcg fentanyl (total volume 3.3 mL). In Group D, 45 patients were given 0.5% levobupivacaine isobaric 2.8 ml + 10 mcg dexmedetomidine (diluted with normal saline), for a total value of 3.3 ml (45 patients in Group F and 45 in Group D).

Preoperative: Every patient's detailed clinical, general, and systemic history and general and systemic examination were carried out. A complete blood count (CBC), blood sugar, renal profile, serum electrolytes, and ECG (electrocardiogram) were done. After confirming the overnight fasting for 8 hours, all patients were preloaded with Ringer lactate solution (10 mL/kg) over 15 minutes before the spinal anesthesia.

Intraoperative: In the operation room, an electrocardiogram and pulse oximeter are attached for monitoring purposes. Under all strict aseptic precautions, subarachnoid block (spinal anesthesia) was performed using a spinal needle in the intervertebral space after infiltrating the area with the local anesthetic solution. A mixture of drugs as per the assignment was injected after obtaining a free and clear flow of CSF. Immediately after the block, the patients were turned supine. The time of injection was noted as "O." Assessment of sensory and motor characteristics of the subarachnoid block was done as per the grading shown in the table at every 30-second interval until the peak of the blockade was achieved. The sensory block was assessed by skin sensation to pinprick, using the sterile 24G hypodermic needle, and the motor block was assessed according to the modified Borage scale.

Postoperatively: Time to the first analgesic requirement was monitored to assess the analgesic effects in both drug groups. Time to first postoperative analgesia would be when the VAS score is >3 on rest VAS or when the score is >5 on movement (dorsiflexion). The VAS score was assessed every 40 minutes until 6 hours post-surgery for the first analgesic requirement.

The duration of the study was June 2025 to June 2026.

Statistical Analysis: A comparison of various parameters was made between both Group F and Group D with a t-test, and a significant p-value was noted. The statistical analysis was carried out in SPSS software. The ratio of males and females was 2:1.

RESULTS

[Table 1] Comparison of sensory characteristics of subarachnoid blocks in both groups

- Onset (minutes): 4.882 (± 1.06) in group F, 2.150 (± 0.9) in group D; G. The t-test was 12.6 and p<0.001.
- Time of T10 sensory level (min): 7.832 (± 1.52) in group F, 4.60 (± 0.50) in group D; F. The t-test was 13.9 and p<0.001.
- Peak level (min): 13.80 (± 3.2) in group F, 8.8 (± 2.8) in group D; G. The t-test was 7.77 and p<0.001.
- Time to 2 sensory level regression (min): 103.6 (± 23.2) in group F, 51.3 (± 9.32) in group D; G. The t-test was 14.01 and p<0.001.
- Time to reach S2 sensory level (minutes): 356.4 (± 52.3) in group F, 232.72 (± 48.5) in group D; G. The t-test was 11.6 and p<0.001.

[Table 2] Comparison of effective analysis amongst study group

Sensory characteristics—Time to give dose of postoperative analgesia: 362.02 (± 56.6) in group F, 245.30 (± 51.5) in group D; G. The t-test was 10.2 and p < 0.001.

[Table 3] Comparison of VAS scores at different intervals postoperatively amongst the study groups

VAS Scores –

- VAS at 90 minutes: 0.5 (± 0.03) in group F, 0.16 (± 0.04) in group D; G. The t-test was 2.77 and p < 0.001.
- VAS at 120 minutes: 0.2 (± 0.01) in group F, 0.75 (± 0.083) in group D; G. The t-test was 44.1 and p<0.001.
- VAS at 180 minutes: 0.49 (± 0.73) in group F, 1.4 (± 0.09) in group D; G. The t-test was 67.6 and p < 0.001.
- VAS at 210 minutes: 0.69 (± 0.05) in group F, 2.45 (± 0.09) in group D; G. The t-test was 125 and p < 0.001.
- VAS at 240 minutes: 1.19 (± 0.03) in group F, 2.6 (± 0.93) in group D; G. The t-test was 10.1 and p<0.001.
- VAS at 270 minutes: 1.8 (± 0.52) in group F, 2.12 (± 0.72) in group D; G. The t-test was 2.40 and p < 0.001.
- VAS at 300 minutes: 2.03 (± 0.09) in group F, 1.5 (± 0.08) in group D; G. The t-test was 29.5 and p < 0.001.

[Table 4] Comparison of oxygen saturation amongst study groups,

- Baseline and at different intervals of time, both values are similar; hence, the p-value is insignificant.

[Table 5] Comparison of individual side effects amongst study groups—

- Shivering: 19 (42%) in group D only.
- Nausea: 1 (2.2%) in group D, 29 (64.4%) in group F.
- Vomiting: 23 (51.1%) only in group F.

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Table 1: Comparison of sensory characteristics of subarachnoid block in both groups (Total No of patient - 90)

Sensory characteristics	Group-F (Mean ± SD) (N=45)	Group-D (Mean ± SD) (N=45)	t- test	p-value
Onset (min)	4.882 (± 1.108)	2.150 (± 0.93)	12.6	P<0.001
Time to T10 sensory level (min)	7.832 (± 1.52)	4.60 (± 0.35)	13.9	P<0.001
Peak Level (min)	13.80 (± 3.28)	8.8 (± 2.80)	7.77	P<0.001
Time to 2 sensory level regression (min)	103.6 (± 23.22)	51.3 (± 9.32)	14.01	P<0.001
Time to reach S2 Sensory level (min)	356.4 (± 52.3)	232.72 (± 48.5)	11.6	P<0.001

P<0.001 = p value was highly significant

Table 2: Comparison of duration of effective analysis amongst study group (Total No of patient - 90)

Sensory characteristics	Group-F (Mean ± SD)	Group-D (Mean ± SD)	t- test	p value
Time to give 1st dose of post-operative analgesia	362.03 (± 56.6)	245.30 (± 51.5)	10.2	P<0.001

Table 3: Comparison of VAS score at different intervals postoperatively amongst the study group

VAS scores	Group F-45 (Mean ±SD)	Group D-45 (Mean ±SD)	t-test	P-value
VAS @30 min	0	0	0	0
VAS @60 min	0	0	0	0
VAS @90 min	0.5 (± 0.03)	0.16 (± 0.82)	2.77	P<0.001
VAS @120 min	0.2(± 0.01)	0.75 (± 0.083)	44.1	P<0.001
VAS @180 min	0.49 (± 0.073)	1.4 (± 0.09)	67.6	P<0.001
VAS @210 min	0.69 (± 0.05)	2.45 (± 0.08)	125.1	P<0.001
VAS @240 min	1.19 (± 0.03)	2.6 (± 0.93)	10.1	P<0.001
VAS @270 min	1.8 (± 0.522)	2.12 (± 0.722)	2.40	P<0.001
VAS @300 min	2.03 (± 0.09)	1.5 (± 0.08)	29.5	P<0.001

P<0.001 = p value is highly significant

Table 4: Comparison of oxygen saturation amongst study group

	Group D (45)	Group F (45)	t-test	P-value
Baseline	99.25 (± 4.83)	97.93 (± 5.52)	1.5	p>0.11
5 Min	99.33 (± 0.63)	99.12 (± 1.13)	1.08	p>0.27
10 Min	99.25 (± 0.720)	99.10 (± 9.22)	0.10	P>0.91
15 Min	99.25 (± 0.790)	99 (± 1.223)	1.15	p>0.25
20 Min	99.25 (± 0.792)	99.06 (± 1.152)	0.95	p>0.33
25 Min	99.32 (± 0.742)	99 (± 0.810)	1.94	P>0.54
30 Min	99.30 (± 0.745)	99.35 (± 0.8)	0.30	p>0.759
40 Min	99.36 (± 0.726)	99.36 (± 0.5)	0.00	p>1.00
50 Min	99.3 (± 0.762)	99.25 (± 1.166)	0.24	p>0.810
60 Min	99.32 (± 0.745)	99.43 (± 0.712)	0.71	p>0.47
70 Min	99.3 (± 0.756)	99.35 (± 0.852)	0.29	p>0.769
80 Min	99.25 (± 0.725)	99.23 (± 0.830)	0.12	p>0.903
90 Min	99.33 (± 0.6)	99.26 (± 0.782)	0.47	p>0.63
100 Min	99.3 (± 0.729)	99.26 (± 0.783)	0.25	p>0.802
110 Min	99.32 (± 0.62)	99.28 (± 0.622)	0.30	p>0.7607
120 Min	99.0 (± 0.73)	99.26 (± 0.80)	1.61	p>0.110
130 Min	99.2 (± 0.626)	99.4(± 0.855)	1.265	p>0.208
140 Min	99.3 (± 0.626)	99.12 (± 0.83)	1.16	p>0.24
150 Min	99.2 (± 0.660)	99.4 (± 0.85)	1.24	p>0.215
180 Min	99.2 (± 0.65)	99.11 (± 0.782)	0.59	p>0.55
210 Min	99.5 (± 0.63)	99.4 (± 0.66)	0.73	p>0.464
240 Min	99.4 (± 0.645)	99.95 (± 0.722)	0.69	p>0.490
300 Min	99.16 (± 0.65)	99.95 (± 0.720)	0.46	p>0.62
360 Min	99.6 (± 5.82)	100.66 (± 7.92)	0.72	p>0.471

(p value is highly insignificant)

Table 5: Comparison of individual side effects amongst study group

	Group D (45)	Group F (45)	Total
Shivering	19 (42%)	0	10
Pruritus	0	0	0
Nausea	1 (2.2%)	29 (64.4%)	24
Vomiting	0	23 (51.1%)	19
Respiratory depression	0	0	0
Urinary Retention	0	0	0

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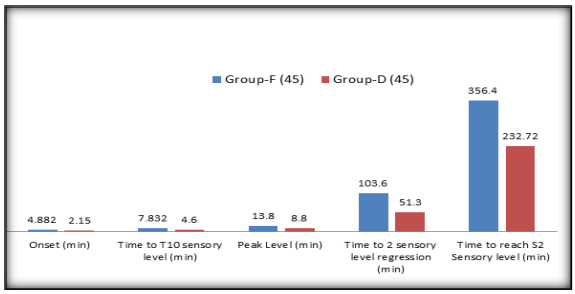

Figure 1: Comparison of sensory characteristics of subarachnoid block in both groups (Total No of patient - 90)

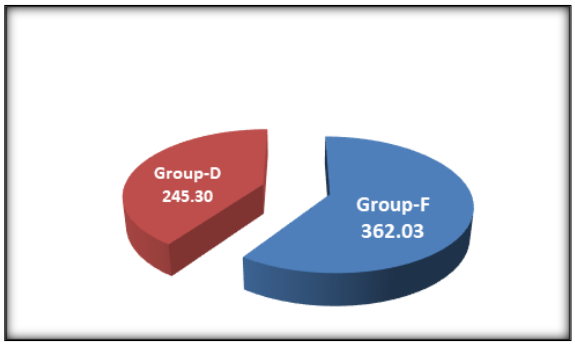

Figure 2: Comparison of duration of effective analysis amongst study group (Total No of patient - 90)

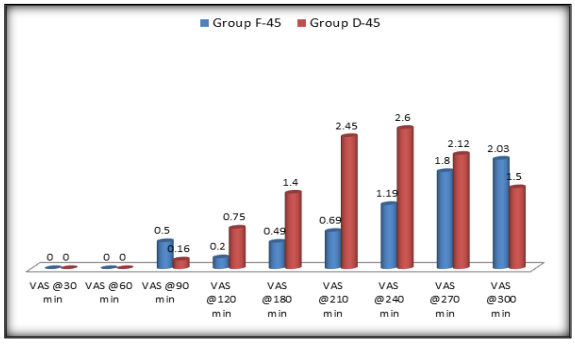

Figure 3: Comparison of VAS score at different intervals postoperatively amongst the study group

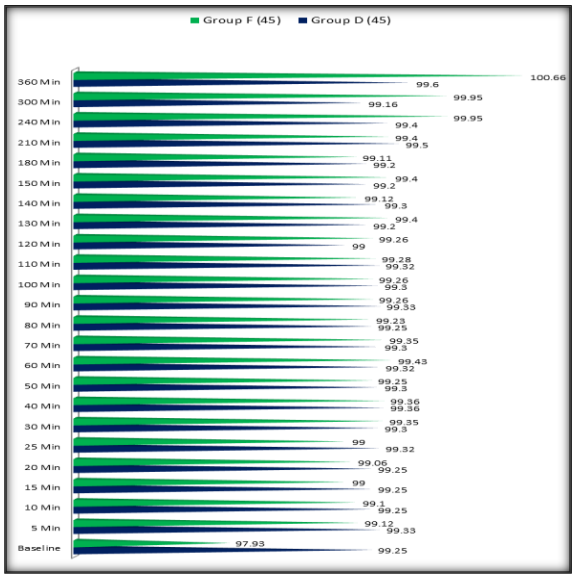

Figure 4: Comparison of oxygen saturation amongst study group

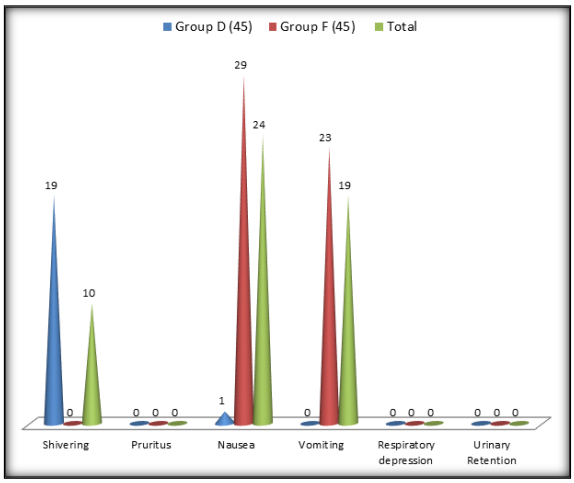

Figure 5: Comparison of individual side effects amongst study group

DISCUSSION

A comparison of intrathecal dexmedetomidine and fentanyl as adjuvants to levobupicaine for postoperative analgesia in knee surgeries in the Tamil Nadu population was done. In comparison, the sensory characteristic of the subarachnoid block in both groups had a significant p-value ($p<0.001$) [Table 1] The duration of effective analysis in both groups had a significant p-value ($p<0.001$) [Table 2] The comparison of VAS scores at different intervals had a significant p-value ($p<0.001$) [Table 3] In the comparison of oxygen saturation, similar values were noted; hence, insignificant p-values are noted ($p>0.001$) [Table 4] In a comparison of side effects in both groups, shivering was 19 (42%) and nausea was 1 (2.2%) in group D, and nausea was 29 (64.4%) and vomiting was 23 (51.1%) in group F [Table 5] These findings are more or less in agreement with previous studies.[5-7] The intrathecal technique helped reduce the dose of local anesthetics, prolonging the duration of action, and achieving more hemodynamic stability.[8] A reduced dosage of local anesthetics can limit the extent of motor block and have fewer side effects; however, a smaller concentration of drug may be insufficient to provide adequate spinal block, hence various adjuvants like opioids and steroids.[9] Alpha-2 agonists, ketamine, $MgSO_4$, and neostigmine have been used with various success rates. Dexmedetomidine is a strong alpha-2 agonist that potentiates the effects of local anesthesia. It has 8 times greater affinity for alpha-2 receptors, with action at the spinal and supraspinal levels as an adjuvant to LA.

The effects of fentanyl and dexmedetomidine as adjuvants to intrathecal isobaric levobupivacaine on the start and duration of sensory and motor blockade and on hemodynamic parameters were different. When dexmedetomidine was used as an adjuvant instead of fentanyl, the length of the sensory block was longer with a slow onset. In the present study, motor block was intensified and prolonged in group D as compared to group F, which is confirmed by

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previous studies.[10] In analgesic studies, Group D had more prolongation than Group F; similar findings were also reported in previous studies.[11] Levobupivacaine molecules are more cardiostable than hyperbaric bupivacaine. It is confirmed that dexmedetomidine has better analgesia than fentanyl, with no significant differences in hemodynamics with either drug.

CONCLUSION

In the comparative study of intrathecal dexmedetomidine and fentanyl as adjuvants to levobupivacaine for postoperative analgesia in knee surgeries in the Tamil Nadu population, it is noted that Group-F had a faster onset and a faster time to peak onset of sensory blockade, but the duration of motor block was shorter in Group-F; hence, Group-D patients require lesser postoperative rescue analgesia. Side effects like nausea and vomiting were observed in Group F. The present study demands that such clinical trials be conducted in a large number of populations where the latest techniques are available to combat any type of side effect because the exact pharmacological actions of the anesthetic drugs used in the present study are still unclear.

Limitation of study: Owing to remote locations of the research center, small number of patients, and lack of latest techniques, we have limited findings and results.

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