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Original Research Article

Comparison Study of Intrathecal Dexmedetomidine and Fentanyl as an Adjuvant to Levobupivacaine for Postoperative Analgesia in Knee Surgeries – Retrospective Study

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Abstract

Background: Various adjuvants have been used with local anesthetics in spinal anesthesia to avoid intraoperative somatic pain and to provide prolonged postoperative analgesia. Dexmedetomidine, the new highly selective α2 antagonist drug, is now being used as a neuro-axial adjuvant in knee joint surgeries.

Method: Out of 72 (seventy-two) patients, 36 (Group F) were administered isobaric levobupivacaine (0.5%, 2.8 ml) and fentanyl (25 mcg, 0.5 ml), total volume: 3.3 ml. 36 (Group D) were administered isobaric Levobupivaine (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.

Results: 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 hemodynamic 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 noted that, Group F had faster onset and required less time to reach the peak onset of sensory blockage hence group F drugs were preferred than drugs of D group.

Keywords: Oxygen Saturation, Intrathecal, Sensory And Motor Blockage, VAS Score, Modified Bromage Scale.

Introduction

Spinal anesthesia was first introduced by J. Leonard Corning of New York in 1885. He injected 3 ml of 0.5% cocaine in the intrathecal space. Spinal anesthesia is the most commonly used technique for lower limb orthopedic surgeries, as it is very economical and easy to administer [1]. However, postoperative pain control is a major concern in knee surgeries because spinal anesthesia has a relatively short duration of action [2]; thus, early analgesic intervention is needed in the postoperative period. Most of the individuals undergoing knee surgeries belong to the geriatric population with various co-morbidities. Hence, hemodynamic stability, perioperative analgesia, and early ambulation are very much essential for these patients [3]. Spinal anesthesia has benefits such as staying awake and maintenance of protective reflexes, but postoperatively, adjuvant is essential to manage or prolong the stability of patients' hemodynamic profile [4]. Hence, an attempt is made to compare the combination of isobaric levobupivacaine with fentanyl and Dexmedetomine to evaluate the spinal blockade with respect to onset, duration, side effects, and hemodynamics in knee joint surgeries.

Material and Method

72 (seventy-two) patients aged between 18 to 70 years at Government Medical College Hospital Chandigarh-160030 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, 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-36 patients were given 0.5% isobaric levobupivacaine 2.8 mL + 25 mcg fentanyl (total volume 3.3 mL). In Group D, 36 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. (36 patients in group F and 36 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.

Intra-operative: 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 November 2017 to May 2019.

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.

Observation and Results

Table 1: Comparison of sensory characteristics of subarachnoid blocks in both groups

- Onset (minutes): 4.880 (± 1.10) in group F, 2.152 (± 0.9) in group D, t test was 11.4 and p<0.001.
- Time of T_{10}sensory level (min): 7.830 (± 1.50) in group F, 4.62 (± 0.52) in group D, t test was 12.1 and p<0.001.
- Peak level (min): 13.82 (± 3.2) in group F, 8.9 (± 2.8) in group D, t test was 6.9 and p<0.001.
- Time to 2 sensory level regression (min): 103.5 (± 23.2) in group F, 51.2 (± 9.30) in group D, t test was 12.5 and p<0.001.
- Time to reach S_2 sensory level (minutes): 356.2 (± 52.2) in group F, 232.74(± 48.3) in group D, t test was 10.4 and p<0.001.

Table 2: Comparison of effective analysis amongst study group

Sensory characteristics – Time to give dose of post-operative analgesia: 361.02 (± 56.5) in group F, 242.35 (± 51.7) in group D, t test was 9.2 and p<0.001.

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

VAS Scores –

- VAS @ 90 minutes: 0.5 (± 0.02) in group F, 0.15 (± 0.04) in group D, t test was 46 and p<0.001.
- VAS @ 120 minutes: 0.2 (± 0.01) in group F, 0.74 (± 0.082) in group D, t test was 39.2 and p<0.001.
- VAS @ 180 minutes: 0.48 (± 0.72) in group F, 1.4 (± 0.08) in group D, t test was 51.2 and p<0.001.
- VAS @ 210 minutes: 0.68 (± 0.06) in group F, 2.46 (± 0.09) in group D, t test was 98 and p<0.001.
- VAS @ 240 minutes: 1.18 (± 0.02) in group F, 2.5 (± 0.92) in group D, t test was 8.60 and p<0.001.
- VAS @ 270 minutes: 1.8 (± 0.52) in group F, 2.10 (± 0.72) in group D, t test was 2.02 and p<0.001.
- VAS @ 300 minutes: 2.02 (± 0.08) in group F, 1.5 (± 0.09) in group D, t test was 10.9 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 p value is insignificant.

Table 5: Comparison of individual side effects amongst study groups –

- Shivering15 (41%) in group D only.
- Nausea: 1 (2.7%) in group D, 23 (63.8%) in group F.
- Vomiting: 19 (52%) only in group F.

Table 1: Comparison of sensory characteristics of subarachnoid block in both groups

Sensory characteristics	Group-F (Mean ± SD) (N=36)	Group-D (Mean ± SD) (N=36)	t test	p value
Onset (min)	4.880 (± 1.105)	2.152 (± 0.91)	11.4	P<0.001
Time to T10 sensory level (min)	7.830 (± 1.50)	4.62 (± 0352)	12.1	P<0.001
Peak Level (min)	13.82 (± 32.5)	8.9 (± 2.82)	6.9	P<0.001
Time to 2 sensory level regression (min)	103.5 (± 23.24)	51.2 (±9.30)	12.5	P<0.001
Time to reach S2 Sensory level (min)	356.2 (±52.2)	232.74 (± 48.3)	10.4	P<0.001

P<0.001 = p value was highly significant

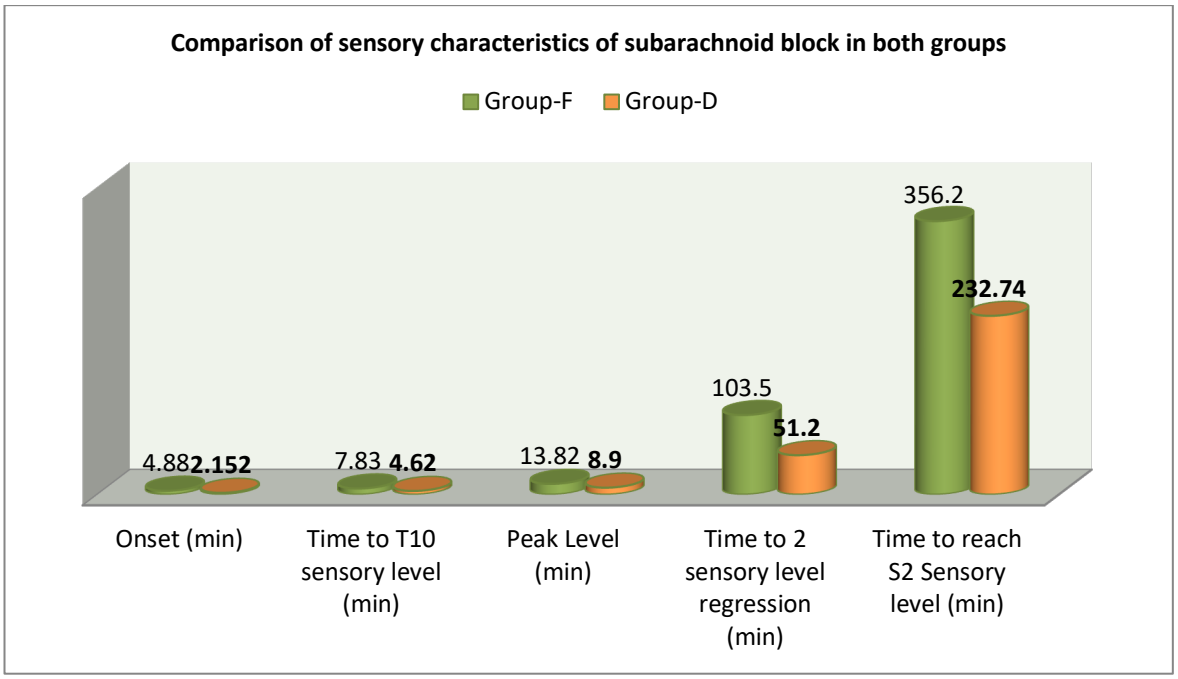

Figure 1: Comparison of sensory characteristics of subarachnoid block in both groups

Table 2: Comparison of duration of effective analysis amongst study group

Sensory characteristics	Group-F (Mean ± SD)	Group-D (Mean ± SD)	t test	p value
Time to give 1st dose of post-operative analgesia	361.02 (± 56.5)	242.35 (±51.7)	9.2	P<0.001

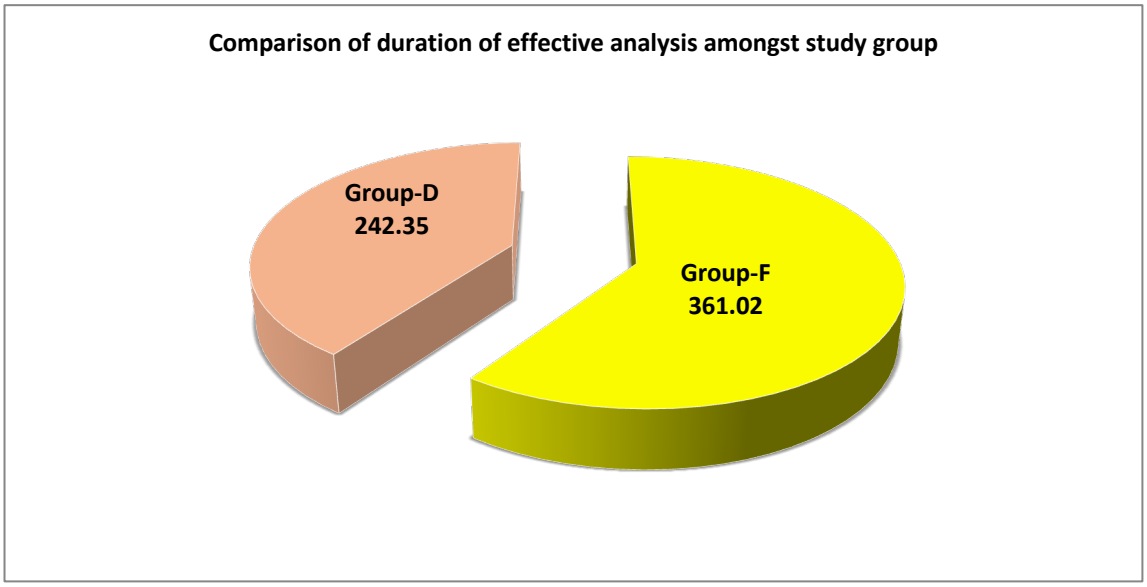

Figure 2: Comparison of duration of effective analysis amongst study group

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

VAS scores	Group F (Mean ±SD)	Group D (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 (± 0.02)	0.15 (±0.84)	46	P<0.001
VAS @120 min	0.2 (±0.01)	0.74 (± 0.082)	39.2	P<0.001
VAS @180 min	0.48 (± 0.072)	1.4 (± 0.08)	51.2	P<0.001
VAS @210 min	0.68 (± 0.06)	2.46 (± 0.09)	98.7	P<0.001
VAS @240 min	1.18 (± 0.02)	2.5 (± 0.92)	8.60	P<0.001
VAS @270 min	1.8 (± 0.520)	2.10 (± 0.720)	2.02	P<0.001
VAS @300 min	2.02 (± 0.08)	1.5 (± 0.09)	10.9	P<0.001

P<0.001 = p value is highly significant

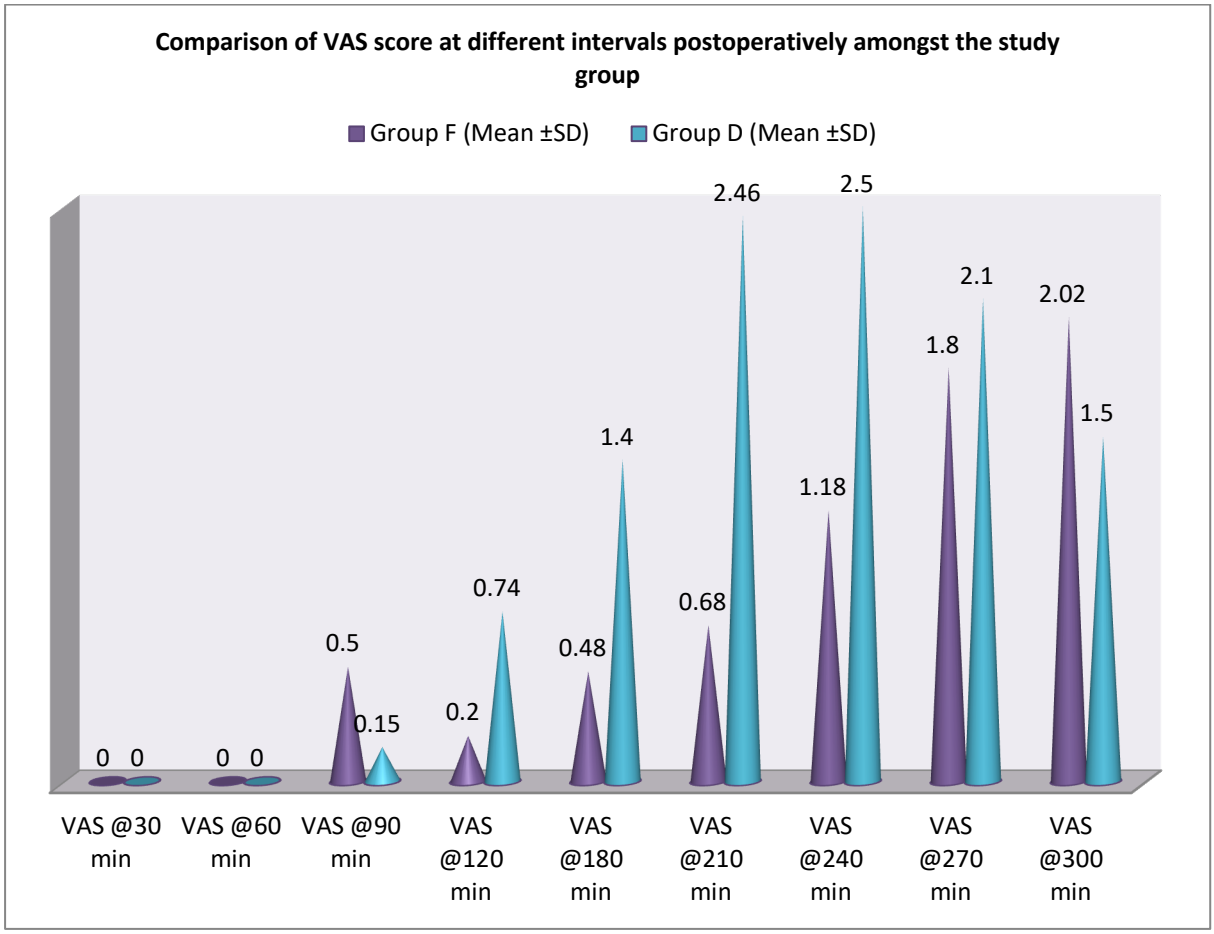

Figure 3: Comparison of VAS score at different intervals postoperatively amongst the study group

Table 4: Comparison of oxygen saturation amongst study group

	Group D	Group F	t test	P value
Baseline	99.26 (± 0.82)	97.92 (± 5.50)	1.4	p>0.9
5 Min	99.32 (± 0.62)	99.10 (± 1.12)	1.03	p>0.30
10 Min	99.26 (± 0.721)	99.10 (± 9.20)	0.10	P>0.91
15 Min	99.26 (± 0.791)	99 (± 1.222)	0.60	p>0.511
20 Min	99.26 (± 0.790)	99.05 (± 1.150)	0.90	p>0.36
25 Min	99.30 (± 0.740)	99 (± 0.815)	1.59	P>0.11
30 Min	99.30 (± 0.746)	99.30 (± 0.8)	0.00	p>1.00
40 Min	99.35 (± 0.725)	99.35 (± 0.6)	0.001	p>1.00
50 Min	99.2 (± 0.764)	99.26 (± 1.165)	0.34	p>0.73
60 Min	99.30 (± 0.746)	99.42 (± 0.710)	0.58	p>0.56
70 Min	99.2 (± 0.755)	99.35 (± 0.850)	0.52	p>0.59
80 Min	99.26 (± 0.725)	99.22 (± 0.832)	0.21	p>0.82

90 Min	99.32 (± 0.5)	99.25 (± 0.782)	0.45	p>0.65
100 Min	99.2 (± 0.727)	99.25 (± 0.782)	0.28	p>0.77
110 Min	99.30 (± 0.64)	99.30 (± 0.620)	0.00	p>1.000
120 Min	99.0 (± 0.72)	99.25 (± 0.82)	1.37	p>0.17
130 Min	99.4 (± 0.625)	99.4 (± 0.856)	0.001	p>1.000
140 Min	99.3 (± 0.625)	99.10 (± 0.83)	1.15	p>0.25
150 Min	99.4 (± 0.663)	99.4 (± 0.83)	0.00	p>1.000
180 Min	99.2 (± 0.66)	99.12 (± 0.780)	0.46	p>0.64
210 Min	99.4 (± 0.62)	99.4 (± 0.65)	0.00	p>1.000
240 Min	99.4 (± 0.646)	99.95 (± 0.724)	0.00	p>1.66
300 Min	99.15 (± 0.66)	99.95 (± 0.726)	0.31	p>0.75
360 Min	99.4 (± 5.84)	100.65 (± 7.90)	0.76	p>0.44

(p value is highly insignificant)

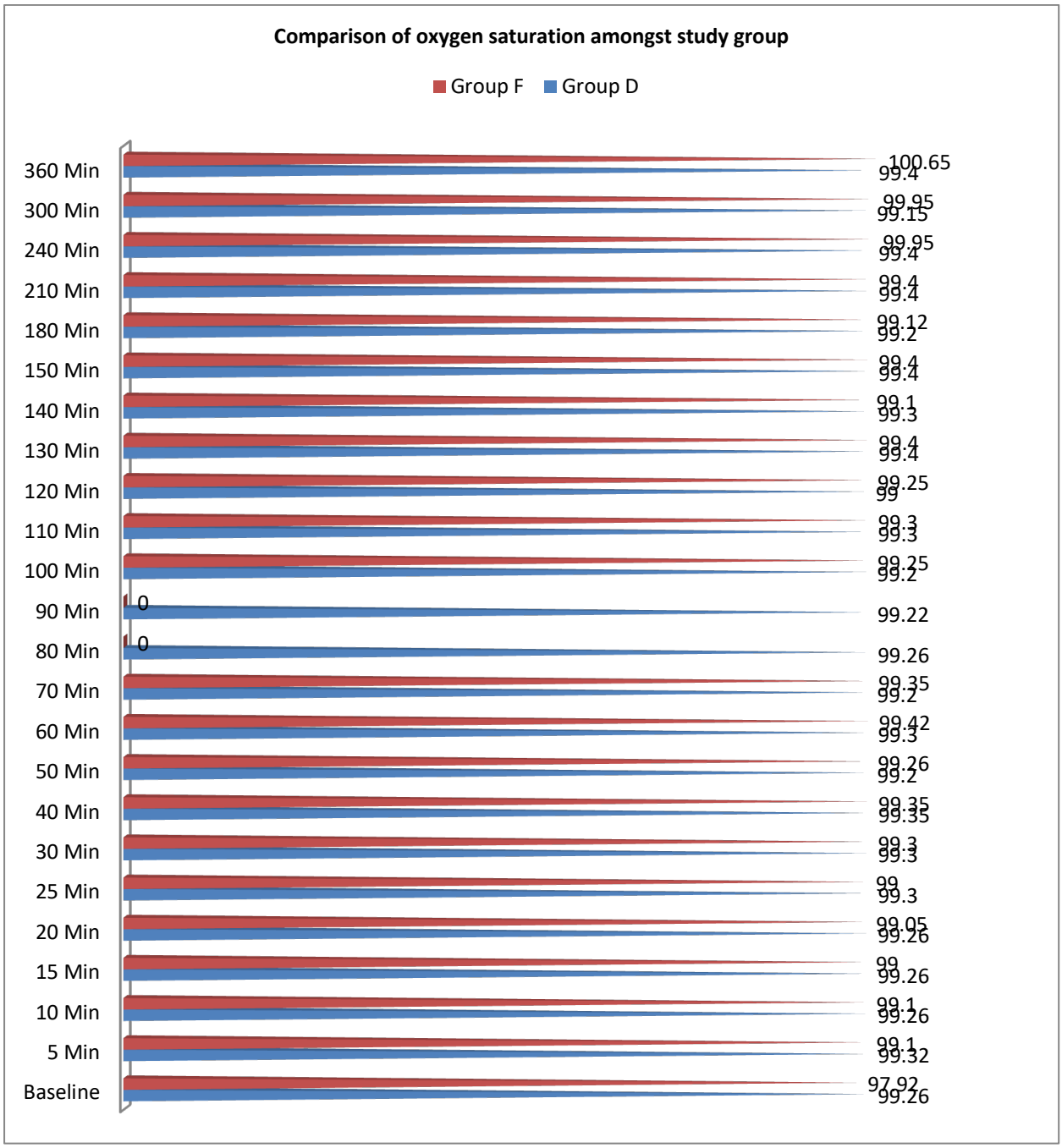

Figure 4: Comparison of oxygen saturation amongst study group

Table 5: Comparison of individual side effects amongst study group

	Group D (36)	Group F (36)	Total
Shivering	15 (41%)	0	10
Pruritus	0	0	0
Nausea	1 (2.7%)	23 (63.8%)	24
Vomiting	0	19 (52%)	19
Respiratory depression	0	0	0
Urinary Retention	0	0	0

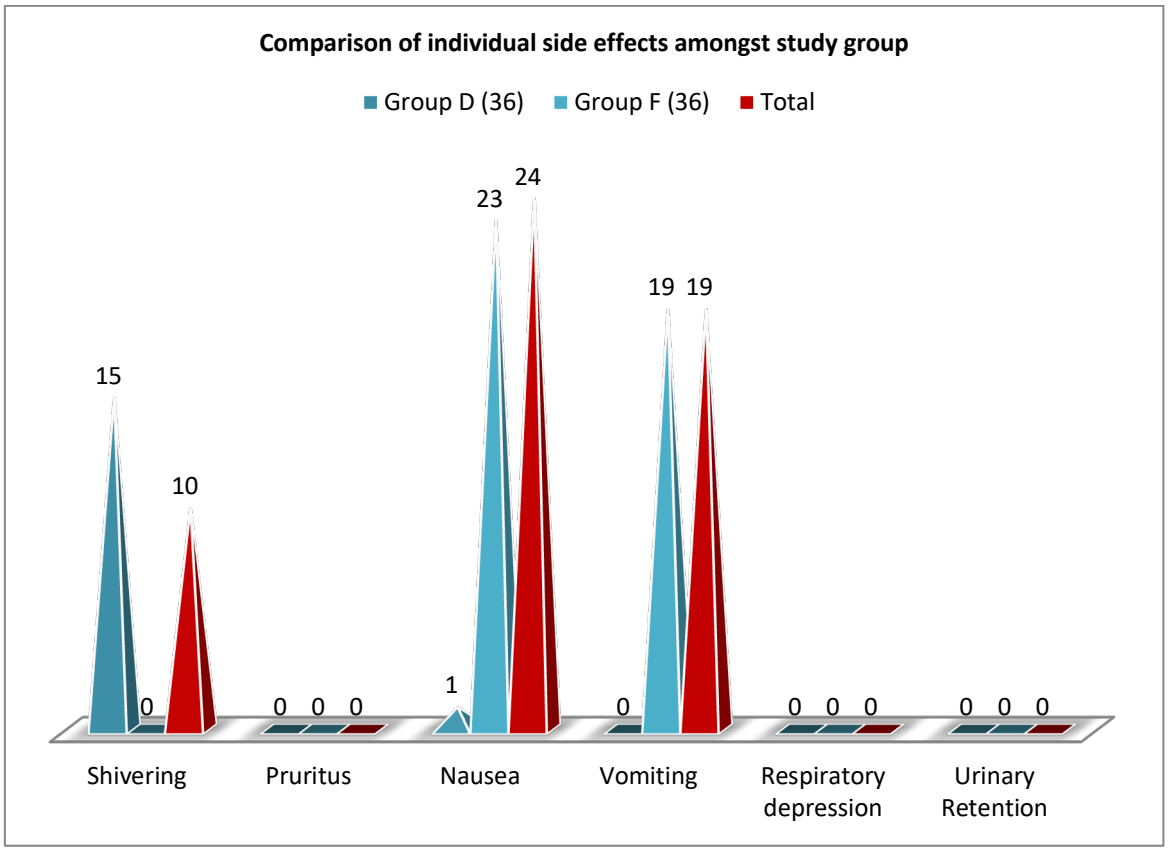

Figure 5: Comparison of individual side effects amongst study group

Discussion

A comparison of intrathecal dexmedetomidine and fentanyl as adjuvants to levobupicaine for postoperative analgesia in knee surgeries in the Chandigarh 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 15 (40%) and nausea was 1 (2.7%) in group D, and nausea was 23 (63.8%) and vomiting was 19 (52%) in group F (Table 5). These findings are more or less in agreement with previous studies [5,6,7]. 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 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 both drugs.

Summary and Conclusion

In the comparative study of intrathecal dexmedetomidine and fentanyl as adjuvants to levobupivacaine for postoperative analgesia in knee surgeries in the Chandigarh 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 is still unclear.

Limitations 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.

This research work has been approved by the ethical committee of Government Medical College Hospital Chandigarh-160030.

References

1. Honca M, Dereli N, Kose EA, Honca T, Kutuk S, Unal SS, Horasanli E: low dose levobupivacaine plus fentanyl combination for spinal anesthesia in anorectal surgery. Revista de anestesiologia, 2015, Nov; 65; 641–5.
2. Airani HV, Jayaram S, Chandrakumar BM: Efficacy of intrathecal α2 agonists as adjuvants with a low dose of levobupivacaine for lower limb surgeries in elderly patients. Indian Journal of Clinical Anaesthesia 2017, 4 (2); 176–82.
3. Prasad V, Gupta ML: In lower limb orthopaedic surgery, a comparison of intrathecal dexmedetomidine and fenthanyl as adjuvants of isobaric levobupivacaine: an RCT trial European Journal of Molecular and Clinical Medicine 2021 Jun. 11; 7 (10); 4294-301.
4. Rahimzadeh P, Faiz SH, Imani F, Derakhshan P, Amniati S: Comparative addition of dexmedetomidine and fentanyl to intraithecal bupivacaine in orthopedic procedures in lower limbs. BMC anesthesiology. 2018 Dec. 18 (1); 1–7.
5. Bhura A, Jagtap N: A comparison of intrathecal dexmedetomidine and fentanyl as an adjuvant to isobaric levobupivacaine for lower limb orthopedic surgery Indian Journal of Clinical Anesthesia 2019, Jan 6 (1); 89–96.
6. Mohamed T, Susheela I, Balakrishna BP, Kaniyil S: Dexmedetomidine as an adjuvant to lower doses of intrahecal bupivacaine for lower limb orthopedic surgeries Anesthesia, essays, and researches 2017, July 11 (3); 681.
7. Jain S: Double blinded clinical comparative trial of inrathecal dexmedetomidine and fentanyl as an adjuvant to isobaric levobupivacaine IJMA. 2018, 1 (1); 36–40.
8. Kataria AP, Kumar R, Kashyap A: Comparison of levobupivacaine and levobupivacaine with dexmedetomidine in infraumbilical surgeries under spinal anesthesia. Anesthesia, essays, and research 2018, Jan 12 (1); 251.
9. Fairbanks CA, Wilcox GL: Spinal anti-inociceptive synergism between morphine and clonidine persists in mice made acutely or chronically tolerant to morphine. Journal of Pharmacology and Experimental Therapeutics 1999, Mar. 1; 288 (3); 1107–16.
10. E. Mather: Clinical Pharmacokinetics of Fentanyl and its Newer Derivatives. Clinical Pharmacokinetics 1983; 8; 422-46.
11. Esmaoglu A, Turk S, Bayram A, Akin A, Ugur F, Ulgey A: The effects of dexmedetomidine added to spinal levobupivacaine for transurethral endoscopic surgery. Balkan Medical Journal 2013, Jun; 30 (2); 186.