Original Article

ISSN (0): 2635-0823; ISSN (P): 2635-0815

Evaluation of Clonidine as an Alternative to Fentanyl as Adjuvant in Sub Arachnoid Block in Adults Scheduled for Elective Procedures: A Randomized Controlled Trial

Syed Kamran Habib[1], Umar Sherwani[2], Zainab Jamal[3], Saif Ur Rehman[3]

[1]Assistant Professor, Department of Anaesthesiology, J.N Medical College, AMU, Aligarh, Uttar Pradesh, India.

[2]Resident, Department of Anaesthesiology, J.N Medical College, AMU, Aligarh, Uttar Pradesh, India.

[3]Intern, Department of Anaesthesiology, J.N Medical College, AMU, Aligarh, Uttar Pradesh, India.

Abstract

Background: Regional anesthesia is commonly favored for surgeries involving the lower abdomen and lower limbs, as it enables the patient to stay awake and reduces complications linked to airway management. Although hyperbaric bupivacaine 0.5% is widely applied in spinal anesthesia, its major drawback is its limited duration of action. Subarachnoid block with adjuvants such as Clonidine or fentanyl is often administered in lower limb surgeries to extend intraoperative and postoperative analgesia and enhance block quality. This study aimed to compare the onset time of sensory and motor blockade, duration of spinal anaesthesia, and hemodynamic responses between two groups: Group BC (Bupivacaine with Clonidine) and Group BF (Bupivacaine with Fentanyl) in adult patients undergoing elective knee arthroscopy for sports-related injuries. **Subjects and Methods:** A total of sixty ASA I and II patients, aged 18–50 years, were randomly assigned into two equal groups. Group BC received 12.5 mg bupivacaine combined with 30 µg prediluted Clonidine, while Group BF received 12.5 mg bupivacaine with 25 µg fentanyl. The onset times of sensory and motor block, total duration of spinal anaesthesia, time to two-segment regression and hemodynamic parameters were compared between the two groups. **Results:** Both groups were comparable in demographic data and ASA classification. The onset of sensory and motor block was slightly faster in Group BC than in Group BF, though the difference was not statistically significant (sensory: 5.61 ± 0.87 vs 5.70 ± 1.14 minutes; motor: 6.21 ± 0.816 vs 6.25 ± 1.15 minutes; $p > 0.05$). The duration of spinal anesthesia was significantly longer in Group BC (248.66±7.76 minutes) compared with Group BF (230.50±10.53 minutes; $p < 0.001$). Mean arterial pressure and heart rate remained comparable between groups throughout the procedure. **Conclusion:** In conclusion, intrathecal Clonidine produces a faster onset of sensory and motor block, a longer duration of spinal anaesthesia, and stable hemodynamic parameters compared to intrathecal fentanyl. Both adjuvants were found to be clinically useful in regional anaesthesia with minimal adverse effects when used in appropriately selected patients.

Keywords: Bupivacaine, clonidine, spinal anaesthesia, intrathecal adjuvant.

Corresponding Author: Dr. Umar Sherwani, Resident, Department of Anaesthesiology, J.N Medical College, AMU, Aligarh, Uttar Pradesh, India.
Email: sherwaniumar9@gmail.com

Received: 17 February 2023 **Revised: 22 March 2023** **Accepted: 09 April 2023** **Published: 30 June 2023**

Introduction

Spinal, epidural, and combined spinal–epidural anaesthesia are well-established and dependable techniques commonly used for surgeries involving the lower limbs. The duration of intrathecal anaesthesia and postoperative analgesia can be enhanced by incorporating adjuvants such as fentanyl, epinephrine, and alpha-2 adrenergic agonists like clonidine and dexmedetomidine. These alpha-adrenergic agonists possess multiple beneficial effects, including sedative, analgesic, sympatholytic, anaesthetic-protective, and hemodynamic-stabilising properties.[1]

Clonidine, a selective alpha-2 adrenergic receptor agonist, provides sedation, analgesia, anxiolysis, and sympatholysis.[2] In contrast, fentanyl, a synthetic opioid acting centrally, is often added to local anaesthetics to extend the duration of anaesthesia and analgesia.[3] However, intrathecal administration of opioids may lead to adverse effects such as pruritus, urinary retention, nausea, vomiting, and respiratory depression.[4]

This double-blind, randomised study therefore aims to compare intrathecal Fentanyl (25 µg) and Clonidine (30 µg) as adjuvants to 12.5 mg hyperbaric bupivacaine in adult patients undergoing elective lower-limb surgeries. The effectiveness of intrathecal fentanyl and clonidine as adjuvants was measured in terms of onset time of sensory and motor block, duration of spinal anaesthesia, time to two-segment regression, and hemodynamic stability among adult patients undergoing elective lower limb arthroscopic surgeries.

Subjects and Methods

This prospective, randomised, double-blind study was conducted at Jawaharlal Nehru Medical College, AMU, following approval from the Institutional Ethics Committee and after obtaining written informed consent from all participants. The study period extended from November

2022 to November 2023 and was registered in the Clinical Trials Registry (CTRI/2023/04/051460).

A total of sixty adult patients, aged 18–50 years, of either sex, classified as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective lower limb surgeries under subarachnoid block, were included in the study.

Patients with contraindications to spinal anaesthesia, hypersensitivity to study medications, cardiac arrhythmias, uncontrolled hypertension, hepatic or renal impairment, coagulopathy, local infection at the puncture site, or unwillingness to participate were excluded.

Participants were randomly assigned to two equal groups of thirty patients each using the sealed-envelope technique:

- Group BC: received 12.5 mg (2.5 ml) of 0.5% hyperbaric bupivacaine with 30 µg Clonidine (diluted to 0.5 ml).
- Group BF: received 12.5 mg (2.5 ml) of 0.5% hyperbaric bupivacaine with 25 µg Fentanyl (diluted to 0.5 ml).

The total intrathecal injection volume was maintained at 3 ml in both groups.

Under strict aseptic conditions, spinal anaesthesia was administered at the L3–L4 interspace using a 23-gauge Quincke needle, with patients positioned sitting during the procedure. Immediately after intrathecal drug administration, patients were placed in the supine position. Standard intraoperative monitoring, including ECG, non-invasive blood pressure (NIBP), and pulse oximetry, was initiated. Heart rate (HR), mean arterial pressure (MAP), and oxygen saturation (SpO_2) were recorded at baseline, immediately post-injection and subsequently every 15 minutes up to 150 minutes or until completion of surgery, whichever occurred first.

The onset of sensory block was defined as the time from intrathecal injection to loss of pinprick sensation at the T8 dermatome, while the onset of motor block was identified by achieving a Modified Bromage score of 3. The duration of spinal anaesthesia was measured as the interval between intrathecal injection and the patient's first report of pain in the postoperative period. The time required for two-segment regression was defined as the duration between attainment of the T8 block level and regression of sensory block by two dermatomal segments.

Motor block was assessed using the Modified Bromage Scale:

- Bromage 0: Full movement of hip, knee, and ankle.
- Bromage 1: Inability to move the hip; able to move knee and ankle.
- Bromage 2: Inability to move hip and knee; able to move ankle.
- Bromage 3: Complete inability to move hip, knee, and ankle.

Statistical analysis and sample size: Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 27.0 (Evaluation version) after completion of data collection. The sample size was determined based on a previous study (5), assuming a 25% difference in postoperative analgesia duration between the two groups. A study power of 80% and a 95% confidence level were considered appropriate, yielding a required sample size of 26 patients per group. To account for potential dropouts, 30 participants were finally enrolled in each group.

Data were presented as mean values with standard deviations (SD). Categorical variables such as gender and ASA physical status were analysed using the Chi-square test, while continuous variables were compared using the unpaired t-test. A significance threshold (α) of 0.05 was applied, and a p-value less than 0.05 was considered statistically significant.

Results

All 60 patients completed the study, with 30 participants in each group. There were no significant differences between the groups in terms of age, gender distribution, ASA physical status and duration of surgery ($p > 0.05$), as presented in Table 1.

Therefore, the demographic parameters were comparable and did not act as confounding factors in evaluating the effects of the adjuvant drugs.

Table 1: Demographic Characteristics, ASA grades and Duration of surgery.

Variables	Group BF	Group BC	p-value
Age(years)	31.73± 8.01	31.46 ± 8.05	0.897
Sex (M:F)	14:16	15:15	0.799
ASA (I:II)	19:11	19:11	1.000
Duration of surgery(min)	120.83±11.45	126.70±10.09	0. 066

Table 2: Comparison of Block Characteristics Between Fentanyl (BF) and Clonidine (BC) Groups

Parameter	Group BF (Fentanyl 25 µg)	Group BC (Clonidine 30 µg)	p-value
Sensory onset (min)	5.70±1.14	5.61±0. 87	0.745
Motor onset (min)	6.25±1.15	6.21±0.816	0.890
Two-segment regression (min)	80.10±3.42	100.63 ± 4.90	<0.001
Duration of spinal block (min)	230.50±10.53	248.66 ± 7.76	<0.001

Block characteristics are summarised in [Table 2].

The average time to achieve sensory blockade at the T8 dermatome was comparable across both groups (Group BF: 5.70 ± 1.14 minutes; Group BC: 5.61 ± 0.87 minutes; p = 0.745). Likewise, the onset of motor block, determined by reaching a modified Bromage score of 3, showed no significant difference between the groups (Group BC: 6.25 ± 1.15 minutes; Group BC: 6.21 ± 0.82 minutes; p = 0.890).

In contrast, there were significant differences in the duration-related outcomes. The total duration of spinal anaesthesia, measured from intrathecal injection to the first postoperative pain report, was 230.50 ± 10.53 minutes in Group BF and 248.66 ± 7.76 minutes in Group BC ($p < 0.001$). Additionally, clonidine prolonged the time to two-segment regression of sensory block (100.63 ± 4.90 minutes) compared to fentanyl (80.10 ± 3.42 minutes; $p < 0.001$).

Throughout the intraoperative period, mean arterial pressure (MAP) and heart rate (HR) were consistently stable and similar between groups ($p > 0.05$). Minor, transient reductions in HR and MAP occurred within the first 15–30 minutes post-block but were clinically insignificant. Figures 1 and 2 illustrate the parallel and stable MAP and HR trends over the 150-minute observation interval.

Minor adverse events, including nausea, bradycardia, hypotension, and urinary retention, were observed sporadically in both groups with a comparable frequency and no statistically significant differences ($p > 0.05$).

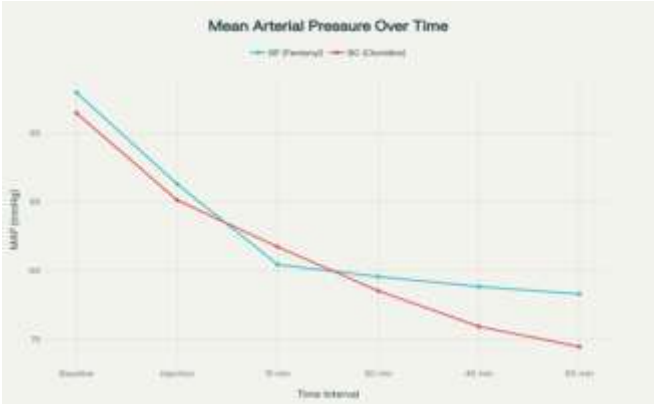

Figure 1: Mean Arterial Pressure (MAP) Trends Over Time

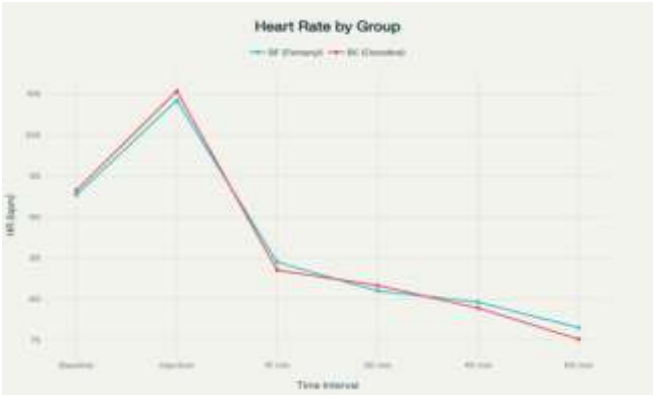

Figure 2: Heart Rate (HR) Trends Over Time

Discussion

In our study, both the groups (BF and BC) were comparable in context to the observed demographic variables, ASA grade and duration of surgeries, ensuring that observed differences were attributable to the pharmacodynamic profiles of the adjuvants rather than patient variability.

The present randomized, double-blind comparison showed that adding 30 µg clonidine resulted in a slightly faster onset of sensory and motor blocks than 25 µg fentanyl, although the difference was not statistically significant. This aligns with findings by Singh R et al,[5] who also reported similar block onset when bupivacaine was combined with either adjuvant.

The result also demonstrates that the addition of intrathecal Clonidine (30 µg) to hyperbaric bupivacaine significantly prolongs total duration of spinal anaesthesia, and time to two-segment regression compared with Fentanyl (25 µg), while maintaining stable haemodynamic parameters. Radhe Sharan et al,[6] also conducted a study on 100 patients and concluded that Clonidine prolongs the duration of the spinal block more than fentanyl with prolonged time to two segment regression.

Intraoperative haemodynamic stability, depicted in Figures 1 and 2, was maintained in both groups. Specifically, there were no statistically significant differences in Mean Arterial Pressure (MAP), or heart rate (HR) throughout the observed study period ($P>0.05$). Similarly, Dash et al,[7] studied clonidine and fentanyl when added to bupivacaine and reported that hemodynamics were comparable between both groups.

Overall, our study is consistent with existing literature.

Importantly, no major complications were encountered, indicating that the agents are well-tolerated as intrathecal adjuvants. In study by Routray SS et al,[8] in the analysis of side effects across the Clonidine and Fentanyl groups, bradycardia, hypotension, nausea, vomiting, pruritus, and shivering did not show significant differences among the groups.

Collectively, these results reaffirm that Clonidine provides longer and stable spinal anaesthesia compared with Fentanyl without compromising safety. The data thus support its preferential use as an α_2-agonist adjuvant in lower-limb surgeries requiring prolonged anaesthetic effect and postoperative comfort.

Conclusion

Based on results from our study, intrathecal Clonidine produced a more rapid onset of both sensory and motor blockades, and led to an extended duration of spinal anaesthesia compared to patients receiving intrathecal fentanyl, while maintaining similar hemodynamic stability between groups. Consequently, Clonidine demonstrates strong potential as an effective and clinically practical adjuvant for regional anaesthesia procedures.

References

1. Zhang C, Li C, Pirrone M, Sun L, Mi W. Comparison of Dexmedetomidine and Clonidine as Adjuvants to Local Anesthetics for Intrathecal Anesthesia: A Meta-Analysis of Randomized Controlled Trials. J Clin Pharmacol. 2016;56(7):827-34.
2. Mahendru V, Tewari A,. A comparison of intrathecal Dexmedetomidine, clonidine, and fentanyl as adjuvants to hyperbaric bupivacaine for lower limb surgery: a double blind controlled study. J

Anaesthesiology Clin Pharmacology. 2013;29(4):496. doi: 10.4103/0970-9185.119151
3. Rahimzadeh P, Faiz. Comparative addition of Dexmedetomidine and fentanyl to intrathecal bupivacaine in orthopedic procedure in lower limbs. BMC Anesthesiology 2018;18(1):62. doi: 10.1186/s12871-018-0531-7
4. Belzarena SD. Clinical effects of intrathecally administered fentanyl in patients undergoing cesarean section. Anesth Analg. 1992;74(5):653–657. doi: 10.1213
5. Singh R, Kundra S, Gupta S, Grewal A, Tewari A. Effect of clonidine and/or fentanyl in combination with intrathecal bupivacaine for lower limb surgery. J Anaesthesiology Clin Pharmacol. 2015;31(4):485–90.
6. Sharan R, Verma R, Dhawan A, Kumar J. Comparison of clonidine and fentanyl as adjuvant to ropivacaine in spinal anesthesia in lower abdominal surgeries. Anesthesiology Essays Res. 2016;10(3):526–31.
7. Dash UK, Kiran S, Tandon U, Jinjil K. A comparative study on effect of addition of clonidine and fentanyl as adjuvants to local anaesthetics for subarachnoid block 92 References in patients undergoing lumbar laminectomies. Anesth Essays Res. 2016;10(3):618–23.
8. Routray SS, Raut K, Pradhan A, Dash A, Soren M. Comparison of Intrathecal Clonidine and Fentanyl as Adjuvant to Hyperbaric Bupivacaine in Subarachnoid Block for Lower Limb Orthopedic Surgery. Anesth Essays Res. 2017;11(3):589 93.

How to cite this article: Habib SK, Sherwani U, Jamal Z, Rehman SU. Evaluation of Clonidine as an Alternative to Fentanyl as Adjuvant in Sub Arachnoid Block in Adults Scheduled for Elective Procedures: A Randomized Controlled Trial. Adv Clin Med Res. 2023;4(2): 16-19.

Source of Support: Nil, **Conflict of Interest:** None declared.