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# A Comparative Study of the Effect of Clonidine versus Fentanyl with Hyperbaric Bupivacaine on Spinal Block Characteristics

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## Abstract

**Background**: Spinal anaesthesia is most widely used techniques for lower abdominal, orthopaedic, urological surgeries. Major limitation of spinal block with local anaesthetics is lack of prolonged postoperative analgesia. Addition of intrathecal adjuvants like clonidine and fentanyl improves quality and duration of block. The aim of this study was to compare the efficacy of intrathecal clonidine (1 µg/kg) and fentanyl (25 µg) as adjuvants to 0.5% 3ml hyperbaric bupivacaine on spinal block characteristics.

**Methodology**: A prospective randomized comparative study was conducted on 100 ASA I - II patients undergoing surgeries under spinal anaesthesia. Two groups (n=50 each) were formed, Group C received clonidine 1 µg/kg with 3 ml of 0.5% hyperbaric bupivacaine and Group F received fentanyl 25 µg with 3 ml of 0.5% hyperbaric bupivacaine intrathecally. Hemodynamic stability, sensory and motor block characteristics, duration of analgesia, VAS pain scores and side effects were observed.

**Results**: The groups were comparable with respect to demographic variables and intraoperative parameters. Clonidine group showed significantly prolonged duration of analgesia (409.04±9.84 min vs 240.16±8.86 min, p<0.001), higher sedation scores and lower VAS

scores at 6th and 12th hour compared to fentanyl group. Incidence of side effects was minimal and comparable between both groups.

**Conclusion**: Intrathecal clonidine as adjuvant to hyperbaric bupivacaine significantly prolongs sensory and motor block, enhances postoperative analgesia and provides better patient comfort compared to fentanyl, with slightly higher sedation scores. Similar findings were reported in previous studies.[1,2] This is consistent with studies by Singh et al. and Tilkar et al.[2,3]

**Keywords**: Spinal anaesthesia, Clonidine, Fentanyl, Bupivacaine, Analgesia, Adjuvant

## Introduction

Spinal anaesthesia is the preferred technique for lower abdominal, urological, orthopaedic and gynaecological surgeries because it is simple, safe, cost-effective, and provides excellent surgical conditions. Hyperbaric bupivacaine 0.5% is the most commonly used local anaesthetic agent; however, it is limited by its relatively short duration of postoperative analgesia. Adjuvants such as opioids (fentanyl, morphine) and alpha-2 adrenergic agonists (clonidine, dexmedetomidine) are commonly combined with local anaesthetics to improve block quality and prolong analgesia. Fentanyl, a lipophilic μ-opioid agonist, provides rapid onset of action and enhances intraoperative analgesia but is associated with pruritus, nausea and vomiting. Clonidine, an α2 adrenergic agonist, prolongs both sensory and motor blockade, reduces requirement of local anaesthetics, and provides extended postoperative analgesia with sedation as a side effect. This study compares intrathecal clonidine (1 μg/kg) and fentanyl (25 μg) as adjuvants to hyperbaric bupivacaine 0.5%, with emphasis on spinal block characteristics, duration of analgesia, hemodynamic stability and side effect profile. Similar findings have been reported in previous studies.[1,2] Comparable adverse events have been observed in other randomized trials.[4,5]

## Materials and Methods

This prospective randomized study was conducted in 100 ASA I and II patients, aged 18–65 years, scheduled for elective lower abdominal, orthopaedic, gynaecological and urological surgeries under spinal anaesthesia. After ethical approval and informed consent, patients were randomly allocated into two equal groups (n=50 each). Group C received intrathecal clonidine 1 μg/kg combined with 3 ml 0.5% hyperbaric bupivacaine, while Group F received intrathecal fentanyl 25 μg with 3 ml 0.5% hyperbaric bupivacaine. Monitoring included heart rate, mean arterial blood pressure, SpO2, respiratory rate, Visual Analogue Scale (VAS) for pain, and Campbell Sedation Score (CSS). Characteristics of spinal block such as onset of sensory and motor blockade, highest dermatomal level achieved, duration of motor block, time for regression to L1, and duration of effective analgesia were recorded. Hemodynamic side effects including bradycardia, hypotension, nausea, vomiting, pruritus and respiratory depression were noted. Data was analysed using unpaired t-test and chi-square test, with $p<0.05$ considered significant.

## Results

A total of 100 patients were included in the study and analysed. Demographic variables such as age, sex, height, weight and duration of surgery were comparable between the two groups. The mean duration of surgery was 123.18±25.03 min in Group C and 121.34±22.79 min in Group F ($p>0.05$). Spinal block characteristics showed no significant difference in the onset of sensory or motor blockade between groups. However, duration

of analgesia was significantly longer in Group C (409.04±9.84 min) compared to Group F (240.16±8.86 min, p<0.001). Regression to L1 was similar between groups (169.98±8.45 vs 167.02±6.90 min). VAS scores were significantly lower in the clonidine group at 6 hours and 12 hours postoperatively. Campbell sedation scores were significantly higher in Group C at 3, 6 and 12 hours, reflecting mild sedation. Side effects were minimal, with bradycardia in 10% of clonidine patients and itching/shivering in 2% of fentanyl patients, but no incidence of respiratory depression or hypotension. Detailed results are presented in Tables 1–11 with corresponding figures. Similar findings have been reported in previous studies.[1,2] This is consistent with studies by Singh et al. and Tilkar et al.[2,3]

Table 1: Demographic Data

| Parameters | Group C (n=50) | Group F (n=50) | P value | Result |
|---|---|---|---|---|
| Age (years) | 39.58±14.61 | 41.69±14.49 | 0.470 | Not Significant |
| Weight (kg) | 54.1±8.00 | 52.22±7.24 | 0.220 | Not Significant |
| Height (cm) | 158.02±9.67 | 159.2±10.33 | 0.556 | Not Significant |
| Sex (M/F) | 27/23 | 31/19 | - | Not Significant |
| Duration of surgery (min) | 123.18±25.03 | 121.34±22.79 | 0.701 | Not Significant |

The two groups were comparable with respect to age, sex, height, weight, and duration of surgery (p>0.05).

Table 2: Types of Surgery

| Types of Surgery | Group C (n=50) | Group F (n=50) |
|---|---|---|
| Gynecological | 8 (16%) | 8 (16%) |
| Urological | 15 (30%) | 11 (22%) |
| Orthopedic | 17 (34%) | 19 (38%) |
| Gastrointestinal | 10 (20%) | 12 (24%) |

Distribution of surgical procedures was similar in both groups (p>0.05).

Table 3: Comparison of Heart Rate

| Time Interval | Group C | Group F | P value | Result |
|---|---|---|---|---|
| 0 min | 90.36±9.38 | 90±8.32 | 0.928 | Not Significant |
| 10 min | 83.6±11.29 | 83.4±4.35 | 0.908 | Not Significant |
| 30 min | 78.88±4.68 | 78.6±4.59 | 0.829 | Not Significant |
| 12 hr | 74.12±4.70 | 73.71±4.31 | 0.654 | Not Significant |

Mean heart rate was comparable between the two groups at all time intervals (p>0.05). The mean of heart rate for Group C at 1 hour was noted as 78.4±4.40, at 2 hours was 78.32±4.76, at 3 hours was 77.88±5.63, at 6 hours 77.28±77.28±4.03 which were all not significant statistically. Similarly for Group F, the mean heart rate at 1 hour was 78.04±4.72, at 2 hours was 78.28±4.98, at 3 hours was 77.92±4.49 and at 6 hours was 77.64±3.97 all of which were not significant statistically.

Table 4: Comparison of Mean Arterial Blood Pressure

| Time Interval | Group C | Group F | P value | Result |
|---|---|---|---|---|
| 0 min | 94.74±5.26 | 93.14±5.54 | 0.141 | Not Significant |
| 10 min | 92.86±5.26 | 92.76±7.35 | 0.937 | Not Significant |
| 20 min | 92.56±6.11 | 92.7±5.63 | 0.905 | Not Significant |
| 30 min | 92.26±5.98 | 92.96±5.97 | 0.559 | Not Significant |
| 1 hr | 93.8±5.73 | 93.7±5.65 | 0.944 | Not Significant |
| 2 hr | 93.04±6.01 | 93.5±6.22 | 0.769 | Not Significant |
| 3 hr | 92.98±5.01 | 92.8±5.15 | 0.859 | Not Significant |
| 6 hr | 91.34±5.36 | 91.08±5.44 | 0.810 | Not Significant |
| 12 hr | 89.46±5.02 | 89.32±5.10 | 0.890 | Not Significant |

Both groups maintained stable blood pressures with no significant differences ($p>0.05$).

Table 5: Comparison of Respiratory Rate

| Time Interval | Group C | Group F | P value | Result |
|---|---|---|---|---|
| 0 min | 14.43±0.77 | 14.42±0.83 | 0.618 | Not Significant |
| 1 hr | 14.38±0.77 | 14.5±0.88 | 0.469 | Not Significant |
| 12 hr | 14.46±0.81 | 14.5±0.90 | 0.815 | Not Significant |

Respiratory rates remained stable and comparable in both groups ($p>0.05$). At 10 minutes, the values were 14.28 ± 0.78 in Group C and 14.40 ± 0.83 in Group F ($p=0.458$,). At 20 minutes, the mean was 14.44 ± 0.86 in Group C and 14.48 ± 0.95 in Group F ($p=0.825$). At 30 minutes, the values were 14.30 ± 0.81 in Group C and 14.48 ± 0.83 in Group F ($p=0.865$). At 2 hours, both groups showed identical mean values (14.48 ± 0.78 in Group C and 14.48 ± 0.88 in Group F, $p=0.999$). At 3 hours, the values were 14.50 ± 0.88 in Group C and 14.54 ± 0.93 in Group F ($p=0.825$). At 6 hours, the parameter was 14.42 ± 0.83 in Group C and 14.60 ± 0.92 in Group F ($p=0.309$); which were all statistically not significant.

Table 6: Sensory Block Characteristics

| Parameters | Group C | Group F | P value | Result |
|---|---|---|---|---|
| Onset of Sensory Block (min) | 2.73±0.41 | 2.66±0.35 | 0.360 | NS |
| Time to Highest Level (T6) | 8.54±0.63 | 8.32±0.59 | 0.647 | NS |

Onset of sensory block and time to reach highest dermatomal level were comparable in both groups ($p>0.05$).

Table 7: Motor Block Characteristics

| Parameters | Group C | Group F | P value | Result |
|---|---|---|---|---|
| Onset of Motor Block (min) | 3.12±0.35 | 2.92±0.39 | 0.451 | NS |
| Duration of Motor Blockade (min) | 205.96±9.58 | 213.96±10.12 | 0.702 | NS |

The onset and duration of motor block were similar between the groups ($p>0.05$).

Table 8: Duration of Analgesia and Regression

| Parameters | Group C | Group F | P value | Result |
|---|---|---|---|---|
| Duration of Analgesia (min) | 409.04±9.84 | 240.16±8.86 | <0.0001 | Highly Significant |
| Regression to L1 (min) | 169.98±8.45 | 167.02±6.90 | 0.159 | NS |

Clonidine significantly prolonged the duration of analgesia compared to fentanyl ($p<0.001$).

Table 9: Postoperative VAS Scores

| Time | Group C | Group F | P value | Result |
|---|---|---|---|---|
| 6 hr | 0.18±0.38 | 1.1±0.54 | 0.015 | Significant |
| 12 hr | 0.58±0.53 | 1.58±0.67 | <0.001 | Significant |

VAS scores at 6 and 12 hours were significantly lower in clonidine group ($p<0.05$). The VAS score at baseline 0 hr, 10 mins, 20 mins, 30 mins, 1 hour, 2 hour and 3 hours were not statistically significant.

Table 10: Campbell Sedation Score

| Time | Group C | Group F | P value | Result |
|---|---|---|---|---|
| 3 hr | 1.42±0.53 | 1.02±0.14 | <0.001 | Significant |
| 6 hr | 1.66±0.51 | 1.04±0.19 | <0.001 | Significant |
| 12 hr | 1.36±0.48 | 1.04±0.19 | <0.001 | Significant |

Sedation was significantly higher in clonidine group at 3, 6 and 12 hours ($p<0.001$). At baseline (0 hr, just after spinal anesthesia), the mean score was 1 ± 0 in both Group C and Group F. At 10 minutes and 20 minutes, values remained 1 ± 0 in both groups, showing no difference. At 30 minutes, the mean was 1.12 ± 0.32 in Group C compared to 1 ± 0 in Group F. At 1 hour, Group C showed 1.26 ± 0.44 while Group F remained at 1 ± 0, and at 2 hours, Group C increased further to 1.36 ± 0.52 compared to 1 ± 0 in Group F; however, these differences were not statistically significant.

Table 11: Side Effects

| Side Effect | Group C (n=50) | Group F (n=50) |
|---|---|---|
| Nausea & Vomiting | 6 (12%) | 4 (8%) |
| Bradycardia | 5 (10%) | 0 |
| Itching | 0 | 1 (2%) |
| Shivering | 0 | 1 (2%) |
| Respiratory Depression | 0 | 0 |
| Hypotension | 0 | 0 |

Adverse events were minimal and comparable between groups; bradycardia was more frequent with clonidine, while itching and shivering were observed in the fentanyl group.

**Discussion**

The present study demonstrates that intrathecal clonidine 1 µg/kg with hyperbaric bupivacaine significantly prolongs the duration of analgesia compared to intrathecal fentanyl 25 µg. Both groups had stable hemodynamics and comparable onset of sensory and

motor blockade. Our results are in agreement with Shidhaye et al., who found clonidine produced longer postoperative analgesia than fentanyl. Similarly, studies by Singh et al. and Tilkar et al. have shown clonidine provides superior prolongation of block duration. However, sedation scores were higher in clonidine group, which may be advantageous in providing perioperative comfort but requires caution in elderly patients. The side effect profile was comparable, with no significant adverse effects. In contrast, fentanyl was associated with pruritus and nausea in other studies, though these were minimal in our study. Thus, clonidine proves to be a more effective adjuvant than fentanyl when prolonged postoperative analgesia is desired. The findings are clinically significant in reducing the need for rescue analgesics and improving patient satisfaction. Similar findings have been reported in previous studies.[1,2] This is consistent with studies by Singh et al. and Tilkar et al.[2,3] Comparable adverse events have been observed in other randomized trials.[4,5]

**Conclusion**

Intrathecal clonidine (1 µg/kg) as an adjuvant to hyperbaric bupivacaine 0.5% provides longer duration of sensory and motor block, superior postoperative analgesia, and better patient comfort compared to fentanyl (25 µg). While associated with higher sedation, clonidine maintains stable hemodynamics and has minimal side effects. Clonidine may thus be preferred as an adjuvant in spinal anaesthesia, particularly where prolonged postoperative pain relief is desired.

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