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A Comparison Of Hyperbaric Bupivacaine 0.5% With Buprenorphine (50µg) Vs Hyperbaric Bupivacaine 0.5% With Fentanyl (25µg) For Subarachnoid Block In Lower Abdominal And Lower Limb Surgeries In Adults.

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ABSTRACT

Spinal anesthesia is commonly employed for lower abdominal and lower limb surgeries. Hyperbaric bupivacaine 0.5% is a preferred agent, and the addition of adjuvants like buprenorphine or fentanyl enhances the anesthetic and analgesic effects. This study compares the efficacy of buprenorphine (50 µg) and fentanyl (25 µg) when combined with hyperbaric bupivacaine. A randomized comparative study was conducted on 60 adult patients scheduled for elective surgeries under spinal anesthesia. Patients were randomized into two groups of 30 each: Group B received buprenorphine, and Group F received fentanyl, combined with hyperbaric bupivacaine. Parameters assessed included sensory and motor block characteristics, postoperative analgesia, and side effects. Group F demonstrated a faster onset of sensory block (5.7 ± 0.88 minutes vs. 7.1 ± 1.16 minutes, $p < 0.0001$) and shorter time to the highest sensory level (9.47 ± 2.42 minutes vs. 13.3 ± 2.34 minutes, $p < 0.0001$). Group B exhibited prolonged sensory regression (163.27 ± 26.19 minutes vs. 129.77 ± 44.59 minutes, $p = 0.0008$) and longer postoperative analgesia (420.07 ± 49.04 minutes vs. 283 ± 41.16 minutes, $p < 0.0001$). Side effects were minimal in both groups. Buprenorphine provides prolonged analgesia, while fentanyl ensures a faster onset. The choice of adjuvant should be tailored to surgical and postoperative requirements.

Keywords: Spinal anesthesia, buprenorphine, fentanyl

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INTRODUCTION

Spinal anesthesia is a widely used regional anesthetic technique, particularly for lower abdominal and lower limb surgeries [1]. It provides rapid onset, profound sensory blockade, and excellent muscle relaxation while reducing systemic complications compared to general anesthesia. Hyperbaric bupivacaine 0.5% is a commonly employed local anesthetic agent in subarachnoid block (SAB) due to its potency, prolonged duration of action, and safety profile [2, 3]. However, the addition of opioids as adjuvants enhances the quality of anesthesia, extends postoperative analgesia, and reduces the total dose of local anesthetic required, thereby minimizing potential side effects [4].

Buprenorphine, a partial opioid agonist, and fentanyl, a synthetic full opioid agonist, are two widely used adjuvants in SAB. Both agents improve intraoperative and postoperative analgesia but differ in potency, onset, duration of action, and side effect profile. Buprenorphine provides prolonged analgesia due to its high receptor affinity, whereas fentanyl, with its rapid onset and shorter duration, ensures effective analgesia with a favorable recovery profile. Comparing these agents when combined with hyperbaric bupivacaine in SAB is essential to determine the optimal adjuvant for improving patient outcomes in terms of anesthesia quality, analgesia duration, and safety [5, 6].

This study aims to compare hyperbaric bupivacaine 0.5% with buprenorphine (50 µg) versus fentanyl (25 µg) for SAB in adults undergoing lower abdominal and lower limb surgeries.

METHODOLOGY

The study was conducted in Operation Theatres of Tertiary Care Centre. 60 patients scheduled for elective surgeries of lower abdomen and lower limbs surgeries under spinal anaesthesia of age 18-60 years were included in the study. The participants were randomly divided into two groups, Group B and Group F of 30 each using a computerized randomization table in a double-blind manner. Group B was given Buprenorphine (50µg) with 3.5ml of 0.5% hyperbaric Bupivacaine Group F was given Fentanyl (25µg) with 3.5 ml of 0.5% hyperbaric Bupivacaine.

Table 1: Comparison of onset time of sensory block(minutes) between group B and F.

Onset time of sensory block(minutes)	Group B(n=30)	Group F(n=30)	Total	P value
Mean ± SD	7.1 ± 1.16	5.7 ± 0.88	6.4 ± 1.24	<.0001‡
Median (25th-75th percentile)	7(6-8)	6(5-6)	6(6-7)	
Range	5-10	4-7	4-10	

‡ Independent t test

Table 2: Comparison of time to highest sensory level(minutes) between group B and F.

Time to highest sensory level(minutes)	Group B(n=30)	Group F(n=30)	Total	P value
Mean ± SD	13.3 ± 2.34	9.47 ± 2.42	11.38 ± 3.05	<.0001‡
Median (25th-75th percentile)	14(12-15)	10(8-10)	10(9.75-15)	
Range	9-17	5-15	5-17	

‡ Independent t test

Table 3: Comparison of time for 2 segment sensory regression to L1(minutes) between group B and F.

Time for 2 segment sensory regression to L1(minutes)	Group B(n=30)	Group F(n=30)	Total	P value
Mean ± SD	163.27 ± 26.19	129.77 ± 44.59	146.52 ± 40	0.0008‡
Median (25th-75th percentile)	171.5(145.5-180)	125(110.75-139.25)	140(121.75-174.75)	
Range	110-210	90-345	90-345	

‡ Independent t test

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Table 4: Comparison of onset of time to reach Modified Bromage 3(minutes) between group B and F.

Onset of time to reach Modified Bromage 3(minutes)	Group B(n=30)	Group F(n=30)	Total	P value
Mean ± SD	5.73 ± 1.8	6.03 ± 2.58	5.88 ± 2.21	0.603‡
Median (25th-75th percentile)	5.5(4-7)	6(3.25-8)	6(4-7)	
Range	3-9	3-12	3-12	

‡ Independent t test

Table 5: Comparison of duration of motor block(minutes) between group B and F.

Duration of motor block(minutes)	Group B(n=30)	Group F(n=30)	Total	P value
Mean ± SD	336.73 ± 64.51	253.03 ± 62.07	294.88 ± 75.63	<.0001‡
Median (25th-75th percentile)	335(301.75-366)	253(218-298)	298(238.75-340)	
Range	215-495	125-367	125-495	

‡ Independent t test

Table 6: Comparison of time to post operative analgesia(minutes) between group B and F.

Time to post operative analgesia(minutes)	Group B(n=30)	Group F(n=30)	Total	P value
Mean ± SD	420.07 ± 49.04	283 ± 41.16	351.53 ± 82.41	<.0001‡
Median (25th-75th percentile)	427.5(390-456)	275(246.5-319.25)	345(270-426.25)	
Range	270-490	218-345	218-490	

‡ Independent t test

Table 7: Comparison of side effects between group B and F.

Side effects	Group B(n=30)	Group F(n=30)	Total	P value
None	27 (90%)	22 (73.33%)	49 (81.67%)	0.334*
Nausea	0 (0%)	1 (3.33%)	1 (1.67%)	
Pruritus	1 (3.33%)	4 (13.33%)	5 (8.33%)	
Shivering	0 (0%)	1 (3.33%)	1 (1.67%)	
Vomiting	2 (6.67%)	2 (6.67%)	4 (6.67%)	
Total	30 (100%)	30 (100%)	60 (100%)	

*** Fisher's exact test**

DISCUSSION

This study aimed to compare the effectiveness of hyperbaric bupivacaine 0.5% combined with either buprenorphine (50 µg) or fentanyl (25 µg) for spinal anesthesia in lower abdominal and lower limb surgeries. The comparison focused on parameters such as the onset and duration of sensory and motor block, postoperative analgesia duration, and the incidence of side effects. The findings offer valuable insights into the differential effects of these adjuvants in optimizing spinal anesthesia outcomes [7, 8].

Onset of Sensory Block

The onset of sensory block was significantly faster in Group F (fentanyl) compared to Group B (buprenorphine), with mean times of 5.7 ± 0.88 minutes versus 7.1 ± 1.16 minutes ($p < 0.0001$). This is consistent with the pharmacokinetics of fentanyl, which has a rapid onset of action due to its high lipid solubility. Buprenorphine, although highly potent, has a slower onset because of its partial agonist properties and lower lipid solubility. Faster sensory block onset is advantageous in surgeries requiring quicker preparation and execution, giving fentanyl an edge in such scenarios.

Time to Highest Sensory Level

The time to achieve the highest sensory level was significantly shorter in Group F, with a mean of 9.47 ± 2.42 minutes compared to 13.3 ± 2.34 minutes in Group B ($p < 0.0001$). The rapidity of fentanyl's action facilitates the earlier establishment of optimal sensory blockade. However, buprenorphine's delayed peak sensory blockade may be better suited for prolonged surgical procedures, as its effects extend over a longer duration.

Sensory Regression to L1

The time for two-segment sensory regression to L1 was significantly longer in Group B (163.27 ± 26.19 minutes) compared to Group F (129.77 ± 44.59 minutes, $p = 0.0008$). This finding highlight buprenorphine's ability to prolong sensory blockade, attributed to its high receptor affinity and longer half-life. Prolonged sensory blockade is beneficial for postoperative pain control and may reduce the need for additional analgesics during recovery. In contrast, fentanyl, with its shorter sensory regression time, may be more appropriate for shorter procedures or when rapid postoperative recovery is desired.

Motor Block

The onset time to achieve a Modified Bromage score of 3 was similar between the groups, with no statistically significant difference ($p = 0.603$). This suggests that both adjuvants provide comparable motor blockade onset. However, the duration of motor block was significantly longer in Group B (336.73 ± 64.51 minutes) compared to Group F (253.03 ± 62.07 minutes, $p < 0.0001$). Buprenorphine's extended motor blockade aligns with its prolonged sensory effects, making it a preferable choice for surgeries where extended immobilization is desirable.

Postoperative Analgesia

The duration of postoperative analgesia was markedly longer in Group B, with a mean time of 420.07 ± 49.04 minutes compared to 283 ± 41.16 minutes in Group F ($p < 0.0001$). This superior analgesic effect of buprenorphine can be attributed to its prolonged receptor binding and intrinsic analgesic properties. Prolonged analgesia is particularly advantageous in reducing the need for postoperative opioid administration, improving patient comfort, and minimizing side effects associated with systemic analgesics.

Side Effects

The overall incidence of side effects was low in both groups, with no statistically significant differences ($p = 0.334$). Group B had a slightly higher incidence of vomiting (6.67%) but no cases of pruritus or nausea. Group F, on the other hand, showed a higher incidence of pruritus (13.33%) and isolated cases of nausea and shivering. These findings align with the known side effect profiles of the two opioids. Fentanyl's higher lipid solubility contributes to a slightly increased risk of pruritus. Buprenorphine's emetogenic potential might explain the marginally higher incidence of vomiting in Group B. Importantly, the high proportion of patients in both groups without any side effects (90% in Group B and 73.33% in Group F) indicates the overall safety of both combinations in clinical practice [9].

The results suggest distinct advantages of each opioid adjuvant when used with hyperbaric bupivacaine for spinal anesthesia. Fentanyl provides a faster onset and shorter duration of sensory blockade, making it suitable for shorter procedures or surgeries requiring rapid recovery. Conversely, buprenorphine offers prolonged sensory and motor blockade and extended postoperative analgesia, making it ideal for longer procedures or when extended pain relief is a priority [10-12].

CONCLUSION

Our study has shown that the addition of Buprenorphine to intrathecal hyperbaric Bupivacaine significantly prolongs both sensory and motor block. Both Fentanyl and Buprenorphine provided good quality intra operative and postoperative analgesia and haemodynamic stability. The analgesia was clinically better in Buprenorphine group as compared to Fentanyl group and it was statistically significant.

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