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Low-Dose Hyperbaric Bupivacaine with Fentanyl versus Bupivacaine Alone for Spinal Anaesthesia in Total Abdominal Hysterectomy.

Shilpi Tada [1], Md. Simab[2], Pankaj Kumar[3], Arun Kumar[4]*, KK Kshayap[5].

[1]*Specialist Medical Officer (SMO), Department of Anaesthesia, Sadar Hospital, Araria, Bihar (India).*

[2]*Assistant Professor, Department of Anaesthesia, Viraat Ramayan Institute of Medical Sciences (VRIMS), Chakiya, Bihar (India).*

[3]*Senior Resident, Department of Pharmacology, Sri Krishna Medical College & Hospital (SKMCH), Muzaffarpur, Bihar (India).*

[4]*Assistant Professor, Department of Pharmacology, Viraat Ramayan Institute of Medical Sciences (VRIMS), Chakiya, Bihar (India).*

[5]*Superintendent, Sadar Hospital, Araria, Bihar (India).*

Correspondence:
Arun Kumar.
Assistant Professor, Department of Pharmacology, Viraat Ramayan Institute of Medical Sciences (VRIMS), Chakiya, Bihar (India).

Email:
ARUNAKASH71@gmail.com

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Abstract

Background: Spinal anaesthesia is widely used for total abdominal hysterectomy because of its favorable intraoperative and postoperative outcomes. However, conventional doses of hyperbaric bupivacaine are associated with hypotension and prolonged motor blockade. The addition of intrathecal fentanyl to a reduced dose of hyperbaric bupivacaine may improve block characteristics while maintaining hemodynamic stability and postoperative analgesia. This study compared the efficacy and safety of low-dose hyperbaric bupivacaine with fentanyl versus conventional-dose hyperbaric bupivacaine alone in patients undergoing total abdominal hysterectomy. ***Methods:*** In this prospective randomized comparative study, 40 ASA I–II female patients undergoing elective total abdominal hysterectomy were allocated into two groups (n=20 each). Group BF received 8 mg of 0.5% hyperbaric bupivacaine with fentanyl 25 µg, while Group B received 12.5 mg of 0.5% hyperbaric bupivacaine alone. Sensory and motor block characteristics, hemodynamic parameters, postoperative analgesia, pain scores, rescue analgesic requirement, patient satisfaction, and adverse events were compared. ***Results:*** Group BF demonstrated significantly faster onset of sensory block, earlier achievement of maximum sensory level, higher sensory blockade, prolonged two-segment sensory regression, and shorter duration of motor block than Group B ($p<0.05$). Patients receiving fentanyl experienced better hemodynamic stability, required lower vasopressor doses, had significantly longer postoperative analgesia, lower postoperative pain scores, fewer rescue analgesic doses, and higher patient satisfaction ($p<0.05$). The incidence of adverse events was comparable between groups, with no cases of respiratory depression. ***Conclusion:*** Low-dose hyperbaric bupivacaine combined with intrathecal fentanyl provides superior sensory block characteristics, prolonged postoperative analgesia, improved hemodynamic stability, earlier motor recovery, and greater patient satisfaction compared with conventional-dose hyperbaric bupivacaine alone.

Keywords: Total abdominal hysterectomy; Spinal anesthesia; Hyperbaric bupivacaine; Intrathecal fentanyl; Postoperative analgesia; Hemodynamic stability.

INTRODUCTION

Total abdominal hysterectomy (TAH) remains one of the most frequently performed major gynecological procedures worldwide for benign and malignant uterine conditions. It involves significant surgical trauma to the lower abdomen and pelvis, necessitating reliable anaesthesia that provides dense sensory blockade to the T4–T6 dermatome level, adequate muscle relaxation, hemodynamic stability, and effective postoperative analgesia [1]. Spinal anaesthesia has emerged as the preferred technique for TAH and other lower abdominal surgeries because it offers superior postoperative pain control, reduced blood loss, decreased risk of thromboembolic events, earlier mobilization, lower incidence of postoperative nausea and vomiting, and avoidance of airway instrumentation compared with general anaesthesia [1, 2].

Hyperbaric bupivacaine (0.5%) is the most widely used local anaesthetic for subarachnoid block in these procedures owing to its reliable onset, predictable duration of action, and dense sensory and motor blockade. Conventional doses ranging from 12.5 to 15 mg typically achieve the required block height; however, they are frequently associated with dose-dependent adverse effects, most notably hypotension secondary to extensive sympathetic blockade, prolonged motor recovery, delayed ambulation, and urinary retention [3, 4]. These effects can compromise patient comfort, prolong recovery room stay, and increase the need for vasopressor support, particularly in older patients or those with cardiovascular comorbidities. In recent years, the concept of low-dose spinal anaesthesia has gained prominence as a strategy to minimize these hemodynamic and recovery-related drawbacks [5, 6].

Reducing the dose of hyperbaric bupivacaine to 7–10 mg attenuates the extent of sympathetic blockade and shortens motor recovery time, yet the lower dose alone may result in inadequate sensory block height, incomplete surgical anesthesia, or earlier return of pain, thereby risking intraoperative discomfort or the need for supplemental analgesia or conversion to general anesthesia [5, 6]. The addition of a lipophilic opioid adjuvant, most commonly fentanyl (10–25 µg), addresses this limitation. Intrathecal fentanyl acts synergistically with local anesthetics at spinal opioid receptors, intensifying and prolonging sensory analgesia while permitting a substantial reduction in the local anesthetic dose [7].

This combination accelerates the onset of sensory blockade, extends the duration of effective analgesia into the early postoperative period, improves the quality of intraoperative anesthesia, and maintains hemodynamic stability with only a modest increase in the incidence of mild, self-limiting side effects such as pruritus. Multiple randomized trials in patients undergoing hysterectomy and other lower abdominal procedures have demonstrated that the addition of 20–25 µg fentanyl to hyperbaric bupivacaine significantly hastens sensory onset, elevates maximum block height, prolongs sensory regression times, and reduces postoperative analgesic requirements without clinically important respiratory depression or hemodynamic compromise [2, 3, 8, 9]. Despite these documented advantages, the optimal balance between a reduced bupivacaine dose and fentanyl remains an area of ongoing investigation for TAH specifically. Many earlier studies employed standard rather than low doses of bupivacaine, or examined vaginal rather than abdominal hysterectomy, leaving residual uncertainty regarding efficacy, block characteristics, hemodynamic profiles, and recovery parameters when a deliberately low dose of hyperbaric bupivacaine is combined with fentanyl for open abdominal hysterectomy. Furthermore, contemporary emphasis on enhanced recovery after surgery protocols underscores the need for anaesthetic techniques that minimize physiological disturbance while ensuring rapid return of motor function and early ambulation [10].

The present study was therefore designed to compare the efficacy and safety of low-dose hyperbaric bupivacaine combined with fentanyl versus a conventional dose of hyperbaric bupivacaine alone for spinal anaesthesia in patients undergoing total abdominal hysterectomy. The primary research question is whether the combination of low-dose hyperbaric bupivacaine with intrathecal fentanyl provides superior sensory block characteristics (faster onset, higher maximum level, and prolonged duration), greater hemodynamic stability, and longer postoperative analgesia compared with an equivalent or conventional dose of hyperbaric bupivacaine alone in patients undergoing total abdominal hysterectomy under spinal anaesthesia. It is hypothesized that the addition of fentanyl to a reduced dose of hyperbaric bupivacaine will significantly accelerate the onset of sensory blockade, elevate the maximum sensory level achieved, prolong the duration of effective sensory analgesia, reduce the incidence and severity of intraoperative hypotension, and delay the time to first rescue analgesic request, without a clinically important increase in adverse effects such as pruritus, nausea, or respiratory depression, relative to bupivacaine administered alone.

MATERIALS AND METHODS

This prospective, randomized, parallel-group, comparative clinical study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee.

Study Population

The study population consisted of adult female patients scheduled for elective total abdominal hysterectomy under spinal anaesthesia. Patients aged 30–65 years belonging to the American Society of Anesthesiologists (ASA) physical status I or II were included after providing written informed consent. Patients with contraindications to spinal anaesthesia, known allergy to local anaesthetics or opioids, coagulation abnormalities, local infection at the puncture site, severe cardiovascular, hepatic or renal disease, neurological disorders, chronic opioid use, pregnancy, morbid obesity, or inability to provide informed consent were excluded from the study.

Sampling Method and Sample Size

Consecutive eligible patients fulfilling the selection criteria during the study period were recruited until the required sample size was achieved.

The sample size was calculated using the findings of Poudel et al. (2020), who reported a significant difference in the duration of postoperative analgesia between patients receiving intrathecal hyperbaric bupivacaine with fentanyl (270.54 ± 25.08 minutes) and hyperbaric bupivacaine alone (230.32). Considering a two-sided confidence level of 95%, study power of 95%, and an alpha error of 0.05, the minimum calculated sample size was approximately 11 patients per group using the formula for comparison of two independent means. To compensate for possible protocol deviations and dropouts, 20 patients were included in each group, giving a total sample size of 40 patients.

Intervention

Participants were randomly allocated in a 1:1 ratio to either the low-dose hyperbaric bupivacaine with fentanyl group or the hyperbaric bupivacaine-alone group using a computer-generated randomization sequence. Group allocation was

concealed using sequentially numbered, opaque, sealed envelopes opened immediately before administration of spinal anaesthesia. All patients underwent standard pre-anaesthetic evaluation and fasted according to institutional guidelines. After arrival in the operating room, intravenous access was secured and routine monitoring including electrocardiography, non-invasive blood pressure, pulse rate, and peripheral oxygen saturation, was established. Patients were preloaded with Ringer's lactate solution according to institutional protocol.

Under strict aseptic precautions and with the patient in the sitting position, subarachnoid block was performed at the L3–L4 or L4–L5 intervertebral space using a 25-G Quincke spinal needle. Patients in Group BF received low-dose 0.5% hyperbaric bupivacaine (8 mg) combined with fentanyl 25 µg intrathecally, while patients in Group B received conventional-dose 0.5% hyperbaric bupivacaine (12.5 mg) with preservative-free normal saline to achieve an equal total injectate volume. Immediately after injection, patients were placed in the supine position with a slight left lateral tilt where appropriate. Supplemental oxygen was administered throughout the procedure.

Intraoperative hypotension, defined as a fall in systolic blood pressure greater than 20% from baseline or below 90 mmHg, was treated with intravenous fluids and incremental doses of mephentermine. Bradycardia, defined as heart rate below 50 beats per minute, was treated with intravenous atropine. Any inadequate block requiring supplemental analgesia or conversion to general anaesthesia was recorded.

Outcome Parameters

The primary outcome parameter was the duration of effective postoperative analgesia, defined as the time from intrathecal injection to the first request for rescue analgesic or when the Visual Analogue Scale (VAS) score reached 4 or more.
Secondary outcome parameters included onset time of sensory block to T10 dermatome, time to achieve maximum sensory block height, highest sensory dermatome attained, onset and duration of motor block assessed using the modified Bromage scale, time for two-segment sensory regression, duration of motor blockade, haemodynamic variables including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and oxygen saturation, intraoperative requirement for vasopressors, postoperative pain scores using the VAS, total rescue analgesic requirement during the first 24 hours, patient satisfaction, and incidence of adverse events including hypotension, bradycardia, nausea, vomiting, pruritus, shivering, urinary retention and respiratory depression.

Methodology

Baseline demographic characteristics and preoperative vital parameters were recorded before administration of spinal anaesthesia. Following intrathecal injection, sensory blockade was assessed bilaterally by pinprick every minute until the maximum block level was achieved and subsequently at regular intervals until complete regression. Motor blockade was evaluated using the modified Bromage scale at similar intervals.

Haemodynamic parameters were recorded at baseline, every two minutes for the first ten minutes, every five minutes for the next twenty minutes, every fifteen minutes until completion of surgery, and during the postoperative recovery period. Episodes of hypotension, bradycardia and other complications were managed according to institutional protocols and documented.

Postoperatively, pain intensity was assessed using a 10-cm Visual Analogue Scale at predefined intervals. Rescue analgesia with intravenous diclofenac or paracetamol was administered whenever the VAS score was 4 or greater or upon patient request. The time to first rescue analgesic, total analgesic consumption during the first 24 hours, recovery characteristics, and adverse events were recorded by an investigator blinded to group allocation.

Statistical Analysis

All collected data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range depending on data distribution, whereas categorical variables were presented as frequencies and percentages. Normality of continuous data was assessed using the Shapiro–Wilk test. Continuous variables were compared using the independent samples Student's t-test for normally distributed data or the Mann–Whitney U test for non-normally distributed data. Categorical variables were analysed using the Chi-square test or Fisher's exact test as appropriate. Repeated haemodynamic measurements were compared using repeated-measures analysis of variance with post-hoc correction where applicable. A p-value less than 0.05 was considered statistically significant.

Ethical Consideration

The study was conducted only after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from every participant after explaining the purpose, methodology, potential benefits and possible risks of the study in their native language. Confidentiality of participant information was maintained throughout the study by

anonymising all records. Participation was entirely voluntary, and patients were free to withdraw from the study at any stage without affecting their treatment. The study adhered to the ethical principles of the Declaration of Helsinki and Good Clinical Practice guidelines.

RESULTS

The baseline demographic and clinical characteristics were comparable between Group BF (low-dose hyperbaric bupivacaine with fentanyl) and Group B (hyperbaric bupivacaine alone). There were no statistically significant differences in mean age, weight, height, body mass index, ASA physical status distribution, or duration of surgery (all $p>0.05$) [Table 1].

Table 1. Baseline Demographic and Clinical Characteristics

Variable	Group BF (n=20)	Group B (n=20)	p-value
Age (years), Mean ± SD	48.5 ± 6.4	47.8 ± 7.1	0.7451*
Weight (kg), Mean ± SD	61.9 ± 7.2	62.8 ± 6.9	0.6888*
Height (cm), Mean ± SD	156.8 ± 5.6	157.5 ± 5.2	0.6844*
BMI (kg/m²), Mean ± SD	25.2 ± 2.8	25.5 ± 3.1	0.7498*
ASA I, n (%)	12 (60.0)	11 (55.0)	>0.9999**
ASA II, n (%)	8 (40.0)	9 (45.0)	
Duration of surgery (min), Mean ± SD	88.7 ± 12.3	91.5 ± 11.8	0.4671*

*Unpaired t test, **Fisher's exact test

Patients receiving low-dose hyperbaric bupivacaine with fentanyl demonstrated significantly superior sensory block characteristics compared with those receiving bupivacaine alone. Group BF achieved a faster onset of sensory block, reached the highest sensory level more rapidly, attained higher sensory blockade more frequently (T4), and exhibited a significantly longer time to two-segment sensory regression (all $p<0.05$). Although the onset of motor block was similar between groups, the duration of motor blockade was significantly shorter in Group BF ($p<0.0001$), indicating earlier motor recovery. Overall, the addition of intrathecal fentanyl enhanced sensory anesthesia while reducing the duration of motor impairment [Table 2].

Table 2. Comparison of Sensory and Motor Block Characteristics

Variable	Group BF (n=20)	Group B (n=20)	p-value
Onset of sensory block to T10 (min), Mean ± SD	2.8 ± 0.6	4.1 ± 0.8	<0.0001*
Time to highest sensory level (min), Mean ± SD	5.4 ± 0.8	6.9 ± 1.0	<0.0001*
Highest sensory level (T4/T5/T6), n (%)	10/7/3	4/9/7	0.031**
Onset of motor block (min), Mean ± SD	3.5 ± 0.7	3.2 ± 0.6	0.1538*
Duration of motor block (min), Mean ± SD	144.8 ± 18.2	178.3 ± 20.7	<0.0001*
Two-segment sensory regression (min), Mean ± SD	118.4 ± 15.3	95.2 ± 12.8	<0.0001*

*Unpaired t test, **Fisher's exact test

Baseline mean arterial pressure and heart rate were comparable between the two groups, confirming similar preoperative hemodynamic status. During surgery, Group BF maintained significantly higher lowest mean arterial pressure and required a significantly lower total dose of mephentermine than Group B ($p<0.05$), suggesting improved hemodynamic stability with the low-dose bupivacaine-fentanyl regimen. Although fewer patients in Group BF required vasopressor support and the lowest heart rate was slightly higher, these differences were not statistically significant [Table 3].

Table 3. Hemodynamic Parameters

Parameter	Group BF (n=20)	Group B (n=20)	p-value
Baseline MAP (mmHg), Mean ± SD	94.8 ± 8.1	95.3 ± 7.8	0.8434*
Lowest MAP (mmHg), Mean ± SD	76.5 ± 7.3	69.8 ± 8.6	0.0115*
Baseline HR (beats/min), Mean ± SD	82.7 ± 8.4	81.5 ± 7.8	0.6423*
Lowest HR (beats/min), Mean ± SD	70.6 ± 7.1	68.3 ± 8.2	0.3490*
Patients requiring vasopressor, n (%)	3 (15.0)	8 (40.0)	0.1552**
Total Mephentermine dose (mg), Mean ± SD	2.8 ± 4.2	6.5 ± 5.6	0.0233*

*Unpaired t test, **Fisher's exact test

Postoperative analgesic outcomes were significantly better in Group BF than in Group B. Patients receiving low-dose hyperbaric bupivacaine with fentanyl experienced a substantially longer duration before requiring the first rescue analgesic, required fewer rescue analgesic doses during the first 24 hours, and reported significantly lower pain scores at 2, 4, and 6 hours postoperatively (all $p<0.01$). Furthermore, patient satisfaction scores were significantly higher in Group BF ($p<0.0001$) [Table 4].

Table 4. Postoperative Analgesia and Pain Scores

Variable	Group BF (n=20)	Group B (n=20)	p-value (Unpaired t test)
Time to first rescue analgesic (min)	322.6 ± 34.5	238.9 ± 29.7	<0.0001
Rescue analgesic doses (24 h)	1.6 ± 0.6	2.4 ± 0.7	0.0004
VAS at 2 h	1.8 ± 0.7	2.6 ± 0.8	0.0018
VAS at 4 h	2.4 ± 0.9	3.8 ± 0.9	<0.0001
VAS at 6 h	3.5 ± 1.0	4.8 ± 0.9	0.0001
Patient satisfaction score (0–10)	9.3 ± 0.6	8.2 ± 0.8	<0.0001

Value in Mean ± SD

The incidence of adverse events was generally low and comparable between the two study groups. Although hypotension, nausea/vomiting, shivering, and urinary retention occurred less frequently in Group BF, these differences did not reach statistical significance. Pruritus was observed only in the fentanyl group, consistent with the known pharmacological effects of intrathecal opioids, but its incidence was low and not statistically significant. Importantly, no patient in either group experienced respiratory depression. [Table 5].

Table 5. Comparison of Adverse Events

Adverse Event	Group BF (n=20)	Group B (n=20)	p-value
Hypotension	3 (15.0%)	8 (40.0%)	0.1552
Bradycardia	2 (10.0%)	3 (15.0%)	>0.9999
Nausea/Vomiting	2 (10.0%)	4 (20.0%)	0.6614
Pruritus	3 (15.0%)	0 (0%)	0.2308
Shivering	1 (5.0%)	5 (25.0%)	0.1818
Urinary retention	1 (5.0%)	2 (10.0%)	>0.9999
Respiratory depression	0	0	—

DISCUSSION

The present study evaluated the efficacy and safety of low-dose hyperbaric bupivacaine combined with intrathecal fentanyl compared with conventional-dose hyperbaric bupivacaine alone for spinal anesthesia in patients undergoing total abdominal hysterectomy. The findings demonstrated that the addition of fentanyl to low-dose hyperbaric bupivacaine significantly prolonged postoperative analgesia, accelerated the onset of sensory blockade, produced a higher sensory block, delayed sensory regression, improved hemodynamic stability, reduced postoperative pain and rescue analgesic requirements, shortened motor block duration, and increased patient satisfaction without increasing clinically significant adverse effects. Baseline demographic and perioperative characteristics were comparable between the study groups, indicating successful randomization and minimizing potential confounding factors. Similar baseline comparability has been consistently reported by Poudel et al. (2020), Ahmed et al. (2017), Chitraleka et al. (2018), and Tariang et al. (2026), where age, body mass index, ASA physical status, and surgical duration did not differ significantly between treatment groups [2, 11-13]. Regarding sensory block characteristics, our study demonstrated that patients receiving low-dose hyperbaric bupivacaine with fentanyl experienced a significantly faster onset of sensory block, reached the highest sensory level earlier, achieved a higher dermatomal level more frequently, and exhibited significantly delayed two-segment sensory regression compared with patients receiving bupivacaine alone. These observations closely agree with the findings of Poudel et al. (2020), who similarly reported that intrathecal fentanyl significantly hastened attainment of maximum sensory block height and produced higher sensory levels than bupivacaine alone [2]. Likewise, Tariang et al. (2026) demonstrated a faster onset of sensory blockade with fentanyl compared with control while prolonging sensory block duration [13].

Ahmed et al. (2017) also observed significantly prolonged two-segment sensory regression in patients receiving fentanyl-containing spinal anesthesia compared with bupivacaine alone [11]. Although Chitraleka et al. (2018), Thada et al. (2017), Varghese et al. (2017), and Prasad et al. (2025) compared fentanyl with dexmedetomidine rather than with bupivacaine alone [12, 14, 15], they consistently reported that fentanyl provides effective sensory blockade, although dexmedetomidine generally produced an even longer duration of sensory block. Motor block characteristics in the present study showed no significant difference in onset between the groups; however, the duration of motor blockade was significantly shorter in the fentanyl group despite prolonged sensory analgesia. This finding is clinically advantageous because early motor

recovery facilitates earlier ambulation and supports enhanced recovery after surgery protocols. Similar observations regarding unchanged motor block onset with fentanyl were reported by Ahmed et al. (2017), Prasad et al. (2025), and Thada et al. (2017) [11, 14, 16]. However, studies comparing fentanyl with dexmedetomidine consistently found substantially longer motor blockade in the dexmedetomidine groups, as demonstrated by Chitraleka et al. (2018), Varghese et al. (2017), Prasad et al. (2025), and Thada et al. (2017) [12, 14-16]. In the present study, baseline hemodynamic variables were similar between groups; however, patients receiving low-dose bupivacaine with fentanyl maintained significantly better intraoperative blood pressure, demonstrated higher lowest mean arterial pressure values, and required significantly lower doses of mephentermine. Although the proportion of patients requiring vasopressors was lower in the fentanyl group, the difference was not statistically significant. These findings are highly consistent with those of Poudel et al. (2020), who also reported reduced hypotension among patients receiving intrathecal fentanyl [2]. Das et al. (2023) similarly observed lower incidences of hypotension with fentanyl compared with bupivacaine alone [17]. Systematic evidence summarized by Abate and Belihu also supports improved maternal hemodynamic stability when lower doses of bupivacaine are combined with intrathecal opioids [3]. In contrast, Priyadharshini et al. (2026) demonstrated stable hemodynamics in both epidural study groups [18], whereas Panchgar et al. (2026) observed slightly lower pulse rates and systolic blood pressures with dexamethasone than fentanyl TAP blocks without clinically important instability [19]. Collectively, these studies indicate that combining lower doses of local anesthetic with fentanyl effectively limits sympathetic blockade while maintaining adequate surgical anesthesia.

Patients receiving intrathecal fentanyl experienced significantly prolonged analgesia, delayed requirement for the first rescue analgesic, reduced postoperative analgesic consumption, lower pain scores at all postoperative assessment intervals, and higher patient satisfaction. These findings closely parallel those of Poudel et al. (2020), who demonstrated significantly prolonged postoperative analgesia following the addition of fentanyl to hyperbaric bupivacaine [2]. Similarly, Ahmed et al. (2017) reported longer analgesic duration in fentanyl-containing groups than with bupivacaine alone, although the combination of clonidine and fentanyl produced the greatest prolongation [11]. Tariang et al. (2026) also found that fentanyl markedly extended spinal analgesia compared with control [13]. Although Panchgar et al. (2026) reported superior postoperative analgesia with dexamethasone compared with fentanyl in TAP block, their findings nevertheless confirm the analgesic efficacy of fentanyl [19]. Likewise, Thankaraj et al. (2025), Chitraleka et al. (2018), Prasad et al. (2025), Thada et al. (2017), and Varghese et al. (2017) all demonstrated that dexmedetomidine or clonidine may provide longer postoperative analgesia than fentanyl [12, 14-16, 20]. Nevertheless, compared with bupivacaine alone, the present study clearly demonstrates that fentanyl substantially improves postoperative pain relief while avoiding excessively prolonged motor blockade.

With respect to adverse effects, our study demonstrated a low incidence of complications in both groups. Hypotension, nausea, vomiting, shivering, and urinary retention occurred less frequently in the fentanyl group, although the differences were not statistically significant. Mild pruritus occurred only among patients receiving fentanyl, consistent with the recognized pharmacological profile of intrathecal opioids, but was self-limiting and clinically insignificant. Importantly, no patient developed respiratory depression. These observations closely mirror those reported by Poudel et al. (2020), who similarly found reduced hypotension, mild pruritus, and absence of respiratory depression in the fentanyl group [2]. Das et al. (2023) also documented significantly reduced perioperative shivering with fentanyl together with mild pruritus and no respiratory depression [17]. Ahmed et al. (2017), Tariang et al. (2026), and Priyadharshini et al. (2026) likewise reported comparable safety profiles with low incidences of adverse events [11, 13, 18,]. In contrast, clonidine-containing regimens evaluated by Thankaraj et al. (2025) were associated with higher incidences of bradycardia and hypotension, whereas dexmedetomidine-based studies frequently reported greater sedation and prolonged motor blockade [20]. These findings suggest that fentanyl offers an appropriate balance between efficacy and safety for spinal anesthesia.

The present study has certain limitations. It was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. The study evaluated only short-term perioperative and postoperative outcomes without long-term follow-up, and the results are applicable only to ASA I–II patients undergoing elective total abdominal hysterectomy. Additionally, different doses of intrathecal fentanyl or comparisons with other commonly used adjuvants, such as dexmedetomidine or clonidine, were not evaluated.

CONCLUSION

Overall, the present findings reinforce existing evidence supporting intrathecal fentanyl as an effective adjuvant to hyperbaric bupivacaine during total abdominal hysterectomy. Compared with bupivacaine alone, the addition of fentanyl provided faster sensory onset, improved block quality, prolonged postoperative analgesia, reduced analgesic requirements, enhanced hemodynamic stability, shortened motor recovery, and improved patient satisfaction without increasing clinically significant adverse events. Therefore, low-dose hyperbaric bupivacaine combined with intrathecal fentanyl appears to represent a balanced anesthetic technique that provides effective surgical anesthesia together with rapid postoperative recovery, making it particularly suitable for enhanced recovery pathways following total abdominal hysterectomy.

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