

Original article

INTRATHECAL PENTAZOCINE AND FENTANYL AS ADJUVANT TO BUPIVACAINE IN SUBARACHNOID BLOCK FOR ABDOMINAL HYSTERECTOMY: A RANDOMIZED, DOUBLE BLINDED, CONTROLLED, PROSPECTIVE STUDY (COMPARISON OF PENTAZOCINE AND FENTANYL AS ADJUVANTS FOR SPINAL ANESTHESIA)

Khlor K Tariang, Sagnik Datta, Debasish Bhar, Debaleena Jana, Suman Chattopadhyay, Asim Kumar Maiti

Department of Anesthesiology, Midnapore Medical College & Hospital, West Bengal, India-721201

Datum prijema rada: 26.11.2025. Prva ispravka rukopisa: 17.12.2025. Datum prihvatanja rada: 18.03.2026.

Summary

Introduction: Pentazocine has been used as only anesthetic for subarachnoid block in various infraumbilical surgeries but the role of pentazocine as an additive to local anesthetic in subarachnoid block has not been adequately evaluated. The study aims to compare the effect of pentazocine with fentanyl when added to 3.5 ml of 0.5% bupivacaine heavy for subarachnoid block in abdominal hysterectomy. **Methods:** A total of 150 patients undergoing abdominal hysterectomy were randomly distributed to group P, F and D with 50 patients in each group. Group P received 7.5 mg of pentazocine, Group F received 25 mcg of fentanyl and group C received 0.5 ml of normal saline as an additive to 3.5 ml of 0.5% bupivacaine heavy for spinal anesthesia. Duration of sensory and motor block along with duration spinal analgesia were compared among the groups. Parametric and nonparametric data were analyzed by one-way ANOVA and the Kruskal-Wallis test respectively. **Results:** Sensory block duration in group P (142.8 ± 17.42 min) and F (155.58 ± 10.78 min) were comparable ($P 0.498$). No significant difference was observed between group P (524.58 ± 31.01 min) and F (552.42 ± 31.11 min) regarding motor block ($P 0.927$). Duration of spinal analgesia was also similar in group P (485.00 ± 30.93 min) and F (513.20 ± 30.81 min) ($P 0.931$). Duration of block and spinal analgesia was significantly less in group D compared to other groups. **Conclusion:** For spinal analgesia and extension of block (sensory and motor), intrathecal pentazocine (7.5 mg) is just as effective as 25 mcg fentanyl with no side effects.

Key Words: Anesthesia; spinal; pentazocine; fentanyl; adjuvant; postoperative period; analgesia

Manuscript:

Introduction: For abdominal hysterectomy, spinal anesthesia (SA) is typically recommended, not only because it is relatively easy to administer but also lessens intraoperative blood loss and the stress reaction to surgery. Additionally, spinal anesthesia has been shown to reduce the incidence of postoperative thromboembolism.^{1,2}

Compared to epidural anesthesia, SA has the disadvantages of a shorter block length and a shorter duration of postoperative analgesia, but it also has a faster onset, better blockade, and a lower failure rate.³ This problem has been addressed to some extent by adding intrathecal adjuvant

particularly opioids which also improves the quality of block by blunting visceral sensation.⁴

Among the opioids, fentanyl is probably most widely used without significant side effects. Fentanyl has been used intrathecally in different types of non-obstetric surgery in the dose range of 7.5–25 µg. The majority of research on lower limb and lower abdomen surgery has used 25 µg of fentanyl.⁵⁻¹³

In the recent past, one study has reported the combination of 0.5% hyperbaric bupivacaine and pentazocine as an adjuvant and compared its effect with nalbuphine,¹⁴ but as an adjuvant to 0.5% hyperbaric bupivacaine, the effects of intrathecal pentazocine and fentanyl have not yet been compared.

We hypothesize that no difference would be observed between intrathecal pentazocine and

fentanyl concerning the duration of block and spinal analgesia.

Objective: Comparing the length of sensory block was the study's main goal when 25 µg fentanyl and 7.5 mg pentazocine were used intrathecally for abdominal hysterectomy along with 0.5% bupivacaine heavy. The secondary goals were to compare how long the motor block and spinal analgesia lasted.

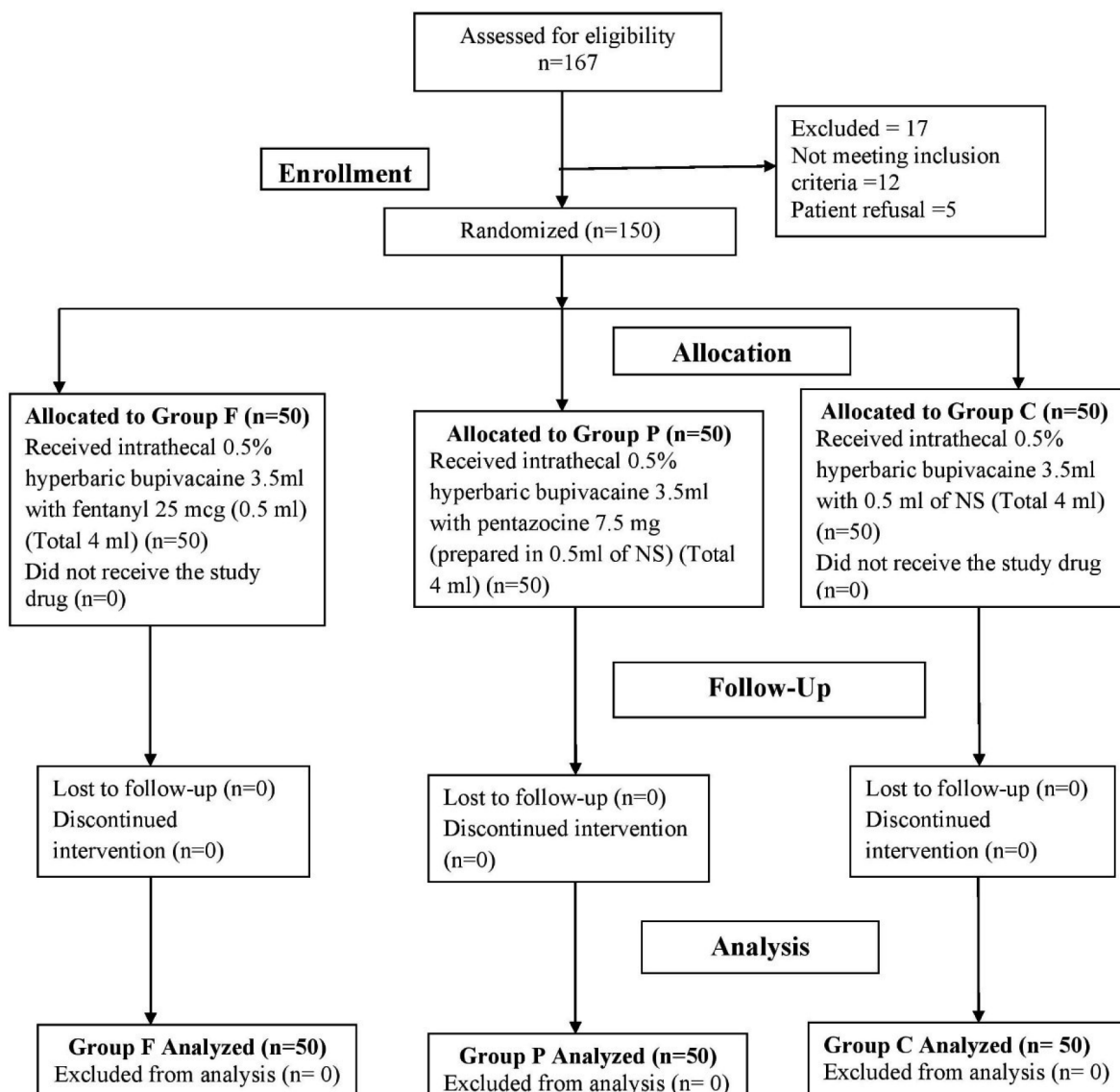
Methods:

After institutional ethical committee approval (MMC/ICE-2020/309 dated 11/02/2020) and registration at Clinical Trial Registry- India (CTRI

/2020/07/026822 dated 27/07/2020) this randomized, prospective, double-blinded and controlled trial was done in this tertiary care institute at gynecology operation theatre over the period of 12 months (August 2020 to July 2021) abiding by the principals of the Declaration of Helsinki, 2013.

Initially eligibility of 167 patients was evaluated. Twelve individuals did not fit the inclusion criteria, and five patients declined to take part in the trial. Following each patient's signed informed consent to take part in the study and utilize their data for educational and research purposes, the current study included 150 ASA class I and II patients undergoing elective abdominal hysterectomy, aged 18 to 60 years. (Figure 1). The current study only

Figure 1. Consolidated Standards of Reporting Trials (CONSORT) 2010 Flow diagram showing patient disposal in the study



included participants with BMIs between 18.5 and 24. The study did not include the patients with neurological, mental, hepatic, renal, or cardio-respiratory disorders. The study also excluded the patients with subarachnoid block failure, conversion to general anesthesia, any contraindication for spinal anesthesia, and medication allergies.

Three groups of fifty patients each were randomly selected from all the patients. Using the program randomizer.org, a computer-generated random number table was used to divide the integers into three groups at random. A sealed, opaque envelope with a number from one of the three groups was given to the patient as part of the randomization process.

Intrathecal 0.5% hyperbaric bupivacaine 3.5 ml and fentanyl 25 µg (0.5 ml) totaling 4 ml of study medication were administered to Group F. Group P was given 3.5 ml of 0.5% hyperbaric bupivacaine and 7.5 mg of pentazocine (made in 0.5 ml of normal saline). Group C received the same dosage of 0.5% hyperbaric bupivacaine in addition to 0.5 ml of normal saline. All intrathecal preservative free study drug formulations were prepared by another anesthesiologist according to the group allocation of the patient by opaque sealed envelope technique under strict aseptic precautions. Anesthesiologist, who prepared the study drug, did not participate in the process of spinal anesthesia and data collection. The anesthesiologist, who performed the subarachnoid blocks, also recorded the data.

Patients were brought into the operation room following a thorough pre-anesthetic examination. The pre-anesthetic examination included an explanation of the 10-point visual analogue scale [VAS] scoring system for evaluating postoperative pain. Any sort of premedication was not administered. Ringer's lactate (RL) solution was started in the operating room after an 18 G intravenous cannula was placed on the non-dominant hand. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), respiratory rate (RR), and peripheral arterial oxygen saturation (SpO₂) were all measured. After injecting 1 milliliter of 2% lignocaine into the skin, a 26G Quincke spinal needle was used to execute a subarachnoid block under stringent aseptic circumstances in sitting positions at the level of the L3-L4 or L2-L3 intervertebral space. The patients were kept in a supine position right after the subarachnoid block.

For the first 30 minutes after the subarachnoid block was administered, intraoperative SBP, DBP and MAP were recorded every five minutes. After that, they were monitored every ten minutes until the procedure was finished. RR, HR, and SpO₂ were monitored continuously. HR, NIBP, and RR were measured every 30 minutes for the first hour following surgery, and then every hour for the next six hours.

For the first 20 minutes, 20 ml/kg of RL was transfused; for the remainder of the intraoperative duration, 10 ml/kg/h.¹⁵ SBP < 90 mmHg or < 70% of the baseline value was used to diagnose hypotension, which was treated with 300 ml of extra fluid or, if no improvement was seen within 5 minutes, mephentermine (6 mg) intravenously.¹⁵ Intravenous atropine (0.6 mg) was used to treat bradycardia (60 beats per minute or less). Intravenous ondansetron (4 mg) was used to treat nausea and vomiting.

Every two minutes after SA was administered, insensitivity to a cold alcohol swab was examined bilaterally in the midclavicular line at the T10 dermatome to assess the time of sensory block onset. Maximum sensory block reached was recorded. Following the start of surgery, sensory testing was carried out in a similar manner every 15 minutes until the two-segment regression of the sensory block. The time between the start of the block and the time needed for two-segment regression was used to calculate the duration of the sensory block.

The Bromage scale was utilized to assess the degree of motor block in patients. This scale categorizes motor function into four levels: Score 1 indicates inability to move both feet and knees; Score 2 signifies movement of the feet only; Score 3 corresponds to movement of the knees only; and Score 4 represents full flexion of the knees. Following the administration of spinal anesthesia (SA), assessments were performed on both sides at three-minute intervals over a period of up to 15 minutes. The onset of motor block was determined by measuring the time from the administration of SA until both sides achieved a Bromage score of 3. The highest level of motor block attained during this period was recorded. The duration of motor block was defined as the time elapsed from the start of the block until a Bromage score of 4 was achieved, indicating complete motor recovery. This systematic evaluation allowed for precise monitoring of

motor function changes and the duration of anesthesia effects.

Hypotension, bradycardia, nausea, vomiting, sedation, pruritus, shivering, and respiratory depression were among the side effects noted.

The duration of spinal analgesia was defined as the interval between the onset of sensory block and the administration of rescue analgesia, which was administered with 75 mg aqueous diclofenac sodium intramuscularly. Postoperative analgesia was measured using VAS every 15 minutes until the patient complained of VAS score ≥ 4 .

The duration of sensory block (time for two-segment regression) was used as the main result to estimate the sample size. Two-segment regression took 155.56 ± 13.45 minutes for group F and 144.59 ± 16.36 minutes for group P, according to a pilot study with 15 patients in each group. Considering the confidence interval (CI) to be 95% and the power of the study 95%, the samples required in each group were estimated to be 46 when 1:1 patient allocation was done. We enrolled a total of 150 patients for the trial, with 50 patients in each group to account for losses and dropouts. PS Power and Sample Size Calculator version 3.1.2, which was published in August 2014, were used to calculate sample size.

Categorical values were reported as percentages, and all nominal values were expressed as mean $\pm$ standard deviation (SD). The findings were examined using unpaired When comparing two groups, the Mann-Whitney U-test was used for nonparametric data and the Student's t-test for parametric data. Three groups were compared using the Kruskal-Wallis test for nonparametric data and one-way ANOVA for parametric data. For categorical data, the Chi-square test and Fisher's exact test were applied as needed. P value < 0.05 was considered statistically significant. All statistical tests were be done by "IBM SPSS Statistica version 19" released in 2010.

Results:

In the current investigation 150 subjects were enrolled and dispersed at random in three groups each consisting of 50 patients. There were no dropouts, so data of all 150 patients were analyzed. (Figure 1)

From Table 1 it was observed that age, height, weight, BMI, length of operation, and ASA status were all similar between the groups.

While there was no discernible difference between groups F and P, the onset of sensory and motor block was substantially faster in groups F and P than in group C ($p < 0.05$). Both groups F and P had comparable duration of motor block and sensory block (as determined by two segment regression), but both were noticeably longer than group C. Although there was little difference between groups F and P, the duration of spinal analgesia was considerably longer in groups F and P than in group C. (Table 2)

Each group had a similar height of sensory block (Table 3). Table 4 suggests that the groups' incidence of adverse events throughout the intraoperative and postoperative phases was comparable.

Over the course of the trial, there was no discernible difference among the groups in mean arterial pressure or heart rate.

Discussion: The length of sensory block, motor block, and spinal analgesia did not differ significantly between the pentazocine and fentanyl groups in the current investigation. However, compared to the other two groups, the control group's block and spinal analgesia lasted much shorter. Both the incidence of adverse effects and the height of the sensory block were similar amongst the groups.

Because of the limited availability of fentanyl due to narcotic law in several areas of our country option of adjuvant becomes restricted.¹⁷ Other non-opioids classes of drugs particularly alpha 2 agonists are widely used with intrathecal bupivacaine in an attempt to prolong the duration of block and spinal analgesia but hypotension and bradycardia often preclude their use,¹⁸ so the search of an alternative adjuvant for subarachnoid block along with bupivacaine is always on.

When administered intravenously, 30 mg of pentazocine is equal to 10 mg of morphine, which is likewise equal to 100 μ g of fentanyl.^[19] An equipotent dose of pentazocine (7.5 mg) and fentanyl (25 μ g) have been used in the current study to assess the efficacy of intathecal pentazocine compared to fentanyl as adjuvant with hyperbaric bupivacaine.

Pentazocine is an agonist antagonist opioid that blocks the spinal cord's pain pathway by acting on kappa receptors.¹⁹ There have been prior reports of using pentazocine intrathecally as the only anesthetic for orthopedic procedures involving the lower abdomen and lower limbs.^{20,21} Administration of pentazocine in the epidural route has been

Table 1. Demographic Profile

	Group F (n = 50)	Group P (n = 50)	Group C (n = 50)	P value
Age (years)	43.04 ± 9.604	43.14 ± 9.612	42.14 ± 11.14	0.904
ASA status (I/II)	38/12	36/14	35/15	0.790
Weight (kg)	57.78 ± 6.36	54.86 ± 4.56	55.98 ± 5.91	0.592
Height (cm)	159.62 ± 6.20	159.52 ± 5.92	158.70 ± 5.39	0.695
BMI (kg/m ²)	20.68 ± 1.89	21.56 ± 1.56	21.37 ± 1.88	0.623
Duration of surgery (min)	87.272 ± 16.61	89.045 ± 15.82	88.59 ± 15.75	0.994

Group F: Intrathecal pentazocine, Group P: Intrathecal fentanyl, Group C: Intrathecal normal saline, BMI: Body mass index, ASA: American Society of Anesthesiologists

Table 2. Block characteristics:

Duration in min	Group F (n = 50)	Group P (n = 50)	Group C (n = 50)	P value
Onset of Sensory Block (min)	2.54 ± 1.09	3.42 ± 1.16	5.74 ± 0.82	F vs. C 0.043 P vs. C 0.004 F vs. P 0.451
Onset of Motor Block (min)	2.60 ± 0.98	3.26 ± 0.96	5.16 ± 0.76	F vs. C 0.014 P vs. C 0.030 F vs. P 0.778
Duration of sensory block (min)	155.58 ± 10.78	142.8 ± 17.42	70.50 ± 6.28	F vs. C <0.001 P vs. C 0.002 F vs. P 0.498
Duration of motor block (min)	352.42 ± 31.11	324.58 ± 31.01	274.34 ± 16.34	F vs. C 0.001 P vs. C 0.002 F vs. P 0.927
Duration of spinal analgesia	513.20 ± 30.81	485.00 ± 30.93	348.96 ± 16.70	F vs. C 0.001 P vs. C 0.002 F vs. P 0.931

Group F: Intrathecal pentazocine, Group P: Intrathecal fentanyl, Group C: Intrathecal normal saline

Table 3: Highest Level of Sensory Block

Level of Sensory Block	Group F (n = 50)		Group P (n = 50)		Group C (n = 50)		P value
	No.	%	No.	%	No.	%	
T6	3	6.0	4	8.0	5	10.0	0.778
T7	1	2.0	6	12.0	5	10.0	0.173
T8	8	16.0	13	26.0	15	30.0	0.338
T9	4	8.0	3	6.0	2	4.0	0.716
T10	10	20.0	12	24.0	10	20.0	0.882
T11	15	30.0	5	10.0	8	16.0	0.059
T12	9	18.0	7	14.0	5	10.0	0.564

Group F: Intrathecal pentazocine, Group P: Intrathecal fentanyl, Group C: Intrathecal normal saline, T: Thoracic dermatome

described with local anesthetic in lower limb orthopedic surgery with lengthening of the analgesic period following surgery.²²

The chemical structure of pentazocine, a derivative of benzomorphan, is somewhat similar to that of a local anesthetic. Both have an aromatic ring, which is joined to the nitrogen moiety via an

intermediary chain. Due to this structural similarity Cheun JK et al used intrathecal pentazocine as the sole anesthetic for total abdominal hysterectomy at a dosage of 1.5 mg/kg where they observed adequate analgesia along with a notable sensory and motor block.²³

Table 4. Adverse events:

Adverse Events	Group F (n = 50)		Group P (n = 50)		Group C (n = 50)		P value
	No.	%	No.	%	No.	%	
Nausea	5	10.0	7	14.0	3	6.0	0.449
Vomiting	1	2.0	2	4.0	3	6.0	0.606
Shivering	2	4.0	3	6.0	3	6.0	0.882
Pruritus	2	4.0	3	6.0	0	0.0	0.246
Hypotension	7	14.0	6	12.0	7	14.0	0.367
Bradycardia	3	6.0	5	10.0	0	0.0	0.093

Group F: Intrathecal pentazocine, Group P: Intrathecal fentanyl,
Group C: Intrathecal normal saline

Nair J et al. in 2013 conducted a single-blinded comparative trial between intrathecal 60 mg of pentazocine (as sole anesthetic agent) and 10 mg of 0.5% bupivacaine heavy in patient posted for lower limb operation. Pentazocine had a shorter duration of sensory block than bupivacaine, but it had a longer duration of motor block and spinal analgesia.²¹

In another study by Arulmozhi KS et al, 1-1.5 mg/kg pentazocine was used intrathecally for lower abdominal surgery and good surgical anesthesia was observed for 103 min with prolonged post-operative analgesia.²⁰

None of the studies that used intrathecal pentazocine as sole anesthetic have reported any serious adverse effects except nausea and vomiting.²⁰ On the contrary, hemodynamic changes were less when compared to bupivacaine.²¹

Despite being used as sole anesthetic in high doses, very few studies have been done so far using pentazocine in conjunction with a local anesthetic for neuraxial block. For epidural anesthesia during orthopedic surgery of lower limb, Arya et al. employed 30 mg of pentazocine with 0.5% bupivacaine (20 ml) and found that the duration of action was longer than that of 50 µg of fentanyl with the same volume of 0.5% bupivacaine.²²

Recently, Boddu et al. compared 3 mg of pentazocine with 0.8 mg of nalbuphine as an adjunct to 3.2 ml of 0.5% bupivacaine heavy intrathecally and observed the extent of spinal analgesia with pentazocine was 339.3 min. [14] The difference in the observation from our study (485 min in pentazocine group) could be due to dosage discrepancy in the two trials.

This trial also has limitations. The VAS score and analgesic requirements in the first 24 hours have not been compared between the groups in this

study. In the current trial single dose of pentazocine was used. Previous studies have used higher doses of intrathecal pentazocine without any significant adverse effects.^{20,21} Due to higher lipid solubility and lesser rostral spread of pentazocine chance of respiratory depression is less with pentazocine.¹⁹ Therefore, compared to traditional opioids, future research employing a greater dose of intrathecal pentazocine as an adjuvant to 0.5% bupivacaine heavy in various surgical procedures may produce better analgesia and longer anesthesia.

Conclusion

According to the current study, 7.5 mg of pentazocine combined with 0.5% bupivacaine heavy can be administered intrathecally in place of 25 µg of fentanyl to prolong sensory block, motor block, and post-operative analgesia without causing any serious side effects.

References:

1. Rodgers A, Walker N, Schug S, McKee A, Kehlet H, van Zundert A, et al. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. *BMJ* 2000;321(7275):1493.
2. Carli D, Meletti JFA, Camargo RPS, Gratacós LS, Gomes VCR, Marques ND. Effect of anesthetic technique on the quality of anesthesia recovery for abdominal hysterectomy: a cross-observational study. *Braz J Anesthesiol*. 2021;71(3):221-27.
3. Yoon HJ, Do SH, Yun YJ. Comparing epidural surgical anesthesia and spinal anesthesia following epidural labor analgesia for intrapartum cesarean section: a prospective randomized controlled trial. *Korean J Anesthesiol*. 2017;70(4):412-19.
4. Swain A, Nag DS, Sahu S, Samaddar DP. Adjuvants to local anesthetics: Current understanding and future trends. *World J Clin Cases* 2017; 5(8): 307-23.

5. Sharma A, Kumari A, Gupta R, Kaur S, Arora D, Kaur K. Comparison of intrathecal bupivacaine-fentanyl and bupivacaine-butorphanol combinations for joint replacement surgeries. *J Anaesthesiol Clin Pharmacol.* 2022; 38(1):79-83.
6. Nayagam HA, Singh NR, Singh HS. A prospective randomised double blind study of intrathecal fentanyl and dexmedetomidine added to low dose bupivacaine for spinal anesthesia for lower abdominal surgeries. *Indian J Anaesth.* 2014;58(4):430-35.
7. Kumar B, Williams A, Liddle D, Verghese M. Comparison of intrathecal bupivacaine-fentanyl and bupivacaine-butorphanol mixtures for lower limb orthopedic procedures. *Anesth Essays Res.* 2011;5(2):190-95.
8. Chavan G, Chavan A, Ghosh A. Effect of intrathecal fentanyl on subarachnoid block with 0.5% hyperbaric bupivacaine. *Int J Health Biomed Res.* 2014;2: 67-76.
9. Kumar A, Kumar R, Verma VK, Prasad C, Kumar R, Kant S et al. A randomized controlled study between fentanyl and Butorphanol with low dose intrathecal bupivacaine to facilitate early postoperative ambulation in urological procedures. *Anesth Essays Res.* 2016;10(3):508-11.
10. Upadya M, Neeta S, Manissery JJ, Kuriakose N, Singh RR. A randomized controlled study comparing intrathecal hyperbaric bupivacaine-fentanyl mixture and isobaric bupivacaine-fentanyl mixture in common urological procedures. *Indian J Anaesth.* 2016;60(1):44-49.
11. Singh V, Gupta LK, Singh GP. Comparison among intrathecal fentanyl and butorphanol in combination with bupivacaine for lower limb surgeries. *J Anesth Clin Pharmacol.* 2006; 22:371-75.
12. Reddy NG, Manohar S, Supriya P, Himani A. Comparison of efficacy of butorphanol and fentanyl as intrathecal adjuvant to bupivacaine. *J Evol Med Dent Sci.* 2015;4: 5675-81.
13. Goel S, Bhardwaj N, Grover VK. Intrathecal fentanyl added to intrathecal bupivacaine for day case surgery: a randomized study. *Eur J Anaesthesiol.* 2003;20(4):294-297.
14. Boddu S, Aluri A. Intrathecal nalbuphine versus intrathecal pentazocine as adjuvant to 0.5% hyperbaric bupivacaine for infraumbilical surgeries under subarachnoid block: A comparative evaluation. *Med Pulse International Journal of Anesthesiology* 2021; 17(3): 122-27.
15. Loubert C. Fluid and vasopressor management for Cesarean delivery under spinal anesthesia: continuing professional development. *Can J Anaesth.* 2012;59(6):604-619.
16. Bromage PR. A comparison of the hydrochloride and carbon dioxide salts of lidocaine and prilocaine in epidural analgesia. *Acta Anaesthesiol Scand Suppl.* 1965; 16:55-69.
17. Wang C, Lassi N, Zhang X, Sharma V. The evolving regulatory landscape for fentanyl: China, India and global drug governance. *Int J Environ Res Public Health* 2022; 19:2074.
18. Filos KS, Goudas LC, Patroni O, Polyzou V. Hemodynamic and analgesic profile after intrathecal clonidine in humans. A dose-response study. *Anesthesiology.* 1994;81(3):591-601.
19. Henderson K. Pentazocine. *Update in Anaesthesia* 2008; 24(1):8-12.
20. Arulozhi KS, Ratnam R. Evaluation of efficacy of intrathecal pentazocine as a sole anaesthesia agent for lower abdominal surgeries. *IOSR-Journal of Dental and Medical Sciences* 2016; 15(4):46-48.
21. Nair J, Rajan S, Paul J, Andrews S. Efficacy and safety of intrathecal pentazocine as a sole anesthetic agent for lower limb surgeries. *Anesth Essays Res.* 2013;7(1):49-53.
22. Arya AK, Singh M. Comparison of efficacy of epidural fentanyl and pentazocine for lower limb orthopedic surgeries. *Journal of Clinical Orthopaedics and Trauma* 2010; 1(2): 92-94.
23. Cheun JK, Cho ST. Spinal anesthesia with pentazocine for total abdominal hysterectomy. *J Anesth.* 1988; 2(1):98-100. doi:10.1007/s0054080020098.