Egyptian Journal of Anaesthesia

Vol. 41, 2025
ISSN: 1110-1849 (print)
ISSN: 1687-1804 (online)
DOI: 10.21608/EGJA.2025.386487.1091

ORIGINAL ARTICLE

Comparing the Effect of Spinal Bupivacaine Versus Spinal Prilocaine on Maternal Blood Pressure in Caesarean Section: A Randomized Controlled Trial

Zeinab Mustafa Sayed[1], Omima Emadeldin Mahran[2], Mohamed Gaber Ahmed[1]
Anesthesia, Intensive Care, and Pain Management Department, Faculty of Medicine, [1]South Valley University, Qena, [2]Sohag University, Sohag, Egypt.

Correspondence to *Zeinab Mustafa Sayed, Anesthesia, Intensive Care, and Pain Management Department, Faculty of Medicine, South Valley University, Qena, Egypt.*
E-mail: zeinab.mustafa@med.svu.edu.eg

Background Hypotension following spinal anesthesia (SA) occurs in 80-90% of parturients undergoing caesarean section (CS), potentially compromising maternal and fetal outcomes. This study evaluated the hemodynamic effects and recovery profiles of spinal bupivacaine versus prilocaine in parturients undergoing CS.

Methods This triple-blinded randomized trial included 120 pregnant women (aged 18-35 years old) scheduled for CS. Participants received either 10mg hyperbaric bupivacaine 0.5% in Group A or 50mg hyperbaric prilocaine 2% in Group B, combined with 100µg morphine (total volume 3ml). Maternal blood pressure (BP) was measured at baseline, every 3 minutes during the first 15 minutes post-SA, every 5 minutes until surgery completion, and hourly for 6 hours postoperatively.

Results Group A exhibited significantly lower systolic and diastolic BP at 3- and 6-minutes post-SA than Group B ($p<0.05$). Group A required significantly higher ephedrine doses than Group B (27.93±11.6mg versus 8.39±4.54mg; $p<0.001$). Motor block recovery was substantially faster in Group B, with significant differences emerging at 30 minutes postoperatively and persisting through 180 minutes ($p<0.001$ at all-time points). Complication rates were comparable between groups.

Conclusions Spinal prilocaine demonstrates superior hemodynamic stability with lower vasopressor requirements and faster motor recovery compared to bupivacaine for CS, these benefits support the use of prilocaine in enhanced recovery pathways for CS.

Keywords Bupivacaine, Caesarean Section, Hypotension, Motor Recovery, Prilocaine, Spinal Anesthesia.
Received: 18 May 2025, **Accepted:** 26 July 2025
Egyptian Journal of Anaesthesia 2025,

INTRODUCTION

Caesarean section (CS) has emerged as a prevalent method of childbirth termination globally, influenced by factors including advanced maternal age, decreased vaginal delivery rates, and increased utilization of electronic fetal monitoring [1]. The procedure's safety profile has improved significantly over recent decades, with enhanced recovery protocols emphasizing early mobilization and urinary catheter removal to facilitate optimal maternal outcomes [2,3].

Spinal anesthesia (SA) represents the gold standard for elective CS, offering substantial maternal and neonatal advantages compared to general anesthesia [4,5]. This neuraxial technique provides rapid onset, reduces fetal drug exposure, and minimizes maternal pulmonary aspiration risk, making it the preferred approach [6,7]. Achieving adequate sensory block level remains critical for surgical comfort while avoiding excessive sympathetic blockades [8].

Hypotension following SA constitutes a significant complication, affecting approximately 80-90% of parturients and potentially compromising both maternal and fetal outcomes [9]. This hemodynamic disturbance, caused by sympathetic blockade leading to reduced systemic vascular resistance, is associated with severe hypotension, which correlates with fetal hypoxia and elevated maternal morbidity [10]. Prophylactic interventions have been implemented to mitigate these risks, including crystalloid preloading, vasopressor co-infusion, and optimal patient positioning [11].

Bupivacaine remains the most widely utilized intrathecal local anesthetic for CS, typically administered in hyperbaric formulation to achieve predictable sensory block spread [12]. Despite its established efficacy, concerns persist regarding its unpredictable motor block duration and variability, potentially delaying recovery and hospital discharge [13]. Efforts have been made to optimize bupivacaine dosing and adjuvant combinations to minimize complications while maintaining adequate surgical anesthesia [14].

Prilocaine, an intermediate-acting local anesthetic, has recently garnered attention as a potential alternative to bupivacaine for caesarean anesthesia, particularly within enhanced recovery pathways [15]. This agent demonstrates shorter motor block duration and improved recovery profiles than bupivacaine, potentially facilitating earlier mobilization and discharge [16].

Thus, this study aimed to evaluate the effect of spinal bupivacaine versus prilocaine on maternal BP during CS and their effect on maternal hemodynamics.

MATERIAL AND METHODS

This randomized, controlled, triple-blinded trial involved 120 women aged 18-35 years old, pregnant >36 weeks singleton baby, American Society of Anesthesiologists (ASA) physical status II underwent CS at South Valley University Hospital, Egypt from April 2024 to January 2025. The institutional ethical committee approved the study (ID: SVU-MED-AIP029-4/24/2/817) and registered it on ClinicalTrials.gov (ID: NCT06290583). Informed written consent was obtained from all women before enrolment.

Exclusion criteria included cardiac disease, psychiatric illness, those who received SA that was later converted to general anesthesia, known sensitivity to local anesthetics, eclampsia, placental abruption or placenta previa, coagulopathy, thrombocytopenia with a platelet count below 80,000/cm^3, or myasthenia.

Randomization and blindness:

In sealed opaque envelopes, participants were randomly assigned to two equal groups using computer-generated random numbers (https://www.randomizer.org/).

SA was administered in both groups using a combination of a local anesthetic and 100µg of morphine, diluted with 0.9% saline to a final volume of 3ml. Group A received 10mg of hyperbaric bupivacaine (Sunny Pivacaine Hyperbaric Bupivacaine 0.5%, 20mg/4ml), while Group B received 50mg of hyperbaric prilocaine (Takipril® Hyperbaric Prilocaine 2%, 20mg/1ml, Sintetica Pharma).

The study was designed as a triple-blinded trial in which the participants, care providers, and outcome assessors were all blinded to group allocation.

The first anesthetist prepared, under sterile conditions, the syringe containing the local anesthetic solutions. The second anesthetist blinded to the study solution, provided anesthesia care and recorded the data. The parturient was not informed of the administered study drug.

All patients received intravenous ranitidine (150mg) and metoclopramide (10mg) 30 minutes before anesthesia. Standard monitoring was employed, including pulse oximetry, temperature probe, noninvasive BP, and electrocardiogram. Preload hydration was administered using Ringer's lactate solution at 10ml/kg via an 18-gauge intravenous catheter.

SA was performed in the sitting position at the L4/L5 interspace, aligned with the posterior superior iliac spine. Upon confirming access to the subarachnoid space, the study solution at room temperature was injected over 30 seconds. The patient was then positioned supine with a left lateral tilt and received oxygen via face mask at 6L/min. A urinary catheter was inserted following positioning.

Adequate anesthesia was defined as achieving a bilateral T4 sensory level, assessed by pinprick, and complete motor block, evaluated using the Modified Bromage scale [17]. Motor block was assessed before skin incision, at 15-minute intervals intraoperatively and 30-minute intervals postoperatively until complete recovery. The duration of the motor block was defined as the time from complete block (score 1) to full recovery (score 6) according to the Modified Bromage Score.

Maternal BP was recorded at baseline, every 3 minutes during the first 15 minutes post-SA, every 5 minutes thereafter until the end of surgery, and then hourly for 6

hours postoperatively. Hypotension was defined as a ≥20% decrease in systolic blood pressure (SBP) from baseline and was managed with intravenous ephedrine (5mg increments), titrated to maintain ≥90% of baseline values at the anesthetist's discretion.

All patients underwent a standardized surgical technique involving uterine exteriorization. The total dose of vasopressors administered, as well as intraoperative parameters and complications, were recorded throughout the study. Patients in both groups were asked to describe their overall satisfaction as one of the following (excellent, good, fair, poor, very poor).

The primary outcome was maternal BP. Secondary outcomes included the assessment of motor block duration, and the dose of ephedrine administered in each group.

Sample size calculation:

G*Power 3.1.9.2 (Universitat Kiel, Germany) was used for sample size calculation, informed by a pilot study (n= 5/group) showing SBP at 3min as 108.6±13.5mmHg (Group A) and 99.6±19.2mmHg (Group B). With a 0.542 effect size, 95% confidence, 80% power, 1:1 ratio, and 5 added per group for dropout, 60 patients were recruited per group.

Statistical analysis:

SPSS v26 (IBM Inc., Chicago, IL, USA) performed statistical analysis. Quantitative variables (mean±SD) were compared via unpaired t-test. Qualitative variables (frequency, %) were analyzed using Chi-square or Fisher's exact test (as needed). Statistical significance was set at a two-tailed P≤0.05.

RESULTS

Of 139 patients screened, 12 were ineligible, and seven refused, leaving 120 patients randomly allocated into two equal groups of 60. All these 120 patients completed the study and were statistically analyzed (Figure 1).

Both groups exhibited comparable demographic profiles and duration of surgery (Table 1).

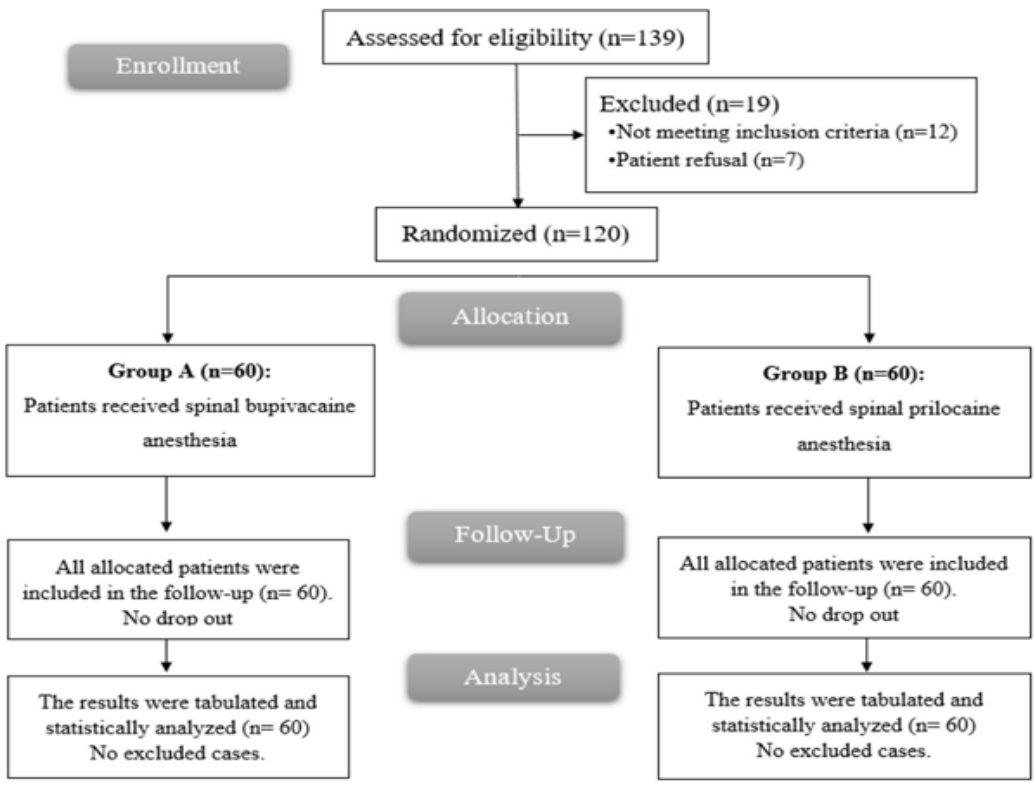

Figure 1: CONSORT flowchart of the enrolled patients.

Table 1: Demographic data distribution and duration of surgery of the studied groups:

	Group A (*n*=60)	Group B (*n*=60)	*P* value
Age (years)	28. 7±5.5	29.2±5.5	0.565
Gestational age (week)	38.5±0.6	38.6±0.5	0.426
Weight (kg)	92.9±11.3	90.7±13.6	0.323
Height (cm)	164.2±5.5	165.5±7.3	0.257
Body mass index (kg/m^2)	34.6±4.8	33.3±6.03	0.197
Duration of surgery (min)	51.9±5. 5	53.3±7.7	0.276

The data were presented as the mean±SD.

At baseline, Group A demonstrated a significantly higher mean SBP than Group B (p= 0.030). At 3 minutes, Group A exhibited a significantly lower SBP than Group B (p= 0.002), a pattern that persisted at 6 minutes (p= 0.001). At 35 minutes, Group B again demonstrated significantly higher SBP than Group A (p= 0.024). In the postoperative phase, a significant difference was observed at 1 hour (p= 0.018), after which no significant differences in SBP were noted through 6 hours (Figure 2A).

For diastolic BP (DBP), baseline values were comparable. Significant differences emerged at 3 minutes (p<0.001) and 6 minutes (p= 0.002), with Group A showing lower values. At 35 minutes, Group B demonstrated significantly higher DBP values (p= 0.001), and this trend continued at 40 minutes (p= 0.005). No significant differences in DBP were observed during the postoperative period from 1-6 hours (Figure 2B).

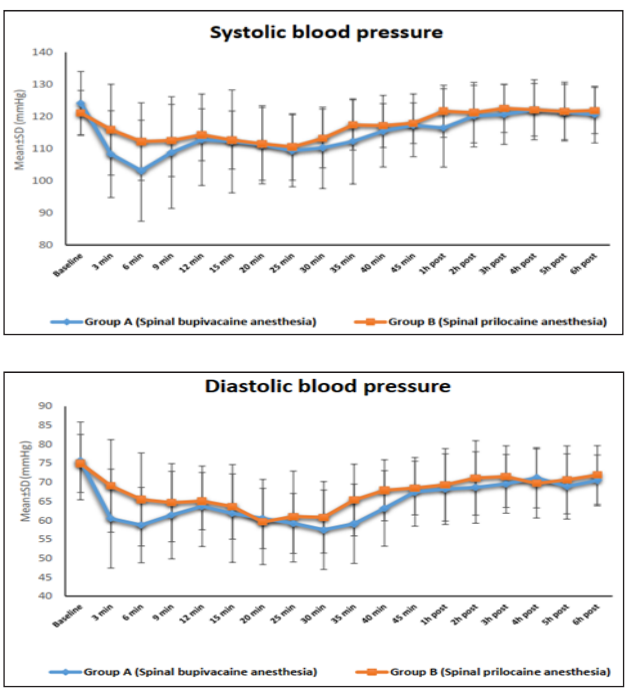

Figure 2: (A) Systolic blood pressure changes, and (B) Diastolic blood pressure changes of the studied groups.

Both groups exhibited a complete motor blockade during the operating period (15-45 minutes). However, significant differences emerged in the postoperative recovery phase. At 30 minutes postoperatively, Group B demonstrated a significantly higher mean motor block score (p<0.001). This disparity widened at 60 minutes (p<0.001) and persisted through 120 minutes (p<0.001) and 180 minutes (p<0.001). All surgeries were completed within the duration of effective spinal anesthesia for both agents, with no intraoperative complaints of pain or conversion to general anesthesia (Figure 3).

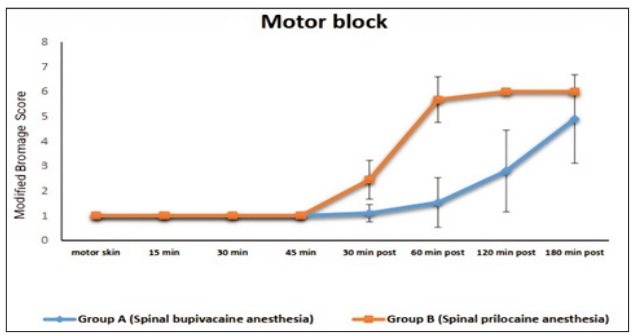

Figure 3: Motor block duration of the studied groups.

Group A required significantly higher ephedrine doses than Group B (27.93±11.6 mg versus 8.39±4.54mg; p<0.001) (Table 2).

The incidences of bradycardia, uterine laxity, nausea, and vomiting were comparable between groups. Patient satisfaction was insignificantly different between groups (Table 3).

Table 2: Ephedrine requirements of the studied groups:

	Group A (*n*=60)	Group B (*n*=60)	*P* value
Ephedrine (mg)	27.9±11.6	8.4±4.5	<0.001

The data was presented as the mean±SD.

Table 3: Complications and patient satisfaction of the studied groups:

		Group A (*n*=60)	Group B (*n*=60)	*P* value
Complications	Bradycardia	3(5%)	1(1.7%)	0.361
	Laxity in uterus	0(0%)	1(1.7%)	1.000
	Nausea	2(3.3%)	1(1.7%)	0.616
Patient satisfaction	Excellent	39(65%)	36 (60%)	0.458
	Good	15(25%)	12(20%)	
	Fair	5(8.3%)	9(15%)	
	Poor	1(1.7)	3(5%)	
	Very poor	0(0%)	0(0%)	

The data was presented as numbers (%).

DISCUSSION

The current study demonstrated significant differences in SBP response between patients receiving intrathecal bupivacaine versus prilocaine during CS. Most notably, bupivacaine showed a faster, more pronounced SBP drop early on, with lower values than prilocaine. SBP levels converged between 9–30 minutes, then diverged again at 35 minutes and 1 hour postoperative, where prilocaine maintained higher SBP, suggesting earlier sympathetic recovery compared to the prolonged effect of bupivacaine. These findings align with Helill *et al.,* [12], who reported significant hemodynamic variability following bupivacaine administration.

DBP trends mirrored SBP patterns, with bupivacaine causing a greater early drop, notably at 3 minutes. Differences reappeared at 35–40 minutes, favoring prilocaine for hemodynamic stability. Postoperatively, DBP values equalized, indicating a similar recovery of sympathetic tone with both agents after CS. These findings extend the observations of Huang *et al.,* [18], who demonstrated that optimizing bupivacaine dosing could mitigate hypotension risk. The more stable DBP profile with prilocaine may represent a clinically advantageous feature of this agent, particularly for patients with comorbidities.

Pratiwi *et al.,* [19] further reinforce the hemodynamic advantages of prilocaine, reporting a 0% incidence of hypotension versus 30% with bupivacaine for urologic endoscopy.

Motor block duration differed markedly, with prilocaine enabling significantly faster recovery. The partial motor function returned by 30 minutes and was notably greater by 60 minutes than bupivacaine. Complete recovery occurred earlier in the prilocaine group, suggesting advantages for early postoperative mobilization. These findings closely corroborate those reported by Chapron *et al.,* [15], who found a significantly shorter median motor block duration with prilocaine compared to bupivacaine (158 minutes versus 220 minutes; $p<0.001$), as well as a reduced incidence of persistent motor block at 180 minutes (32% versus 88%; $p<0.001$). Similarly, Ibrahim *et al.,* [20] demonstrated significantly faster motor recovery with prilocaine than bupivacaine in patients undergoing lower abdominal surgery. Moreover, Pratiwi *et al.,* [19] demonstrated that prilocaine's shorter motor block duration (102 minutes) compared to bupivacaine (220 minutes) correlates with faster sympathetic recovery.

The consistency across these studies strengthens the evidence that prilocaine offers a reliable advantage in motor recovery, which may translate to reduced risk of thromboembolic complications, improved patient satisfaction, and potentially earlier discharge in appropriate clinical settings.

Ephedrine requirements were over three times higher in the bupivacaine group, highlighting a markedly greater need for hemodynamic support compared to prilocaine. This substantial disparity in vasopressor usage directly reflects the greater hypotensive tendency of bupivacaine and carries important implications for clinical practice. Higher vasopressor requirements indicate more severe hemodynamic compromise and potentially increase the risk of adverse effects associated with vasopressor administration, including tachycardia, arrhythmias, and uterine artery vasoconstriction. Interestingly, our findings diverge somewhat from those of Chapron *et al.,* [15], who reported similar rates of maternal hypotension between prilocaine and bupivacaine groups (80% versus 88%; $p=0.701$), though their study did not quantify the severity of hypotension or the total dose of vasopressors required. The marked reduction in vasopressor requirements with prilocaine in our study suggests that this agent may offer particular advantages in patients at higher risk for hypotension or when hemodynamic stability is a primary concern.

Complication rates were low and similar across groups. Bupivacaine showed slightly higher, non-significant rates of bradycardia and nausea, while uterine laxity occurred only with prilocaine. Overall, both agents demonstrated comparable safety profiles without significant differences in adverse events. These findings align with modern SA's generally excellent safety record for CS. Ibrahim *et al.,* [20] similarly found no significant differences in the incidence of nausea, vomiting, and shivering between the bupivacaine and prilocaine groups. However, they reported a higher incidence of transient neurological symptoms (4.5%) with bupivacaine, while no cases occurred with prilocaine, highlighting a potential safety advantage of prilocaine.

Although the sample size was adequately powered for the primary outcome, this single-center study excluded emergent cases, did not assess neonatal outcomes or long-term prilocaine safety, relied on anesthetist-determined ephedrine dosing, and used fixed anesthetic doses. These factors may restrict generalizability and introduce potential bias, limiting applicability to broader obstetric populations (e.g., high-risk parturients or those requiring individualized dosing).

CONCLUSION

Spinal prilocaine demonstrated superior hemodynamic stability, exhibiting a significantly lower incidence of hypotension and reduced ephedrine requirements

compared to bupivacaine, along with faster motor recovery. These benefits support the use of prilocaine in enhanced recovery pathways for CS.

FUNDING

No funding was received for conducting this study.

AUTHORS' CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Z. M. S.], [O. E. M.], and [M. G. A.]. The first draft of the manuscript was written by [Z. M. S.], [O. E. M.], and [M. G. A.]. All authors commented on previous versions of the manuscript. All authors read and approved of the final manuscript.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCE

1. Olapour A, Akhondzadeh R, Rashidi M, Gousheh M, Homayoon R. (2020). Comparing the effect of bupivacaine and ropivacaine in cesarean delivery with spinal anesthesia. Anesth Pain Med. 10:e94155.
2. Bollag L, Lim G, Sultan P, Habib AS, Landau R, Zakowski M, *et al.* (2021). Society for obstetric anesthesia and perinatology: Consensus statement and recommendations for enhanced recovery after cesarean. Anesth Analg. 132:1362-77.
3. Macones GA, Caughey AB, Wood SL, Wrench IJ, Huang J, Norman M, *et al.* (2019). Guidelines for postoperative care in cesarean delivery: Enhanced recovery after surgery (ERAS) society recommendations (part 3). Am J Obstet Gynecol. 221:e1-e9.
4. Caughey AB, Wood SL, Macones GA, Wrench IJ, Huang J, Norman M, *et al.* (2018). Guidelines for intraoperative care in cesarean delivery: enhanced recovery after surgery society recommendations (part 2). Am J Obstet Gynecol. 219:533-44.
5. Kim W, Hur M, Park S-K, Yoo S, Lim T, Yoon H, *et al.* (2019). Comparison between general, spinal, epidural, and combined spinal-epidural anesthesia for cesarean delivery: A network meta-analysis. Int J Obstet Anesth. 37:5-15.
6. Traynor AJ, Aragon M, Ghosh D, Choi RS, Dingmann C, Tran ZV, *et al.* (2016). Obstetric anesthesia workforce survey: A 30-year update. Anesth Analg. 122:1939-46.
7. Mhyre JM, Sultan P. (2019). General anesthesia for cesarean delivery: Occasionally essential but best avoided. Anesthesiol. 130:864-6.
8. Benhamou D, Wong C. (2009). Neuraxial anesthesia for cesarean delivery: What criteria define the optimal technique? Anesth Analg. 109:1370-3.
9. Šklebar I, Bujas T, Habek D. (2019). Spinal anaesthesia-induced hypotension in obstetrics: Prevention and therapy. Acta Clin Croat. 58:90-5.
10. Javed S, Hamid S, Amin F, Mahmood KT. (2011). Spinal anesthesia induced complications in caesarean section: A review. J Pharm Sci Res. 3:1530-8.
11. Kinsella S, Carvalho B, Dyer R, Fernando R, McDonnell N, Mercier F, *et al.* (2018). International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia. Obstet Anesth Dig. 38:171-2.
12. Helill SE, Sahile WA, Abdo RA, Wolde GD, Halil HM. (2019). The effects of isobaric and hyperbaric bupivacaine on maternal hemodynamic changes post spinal anesthesia for elective cesarean delivery: A prospective cohort study. PloS One. 14:e0226030.
13. Smiley R, Redai I. (2004). More failed spinal anesthetics with hyperbaric bupivacaine. Int J Obstet Anesth. 13:132-4.
14. Derakhshan P, Imani F, Koleini ZS, Barati A. (2018). Comparison of adding sufentanil and low-dose epinephrine to bupivacaine in spinal anesthesia: A randomized, double-blind, clinical trial. Anesth Pain Med. 8:e69600.
15. Chapron K, Sleth JC, Capdevila X, Bringuier S, Dadure C. (2021). Hyperbaric prilocaine vs. hyperbaric bupivacaine for spinal anaesthesia in women undergoing elective caesarean section: A comparative randomised double-blind study. Anaesthesia. 76:777-84.
16. Vagts D, Bley C, Mutz C. (2013). Use of 2% hyperbaric prilocaine for spinal anesthesia: Sensitivity analysis in outpatient surgery. Der Anaesthesist. 62:271-7.
17. Craig D, Carli F. (2018). Bromage motor blockade score–a score that has lasted more than a lifetime. Can J Anaesth. 65:837-8.
18. Huang Q, Wen G, Hai C, Zheng Z, Li Y, Huang Z, *et al.* (2022). A height-based dosing algorithm of bupivacaine in spinal anesthesia for decreasing maternal hypotension in cesarean section without prophylactic fluid preloading and vasopressors: A randomized-controlled non-inferiority trial. Front Med. 9:858115.
19. Pratiwi A, Rum M, Palinrungi A, Salahuddin A, Faisal F, Nurdin H. (2024). Prilocaine vs bupivacaine in spinal anesthesia for urologic endoscopy: Clinical trials & historical overview. Messenger Anesthesiol Resusc. 21:50-9.
20. Ibrahim ZA, Mohammad KA, Mohamed BA. (2022). Effect of spinal anesthesia by prilocaine 2% versus lidocaine 2% and bupivacaine 0.5% in day-case lower abdominal surgery outcome. Med J Cairo Univ. 90:1903-9.