Section: Anaesthesia

Original Research Article

A COMPARATIVE STUDY OF SITTING VERSUS LATERAL POSITION FOR INDUCTION OF SPINAL ANAESTHESIA IN ELDERLY PATIENTS: EFFECTS ON HEMODYNAMIC STABILITY, BLOCK CHARACTERISTICS, AND PATIENT COMFORT

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ABSTRACT

Background: Spinal anaesthesia is frequently used in elderly patients but is often associated with hemodynamic instability. Patient positioning during induction may influence cardiovascular responses, block characteristics, and patient comfort. The aim is to compare sitting versus lateral position for induction of spinal anaesthesia in elderly patients with respect to hemodynamic stability, block characteristics, and patient comfort. **Materials and Methods:** This prospective comparative study included 60 elderly patients (≥60 years) undergoing surgeries under spinal anaesthesia, divided into two groups: lateral position (n=30) and sitting position (n=30). Hemodynamic parameters were recorded at baseline and predefined intervals following spinal anaesthesia. Sensory and motor block characteristics were assessed, and patient comfort during induction was evaluated. Data were analyzed using appropriate statistical tests, with $p<0.05$ considered significant. **Result:** Baseline demographic characteristics were comparable between the two groups. Heart rate trends were similar throughout the study period. The lateral position demonstrated significantly better early hemodynamic stability, with higher systolic blood pressure and mean arterial pressure during the initial post-spinal period. Sensory onset time and motor block characteristics were comparable between the two positions. Patient comfort was higher in the lateral group, showing a clinically meaningful advantage. **Conclusion:** Lateral positioning for induction of spinal anaesthesia in elderly patients provides improved early hemodynamic stability and better patient comfort without compromising block quality. It may be considered a preferable alternative to the sitting position in this population.

INTRODUCTION

The global increase in life expectancy has led to a rising proportion of elderly patients presenting for surgical procedures, particularly lower abdominal, lower limb, and urological surgeries. Anaesthetic management in this population is challenging due to age-related physiological changes, reduced cardiovascular reserve, and the presence of multiple comorbidities. Spinal anaesthesia is commonly preferred in elderly patients as it avoids airway manipulation, reduces perioperative pulmonary complications, and provides effective analgesia with minimal systemic drug exposure when compared to general anaesthesia.[1,2]

Despite its advantages, spinal anaesthesia in elderly patients is frequently associated with hemodynamic instability, particularly hypotension and bradycardia. These adverse effects are largely attributed to sympathetic blockade, reduced venous return, and impaired autonomic compensatory mechanisms seen with advancing age. Even small reductions in systemic vascular resistance or preload may result in significant blood pressure fluctuations, making perioperative management in elderly patients particularly demanding.[3]

Patient positioning during induction of spinal anaesthesia plays a crucial role in determining the spread of local anaesthetic within the subarachnoid space and may significantly influence hemodynamic changes, block characteristics, and patient comfort. The two most commonly employed positions are the sitting and lateral decubitus positions. The sitting position allows better identification of anatomical landmarks, especially in patients with obesity or spinal deformities, and is often preferred for technical ease. However, gravity-induced pooling of blood in the lower extremities combined with sympathetic blockade may predispose elderly patients to more pronounced hypotension in this position.[4]

Conversely, the lateral position is often better tolerated by elderly patients, particularly those with limited mobility or frailty. It may offer improved hemodynamic stability by minimizing venous pooling and allowing a more gradual spread of intrathecal local anaesthetic. However, difficulty in identifying spinal landmarks and challenges in maintaining optimal flexion may sometimes compromise technical success.[5]

Aim: To compare the effects of sitting versus lateral position for induction of spinal anaesthesia on hemodynamic stability, block characteristics, and patient comfort in elderly patients.

Objectives

1. To compare hemodynamic changes including heart rate, systolic, diastolic, and mean arterial pressure following spinal anaesthesia in sitting and lateral positions.
2. To assess and compare sensory and motor block characteristics between the two positions.
3. To evaluate patient comfort and satisfaction during induction of spinal anaesthesia in both positions.

MATERIALS AND METHODS

Source of Data: Data were collected from elderly patients undergoing elective infra-umbilical surgeries under spinal anaesthesia in the operation theatres of a tertiary care hospital.

Study Design: This was a prospective, randomized, comparative observational study.

Study Location: The study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital.

Study Duration: The study was carried out over a period of 18 months.

Sample Size: A total of 60 elderly patients were included in the study.

- Lateral position group: 30 patients
- Sitting position group: 30 patients

Inclusion Criteria

- Patients aged ≥ 60 years
- American Society of Anesthesiologists (ASA) physical status I and II
- Patients undergoing elective infra-umbilical surgeries
- Patients willing to provide informed written consent

Exclusion Criteria

- Patient refusal
- Infection at the site of injection
- Coagulopathy or bleeding disorders
- Severe spinal deformity
- Pre-existing neurological deficits
- Hemodynamically unstable patients
- Allergy to local anaesthetic agents

Procedure and Methodology: All patients were evaluated during the pre-anaesthetic visit one day prior to surgery. Written informed consent was obtained. On the day of surgery, standard fasting guidelines were confirmed. Patients were connected to standard ASA monitors, and baseline heart rate and blood pressure were recorded. An intravenous line was secured, and patients were preloaded with Ringer's lactate solution.

Patients were randomly allocated into either the sitting or lateral position group. Under strict aseptic precautions, spinal anaesthesia was administered at the L3–L4 or L4–L5 interspace using a midline approach with a 23G or 25G Quincke spinal needle. Hyperbaric bupivacaine 0.5% was injected after confirmation of free flow of cerebrospinal fluid. Immediately after injection, patients were placed in the supine position.

Sensory block was assessed using pin-prick method, and motor block was evaluated using the Modified Bromage Scale. Hemodynamic parameters were recorded at predetermined intervals.

Sample Processing: No laboratory sample processing was involved as this was a purely clinical observational study.

Data Collection: Data were collected using a structured case record form and included demographic details, hemodynamic variables, block characteristics, and patient comfort scores.

Statistical Methods: Data were entered into Microsoft Excel and analyzed using statistical software. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Independent t-test and chi-square test were applied as appropriate. A p-value < 0.05 was considered statistically significant.

RESULTS

[Table 1] summarizes the baseline demographic characteristics, overall comfort, and initial block profile of the study participants, with 30 patients in each group. The lateral position group had a lower proportion of males compared to the sitting group (66.7% vs. 80.0%), though this difference was not statistically significant (χ^2=1.36, p=0.244), with a relative risk of 0.83 (95% CI: 0.61–1.14). Age distribution was comparable between the two groups, with the majority of patients belonging to the 60–65-year age group in the sitting position (53.3%) and a higher proportion of patients aged over 76 years in the lateral position (40.0% vs. 20.0%); however, these differences were not statistically significant (χ^2=4.07, p=0.254). Patient comfort showed a clinically relevant trend, with a greater proportion of patients in the lateral position reporting comfort during induction (70.0%) compared to the sitting position (43.3%), although this did not reach statistical significance (RR=1.62, 95% CI: 0.99–2.62; p=0.067). The mean onset time of sensory block was similar between the two groups (3.60 ± 0.81 min in lateral vs. 3.47 ± 0.82 min in sitting), with no

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statistically significant difference (mean difference +0.13 min; 95% CI: −0.29 to +0.56; p=0.531).

Table 1: Baseline distribution and overall comfort/block summary (n=30 per group)

Variable	Lateral (n=30)	Sitting (n=30)	Test of significance	Effect size (95% CI)	p-value
Sex (Male)	20 (66.7%)	24 (80.0%)	$\chi^2(1)=1.36$	RR=0.83 (0.61–1.14)	0.244
Sex (Female)	10 (33.3%)	6 (20.0%)			
Age 60–65 y	10 (33.3%)	16 (53.3%)	$\chi^2(3)=4.07$	—	0.254
Age 66–70 y	3 (10.0%)	4 (13.3%)			
Age 71–75 y	5 (16.7%)	4 (13.3%)			
Age >76 y	12 (40.0%)	6 (20.0%)			
Comfort "Yes"	21 (70.0%)	13 (43.3%)	Fisher exact	RR=1.62 (0.99–2.62)	0.067
Comfort "No"	9 (30.0%)	17 (56.7%)			
Sensory onset time (min) (from distribution)	3.60 ± 0.81	3.47 ± 0.82	t=0.63	Mean diff=+0.13 (−0.29 to +0.56)	0.531

Table 2: Hemodynamic changes after spinal anaesthesia (n=30 per group)

(A) Heart Rate (beats/min)					
Time	**Lateral Mean±SD**	**Sitting Mean±SD**	**Test**	**Mean diff (L−S) 95% CI**	**p-value**
Baseline	99.0±11.10	95.5±8.06	t=1.40	+3.50 (−1.47 to +8.47)	0.166
2 min	96.0±11.10	92.1±7.49	t=1.58	+3.90 (−1.04 to +8.84)	0.119
4 min	89.3±11.40	91.1±8.09	t=−0.70	−1.80 (−6.90 to +3.30)	0.486
6 min	86.5±10.50	90.0±10.10	t=−1.32	−3.50 (−8.78 to +1.78)	0.193
10 min	85.7±11.50	89.9±9.32	t=−1.56	−4.20 (−9.60 to +1.20)	0.124
20 min	83.3±11.30	81.5±10.80	t=0.63	+1.80 (−3.90 to +7.50)	0.531
30 min	79.6±11.40	78.7±8.39	t=0.35	+0.90 (−4.05 to +5.85)	0.726
60 min	73.7±10.90	72.3±9.03	t=0.54	+1.40 (−3.77 to +6.57)	0.592
(B) Systolic Blood Pressure (mmHg)					
Time	**Lateral Mean±SD**	**Sitting Mean±SD**	**Test**	**Mean diff (L−S) 95% CI**	**p-value**
Baseline	123.0±12.70	122.0±9.33	t=0.34	+1.00 (−4.80 to +6.80)	0.731
4 min	113.0±12.70	107.0±9.80	t=2.05	+6.00 (+0.12 to +11.88)	0.045
6 min	109.0±11.40	101.0±9.75	t=2.75	+8.00 (+2.28 to +13.72)	0.007
8 min	106.0±11.60	98.5±11.00	t=2.56	+7.50 (+1.63 to +13.37)	0.013
10 min	104.0±10.10	97.7±10.30	t=2.39	+6.30 (+1.02 to +11.58)	0.020
30 min	98.9±10.80	96.5±9.78	t=0.91	+2.40 (−2.88 to +7.68)	0.368
60 min	94.6±7.97	96.1±10.80	t=−0.61	−1.50 (−6.43 to +3.43)	0.542
(C) Diastolic Blood Pressure (mmHg)					
Time	**Lateral Mean±SD**	**Sitting Mean±SD**	**Test**	**Mean diff (L−S) 95% CI**	**p-value**
Baseline	73.4±8.38	73.4±6.10	t=0.00	0.00 (−3.74 to +3.74)	1.000
2 min	66.1±5.91	69.5±5.72	t=−2.26	−3.40 (−6.41 to −0.39)	0.029
6 min	63.8±4.02	61.2±4.54	t=2.34	+2.60 (+0.38 to +4.82)	0.023
20 min	56.7±5.98	61.3±6.28	t=−2.91	−4.60 (−7.76 to −1.44)	0.005
60 min	61.1±5.93	62.8±4.84	t=−1.22	−1.70 (−4.49 to +1.09)	0.229
(D) Mean Arterial Pressure (mmHg)					
Time	**Lateral Mean±SD**	**Sitting Mean±SD**	**Test**	**Mean diff (L−S) 95% CI**	**p-value**
Baseline	90.0±8.73	89.8±5.50	t=0.10	+0.20 (−3.57 to +3.97)	0.916
6 min	78.8±5.30	74.6±5.57	t=2.99	+4.20 (+1.39 to +7.01)	0.004
10 min	74.3±6.34	72.8±5.21	t=1.01	+1.50 (−1.53 to +4.53)	0.316
60 min	72.3±5.71	73.9±6.62	t=−1.00	−1.60 (−4.80 to +1.60)	0.323

[Table 2] details the hemodynamic changes following spinal anaesthesia. Heart rate trends over time were comparable between the two positions, with both groups showing a gradual decline from baseline to 60 minutes. At no time point did heart rate differ significantly between the lateral and sitting groups (all p>0.05), indicating similar chronotropic responses to spinal anaesthesia. In contrast, systolic blood pressure (SBP) showed significant intergroup differences in the early post-spinal period. Between 4 and 10 minutes after spinal anaesthesia, SBP was significantly higher in the lateral group compared to the sitting group, with mean differences ranging from +6.0 to +8.0 mmHg (p values between 0.045 and 0.020). These differences were no longer evident at later time points, including 30 and 60 minutes. Diastolic blood pressure (DBP) demonstrated variable but significant differences at selected intervals: DBP was significantly lower in the lateral group at 2 minutes (p=0.029) and 20 minutes (p=0.005), while it was significantly higher at 6 minutes (p=0.023). Mean arterial pressure (MAP) was largely comparable between groups, except at 6 minutes post-spinal anaesthesia, where the lateral group maintained a significantly higher MAP than the sitting group (mean difference +4.20 mmHg; 95% CI: +1.39 to +7.01; p=0.004).

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Table 3: Sensory and motor block characteristics (n=30 per group)

(A) Onset of sensory block (minutes)					
Onset time	**Lateral n(%)**	**Sitting n(%)**	**Test of significance**	**Effect size (95% CI)**	**p-value**
2 min	1 (3.3)	2 (6.7)	χ^2 test (4×2)	—	0.969
3 min	15 (50.0)	16 (53.3)			
4 min	9 (30.0)	8 (26.7)			
5 min	5 (16.7)	4 (13.3)			
Mean ± SD (derived)	3.60 ± 0.81	3.47 ± 0.82	t-test	+0.13 (−0.29 to +0.56)	0.531
(B) Motor block (Bromage) at 5 minutes					
Bromage at 5 min	**Lateral n(%)**	**Sitting n(%)**	**Test of significance**	**Effect size (95% CI)**	**p-value**
Grade 2	26 (86.7)	24 (80.0)	Fisher exact	—	0.731
Grade 3	4 (13.3)	6 (20.0)		RR (Grade 3) = 0.67 (0.21–2.08)	

[Table 3] compares sensory and motor block characteristics between the two positions. The distribution of sensory block onset times was similar in both groups, with the majority of patients achieving sensory block within 3–4 minutes. There was no statistically significant difference in the categorical distribution of onset times (χ^2 test, p=0.969). The derived mean onset time of sensory block was comparable between the lateral and sitting groups (3.60 ± 0.81 vs. 3.47 ± 0.82 minutes, respectively), with no significant difference (p=0.531). Motor block assessment at 5 minutes showed that most patients in both groups achieved Bromage grade 2, while a smaller proportion reached grade 3. The difference in motor block grades between the two positions was not statistically significant (p=0.731), and the relative risk for achieving grade 3 block in the lateral group was 0.67 (95% CI: 0.21–2.08), indicating comparable motor block characteristics.

Table 4: Patient comfort and satisfaction during induction (n=30 per group)

Variable	**Lateral (n=30)**	**Sitting (n=30)**	**Test of significance**	**Effect size (95% CI)**	**p-value**
Comfort "Yes"	21 (70.0%)	13 (43.3%)	Fisher exact	RR = 1.62 (0.99–2.62)	0.067
Comfort "No"	9 (30.0%)	17 (56.7%)			

[Table 4] focuses on patient comfort and satisfaction during induction of spinal anaesthesia. A higher proportion of patients in the lateral position reported being comfortable compared to those in the sitting position (70.0% vs. 43.3%), whereas discomfort was more frequently reported in the sitting group (56.7% vs. 30.0%). Although this difference did not achieve statistical significance (p=0.067), the relative risk of comfort favored the lateral position (RR=1.62, 95% CI: 0.99–2.62), suggesting a clinically meaningful advantage of the lateral position in terms of patient comfort during induction.

DISCUSSION

In the present study, baseline characteristics were comparable between the lateral and sitting groups [Table 1]. Male predominance was seen in both groups (66.7% vs 80.0%) without significant difference (p=0.244), and the age distribution across 60–65, 66–70, 71–75 and >76 years was also statistically similar (p=0.254). This baseline comparability is consistent with most comparative studies assessing induction position for spinal anaesthesia, where demographic factors typically do not differ significantly after randomization and therefore do not confound hemodynamic or block outcomes. Kongur E et al (2021),[6] similarly reported comparable baseline profiles in elderly patients undergoing lower-limb surgery while comparing sitting and lateral positions.

A clinically important observation in our dataset was better patient comfort in the lateral group (70.0% vs 43.3%), showing a favorable trend though not statistically significant (RR=1.62; p=0.067) [Table 1 and 4]. This aligns well with published evidence where lateral positioning is often rated as more comfortable, particularly in older patients with limited mobility, pain, or reduced ability to maintain flexion in sitting posture. Kongur E et al. (2021),[6] observed significantly higher comfort and satisfaction in the lateral position compared with sitting in their comparative work. In another comparative report, Bansal S et al. (2023),[3] also concluded that although hemodynamic parameters and block levels were similar, lateral position was more comfortable than sitting.

Regarding block onset and early block quality, our findings showed no significant difference in onset of sensory block between the two groups (mean 3.60±0.81 vs 3.47±0.82 minutes; p=0.531), and the distribution of onset categories (2–5 minutes) was also similar (p=0.969) (Table 3). Motor block at 5 minutes was comparable, with most patients achieving Bromage grade 2 (86.7% vs 80.0%; p=0.731). These findings are in agreement with studies reporting that induction position may not substantially alter onset time or early motor block when standard doses of hyperbaric bupivacaine are used and patients are made supine soon after injection. Jaffari A et al,[7] (2025) also reported broadly similar outcomes between positions, although they noted that lateral positioning was generally perceived as more comfortable. However, some studies have demonstrated faster onset and/or higher sensory levels in the lateral position, likely influenced by baricity, duration maintained in that posture, and population differences. Puthenveettil N

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et al,[8] (2024) highlighted that position affects spread and can influence block characteristics, and other comparative studies in obstetric and non-obstetric cohorts have reported earlier block onset in lateral decubitus settings.

The most relevant and clinically meaningful differences in our study were observed in early hemodynamics [Table 2]. Heart rate trends were comparable at all time points (all p>0.05), indicating that the chronotropic response was similar in both positions. In contrast, systolic blood pressure was significantly better maintained in the lateral group at 4, 6, 8 and 10 minutes post-spinal (mean differences +6 to +8 mmHg; p=0.045 to 0.007). Similarly, MAP was significantly higher at 6 minutes in the lateral group (mean difference +4.20 mmHg; p=0.004), suggesting improved early stability. This pattern supports the physiological rationale that sitting position may predispose to a greater early fall in preload due to gravitational venous pooling plus sympathectomy, whereas lateral induction may reduce the magnitude of early hypotension in vulnerable elderly patients. This observation is consistent with multiple reports showing higher hypotension incidence or greater hemodynamic drop in sitting. Deshmi R et al (2024),[9] reported a higher incidence of spinal hypotension in sitting than lateral positioning. Similarly, Kang SY et al (2025),[10] discussed that lateral positioning can be associated with less hemodynamic change, attributed to limiting sympathetic block spread and improving venous return.

At the same time, the literature is not fully uniform. Yoshida K et al (2023),[11] reported that systolic/diastolic/MAP values were significantly lower in lateral decubitus compared with sitting after spinal anesthesia in their cohort, illustrating that the direction of effect can vary with study population (obstetric vs elderly), anesthetic solution baricity, timing of turning supine, and co-loading/vasopressor practices. Therefore, our findings—showing better early SBP and MAP preservation with lateral induction in elderly—are best interpreted as evidence supporting lateral positioning for early stability in geriatric patients, while acknowledging that technique standardization (dose, speed of injection, time spent in position, and fluid/vasopressor protocol) strongly influences outcomes.

CONCLUSION

This comparative study evaluated the impact of sitting versus lateral position for induction of spinal anaesthesia in elderly patients, focusing on hemodynamic stability, block characteristics, and patient comfort. The baseline demographic profiles were comparable between the two groups, ensuring that observed differences were attributable to positioning rather than confounding factors. The findings demonstrated that the lateral position was associated with better early hemodynamic stability, particularly in the immediate post-spinal period, as evidenced by significantly higher systolic blood pressure and mean arterial pressure at critical early time points. This suggests that lateral positioning may attenuate the initial sympathetic blockade–induced hypotension commonly encountered in elderly patients.

Heart rate trends were similar in both positions throughout the observation period, indicating comparable chronotropic responses. Sensory and motor block characteristics, including onset time and degree of motor blockade, did not differ significantly between the two groups, confirming that lateral positioning does not compromise the efficacy or quality of spinal anaesthesia. Importantly, patient comfort and satisfaction were higher in the lateral position, with a clinically meaningful trend favoring lateral induction, highlighting its advantage in elderly patients who may have difficulty maintaining the sitting posture.

Limitations of the Study

1. The study had a relatively small sample size, which may limit the generalizability of the findings.
2. It was conducted at a single tertiary care center, and results may vary in different clinical settings.
3. Only short-term intraoperative hemodynamic parameters were assessed; long-term postoperative outcomes were not evaluated.
4. The study included elderly patients undergoing a variety of surgical procedures, which may have influenced hemodynamic responses.
5. The degree of spinal flexion and exact duration maintained in each position were not objectively quantified.
6. Patient comfort was assessed subjectively, which may introduce response bias.
7. Use of a single local anesthetic regimen limits extrapolation to other drugs or adjuvant combinations.

REFERENCES

1. Sajjad R, Ahmad M, Ashfaq M, Zafar Z, Amir A, Hassan MF, Din IU. The Impact of Spinal Anesthesia in Sitting Versus Lateral Decubitus Positions on Sensory Block Onset and Hemodynamic Stability in Lower Limb Surgeries. Journal of Health, Wellness and Community Research. 2025 Jun 20:e382-.
2. Manouchehrian N, Moradi A, Torkashvand L. Comparative study of effect of spinal anesthesia in sitting and lateral positions on the onset time of sensory block and hemodynamic condition in cesarean section: a randomized clinical trial. Anesthesiology and Pain Medicine. 2021 Feb 27;11(1):e111483.
3. Bansal S, Rao MM, Rao MM. Sitting against Lateral Position for Spinal Anaesthesia in Elderly Patients Undergoing Lower Limb Surgeries: An Observational Study. Journal of Clinical & Diagnostic Research. 2023 Feb 1;17(2).
4. Befkadu A, Timerga S, Mihretu F, Seyoum F, Alimawu AA. The sitting versus lateral position during induction of spinal anesthesia for elective cesarean delivery on block characteristics and severity of hypotension: a prospective randomized clinical trial, 2023. International Journal of Surgery Open. 2024 Aug 1;62(4):431-9.

5. Bajwa SP, Hussain A, Akram M, Shahzad S, Khan U. Comparison of Hemodynamic Effects and Patient Satisfaction Between Lateral Versus Sitting Maternal Positions for Cesarean Deliveries in Spinal Anesthesia. Pakistan Armed Forces Medical Journal. 2024 Aug 31;74(4):965.
6. Kongur E, Saylan S, Eroğlu A. The effects of patient position on early complications of spinal anesthesia induction in arthroscopic knee surgery. Acta Clinica Croatica. 2021 Mar 1;60(1.):68-74.
7. Jaffari A, Aghamohammadi H, Forouzmehr M. Effect of Position Change After Induction of Spinal Anesthesia with Hyperbaric 0.5% Bupivacaine on Duration of Analgesia and Opioid Demand in Percutaneous Nephrolithotomy Candidates. Anesthesiology and Pain Medicine. 2025 Jan 21;15(1):e153617.
8. Puthenveettil N, Rahman S, Achary AR, Nair S, Kadapamannil D, Paul J. Comparison of induction of spinal anesthesia in sitting position with legs parallel and crossed for cesarean section: A randomized controlled trial. Journal of Anaesthesiology Clinical Pharmacology. 2024 Jan 1;40(1):154-8.
9. Deshmi R, Gajula A, Reddy RS. Comparison of Hemodynamic Stability between Spinal Anaesthesia and Combined Spinal-Epidural in Patients with Coronary Artery Disease (CAD). European Journal of Cardiovascular Medicine. 2024 Aug 23;14:1193-9.
10. Kang SY, Kim HS, Kang H. Preferential Flow Patterns of Injectate in Epidural and Inadvertent Subdural Anesthesia: Exploring the Hemodynamic Stability of High-Level Epidural, Subdural and Combined Epidural-Subdural Blocks in Relation to ASA Class. Journal of Pain Research. 2025 Dec 31:4727-41.
11. Yoshida K, Hareyama I, Noji Y, Tanaka S, Watanabe K, Inoue S. The relationship between the orientation of the lateral decubitus position for spinal anesthesia and positioning pain in patients with a femoral neck fracture: randomized non-inferiority trial. JA Clinical Reports. 2023 Jan 27;9(1):3.