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ORIGINAL RESEARCH

Comparison between 60- and 90-seconds Sitting versus Immediate Supine Positioning on Haemodynamic and Ephedrine Use in Spinal Anaesthesia for Lower Abdominal Procedures

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Abstract

Background: The period between spinal anaesthesia (SA) induction and supine positioning can influence haemodynamic profile; however, the optimal interval is not known.
Objective: To evaluate the effects of immediate supine positioning (ISP) versus 60- and 90-second sitting, on haemodynamic profile.
Methods: Eighty women, 18 – 65 years, with American Society of Anesthesiologists (ASA) status I – III, undergoing lower abdominal surgeries (LAS) were randomised. After SA induction, group A had ISP, while groups B and C had 60-secs and 90-secs sitting, respectively. The mean intraoperative pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and rescue ephedrine and intravenous fluid use were compared.
Results: Demographics i.e., mean age, sex, and ASA status were comparable, p-values > 0.05. The mean rescue ephedrine use was 10.22 ± 2.75mg in group A, which is statistically higher than 4.12 ± 1.12mg in B and, 3.46 ± 1.24mg in C, p= value 0.001. The mean SBP was lower at 0, 5, 10, and 15-mins in group A versus B and C, p-value 0.041, 0.015, 0.032, and 0.047, respectively. The mean DBP and MAP values were lower in group A versus B and C, and IV fluid use was increased in group A versus B and C, p-value < 0.05.
Conclusion: There were decreases in SBP, DBP and MAP values and increased rescue ephedrine and fluid use in the immediate supine positioning group versus 60- and 90-secs sitting, following SA for LAS, while 90-secs produced the least changes, enhancing safety and efficacy.

Keywords*: *Ephedrine, Haemodynamics, Lower abdominal surgery, Nigeria, Randomised-controlled trial, Spinal anaesthesia, Supine positioning.

Introduction

Spinal anaesthesia (SA) is the preferred technique for infra-umbilical procedures, due to safety, rapid onset, efficiency, and favourable outcome. Other advantages are airway-sparing, and reduced need for systemic drugs, blood loss and thromboembolism. [1]

Effective SA requires adequate sensory and motor blockade in order to facilitate surgical anaesthesia. [2,3] However, it is critical to balance adequate anaesthesia with preventing high spinal i.e., excessive cephalad local anaesthetic (LA) spread, involving cardio-accelerators i.e., T1–T4 blockade, leading to reduced venous return (VR), cardiac output (CO), systemic vascular resistance (SVR), and resulting in myocardial depression, severe hypotension, cardiac arrest and death. [2]

Various strategies have been used to mitigate these complications. These include pre-loading or co-loading, use of vasopressor e.g., ephedrine, phenylephrine, uterine displacement in gravid patients, adjusting LA volume, baricity, and injection speed, use of lower spinal needle calibers and patient positioning. [4,5]

Specifically, variation in sitting delay before supine positioning is a simple, user-dependent, and controllable modality that can influence SA efficacy and post-spinal haemodynamic. This interval influence cephalad LA spread in the cerebrospinal fluid (CSF), determine anaesthesia quality, reduce postoperative nausea and vomiting (PONV), blood loss, and enhance recovery.[2,3] The reduced complications are particularly a useful outcome in low-resource settings (LRS).

In spite its significance, the optimal time to transition patient to supine position after spinal anesthesia is uncertain. Different intervals have been explored with varying results, i.e., immediate supine positioning (ISP) versus 5-mins sitting in ano-fistula surgeries, [6] 1-, 3-, and 5-mins sitting in elderly patients undergoing varying surgeries, [7] 0-, 30- and, 60-secs sitting interval in patients who had Caesarean section (CS), [8] and 0- and 2-mins sitting in patients undergoing lower limb procedures. [9] These studies were not done in our environment, i.e., a low-resource setting, with its own peculiarities. Furthermore, variations in genetics, physiology, and surgical practices can influence surgical outcome.

The objective of the study is to compare the effects of ISP (0-sec), versus 60-, and 90-seconds sitting on haemodynamic, amount of rescue ephedrine and intravenous fluid consumed, in patients who had SA for lower abdominal surgeries (LAS). We aim to identify the best practices that improve safety, lower complications and optimise outcomes in low-resource settings.

Methods

Study design: This was a clinical, prospective, randomised, and double-blinded study. Approval was obtained from the Ethics and Research Committee of the

Obafemi Awolowo University Teaching Hospitals Complex, (OAUTHC), Ile-Ife, Nigeria, with Protocol No: ERC/2024/04/04. Study period: The study was conducted between April and September 2024.

Inclusion/exclusion criteria: Women, aged 18 – 65 years, with American Society of Anesthesiologists (ASA) physical status I, II, and III, undergoing lower abdominal and pelvic surgeries under spinal anaesthesia were included. Exclusion criteria were emergency procedures, large fluid shift, gravidity, Caesarean section (CS), severe cardiac, respiratory, liver and renal diseases, diabetic mellitus, sepsis, allergy or conversion to general anaesthesia (GA).

Randomisation/Blinding: Patients were randomised into three groups by a statistician, using a computer-generated table of random numbers. Codes were written on leveled card, and placed in opaque envelopes. For each participant, the next envelope was opened, code noted, and the anaesthetist informed, who gave SA using the appropriate sitting interval, and exited the theatre, thereafter. Another anaesthetist provided monitoring and recorded data, thus, providing blinding and removing bias.

Sample size determination: Sample size determination: Cochran's formula [10], was used to compare the mean of two non-dependent variables. The primary objective is the amount of rescue ephedrine used to stabilise haemodynamics. Since there were no previous studies in our institution, we assumed a 50% effect, and using 95% confidence at 1.96 and 5% error margin, thus;

$$n = \frac{Z^2 (p) (1-p)}{e^2}$$

where, n = lowest sample size per group; p = 50%; Z = 1.96 at 95% CI, and e = 5% error margin

$$n = \frac{(1.96)^2\ 0.5\ (1-0.5)}{(0.05)^2}$$

The estimated sample size was 384.

Considering average monthly procedures of 30 – 40, thus;

$$N = n/(1+n/N)$$

$$384/\ (1+384/30) = 384/\ (1+12.8) = 28 \text{ per group}$$

Addition of 10% attrition

$$N = n / (1 – 0.1) = 28/0.9 \approx 31.11 = 31 \text{ per group.}$$

Thus, a total of 93 patients were recruited.

Patient undergoing elective procedures were recruited during the pre-anaesthesia visit. Adequate history, and examination were conducted. Full blood count, electrolytes, chest imaging, and 12-lead electrocardiograph (ECG) results were evaluated. Patients were fasted, and had consent obtained from them.

On the morning of surgery, the anaesthesia machine was checked. Drugs were drawn and labelled. Patient was taken to the theatre. DASH-5000 was used to record baseline pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), 5-lead ECG and oxygen saturation (SpO2). Intravenous (IV) access was obtained and 500 ml 0.9% saline was commenced.

Spinal anaesthesia was administered under sterile condition. In sitting position, the L3/L4 interspace was identified using the Tuffier’s line. The scrubbed Anaesthetist established a sterile field at the back using povidone iodine and methylated spirit. A 23, 24, or 25G Quincke spinal needle was used

to access the sub-arachnoid space, confirmed with free-flowing CSF, and 3.5 ml (17.5 mg) 0.5% hyperbaric Bupivacaine were injected slowly (over 10 secs). Thereafter, patients were placed supine at 0-, 60-, or 90-seconds intervals.

The rising level of sensory blockade was assessed with pin-prick test until deemed fixed, and the time to maximum block was recorded. Bromage score was used to assess motor blockade until grade 3. Intraoperative PR, SBP, DBP, MAP, and SpO2 were recorded every minute for the first 15 mins, and every 10 mins till the end of surgery. Euvolemia, normo-oxygenation, and normothermia were maintained. Ephedrine 5 mg and IV fluids were used to correct hypotension i.e., SBP < 90 mmHg while atropine 0.6 mg was used to correct bradycardia i.e., PR < 60 bpm, at any point, irrespectively of the baseline, and all values were recorded.

After the surgery, patients were transferred to the recovery room and monitored. Modified Aldrete's score ≥ 9 was used to determine discharge fitness to the ward.

The primary outcome was the amount of rescue ephedrine needed to stabilise the haemodynamics. The secondary outcomes were PR, SBP, DBP, and MAP variables every 10 mins till the end of surgery, as well as the atropine, and intravenous fluids consumed.

Data Analysis: Data were cleaned and analysed using the Statistical Package for Scientific Solutions (IBM) 24.0. Categorical variables e.g., ASA status were summarised with frequencies and percentages, and compared using Chi-square test. Continuous variables e.g., age, and weight, and MAP were summarised as mean and standard deviation and compared with student t-test. Group pairing was summarised as A–B, B–C, and A–C. One-way ANOVA was used to analyse data. P-value < 0.05 was considered statistically significant.

Results

Out of 93 recruited participants, 13 had conversion to GA, thus, 80 (86.02%), were randomised into groups A (n-26), B (n-27) and C (n-27) (Figure 1).

The mean age, sex, ASA physical status, height, weight, duration and type of surgery were comparable, p-values 0.162, 0.923, 0.217, 0.144, 0.387, 0.143, and 0.163, respectively. The mean time to achieve maximum sensory block was statistically lower in group A 2.15 ± 1.2 mins, versus 4.05 ± 0.2 mins in B and 4.00 ± 0.2 mins in C, p= 0.041 (Table I).

The mean amount of rescue ephedrine used was 10.22 ± 2.75 mg in group A, which was statistically higher than 4.12 ± 1.12 mg in B and, 3.46 ± 1.24mg in C, p= 0.001. The mean amount of atropine required were comparable in the three groups, p= 0.702. IV fluid consumption was 2.1 ± 0.2 litres in group A, which is statistically more than 1.5 ± 0.2 litres in B and 1.4 ± 0.2 litres in C, p= 0.021 (Table II).

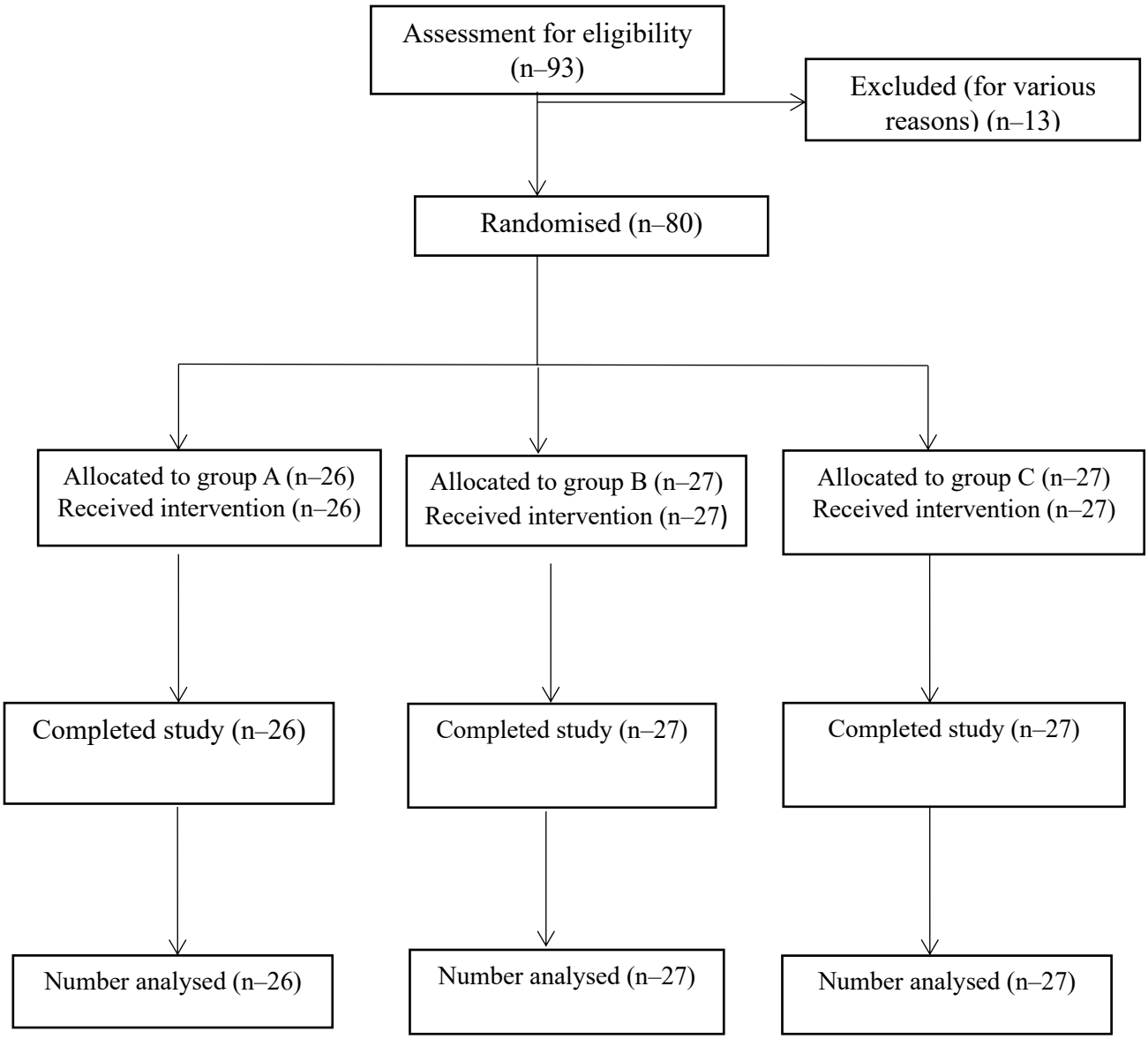


Figure 1. Flowchart showing participant assessment for eligibility, exclusions, randomisation, allocation, intervention, and analysis.

The mean intraoperative PR were similar in the three groups at all time-intervals, p-value > 0.05. (Table III). The mean intraoperative SBP was statistically lower at 0-, 5-, 10-, and 15 mins in group A, compared to B and C, p= 0.041, 0.015, 0.032, and 0.047 respectively (Table IV).

The mean intraoperative DBP was lower at 0-, and 5 mins in group A, versus B and C, p- 0.038, and 0.022 respectively (Table V). The mean intraoperative MAP was lower at 0-, 5-, 10-, and 15 mins in group A, versus B and C, p = -0.013, 0.042, 0.021, and 0.016 respectively (Table VI).

Table I: Demographics and other clinical profile of the participants

	A N–26	**B** N–27	**C** N–27	**p-value**
Mean age (years)	41.22 ± 20.34	38.44 ± 18.68	44.12 ±15.86	0.162
Sex				
Female	26 (100)	27 (100)	27 (100)	0.923
ASA status				
1	21 (80.8)	21 (77.8)	19 (70.4)	
2	3 (11.5)	5 (18.5)	8 (29.6)	0.217
3	2 (7.7)	1 (3.7)	0 (0)	
Height (cm)	1.61 ± 0.2	1.66 ± 0.1	1.66 ± 0.2	0.144
Weight (kg)	68.2 ± 2.2	70.2 ± 2.1	70.2 ± 2.2	0.387
Maximum sensory block				
T4	0 (0.0)	1 (3.7)	0 (0.0)	
T6	18 (69.2)	25 (92.6)	26 (96.3)	0.331
T8	7 (26.9)	1 (3.7)	0 (0.0)	
T10	1 (3.8)	0 (0.0)	1 (3.7)	
Mean surgery duration (min)	95.50 ± 10.50	90.55 ± 7.25	90.75 ± 8.75	0.143
Mean time to maximum sensory blockade (min)	2.15 ± 1.2	4.05 ± 0.2	4.00 ± 0.2	0.041
Procedures				
Uro-fistula	19 (73.1)	24 (88.9)	18 (66.7)	
Gynaecological	6 (23.1)	2 (7.4)	9 (33.3)	0.163
Ano-rectal	1 (3.8)	0 (0.0)	0 (0.0)	

Table II: Mean intraoperative rescue ephedrine, atropine and IV fluid used in the three groups

	A N–26	**B** N–27	**C** N–27	**p-value**
Mean rescue ephedrine consumed (mg)	10.22 ± 2.75	4.12 ± 1.12	3.46 ± 1.24	0.001
Mean rescue atropine consumed (mg)	0.6 ± 0.0	0.6 ± 0.0	0.6 ± 0.0	0.702
IV fluids (litres)	2.1 ± 0.2	1.5 ± 0.2	1.4 ±0.2	0.021

Table III: Mean intraoperative pulse rate (PR) in the three groups

	A	**B**	**C**	**p-value**
Pre-induction	78.02 ± 10.04	76.54 ± 13.74	78.44 ± 14.19	0.421
After-induction	70.54 ± 8.52	68.68 ± 25.87	74.42 ± 14.94	0.064
5 mins	72.82 ± 10.44	74.62 ± 12.99	70.54 ± 14.70	0.101
10 mins	70.50 ± 10.32	72.61 ± 12.25	70.32 ± 12.97	0.162
15 mins	70.18 ± 10.06	71.08 ± 10.66	72.36 ± 17.86	0.087
30 mins	70.24 ± 12.78	70.94 ± 10.44	74.23 ± 13.10	0.201
60 mins	70.00 ± 12.14	72.88 ± 12.09	76.22 ± 13.65	0.206
90 mins	76.62 ± 10.04	78.90 ± 15.02	72.82 ± 11.67	0.447
120 mins	86.34 ± 8.58	80.82 ± 12.98	86.00 ± 11.86	0.129

Table IV: Mean intraoperative systolic blood pressure (SBP) in the three groups

	A	B	C	p-value
Pre-induction	118.94 ± 14.19	122.00 ± 14.30	116.38 ± 10.64	0.085
After-induction	84.64 ± 20.08	120.22 ± 18.08	122.66 ± 12.68	0.041
5 mins	90.44 ± 16.60	120.22 ± 15.48	120.64 ± 18.28	0.015
10 mins	92.92 ± 14.04	118.64 ± 18.96	124.68 ± 12.64	0.032
15 mins	90.54 ± 15.26	120.30 ± 15.44	120.30 ± 10.52	0.047
30 mins	90.68 ± 14.41	119.78 ± 14.16	122.56 ± 18.78	0.133
60 mins	116.92 ± 14.42	116.04 ± 13.34	124.54 ± 16.92	0.207
90 mins	110.91 ± 16.77	114.90 ± 14.52	122.86 ± 12.90	0.264
120 mins	112.00 ± 16.14	116.68 ± 16.34	118.40 ± 18.44	0.464

Table V: Mean intraoperative diastolic blood pressure (DBP) in the three groups

	A	B	C	p-value
Pre-induction	80.45 ± 12.46	78.80 ± 10.76	78.24 ± 9.28	0.331
After induction	70.23 ± 10.36	78.15 ± 12.83	78.42 ± 15.58	0.038
5 mins	64.53 ± 8.50	72.58 ± 11.02	72.16 ± 12.42	0.022
10 mins	70.05 ± 10.71	69.83 ± 10.55	74.74 ± 11.39	0.342
15 mins	72.41 ± 10.21	70.38 ± 11.89	72.45 ± 13.07	0.622
30 mins	68.39 ± 8.24	66.41 ± 6.42	74.78 ± 12.	0.263
60 mins	68.91 ± 10.07	66.04 ± 9.79	70.89 ± 12.98	0.347
90 mins	70.45 ± 8.09	70.32 ± 11.95	74.38 ± 13.56	0.361
120 mins	74.18 ± 8.18	76.16 ± 151.2	76.38 ± 14.92	0.150

Table VI: Mean intraoperative mean arterial pressure (MAP) in the three groups

	A	B	C	p-value
Pre-induction	71.93 ± 10.57	74.83 ± 10.38	72.52 ± 10.23	0.124
After induction	62.24 ± 8.07	76.55 ± 10.19	78.36 ± 10.48	0.013
5 mins	60.88 ± 10.89	74.28 ± 10.56	80.25 ± 10.69	0.042
10 mins	60.43 ± 12.38	72.10 ± 10.24	76.56 ± 10.61	0.021
15 mins	58.50 ± 12.73	70.89 ± 10.67	79.76 ± 12.54	0.016
30 mins	74.19 ± 8.81	70.96 ± 11.54	78.52 ± 14.03	0.177
60 mins	64.80 ± 10.06	74.19 ± 12.17	72.61 ± 8.59	0.188
90 mins	70.86 ± 8.68	68.56 ± 10.48	70.39 ± 8.77	0.135
120 mins	68.86 ± 6.52	68.22 ± 8.64	68.46 ± 8.66	0.225

Discussion

Safety, efficacy, and rapid recovery are the goals of modern anaesthesia. This study demonstrated a reduced SBP, DBP, and MAP values, and increased rescue ephedrine and fluids consumption in patients who had immediate supine positioning compared to 60- and 90-secs sitting, following spinal anaesthesia for LAS. Notably, 90-secs sitting produced the least changes in haemodynamic and may be the optimal interval.

This is not surprising. The outcome corroborates the increasing evidence that even a short sitting interval could be an efficient post-spinal haemodynamic

stabilising modality, while producing adequate surgical anaesthesia.[2] Haemodynamic stability lowers surgical complications, which is cost-effective and beneficial in low-resource settings. [2,3]

Similarly, Zabetian et al [6] found that in patients who had haemorrhoidectomies and ano-fistula surgeries, 3- and 5-min sitting decreased rescue ephedrine consumption without altering PR, SBP, or DBP values, while producing similar anaesthetic efficacy in all groups. Abdullah et al.,[7] reported that in elderly patients undergoing LAS under SA, 5-mins sitting decreased rescue ephedrine use, and produced an unchanging MAP and adequate surgical anaesthesia, versus 3- and 1-mins sitting. Hasnain et al [8] observed a stable HR, SBP, and MAP values as well as effective sensory and motor blockade with 30- and 60-secs sitting, in 120 parturients who had caesarean section (CS). Khan et al [9] showed that a 90-secs sitting reduced IV fluid consumption and produced stable MAP, SBP, and DBP values in patients who had lower-limb surgeries. Amer et al [11] noted proportional reductions in ephedrine and fluid use with 90-secs, 4-mins, and 6-mins sitting in women who had CS under spinal anaesthesia. Hasnain et al, [12] reported that 30- and 60-secs sitting lower hypotension incidence and stabilise haemodynamic in CS patients. In these studies, while, the transitioning time to supine positioning varies, however the outcome is similar. This probably reflect that even with different sample size, varying patient's physiology and demographics, LA type, volume and concentration, as well as surgery type, sitting delay can optimise post-spinal heamodynamic while ensuring adequate anaesthesia.

Spinal anaesthesia is produced when LA is injected into the intrathecal space to block nerve supply to lower abdomen, pelvis, perineum and lower limbs. LA reversibly inhibit neural depolarisation through the blockade of voltage-gated sodium channels (VGNC). However, high cephalad LA spread in the CSF blocks the cardio-accelerator fibers (T1–T4), and result in decreased SVR, which in turn reduce venous return (VR), preload, stroke volume (SV), cardiac output (CO) and MAP. Phrenic nerves (C3 – C5) blockade (if involved), decrease functional residual capacity (FRC) and lung compliance, resulting in hypoventilation, V/Q mismatch, shunting and hypoxia. [2,4,5] Physiologically, sitting after SA induction may alter the baricity-gravity-CSF dynamic, enabling a smooth LA distribution and controlled sympathectomy. Thus, preload, VR, SV, CO, and MAP variables are stabilized. [2,3,5]

The unchanging perioperative haemodynamic is beneficial in settings with limited resources used to manage complications such as monitoring devices, airway support and intensive care, as well as few anaesthesia providers, high-patient turnover, and low workflow efficiency. However, this modality must be individualised, patient-directed, and balanced against surgical urgency, safety and comfort. [13] Also, the stable haemodynamic is useful in patients with limited cardiac reserve. Cephalad LA spread even with minimal cardiovascular depression may results in pulmonary edema, angina and, cardiac ischemia from

exaggerated reduction in preload, VR and CO in patients with long-term hypertension, fixed CO, non-compliant flow dynamics, elderly, and autonomic dysfunction e.g., diabetes mellitus. [2,14,15]

Furthermore, sitting produces a stable SVR, which decreases venous pooling. This alongside an unchanging CO, SV, and MAP decreases blood loss and transfusion requirement creating a clear surgical field, improved visualisation, operative conditions, and safety. [2,3,5]

This study reports a decreased rescue vasopressor and IV fluid required to correct hypotension, which minimises the incidence of fluid overload, cerebral and pulmonary edema, impaired gas exchange, hypoxia, haemodilution, coagulopathy, platelet dilution, electrolyte and acid–base perturbation, e.g., hyponatremia, and hyperchloremic metabolic acidosis. [2,3,5]

Stable haemodynamics and reduced catecholamine fluctuations lowers chemo-receptor trigger zone (CRTZ) activation, gut hypoperfusion, stasis, and vagal stimulation, which are PONV triggers. The decreased need for intensive monitoring and care, as well as faster recovery and shorter hospital stays, are other useful outcomes in low-resource settings. [5,15]

However, there are limitations to this study. The study population is exclusive to lower abdominal, pelvic and gynaecological procedures. This, alongside a single-centre design, limits the ability to generalise the results to a more diverse and higher-risk populations, surgical settings and procedures. Also, postoperative haemodynamic and other recovery profile such as desaturation, ventilatory failure, pain, shivering, and headache were not assessed. There is a need for a more broad-based study on diverse population, extreme of age, and co-morbidities, to provide a more inclusive finding.

Conclusion

This study showed a decreased SBP, DBP and MAP and increased rescue ephedrine and fluid consumption in patients who had immediate supine positioning compared to 60- and 90-secs sitting in SA for lower abdominal surgeries, while 90-secs sitting produced the least changes. Thus, this simple, and controllable modality enhances SA safety and efficiency.

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Authors' Contributions: AKO – conception and design of research. AKO, SAR, OAO, AOO, and AKA – data analysis and interpretation

AKO, SAR, OAO, AOO, and AKA – drafting of manuscript. AKO, SAR, OAO, AOO, and AKA – revision of drafts. AKO, SAR, OAO, AOO, and AKA – approval of the final version.

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Conflicts of Interest: Nil

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