Original Article

Preoperative Subclavian/Infraclavicular Axillary Vein Collapsibility Index for Predicting Hypotension After Spinal Anaesthesia in Geriatric Patients Undergoing Lower-Limb Surgery: A Prospective Observational Study

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Abstract

Background: Hypotension after spinal anaesthesia is common in older adults and may compromise organ perfusion. This study evaluated whether preoperative subclavian/infraclavicular axillary vein collapsibility index (SCV/AV-CI) predicts post-spinal hypotension in geriatric patients undergoing lower-limb surgery. **Material and Methods:** In this prospective observational study, 100 patients aged >60 years with American Society of Anesthesiologists physical status I-III were evaluated. Right SCV/AV maximum and minimum diameters were measured during normal and deep breathing, and collapsibility indices were calculated. Hypotension was defined as a >20% reduction in mean arterial pressure from baseline. Diagnostic performance was assessed using receiver-operating characteristic analysis. Multivariable logistic models adjusted for age, ASA III status, baseline mean arterial pressure, and fasting duration. **Results:** Hypotension occurred in 69 patients (69%). Normal-breathing CI was higher in patients with hypotension than in those without hypotension (32.63 ± 7.59% vs 17.42 ± 7.97%; P<0.001), as was deep-breathing CI (39.07 ± 7.76% vs 23.43 ± 8.43%; P<0.001). Normal-breathing CI yielded an area under the curve of 0.910 (95% confidence interval [CI], 0.839-0.964); a cutoff of ≥21.3% provided 92.8% sensitivity and 74.2% specificity. Deep-breathing CI yielded an area under the curve of 0.911 (95% CI, 0.839-0.966); a cutoff of ≥26.3% provided 97.1% sensitivity and 74.2% specificity. Each 5% increase independently increased the odds of hypotension (adjusted odds ratio, 3.60 and 3.48, respectively; both P<0.001). **Conclusion:** Preoperative SCV/AV-CI showed strong discrimination for post-spinal hypotension. Deep-breathing CI had high sensitivity and negative predictive value, but external validation is required before routine clinical use.

Keywords: Geriatrics; anaesthesia, spinal; hypotension; subclavian vein; ultrasonography; vascular collapsibility.

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Introduction

Spinal anaesthesia is widely used for lower-limb surgery because it provides reliable neuraxial blockade while avoiding several disadvantages of general anaesthesia. Its most frequent haemodynamic complication is arterial hypotension caused by sympathetic blockade, venous pooling, reduced venous return, and in some patients, a fall in cardiac output.[1] Older adults are particularly susceptible because of age-related autonomic impairment, reduced cardiovascular reserve, and limited ability to augment stroke volume may blunt the compensatory response to neuraxial vasodilatation.[2]

Intraoperative hypotension is clinically important rather than merely a transient numerical change. Both the depth and duration of reduced arterial pressure have been associated with myocardial injury, acute kidney injury, stroke, and mortality after noncardiac surgery.[3] A practical preoperative method that identifies patients likely to develop hypotension could permit closer monitoring, more timely vasopressor preparation, and individualised fluid administration without indiscriminate volume loading.

Point-of-care ultrasonography has therefore been explored as a non-invasive method of estimating intravascular volume and predicting anaesthesia-related hypotension. Inferior vena cava (IVC) diameter and respiratory variation have shown predictive value in selected settings,[4] but IVC imaging may be difficult in patients with obesity, bowel gas, abdominal distension, pain, dressings, or an inaccessible subcostal window. The subclavian vein or its infraclavicular axillary continuation is superficial, readily visualised with a linear transducer, and less affected by intra-abdominal conditions. Pre-anaesthesia SCV/AV measurements have predicted hypotension after induction of general anaesthesia,[5] while respiratory changes in SCV diameter have also correlated with fluid responsiveness and other

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sonographic estimates of volume status. [6,7]

Evidence specific to spinal anaesthesia remains limited and heterogeneous. IVC-guided strategies have reduced or predicted spinal anaesthesia-related hypotension in several studies,[8-10] whereas an obstetric study found that SCV/AV collapsibility did not predict hypotension during caesarean delivery.[11] Pregnancy-related aortocaval compression, different vascular physiology, and varying definitions of hypotension may limit extrapolation of those findings to older surgical patients. We therefore evaluated the diagnostic accuracy of SCV/AV collapsibility during normal and deep breathing for predicting hypotension after spinal anaesthesia in geriatric patients undergoing lower-limb surgery. The primary objective was to determine the discrimination and optimal cutoffs of both indices; secondary objectives were to compare ultrasound measurements between outcome groups and assess their independent associations with hypotension.

Materials and Methods

Study design and setting: This prospective observational diagnostic-accuracy study was conducted in the Department of Anaesthesiology, a tertiary care teaching institute of medical sciences, Dehradun, Uttarakhand, India. Ethical clearance numberThe study period was from 1 September 2025 to 31 March 2026. Written informed consent was obtained from all participants before enrolment. The study was designed and reported with reference to the Standards for Reporting Diagnostic Accuracy Studies (STARD) 2015 recommendations.[12]

Participants: A consecutive sample of 100 completed participants was analysed. Patients were eligible if they were older than 60 years, had American Society of Anesthesiologists (ASA) physical status I, II, or III, and were scheduled for lower-limb surgery under spinal anaesthesia. Exclusion criteria were refusal to participate; baseline mean arterial pressure (MAP) below 70 mmHg; need for vasopressor support to maintain MAP above 65 mmHg; major peripheral vascular disease; severe valvular disease; right-sided heart failure; respiratory distress; hepatic or renal disorder; or an absolute contraindication to spinal anaesthesia.

Preoperative assessment and ultrasonography: A detailed pre-anaesthetic assessment was performed, and age, sex, ASA grade, body mass index, comorbidities, fasting duration, planned surgery, and baseline vital signs were recorded. An 18-gauge intravenous cannula was secured in the nondominant hand. Before fluid administration and spinal anaesthesia, the patient was placed supine and the right SCV or infraclavicular AV was examined using a Sonosite ultrasound system. Preoperative ultrasonography was performed using a GE Versana Active ultrasound system equipped with a 6–12 MHz linear-array transducer. The vein was visualised in the short-axis view by anaesthesiologists involved in this study. Minimum and maximum anteroposterior diameters were measured in M-mode during normal spontaneous breathing and during a standardised deep inspiration. Each collapsibility index (CI) was calculated as: CI (%) = (maximum diameter - minimum diameter) / maximum diameter × 100. When the SCV was not adequately visualised, the infraclavicular AV was measured using the same method.

Spinal anaesthesia and haemodynamic monitoring: After ultrasound measurements, Ringer lactate was started and spinal anaesthesia was administered under aseptic precautions using 0.5% hyperbaric bupivacaine. The observed intrathecal dose ranged from 10 to 13 mg. Heart rate, non-invasive blood pressure, and oxygen saturation were recorded at baseline; every 2 minutes for the first 10 minutes; at 15 minutes; and every 5 minutes thereafter through 35 minutes. Sensory block level and intravenous fluid volumes before and after the block were documented. Hypotension was defined a priori as a reduction in MAP of more than 20% from baseline. Hypotension was treated with intravenous phenylephrine in 50-100 µg aliquots and additional crystalloid according to the study protocol. Bradycardia was treated with intravenous atropine 0.6 mg or glycopyrrolate 0.2 mg.

Outcomes: The primary outcome was the occurrence of post-spinal hypotension. The index tests were the preoperative SCV/AV-CI during normal breathing and during deep breathing. Secondary outcomes included the lowest post-spinal MAP, percentage fall in MAP, time to first hypotensive episode, phenylephrine requirement and dose, additional intravenous fluid, and bradycardia.

Statistical analysis: Continuous variables were presented as mean ± standard deviation or median with interquartile range, as appropriate, while categorical variables were presented as frequencies and percentages. Continuous variables were compared using Welch's independent-samples t-test. Categorical variables were compared using Fisher's exact test for 2 × 2 tables and the Chi-square test for larger tables. Receiver operating characteristic curves were constructed for the collapsibility indices, and the areas under the curve with 95% confidence intervals were calculated using bootstrap resampling. Optimal cut-off values were determined using the maximum Youden index. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated. Separate multivariable binary logistic regression models were used to identify predictors of post-spinal hypotension, and the results were expressed as adjusted odds ratios with 95% confidence intervals. All tests were two-sided, and a p-value of <0.05 was considered statistically significant. Statistical analysis was performed using jamovi version 2.7.37 (The jamovi project, Sydney, Australia).

Results

All 100 participants in the master chart had complete outcome data and were included in the analysis. Their mean age was 74.99 ± 8.40 years; 54 (54%) were men, and 90 (90%) had ASA physical status II or III. Seventy-six participants had at least one recorded comorbidity, including hypertension in 51, diabetes mellitus in 28, and ischaemic heart or other cardiac disease in seven. The SCV was measured in 68 patients and the infraclavicular AV in 32. Baseline demographic, clinical, anaesthetic, and fluid variables were comparable between patients who did and did not develop hypotension [Table 1].

Table 1: Baseline demographic, clinical, and anaesthetic characteristics

Characteristic	Overall (N=100)	Hypotension (n=69)	No hypotension (n=31)	P value
Age (years), mean ± SD	74.99 ± 8.40	74.99 ± 8.37	75.00 ± 8.60	0.994
Male sex, n (%)	54 (54.0)	38 (55.1)	16 (51.6)	0.829
ASA physical status I, n (%)	10 (10.0)	6 (8.7)	4 (12.9)	0.778
ASA physical status II, n (%)	58 (58.0)	40 (58.0)	18 (58.1)	
ASA physical status III, n (%)	32 (32.0)	23 (33.3)	9 (29.0)	
BMI (kg/m²), mean ± SD	25.32 ± 4.69	25.64 ± 4.86	24.60 ± 4.29	0.287
Any comorbidity, n (%)	76 (76.0)	53 (76.8)	23 (74.2)	0.803
Hypertension, n (%)	51 (51.0)	36 (52.2)	15 (48.4)	0.830
Diabetes mellitus, n (%)	28 (28.0)	19 (27.5)	9 (29.0)	1.000
IHD/cardiac disease, n (%)	7 (7.0)	5 (7.2)	2 (6.5)	1.000
Fasting duration (h), mean ± SD	9.37 ± 1.97	9.43 ± 1.94	9.24 ± 2.07	0.664
Baseline HR (bpm), mean ± SD	79.72 ± 10.29	79.81 ± 10.37	79.52 ± 10.27	0.895
Baseline MAP (mmHg), mean ± SD	98.39 ± 7.01	97.91 ± 7.05	99.46 ± 6.89	0.306
SCV visualised, n (%)	68 (68.0)	47 (68.1)	21 (67.7)	1.000
Intrathecal bupivacaine dose (mg), mean ± SD	11.70 ± 1.02	11.67 ± 1.04	11.76 ± 0.99	0.700
IV fluid before SAB (mL), mean ± SD	324.5 ± 55.3	326.8 ± 56.0	319.4 ± 54.3	0.532
Sensory level T8, n (%)	27 (27.0)	20 (29.0)	7 (22.6)	0.601
Sensory level T10, n (%)	35 (35.0)	22 (31.9)	13 (41.9)	
Sensory level T12, n (%)	38 (38.0)	27 (39.1)	11 (35.5)	

Values are mean ± SD or n (%). ASA: American Society of Anesthesiologists; BMI: body mass index; HR: heart rate; IHD: ischaemic heart disease; MAP: mean arterial pressure; SAB: subarachnoid block; SCV: subclavian vein.

Post-spinal hypotension occurred in 69 patients (69%). The first episode occurred at a median of 4 minutes (interquartile range, 4-6 minutes) after the block. All 69 hypotensive patients received phenylephrine; the median total dose was 100 µg (interquartile range, 50-100 µg). Thirteen patients developed bradycardia, including 12 in the hypotension group and one in the non-hypotension group (P=0.059), and all were treated. No other complication was recorded in the master chart.

Maximum venous diameters were similar between outcome groups. In contrast, minimum diameters were smaller and both collapsibility indices were substantially greater in patients who developed hypotension. Normal-breathing CI was 32.63 ± 7.59% in the hypotension group versus 17.42 ± 7.97% in the non-hypotension group (P<0.001). Deep-breathing CI was 39.07 ± 7.76% versus 23.43 ± 8.43%, respectively (P<0.001) (Table 2). Both indices correlated positively with the percentage fall in MAP (Spearman rho=0.549 for normal breathing and 0.567 for deep breathing; both P<0.001).

Table 2: Ultrasound measurements and haemodynamic outcomes

Variable	Overall (N=100)	Hypotension (n=69)	No hypotension (n=31)	P value
Maximum diameter, normal breathing (mm)	10.03 ± 1.51	10.05 ± 1.44	9.98 ± 1.68	0.841
Minimum diameter, normal breathing (mm)	7.25 ± 1.61	6.79 ± 1.32	8.26 ± 1.73	<0.001
CI, normal breathing (%)	27.91 ± 10.43	32.63 ± 7.59	17.42 ± 7.97	<0.001
Maximum diameter, deep breathing (mm)	11.05 ± 1.56	11.08 ± 1.49	11.00 ± 1.73	0.825
Minimum diameter, deep breathing (mm)	7.29 ± 1.67	6.77 ± 1.34	8.45 ± 1.76	<0.001
CI, deep breathing (%)	34.22 ± 10.76	39.07 ± 7.76	23.43 ± 8.43	<0.001
Lowest post-SAB MAP (mmHg)	73.71 ± 10.58	68.20 ± 6.71	85.97 ± 6.51	<0.001
Fall in MAP from baseline (%)	25.14 ± 8.85	30.35 ± 4.55	13.54 ± 3.21	<0.001

Data are mean ± SD. CI: collapsibility index; MAP: mean arterial pressure; SAB: subarachnoid block.

Normal-breathing CI had an AUC of 0.910 (95% confidence interval [CI], 0.839-0.964). A cutoff of ≥21.3% provided 92.8% sensitivity, 74.2% specificity, 88.9% positive predictive value, 82.1% negative predictive value, and 87.0% accuracy. Deep-breathing CI had an AUC of 0.911 (95% CI, 0.839-0.966). A cutoff of ≥26.3% provided 97.1% sensitivity, 74.2% specificity, 89.3% positive predictive value, 92.0% negative predictive value, and 90.0% accuracy (Table 3 and Figure 1). The AUCs did not materially differ (bootstrap difference, 0.001; 95% CI, -0.020 to 0.023).

Table 3: Diagnostic performance of SCV/AV collapsibility indices

Index	AUC (95% CI)	Cutoff	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Normal-breathing CI	0.910 (0.839-0.964)	≥21.3%	92.8	74.2	88.9	82.1	87.0
Deep-breathing CI	0.911 (0.839-0.966)	≥26.3%	97.1	74.2	89.3	92.0	90.0

Cutoffs were selected by the maximum Youden index. AUC: area under the receiver-operating characteristic curve; CI: confidence interval/collapsibility index, as applicable; NPV: negative predictive value; PPV: positive predictive value; SCV/AV: subclavian/infraclavicular axillary vein.

Table 4: Multivariable logistic regression for post-spinal hypotension

Predictor	Normal-breathing CI model aOR (95% CI)	P value	Deep-breathing CI model aOR (95% CI)	P value
Collapsibility index, per 5% increase	3.60 (2.17-5.99)	<0.001	3.48 (2.11-5.75)	<0.001
Age, per 10-year increase	0.95 (0.46-1.97)	0.891	0.97 (0.47-1.99)	0.931
ASA physical status III	1.42 (0.36-5.57)	0.614	1.26 (0.32-4.91)	0.737
Baseline MAP, per 10-mmHg increase	0.60 (0.23-1.57)	0.297	0.59 (0.23-1.54)	0.282
Fasting duration, per hour	1.06 (0.76-1.49)	0.715	1.07 (0.77-1.49)	0.682

Separate models were fitted because normal- and deep-breathing indices were collinear. aOR: adjusted odds ratio; ASA: American Society of Anesthesiologists; CI: confidence interval/collapsibility index, as applicable; MAP: mean arterial pressure.

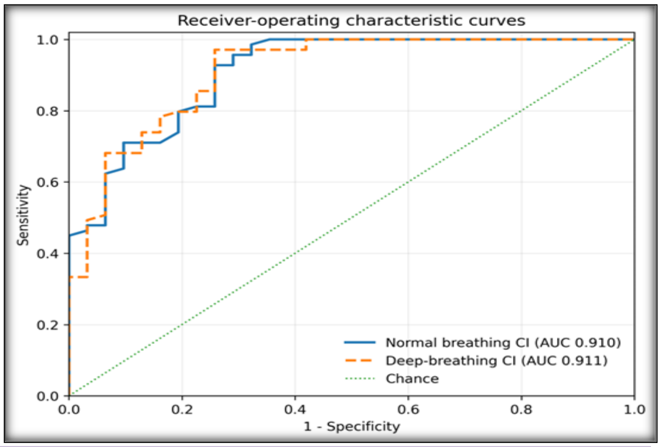

Figure 1: Receiver-operating characteristic curves for normal-breathing and deep-breathing SCV/AV collapsibility indices.

In adjusted analysis, each 5-percentage-point increase in normal-breathing CI was associated with a 3.60-fold increase in the odds of hypotension (aOR, 3.60; 95% CI, 2.17-5.99; P<0.001). The corresponding aOR for deep-breathing CI was 3.48 (95% CI, 2.11-5.75; P<0.001). Age, ASA III status, baseline MAP, and fasting duration were not independently associated with the outcome in either model (Table 4). Mean MAP declined rapidly after spinal anaesthesia in the hypotension group, reached its nadir between 6 and 10 minutes, and subsequently recovered after protocol-directed treatment (Figure 2).

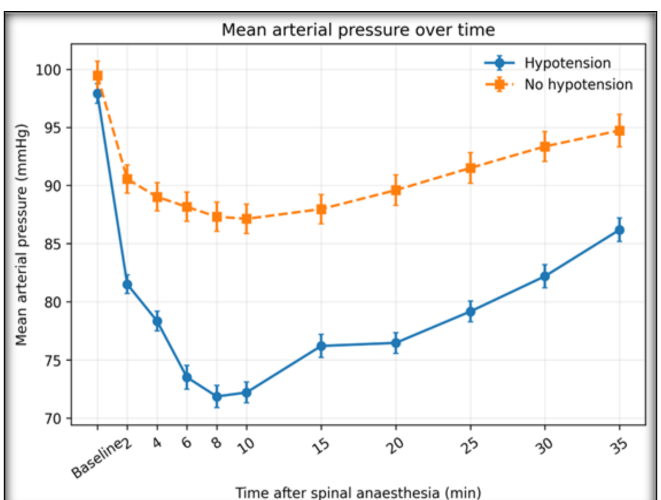

Figure 2: Mean arterial pressure over time after spinal anaesthesia according to hypotension status.

Error bars represent standard error of the mean. Treatment was administered after hypotension according to the study protocol.

Discussion

The principal finding of this prospective observational study was that preoperative subclavian/infraclavicular axillary vein collapsibility index (SCV/AV-CI) strongly discriminated geriatric patients who developed hypotension after spinal anaesthesia from those who remained haemodynamically stable. Both normal-breathing and deep-breathing indices achieved areas under the receiver-operating characteristic curve of approximately 0.91, and both remained independently associated with hypotension after adjustment for age, ASA III status, baseline mean arterial pressure, and fasting duration. The high sensitivity and negative predictive value of deep-breathing CI suggest that this measurement may be particularly useful for identifying patients at comparatively low risk, which is consistent with the predictive value of SCV/AV respiratory variation reported in a pre-anaesthesia study by Choi et al.[5]

The physiological basis of the observed association is plausible in elderly patients. Spinal sympathetic blockade increases venous capacitance, reduces venous return, and may produce an abrupt reduction in cardiac preload. Hofhuizen et al. demonstrated that spinal anaesthesia-induced hypotension in elderly patients was primarily related to a decrease in stroke volume rather than to a major reduction in systemic vascular resistance, indicating that limited preload reserve is an important determinant of haemodynamic instability in this age group.[2] In the present study, patients who developed hypotension had markedly smaller minimum venous diameters but similar maximum diameters, suggesting that dynamic respiratory collapse was more informative than a single static venous measurement.

Rose et al. evaluated 120 adults undergoing general anaesthesia and compared pre-induction ultrasonographic measurements of the subclavian vein and inferior vena cava. They reported that SCV collapsibility measured during spontaneous and deep inspiration could predict post-induction hypotension and that SCV imaging required less acquisition time than IVC imaging.[13] Although their population and anaesthetic technique differed from the present study, their findings support the use of the SCV as an accessible peripheral window for preoperative assessment of effective circulating volume.

Chaudhary et al. prospectively compared SCV-CI with IVC-CI in 132 adults undergoing elective surgery under general anaesthesia. Both indices showed good and comparable diagnostic accuracy for post-induction hypotension, while SCV scanning was completed more rapidly and correlated positively with IVC collapsibility.[14] The strong performance of SCV/AV-CI in our geriatric spinal-anaesthesia cohort extends this concept to neuraxial anaesthesia and indicates that the superficial thoracic venous window may remain useful when abdominal IVC imaging is technically difficult.

Yang et al. studied subclavian vein diameter changes produced by a modified passive leg-raising manoeuvre before general anaesthesia. They found that dynamic SCV diameter responses were associated with subsequent hypotension and provided more haemodynamic information than a single supine diameter measurement.[15] Their results are conceptually similar to our observation that respiratory variation, rather than maximum diameter alone, differentiated patients who developed hypotension after spinal anaesthesia.

Giraud et al. assessed respiratory changes in subclavian vein diameter among spontaneously breathing intensive-care patients and found that SCV respiratory variation predicted fluid responsiveness.[6] This finding supports the physiological interpretation that greater respiratory collapsibility reflects preload dependence. However, fluid responsiveness and spinal anaesthesia-induced hypotension are not identical outcomes; therefore, SCV/AV-CI should be considered a risk marker rather than a direct measure of absolute intravascular volume.

Kent et al. compared subclavian vein and IVC collapsibility in surgical intensive-care patients and demonstrated that subclavian venous ultrasonography could provide a practical alternative assessment of intravascular volume status.[7] This practical advantage is relevant in elderly surgical patients because obesity, bowel gas, abdominal distension, tenderness, dressings, or an inaccessible subcostal window may limit IVC examination, whereas the SCV/AV can generally be assessed using a high-frequency linear transducer without abdominal exposure.

Ceruti et al. used pre-spinal IVC ultrasonography to guide fluid management and reported a reduction in arterial hypotension after spinal anaesthesia.[8] Their interventional findings indicate that dynamic venous ultrasound may have value beyond prediction when incorporated into a structured haemodynamic strategy. Nevertheless, the current study was observational and cannot establish that management based on SCV/AV-CI improves outcomes or reduces vasopressor exposure.

Ni et al. reported that an IVC collapsibility index greater than 42% predicted hypotension after spinal anaesthesia and that IVCCI-guided fluid administration reduced its incidence.[9] The lower optimal thresholds observed for SCV/AV-CI in our study should not be regarded as contradictory because vessel geometry, surrounding tissue pressure, respiratory transmission, measurement site, and the selected breathing manoeuvre differ substantially between the subclavian/axillary vein and the IVC.

Lal et al. found that both IVC collapsibility index and the caval-aorta index predicted spinal anaesthesia-induced hypotension in adults, with preoperative ultrasonography providing a convenient and reproducible risk-assessment method.[10] Our results similarly support the usefulness of dynamic venous measurements; however, direct comparison between SCV/AV-CI, IVC-CI, and the caval-aorta index was not performed and should be included in future comparative diagnostic studies.

Saranteas et al. evaluated echocardiographic predictors of spinal-induced hypotension in elderly patients and found that the ratio of maximum IVC diameter to IVC collapsibility index had greater diagnostic performance than IVCCI alone and several other echocardiographic variables.[16] This observation suggests that combining static venous size with dynamic respiratory variation may improve prediction. Future SCV/AV studies should therefore examine composite measures that integrate maximum diameter, minimum diameter, collapsibility, and patient-level cardiovascular characteristics.

Aslan et al. specifically studied geriatric patients undergoing spinal anaesthesia and reported that preoperative expiratory IVC diameter was useful for predicting post-spinal hypotension, whereas individual ultrasound variables showed differing predictive strengths.[17] Their work reinforces the importance of evaluating elderly patients separately because reduced cardiovascular reserve and altered venous compliance may produce relationships that are not apparent in younger or obstetric populations.

Moschovaki et al. investigated elderly orthopaedic-trauma patients with cardiac disease and left ventricular dysfunction. A preoperative ratio combining maximum IVC diameter and IVCCI showed the best performance among multiple echocardiographic indices for predicting post-spinal hypotension.[18] The high incidence of hypotension in our cohort and the independent association of SCV/AV-CI after adjustment for ASA status and baseline MAP similarly indicate that venous ultrasound may add clinically relevant information to routine pre-anaesthetic risk assessment in older adults.

Our findings differ from those of Aslanlar et al., who reported that SCV/AV collapsibility did not reliably predict spinal anaesthesia-induced hypotension during elective caesarean delivery.[11] Pregnancy is associated with increased circulating volume, altered venous compliance, aortocaval compression, and distinctive vasopressor and fluid co-loading practices. These physiological and procedural differences, together with variation in block height and definitions of hypotension, may explain why results from obstetric cohorts cannot be directly extrapolated to geriatric lower-limb surgery.

The present results have potential clinical relevance because a high SCV/AV-CI could alert the anaesthesiologist to intensify blood-pressure surveillance, prepare vasopressor boluses, avoid delays in treating hypotension, and individualise rather than routinely maximise crystalloid administration. The clinical importance of preventing sustained or profound hypotension is supported by evidence linking the depth and duration of intraoperative hypotension with myocardial injury, acute kidney injury, stroke, and mortality after noncardiac surgery.[3] The derived thresholds should nevertheless be used as risk-stratification values and not as isolated mandates for prophylactic fluid loading in elderly patients with cardiac or renal comorbidity.

This study has several limitations. It was conducted at a single centre with a modest consecutive sample, and the cutoffs were derived and evaluated in the same cohort, which may overestimate diagnostic performance. Measurements were confined to the right SCV/AV, while interobserver and intraobserver reliability, ultrasound operator blinding, and repeated-measure reproducibility were not recorded. The study did not directly compare SCV/AV-CI with IVC indices, echocardiography, or a reference standard of fluid responsiveness, and treatment after hypotension influenced subsequent MAP trajectories. Future multicentre studies should prospectively validate the thresholds, standardise the deep-breathing manoeuvre, report indeterminate examinations, and follow diagnostic-accuracy reporting recommendations.[12]

Conclusion

Preoperative SCV/AV collapsibility during both normal and deep breathing showed strong diagnostic performance for hypotension after spinal anaesthesia in geriatric patients undergoing lower-limb surgery. Deep-breathing CI ≥26.3% was highly sensitive and had a high negative predictive value in this cohort. SCV/AV ultrasonography appears to be a feasible preoperative risk-stratification tool, but externally validated thresholds and interventional evidence are needed before routine management decisions are based on the index.

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Conflicts of interest

There are no conflicts of interest.

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