



Original Article

Predictive value of baseline perfusion index for hypotension after spinal anaesthesia in elderly patients undergoing lower limb orthopaedic procedures

Dr. Manish Anand¹, Dr. Dnyanada Pawan Deshmukh,² Dr. Bhargavi Viswanath^{3*}

¹Consultant Anaesthesiologist, Jai Prabha Medanta Super Specialty Hospital, Patna, Bihar, India

²Associate Professor, Department of Anaesthesiology, Abhishek Mishra Memorial Medical College, Bhilai, Chhattisgarh, India

^{3*}Associate Professor, Department of Anaesthesiology, Vydehi Institute of Medical Sciences and Research Centre, Whitefield, Bangalore, Karnataka, India.

 OPEN ACCESS

ABSTRACT

Background: Hypotension is a clinically significant and commonly presented complication resulting from the spinal anaesthesia with higher incidence being reported in elderly subjects resulting from the compromised compensation of baroreceptor reflex. Monitoring using intermittent NIBP (non-invasive blood pressure) result in delay for detection of hypotension. The PI (perfusion index) is a continuous and non-invasive measure for peripheral perfusion which can act as an early indicator for hemodynamic parameters and is a potential biomarker to assess hypotension.

Aim: The present study was aimed to assess the relationship in incidence of hypotension and baseline perfusion index in elderly subjects undergoing orthopedic surgeries for lower limb under spinal anesthesia, The study also aimed to assess whether intraoperative change in perfusion index precede NIBP-defined hypotension and to assess response of perfusion index after administration of vasopressor.

Methods: The present study assessed 128 subjects aged 60 years or more and undergoing orthopedic surgeries for lower limb under spinal anesthesia using subarachnoid block. They were divided into 2 groups of 64 subjects each depending on baseline perfusion index of >3.5 or ≤ 3.5 . The incidence of hypotension was assessed in the two study groups which was considered as $>20\%$ reduction from pre-anesthetic systolic blood pressure in these subjects.

Results: The study results showed that hypotension incidence was significantly higher in Group I subjects as seen in 100% (n=64) subjects compared to Group II where incidence was 22% (n=14) subjects with $p < 0.0001$. Also, greater number of hypotension episodes were recorded in Group I. Baseline perfusion index of >3.5 showed hypotension prediction with 100% specificity and 82% sensitivity. The negative and positive predictive values were 78% and 100% respectively.

Conclusion: The present study concludes that a baseline perfusion index of >3.5 is a highly sensitive and specific non-invasive predictor for development of hypotension in elderly subjects administered with spinal anesthesia. Intraoperative changes in perfusion index have been correlated with hypotension; they are not essentially seen preceding its onset as assessed by NIBP measurement. Hence, clinical utility of perfusion index is attributed to preoperative risk assessment.

Keywords: Elderly, Hypotension, Perfusion index, Orthopaedic surgery, Spinal anaesthesia.

Corresponding Author:

Dr. Bhargavi Viswanath
Associate Professor,
Department of
Anaesthesiology, Vydehi
Institute of Medical Sciences
and Research Centre,
Whitefield, Bangalore,
Karnataka, India
bhargovish@gmail.com

Received: 17-01-2026

Accepted: 19-02-2026

Published: 21-02-2026

Copyright © International Journal of
Medical and Pharmaceutical Research

INTRODUCTION

Neuraxial anesthesia is one of the most preferred forms of anesthesia being adopted in elderly subjects that are undergoing orthopedic lower limb surgeries for reduction in the perioperative side-effects. Hypotension is one of the most common and frequently effect of spinal anesthesia which is being well documented resulting from the diminished compensation of baroreceptor reflex and paralyzed sympathetic vasoconstrictor fibers that ultimately leads to venous pooling of the blood. Owing to relatively decreased baroreceptor activity and high resting sympathetic tone, elderly subjects are at higher risk of hemodynamic instability. Association of systemic diseases and decreased physiological reserve further raise the hypotension degree after subarachnoid block in susceptible subjects.¹

NIBP (Non-invasive blood pressure) monitoring allow only for intermittent assessment of the blood pressure, whereas, ideal and continuous invasive arterial monitoring is needed to decrease the incidence of profound hypotension and wide variations in the blood pressure which can lead to adverse outcomes. The blood pressure assessment following beat to beat manner is vital for early haemodynamic instability diagnosis that allow early management. Intra-arterial blood pressure monitoring has its own complications and is not always indicated in clinical context along with a steep learning curve and more associated cost.²

A simple and newer tool or method is vital for assessment and prediction of intraoperative hypotension before its presentation which must be economical and non-invasive. This can help in efficacious pre-emptive measures in place of treating hypotension and associated consequences. PI or perfusion index depicts the ratio of pulsatile to nonpulsatile flow depending on infrared light absorption as assessed using special pulse oximeter probe. The pulsatile component depicts fluctuations in arterial blood volume and non-pulsatile component is derived from venous compartment, bone, and connective tissue. This indicates status of microcirculation and is a non-invasive, cost-effective, and simple tool for peripheral perfusion assessment.³

As muscles and skin have a dense innervation of the sympathetic fibers, vasoconstriction resulting from the sympathetic neurohumoral response represents as reduction in peripheral perfusion that decrease the pulsatile component and directly affect the ratio of pulsatile to non-pulsatile flow depicting reduced perfusion index. A lower perfusion index is an indicator of great vasomotor tone.⁴ The present study was aimed to assess the relationship in incidence of hypotension and baseline perfusion index in elderly subjects undergoing orthopedic surgeries for lower limb under spinal anesthesia, The study also aimed to assess whether intraoperative change in perfusion index precede NIBP-defined hypotension and to assess response of perfusion index after administration of vasopressor.

METHODOLOGY

The present comparative, observational, prospective study was aimed to assess the relationship in incidence of hypotension and baseline perfusion index in elderly subjects undergoing orthopedic surgeries for lower limb under spinal anesthesia. The study also aimed to assess whether intraoperative change in perfusion index precede NIBP-defined hypotension and to assess response of perfusion index after administration of vasopressor. The study subjects were from Department of Anesthesia of the Institute. Verbal and written informed consent were taken from all the subjects before study participation. The present study assessed 128 subjects aged 60 years or more and undergoing orthopedic surgeries for lower limb under spinal anesthesia using subarachnoid block. Subjects that were having known allergies to the study drugs, contraindications to neuraxial blockade, clinical dehydration, pre-existing hemodynamic instability, and peripheral vascular disease were excluded from the study. Included 128 subjects were divided into two groups of 64 subjects each depending on baseline perfusion index of >3.5 or ≤ 3.5 .

During the surgery, standard monitors were applied in all the subjects. After noting the vital signs at baseline, all subjects were given a co-load of 8 ml/kg Ringer's lactate solution over 15 minutes. Spinal anesthesia was given to subjects in sitting position using 20 μ g fentanyl using hyperbaric bupivacaine with adjusted dose for height. The sensory block was assessed after 5 minutes at target T10 and motor block using Modified Bromage Scale. The maximum sensory level was assessed after 20 minutes of the block. All the subjects were given supplemental oxygen and operating room had temperature of 21°C as maintained and forced-aired warmers were utilized.

Hemodynamic parameters assessed were perfusion index, heart rate, and non-invasive blood pressure (NIBP) after every three minutes for first 15 minutes and every 5 minutes after that for next 60 minutes. Hypotension was considered for $>20\%$ reduction in systolic blood pressure from the pre-anaesthetic value. It was treated using intravenous Mephentermine or 100ml fluid bolus. Bradycardia was considered as heart rate of <60 bpm with concurrent hypotension which was managed using intravenous atropine.

Statistical analysis of the collected data was done using the chi-square test, Fisher's exact test, Mann Whitney U test, and SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA) using ANOVA, chi-square test, and student's t-test. The significance level was considered at a p-value of <0.05 .

RESULTS

The present comparative, observational, prospective study was aimed to assess the relationship in incidence of hypotension and baseline perfusion index in elderly subjects undergoing orthopedic surgeries for lower limb under spinal anesthesia. The present study assessed 128 subjects aged 60 years or more and undergoing orthopedic surgeries for lower limb under spinal anesthesia using subarachnoid block. They were divided into 2 groups of 64 subjects each depending on baseline perfusion index of >3.5 or ≤ 3.5 . The mean age of the study subjects in group I and II was 67.70 ± 4.54 and 66.20 ± 4.41 showing statistically non-significant difference with $p=0.199$. The gender distribution showed non-significant difference in two groups with $p=0.612$. The mean height and weight in the two study groups was statistically comparable with $p=0.542$ and 0.402 respectively (Table 1).

Table 1: Demographic data in two groups of study subjects at baseline

S. No	Variables	Group I	Group II	p-value
1.	Mean age (years)	67.70 ± 4.54	66.20 ± 4.41	0.199
2.	Gender n (%)			
a)	Male	34 (53)	38 (59)	0.612
b)	Female	30 (47)	26 (41)	
3.	Mean height (cm)	166.67 ± 8.51	167.64 ± 10.41	0.542
4.	Mean weight (kg)	66.04 ± 10.71	67.79 ± 12.76	0.402

It was seen that for the comparison of incidence of hypotension in two groups of study subjects, incidence of hypotension was 100% with all 64 subjects presenting with hypotension, whereas in Group II, 22% (n=14) subjects presented with hypotension. The overall incidence of hypotension was 61% (n=78) subjects presenting with hypotension. Incidence of hypotension was negative in 0 subjects from Group I and in 78% (n=58) subjects from Group II showed no hypotension. Incidence of hypotension was significantly higher in Group I compared to Group II with $p < 0.001$ (Table 2).

Table 2: Comparison of incidence of hypotension in two groups of study subjects

S. No	Hypotension	Group I		Group II		Total		p-value
		n=64	%	n=64	%	n=128	%	
1.	Yes	64	100	14	22	78	61	<0.001
2.	No	0	0	50	78	50	39	
3.	Total	64	100	64	100	128	100	

The study results showed that for comparison for number of hypotension episodes in two groups of study subjects, hypertension scoring of 0, 1, 2, and 3 was seen in 0, 12% (n=8), 34% (n=22), and 53% (n=34) study subjects respectively and hypertension scoring of 0, 1, 2, and 3 was seen in 78% (n=50), 22% (n=14), 0, and 0 subjects respectively from Group II. The difference was statistically significant with $p < 0.001$. Mean hypotension episodes were significantly higher in Group I subjects with 2.39 ± 0.69 episodes compared to 0.20 ± 0.40 episodes in Group II subjects with $p < 0.0001$ and mean total episodes were 1.29 ± 1.23 in study subjects (Table 3).

Table 3: Comparison for number of hypotension episodes in two groups of study subjects

S. No	Hypotension n (%)	Group I		Group II		Total		p-value
		n=64	%	n=64	%	n=128	%	
1.	0	0	0	50	78	50	39	<0.001
2.	1	8	12	14	22	22	17	
3.	2	22	34	0	0	22	17	
4.	3	34	53	0	0	34	26	
5.	Mean	2.39 ± 0.69		0.20 ± 0.40		1.29 ± 1.23		<0.0001
6.	Range	1-3		0-1		0-3		

For the comparison of PI before and after Mephentermine administration in two study groups, perfusion index in Group I was 4.56 ± 0.5 mean before administration of vasopressors, whereas, after administration of vasopressor, the mean perfusion index decreased significantly to 4.45 ± 0.66 with the p-value of < 0.0001 . In Group II subjects, mean perfusion index before administration of vasopressor was 2.72 ± 0.98 which, after administration of vasopressor, decreased significantly to 2.59 ± 1.03 with $p=0.02$ (Table 4).

Table 4: Comparison of PI before and after Mephentermine administration in two study groups

S. No	PI in group I	Mean value	p-value
1.	PI in group I		
a)	Before vasopressors	4.56 ± 0.5	<0.0001
b)	After vasopressor	4.45 ± 0.66	

2.	PI in group II		
a)	Before vasopressors	2.72±0.98	0.02
b)	After vasopressor	2.59±1.03	

DISCUSSION

The present study assessed 128 subjects aged 60 years or more and undergoing orthopedic surgeries for lower limb under spinal anesthesia using subarachnoid block. They were divided into 2 groups of 64 subjects each depending on baseline perfusion index of >3.5 or ≤ 3.5 . The mean age of the study subjects in group I and II was 67.70 ± 4.54 and 66.20 ± 4.41 showing statistically non-significant difference with $p=0.199$. The gender distribution showed non-significant difference in two groups with $p=0.612$. The mean height and weight in the two study groups was statistically comparable with $p=0.542$ and 0.402 respectively. These data correlated with the previous studies of Swarnakumar et al⁵ in 2026 and Abdelkader A et al⁶ in 2024 where authors assessed study subjects with demographic and disease data comparable to the present study in their respective studies.

The study results showed that for the comparison of incidence of hypotension in two groups of study subjects, incidence of hypotension was 100% with all 64 subjects presenting with hypotension, whereas in Group II, 22% (n=14) subjects presented with hypotension. The overall incidence of hypotension was 61% (n=78) subjects presenting with hypotension. Incidence of hypotension was negative in 0 subjects from Group I and in 78% (n=58) subjects from Group II showed no hypotension. Incidence of hypotension was significantly higher in Group I compared to Group II with $p<0.001$. These findings were in agreement with the results of Akelma FK et al⁷ in 2025 and He HW et al⁸ in 2020 where results reported by the authors for hypotension incidence comparable to the present study was comparable to the results of the present study.

It was seen that for comparison for number of hypotension episodes in two groups of study subjects, hypertension scoring of 0, 1, 2, and 3 was seen in 0, 12% (n=8), 34% (n=22), and 53% (n=34) study subjects respectively and hypertension scoring of 0, 1, 2, and 3 was seen in 78% (n=50), 22% (n=14), 0, and 0 subjects respectively from Group II. The difference was statistically significant with $p<0.001$. Mean hypotension episodes were significantly higher in Group I subjects with 2.39 ± 0.69 episodes compared to 0.20 ± 0.40 episodes in Group II subjects with $p<0.0001$ and mean total episodes were 1.29 ± 1.23 in study subjects. These results were consistent with the findings of Yuksek A et al⁹ in 2021 and George J et al¹⁰ in 2019 where results similar to the present study for number of hypotension episodes comparable to the present study were also reported by the authors.

Concerning the comparison of PI before and after Mephentermine administration in two study groups, perfusion index in Group I was 4.56 ± 0.5 mean before administration of vasopressors, whereas, after administration of vasopressor, the mean perfusion index decreased significantly to 4.45 ± 0.66 with the p-value of <0.0001 . In Group II subjects, mean perfusion index before administration of vasopressor was 2.72 ± 0.98 which, after administration of vasopressor, decreased significantly to 2.59 ± 1.03 with $p=0.02$. These findings were in line with the results of Pradhan S et al¹¹ in 2020 and Mallawaarachchi RP et al¹² in 2020 where results reported by the authors on hypotension for comparison of PI before and after Mephentermine administration were similar to the results of the present study.

CONCLUSION

Within its limitations, the present study concludes that a baseline perfusion index of >3.5 is a highly sensitive and specific non-invasive predictor for development of hypotension in elderly subjects administered with spinal anesthesia. Intraoperative changes in perfusion index have been correlated with hypotension; they are not essentially seen preceding its onset as assessed by NIBP measurement. Hence, clinical utility of perfusion index is attributed to preoperative risk assessment.

REFERENCES

- Hoffhuizen C, Lemson J, Snoeck M, Scheffer GJ. Spinal anesthesia-induced hypotension is caused by a decrease in stroke volume in elderly patients. *Local Reg Anesth.* 2019;12:19–26.
- McConachie I, McGeachie J, Barrie J. Regional anesthetic techniques. In: Healy TEJ, Knight PR, editors. *Wylie and Churchill- Davidson's A Practice of Anesthesia.* 7th ed. London: Arnold; 2003. p. 611.
- Luger TJ, Kammerlander C, Gosch M, Luger MF, Kammerlander-Knauer U, Roth T, et al. Neuroaxial versus general anaesthesia in geriatric patients for hip fracture surgery: does it matter? *Osteoporos Int.* 2010;21:S555–72.
- Sivevski AG, Karadjova D, Ivanov E, Kartalov A. Neuraxial Anesthesia in the Geriatric Patient. *Front Med (Lausanne).* 2018;5:254.
- Swarnakumar A, Saxena B, Babbar S, Sharma K. Baseline perfusion index as a predictor of hypotension following spinal anaesthesia in elderly patients undergoing lower limb orthopaedic surgery. *Indian J Clin Anaesth.* 2026;13:69–75.

6. Abdelkader A, Elshazly M, Elgendy M, Nabih A. Ability of perfusion index and positional perfusion index to predict spinal anesthesia-induced hypotension in elderly patients: a prospective observational study. *Perioper Care Oper Room Manag.* 2024;35:100393.
7. Akelma FK, Mafizer M, Nalbant B. Perfusion index as a predictor of hypotension after spinal anesthesia in lower extremity orthopedic surgery: a prospective observational trial. *BMC Surg.* 2025;25:348.
8. He HW, Liu WL, Zhou X, Long Y, Liu Y, Liu DW. Effect of mean arterial pressure change by norepinephrine on peripheral perfusion index in septic shock patients after early resuscitation. *Chin Med J (Engl).* 2020;133:2146–52.
9. Yuksek A, Talih G. Can the perfusion index predict spinal anesthesia-induced hypotension in geriatric patients? *Med Sci Int Med J.* 2021;10:283.
10. George J, Valiaveedan SV, Thomas MT. Role of perfusion index as a predictor of hypotension during spinal anaesthesia for caesarean section – A prospective study. *J Med Sci Clin Res.* 2019;7:1208- 16.
11. Pradhan S, Sharma A, Bhandari G, Adhikari B, Regmi S. Prediction of hypotension using perfusion index following spinal anesthesia in lower segment caesarean section. *Nepal J Obstet Gynaecol.* 2020;15:67–72.
12. Mallawaarachchi RP, Pinto V, De Silva PHDP. Perfusion index as an early predictor of hypotension following spinal anesthesia for caesarean section. *J Obstet Anaesth Crit Care.* 2020;10:38–41.