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Original Article

Anaesthesia Section

# Role of Perfusion Index as an Early Predictor of Successful Ultrasound-guided Supraclavicular Brachial Plexus Block: A Prospective Observational Study

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## ABSTRACT

**Introduction:** Supraclavicular brachial plexus block is commonly used for upper limb surgeries, providing effective anaesthesia and postoperative analgesia. Sensory and motor assessment is subjective and may delay decisions. Perfusion Index (PI) may provide an early objective indicator of sympathetic blockade and block success.

**Aim:** To evaluate pulse oximetry-derived PI as an early objective predictor of successful ultrasound-guided supraclavicular brachial plexus block and to compare it with routine clinical assessment.

**Materials and Methods:** This was a hospital-based prospective observational study conducted in the Department of Anaesthesiology, Krishna Hospital and Medical Research Centre, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India, over 18 months from June 2024 to November 2025. It included 70 adults aged 18-60 years with American Society of Anaesthesiologists (ASA) physical status I or II who underwent upper limb surgery under ultrasound-guided supraclavicular brachial plexus block. PI was measured in the blocked and contralateral limbs at baseline, 10 minutes and 20 minutes after block administration. The PI ratio was calculated by dividing the PI value at 10 minutes after block administration by the baseline PI value. Standard sensory and motor testing was used to assess block success. Independent t-test, Pearson's correlation, and receiver operating characteristic analysis were used.

**Results:** A total of 70 patients were included in the final analysis. The mean age was 45.2±5.4 years, mean weight was 70.0±3.3 kg, mean height was 166.3±3.5 cm, and mean body mass index was 25.3±0.3 kg/m². Successful surgical block was achieved in 54 patients (77.1%), while 16 patients (22.9%) had failed/inadequate block requiring fentanyl supplementation. Among successful blocks, mean sensory onset time was 12.4±0.5 minutes and mean motor onset time was 15.8±0.5 minutes. Baseline PI was comparable between successful and failed/inadequate blocks (1.39±0.07 versus 1.41±0.06; p=0.121). PI at 10 minutes, PI at 20 minutes and the 10-minute PI ratio were significantly higher in successful blocks than in failed/inadequate blocks (p<0.001). The 10-minute PI ratio showed a significant negative correlation with sensory and motor onset times (r=-0.71 and r=-0.70, respectively; p<0.001). ROC analysis demonstrated excellent discriminatory performance within the present dataset. However, the observed estimates should be interpreted cautiously because they were derived from a single-centre observational cohort and require external validation.

**Conclusion:** PI is a simple, non invasive, and reliable adjunct for early prediction of supraclavicular block success. PI demonstrated excellent diagnostic performance and may serve as an objective adjunct to routine sensory and motor assessment.


**Keywords:** Digital blood flow, Peripheral nerve blockade, Plethysmographic waveform, Sympathetic blockade

## INTRODUCTION

Supraclavicular brachial plexus block is a widely used regional anaesthesia technique for surgeries of the upper limb because it provides dense sensory blockade, reliable motor relaxation, good intraoperative anaesthesia, and effective postoperative analgesia [1]. The compact arrangement of the brachial plexus at the supraclavicular level allows a relatively small volume of local anaesthetic to produce anaesthesia for procedures involving the arm, forearm, and hand. With the increasing use of ultrasound guidance, the safety and precision of this block have improved considerably, as the anaesthesiologist can directly visualise the neural structures, surrounding vessels, pleura, needle tip, and spread of local anaesthetic [2-4]. Despite these advantages, incomplete or failed blocks still occur in a small but clinically important proportion of patients, leading to delayed surgery, additional analgesic requirement, patient discomfort, or conversion to general anaesthesia [1,4].

In routine anaesthetic practice, the success of supraclavicular brachial plexus block is commonly assessed by repeated clinical examination of sensory and motor function in the distributions of the median, ulnar, radial, and musculocutaneous nerves [1]. Although this method is simple and widely accepted, it has several practical limitations. Sensory testing depends on patient perception and cooperation, while motor testing may be influenced by anxiety, sedation, pain tolerance, communication difficulty, and inter-observer variation [5].

The PI is a numerical parameter derived from the photoplethysmographic signal of a pulse oximeter [6,7]. It represents the ratio of pulsatile arterial blood flow to the non-pulsatile component of peripheral tissue blood flow. Following a successful brachial plexus block, sympathetic fibres are blocked earlier than complete sensory and motor fibres, resulting in vasodilatation and increased peripheral blood flow in the blocked limb [8,9]. This physiological response produces a measurable rise in PI. Hence, PI may increase before complete clinical evidence of sensory or motor blockade appears, making it a potentially useful early predictor of block success [6-9].

Earlier studies have explored the utility of PI in regional anaesthesia. Galvin EM et al., reported that peripheral flow index could serve

as an early and reliable indicator of regional block success [6]. Ginosar Y et al., demonstrated that pulse oximeter-derived PI could detect sympathectomy after epidural anaesthesia [7]. Kus A et al., further supported the usefulness of PI in detecting the effect of brachial plexus block [8]. In supraclavicular brachial plexus block, Abdelnasser A et al., observed that PI and PI ratio showed good diagnostic accuracy in predicting successful block [10]. Subsequent studies by Raj RLR and Kingslin AS and Hung KC et al., also reported that PI rises significantly after successful upper limb nerve blockade and may help distinguish effective from ineffective blocks [11,12]. More recent reports and meta-analytic evidence have continued to support the role of PI as a bedside marker for identifying failed upper extremity nerve blocks [13,14].

However, important gaps remain in the available literature. First, the proposed cut-off values for PI and PI ratio vary across studies [10], probably due to differences in patient population, local anaesthetic mixture, use of adrenaline, timing of measurement, monitoring devices, and definitions of block success [13,15,16]. Second, several previous studies focused mainly on whether PI increased after block placement [10,11], but fewer studies assessed its relationship with sensory and motor onset times in detail [16,17]. Third, there is limited centre-specific evidence comparing PI with conventional sensory and motor assessment in adults undergoing ultrasound-guided supraclavicular brachial plexus block [10,16]. Fourth, many anaesthesia units still rely primarily on subjective clinical testing, and there is a need to validate a simple objective adjunct that can be incorporated into routine monitoring without additional cost or invasive equipment.

The present study was therefore undertaken to address these gaps by evaluating pulse oximetry-derived PI as an early objective predictor of successful ultrasound-guided supraclavicular brachial plexus block in adult patients undergoing upper limb surgery. The novelty of the present study lies in assessing PI at defined time intervals, calculating the PI ratio, comparing these parameters with routine sensory and motor assessment, and analysing their relationship with block onset. By identifying a practical threshold for early prediction of block success, the current study may help improve operating room efficiency, support timely decision-making, and reduce delays caused by inadequate regional anaesthesia. Therefore, the present study aimed to evaluate pulse oximetry-derived PI as an early objective predictor of successful ultrasound-guided supraclavicular brachial plexus block and to compare it with routine clinical assessment.

## MATERIALS AND METHODS

This was a hospital-based prospective observational study conducted in the Department of Anaesthesiology, Krishna Hospital and Medical Research Centre, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India, over 18 months from June 2024 to November 2025. The study was initiated after approval from the Institutional Ethics Committee (Protocol No. 302/2023-2024; Ref. No. KVV/IEC/05/2024; dated 15/04/2024). Written informed consent was obtained from all participants.

**Inclusion criteria:**

- Patients aged 18-60 years of either gender, belonging to American Society of Anaesthesiologists (ASA) physical status I or II, and scheduled for elective upper limb surgery under supraclavicular brachial plexus block were included.
- The study included 70 adult patients posted for elective upper limb surgeries under ultrasound-guided supraclavicular brachial plexus block. The surgeries included procedures involving the hand, wrist, forearm and elbow, such as fracture fixation, implant removal, tendon repair and soft-tissue procedures. These were minor to intermediate elective orthopaedic and soft-tissue surgeries suitable for regional anaesthesia.

**Exclusion criteria:**

- Patients with major vascular surgeries, emergency procedures and cases planned primarily under general anaesthesia were not included.
- Patients with obesity (BMI ≥30 kg/m$^2$), cardiovascular disease, diabetes mellitus, peripheral vascular disease, pregnancy or lactation, bleeding disorders, local infection at the puncture site, history of seizures, or known allergy to local anaesthetics were excluded.

**Sample size calculation:** The sample size was calculated by considering an expected block success rate of 90% and a failure rate of 10%, based on previous studies evaluating PI as an early predictor of successful supraclavicular brachial plexus block [12]. The following formula was used:

$n=Z^2pq/d^2$

where Z=1.96 at 95% confidence level, p=0.90, q=0.10 and d=0.071.

$n=(1.96)^2\times0.90\times0.10 / (0.071)^2$

$n=3.8416\times0.09 / 0.005041$

$n=68.58$

The calculated sample size was 68.58, which was rounded up. Therefore, 70 adult patients were enrolled in the study.

### Study Procedure

After transfer to the operating room, an 18-gauge intravenous cannula was secured, and standard monitoring was initiated, including electrocardiography, non invasive blood pressure, pulse rate and peripheral oxygen saturation. Baseline haemodynamic parameters were recorded. Intravenous ranitidine 50 mg and midazolam 0.03 mg/kg were administered as premedication.

For measurement of PI, pulse oximeter probes were placed on the index finger of both hands. Baseline PI was recorded in the limb to be blocked and in the contralateral limb after stabilisation of the signal. Ultrasound-guided supraclavicular brachial plexus block was then performed using an insulated needle. A local anaesthetic solution containing 30 mL of 0.5% bupivacaine and 15 mL of 2% lidocaine with adrenaline was injected after confirming appropriate needle position and local anaesthetic spread.

PI was measured again in both limbs at 10 minutes and 20 minutes after block administration. PI ratio was calculated in the blocked limb by dividing the PI value at 10 minutes after block administration by the baseline PI value, based on the method used in previous studies evaluating PI changes after supraclavicular brachial plexus block [10,16].

**Assessment of block characteristics:** Block was assessed clinically at the identical time points. Sensory block was assessed by loss of cold sensation in the median, ulnar, radial and musculocutaneous nerve territories. It was graded using a three-point scale: 0=no block, 1=partial block and 2=complete block. Motor block was assessed by forearm flexion, wrist dorsiflexion, finger opposition and finger abduction, and was graded using the same three-point scale: 0=no block, 1=partial block and 2=complete block [10,16].

**Definition of block success:** A block was considered satisfactory when surgery was completed without pain and without the need for supplemental analgesia. An unsatisfactory block was defined as inadequate surgical anaesthesia requiring intraoperative fentanyl supplementation at a dose of 2 mcg/kg. Complete block failure was defined as persistent pain despite supplementation, requiring conversion to general anaesthesia [10,12].

**Outcome measures:** The primary outcome measure was the predictive value of PI for successful supraclavicular brachial plexus block.

Secondary outcome measures included correlation of PI with sensory and motor onset times, comparison of PI between blocked and unblocked limbs, requirement for intraoperative supplementation, haemodynamic changes, and complications.

## STATISTICAL ANALYSIS

Continuous variables were expressed as mean±standard deviation and categorical variables as frequency and percentage. Independent t-test was used to compare continuous variables between successful and failed block groups. Pearson's correlation coefficient was used to analyse the relationship between PI parameters and sensory and motor onset times. Receiver operating characteristic curves were used to assess predictive accuracy and identify optimal cut-off values. A p-value <0.05 was considered statistically significant.

## RESULTS

A total of 70 patients were included in the final analysis. The baseline demographic and haemodynamic characteristics of the study participants are shown in [Table/Fig-1]. Most participants belonged to ASA physical status I, and the baseline clinical profile was suitable for elective upper limb surgery under regional anaesthesia. Heart rate and mean arterial pressure remained clinically stable during the observation period.

| Variables | Results (Mean±SD) |
|---|---|
| Age (years) | 45.2±5.4 |
| Weight (kg), | 70.0±3.3 |
| Height (cm), | 166.3±3.5 |
| Body mass index (kg/m²), | 25.3±0.3 |
| ASA grade I, n (%) | 37 (52.9) |
| ASA grade II, n (%) | 33 (47.1) |
| Heart rate at baseline (beats/min), | 79.4±2.1 |
| Heart rate at 20 minutes (beats/min), | 77.3±2.1 |
| Mean arterial pressure at baseline (mmHg), | 89.4±2.1 |
| Mean arterial pressure at 20 minutes (mmHg), | 86.6±2.5 |

**[Table/Fig-1]:** Baseline demographic and haemodynamic characteristics of study participants (N=70).

Successful surgical anaesthesia was achieved in the majority of patients. Failed/inadequate blocks required fentanyl supplementation. Among successful blocks, sensory onset occurred earlier than motor onset [Table/Fig-2].

| Parameters | Results (Mean±SD) |
|---|---|
| Successful surgical block, n (%) | 54 (77.1) |
| Failed/inadequate block requiring fentanyl supplementation, n (%) | 16 (22.9) |
| Sensory onset time among successful blocks (minutes), | 12.4±0.5 |
| Motor onset time among successful blocks (minutes) | 15.8±0.5 |

**[Table/Fig-2]:** Block outcome and onset characteristics.

Baseline PI was comparable between successful and failed/inadequate blocks. However, PI at 10 minutes, PI at 20 minutes and PI ratio were significantly higher in successful blocks, suggesting an objective perfusion response after effective sympathetic blockade [Table/Fig-3].

| Time interval/Parameters | Successful block (n=54), (Mean±SD) | Failed/inadequate block (n=16), (Mean±SD) | p-value |
|---|---|---|---|
| Baseline PI | 1.39±0.07 | 1.41±0.06 | 0.121 |
| PI at 10 minutes | 3.87±0.12 | 1.75±0.05 | <0.001 |
| PI at 20 minutes | 4.57±0.11 | 1.85±0.05 | <0.001 |
| PI ratio (10 minutes/baseline) | 3.30±0.12 | 1.31±0.03 | <0.001 |

**[Table/Fig-3]:** Comparison of Perfusion Index (PI) values between successful and failed/inadequate blocks.

Although the baseline difference in PI between the blocked and unblocked limbs was statistically significant, the absolute difference was clinically small. After block placement, the blocked limb showed a marked rise in PI at 10 and 20 minutes, while the unblocked limb remained relatively unchanged, supporting a local sympathetic block-related perfusion response [Table/Fig-4].

| Time interval | Blocked limb PI, (Mean±SD) | Unblocked limb PI, (Mean±SD) | p-value |
|---|---|---|---|
| Baseline | 1.39±0.07 | 1.40±0.05 | <0.001 |
| 10 minutes | 3.39±0.90 | 1.41±0.04 | <0.001 |
| 20 minutes | 3.95±1.15 | 1.43±0.04 | <0.001 |

**[Table/Fig-4]:** Intra-patient comparison of Perfusion Index (PI) between blocked and unblocked limbs (N=70).

PI ratio showed the strongest negative correlation with both sensory and motor onset times, indicating that a greater relative rise in PI was associated with faster block onset. In contrast, absolute PI values at 10 and 20 minutes showed weaker but significant positive correlations with sensory and motor onset times in the analysed dataset [Table/Fig-5].

| PI parameters | Sensory onset time, r, p-value | Motor onset time, r, p-value |
|---|---|---|
| Baseline PI | 0.69, <0.001 | 0.70, <0.001 |
| PI at 10 minutes | 0.37, 0.005 | 0.41, 0.002 |
| PI at 20 minutes | 0.36, 0.008 | 0.40, 0.003 |
| PI ratio | -0.71, <0.001 | -0.70, <0.001 |

**[Table/Fig-5]:** Correlation of Perfusion Index (PI) parameters with sensory and motor onset among successful blocks (n=54).

The PI at 10 minutes, PI at 20 minutes, and PI ratio demonstrated excellent predictive performance for successful supraclavicular brachial plexus block as shown in [Table/Fig-6]. The selected PI-based cut-off values completely differentiated successful blocks from failed/inadequate blocks in the analysed dataset.

The ROC curves for PI at 10 minutes, PI at 20 minutes and PI ratio are shown in [Table/Fig-7]. All three curves overlapped because each parameter demonstrated complete discrimination between successful and failed/inadequate blocks in the analysed study population.

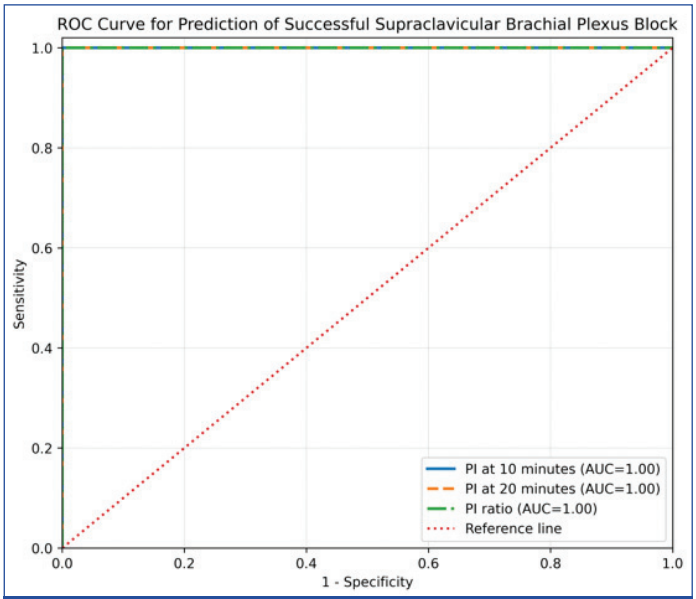
Most successful blocks reached the selected PI thresholds within the early post-block observation period. Vascular puncture was uncommon and was managed conservatively by immediate needle withdrawal followed by local compression, without any major sequelae [Table/Fig-8].

## DISCUSSION

The present study showed that PI was a useful early objective parameter for predicting the success of ultrasound-guided supraclavicular brachial plexus block. Successful surgical block was achieved in 77.1% of patients, while 22.9% had failed or inadequate block requiring fentanyl supplementation. Baseline PI was comparable between successful and failed/inadequate blocks, indicating that pre-block peripheral perfusion did not differ significantly between the two groups. However, PI at 10 minutes, PI at 20 minutes and PI ratio were significantly higher in successful blocks, showing that an early rise in peripheral perfusion was closely related to effective blockade. This observation is consistent with the physiological basis of brachial plexus block, where sympathetic blockade occurs early and produces vasodilatation in the blocked limb [6-9]. Abdelnasser A et al., reported that PI and PI ratio were useful predictors of successful supraclavicular brachial plexus block [10]. Similar post-block increases in PI were also reported by Kumar P et al., Raj RLR and Kingslin AS, Tokuda K et al., and Narasimhan MK et al., [11,12,18,19]. Recent studies by Mahajan A et al., and

| Parameters | AUC | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) | Diagnostic accuracy (%) | Cut-off value |
|---|---|---|---|---|---|---|---|
| PI at 10 minutes | 1.00 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | >2.2 |
| PI at 20 minutes | 1.00 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | >2.5 |
| PI ratio | 1.00 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | >2.0 |

**[Table/Fig-6]:** Predictive performance of Perfusion Index (PI) parameters for successful supraclavicular brachial plexus block.
AUC: Area under the receiver operating characteristic curve; PI: Perfusion index; PPV: Positive predictive value; NPV: Negative predictive value.




**[Table/Fig-7]:** Receiver operating characteristic curve showing the predictive accuracy of Perfusion Index (PI) at 10 minutes, PI at 20 minutes and PI ratio for successful ultrasound-guided supraclavicular brachial plexus block, using final block outcome as the reference standard.

| Parameters | Results (Mean±SD) |
|---|---|
| Mean time to reach PI >2.0 | 8.3±0.5 |
| Mean time to reach PI >2.5 | 11.6±0.6 |
| Mean time to reach PI ratio >2.0 | 8.7±0.5 |
| Vascular puncture, n (%) | 2 (2.9) |
| Vascular puncture managed by immediate needle withdrawal and local compression, n (%) | 2 (2.9) |

**[Table/Fig-8]:** Time to Perfusion Index (PI) thresholds and procedural complications.

Aurangabadwala SAA et al., have further supported the use of PI as an indicator of successful supraclavicular block in upper limb surgeries [20,21]. The present findings add to the available evidence by showing a clear difference in PI behaviour between successful and failed/inadequate blocks at defined time points.

In the present study, comparison between the blocked and unblocked limbs showed that the baseline difference in PI was statistically significant but clinically small. After block administration, the blocked limb showed a marked rise in PI at 10 and 20 minutes, whereas the unblocked limb remained relatively unchanged. This pattern suggests that the post-block increase in PI was mainly due to local sympathetic blockade rather than a systemic haemodynamic effect. Galvin EM et al., demonstrated that peripheral flow index could act as an early marker of regional block success [6], while Ginosar Y et al., showed that PI could detect sympathectomy after neuraxial anaesthesia [7]. Kus A et al., also reported that PI was useful for detecting the effect of brachial plexus block [8]. Lal J et al., observed a significant increase in PI after ultrasound-guided supraclavicular block and suggested its usefulness as a marker of block success [16]. Avcı O and Gündoğdu O compared traditional clinical methods with PI and found that PI provided an objective early assessment of supraclavicular block efficacy [22]. Kim D et al., noted that epinephrine in the local anaesthetic solution can influence PI changes, which may partly explain variation in absolute PI values and cut-off points across studies [15]. The present study agrees with these reports and supports the blocked-limb PI response as a useful bedside sign of effective regional sympathetic blockade.

The relationship between PI parameters and block onset was also assessed in the present study. PI ratio showed the strongest negative correlation with both sensory and motor onset times, indicating that a greater relative rise in PI was associated with faster onset of clinical blockade. In contrast, absolute PI values at 10 and 20 minutes showed weaker but significant positive correlations with onset time in the analysed dataset. This difference suggests that PI ratio may be more clinically meaningful than absolute PI values because it adjusts the post-block value against the patient's own baseline PI. Buono D et al., reported that PI could predict nerve block success at an early stage before complete clinical assessment becomes definite [17]. Chatterjee S et al., also observed that PI had predictive value in assessing supraclavicular block success [14]. Manoj A et al., reported that both PI and PI ratio were useful tools for predicting block success and that PI ratio may provide better discrimination because it reduces the effect of baseline inter-patient variability [23]. Mehta JB et al., evaluated PI for early detection of ulnar nerve sparing after supraclavicular brachial plexus block and supported the role of PI in identifying incomplete block patterns [24]. The present findings similarly suggest that PI ratio can reflect both adequacy and speed of block development.

With regard to diagnostic performance, the present study found that PI at 10 minutes, PI at 20 minutes and PI ratio demonstrated excellent predictive ability for successful supraclavicular brachial plexus block. All three PI-based parameters showed an AUC of 1.00, with 100% sensitivity, specificity, PPV, NPV and diagnostic accuracy at the selected cut-off values. This indicates that, in the analysed dataset, the selected PI thresholds completely differentiated successful blocks from failed/inadequate blocks. Abdelnasser A et al., reported good diagnostic performance of PI and PI ratio for predicting successful supraclavicular block [10]. Hung KC et al., in a meta-analysis of upper extremity nerve blocks, concluded that PI and PI ratio have useful diagnostic value for identifying failed nerve blocks [13]. Chatterjee S et al., and Manoj A et al., also reported that PI and PI ratio were useful adjuncts for early assessment of block adequacy [14,23]. Chu T et al., extended this evidence to children under general anaesthesia, where conventional sensory assessment is difficult, and reported that PI could predict the effectiveness of supraclavicular brachial plexus block [25]. Therefore, the present study supports PI as an objective adjunct to routine clinical evaluation, particularly when early decision-making is required.

The haemodynamic profile and complication pattern in the present study were favourable. Heart rate and mean arterial pressure remained clinically stable during the observation period. Two patients had vascular puncture, and both were managed conservatively by immediate needle withdrawal and local compression, without major sequelae. No nerve injury or local anaesthetic systemic toxicity was observed. These findings suggest that ultrasound-guided supraclavicular brachial plexus block was clinically safe in the selected study population. Previous studies have shown that ultrasound guidance improves localisation of neural structures, visualisation of needle movement and assessment of local anaesthetic spread, thereby improving the quality and safety of upper limb regional anaesthesia [1-4]. Brull R et al., reported that serious neurological complications after regional anaesthesia are

uncommon, although careful monitoring remains essential [26]. The ASRA practice advisory also emphasised proper technique, vigilance and early recognition of neurological or systemic complications during regional anaesthesia [27]. Although PI may be influenced by peripheral temperature, vascular tone, local anaesthetic composition and vasoconstrictor use, it remains a simple, non-invasive and readily available parameter on standard monitors [9,15]. Therefore, PI should be used as a supportive tool along with conventional sensory and motor examination, rather than as a complete replacement for clinical assessment.

### Limitation(s)

The study was conducted at a single centre and included a relatively small number of failed blocks, which limits detailed subgroup analysis. Patients with diabetes mellitus, peripheral vascular disease, and significant cardiovascular disease were excluded; therefore, the proposed thresholds should be applied cautiously in populations with altered peripheral perfusion. Postoperative analgesic outcomes and long-term neurological follow-up were not evaluated.

## CONCLUSION(S)

The present study showed that PI is a simple, non invasive and objective bedside parameter for early assessment of ultrasound-guided supraclavicular brachial plexus block. Baseline PI alone did not differentiate successful and failed/inadequate blocks, whereas PI at 10 minutes, PI at 20 minutes and PI ratio showed a clear post-block rise in successful blocks. PI ratio was closely associated with faster sensory and motor onset, indicating that a greater relative rise in peripheral perfusion reflects earlier development of effective blockade. PI at 10 minutes, PI at 20 minutes and PI ratio demonstrated excellent predictive ability for identifying successful block in the analysed study population. These findings suggest that PI monitoring may help recognise inadequate blocks earlier and support timely decisions regarding further observation or analgesic supplementation. However, PI should be used as an adjunct to standard sensory and motor assessment, and not as a replacement for clinical evaluation.

## REFERENCES


[1] Neal JM, Gerancher JC, Hebl JR, Ilfeld BM, McCartney CJ, Franco CD, et al. Upper extremity regional anesthesia: Essentials of our current understanding, 2008. Reg Anesth Pain Med. 2009;34(2):134-70.
[2] Sandhu NS, Capan LM. Ultrasound-guided infraclavicular brachial plexus block. Br J Anaesth. 2002;89(2):254-59.
[3] Marhofer P, Harrop-Griffiths W, Willschke H, Kirchmair L. Fifteen years of ultrasound guidance in regional anaesthesia: Part 2-recent developments in block techniques. Br J Anaesth. 2010;104(6):673-83.
[4] Williams SR, Chouinard P, Arcand G, Harris P, Ruel M, Boudreault D, et al. Ultrasound guidance speeds execution and improves the quality of supraclavicular block. Anesth Analg. 2003;97(6):1518-23.
[5] Paul D. Predicting successful supraclavicular brachial plexus block using pulse oximeter perfusion index: Is it really an objective outcome? Br J Anaesth. 2018;120(2):405-06.
[6] Galvin EM, Niehof S, Verbrugge SJC, Maissan IM, Jansen JRC, van Bommel J, et al. Peripheral flow index is a reliable and early indicator of regional block success. Anesth Analg. 2006;103(1):239-43.
[7] Ginosar Y, Weiniger CF, Meroz Y, Kurz V, Bdolah-Abram T, Babchenko A, et al. Pulse oximeter perfusion index as an early indicator of sympathectomy after epidural anesthesia. Acta Anaesthesiol Scand. 2009;53(7):1018-26.
[8] Kus A, Gurkan Y, Gormus SK, Solak M, Toker K. Usefulness of perfusion index to detect the effect of brachial plexus block. J Clin Monit Comput. 2013;27(3):325-28.
[9] Hasanin A, Mukhtar A, Nassar H. Perfusion indices revisited. J Intensive Care. 2017;5:24.
[10] Abdelnasser A, Abdelhamid B, Elsonbaty A, Hasanin A, Rady A. Predicting successful supraclavicular brachial plexus block using pulse oximeter perfusion index. Br J Anaesth. 2017;119(2):276-80.
[11] Kumar P, Arora V, Khatri A, Singhal SK, Madan S. Evaluation of perfusion index as an objective indicator of successful interscalene block. Asian J Med Sci. 2023;14(2):46-50. Doi: 10.3126/ajms.v14i2.49867.
[12] Raj RLR, Kingslin AS. Prediction of successful supraclavicular brachial plexus block using pulse oximeter perfusion index. Global Journal for Research Analysis. 2019;8(3):30-32.
[13] Hung KC, Liu CC, Huang YT, Chen JY, Chen HT, Wang KF, et al. The efficacy of perfusion index for identifying failed nerve blocks in patients receiving upper extremity surgery: A meta-analysis. Minerva Anestesiol. 2024;90(4):311-20.
[14] Chatterjee S, Majumdar U, Gupta D, Sarkar C, Chatterjee S. Predictive value of perfusion index for assessing success of supraclavicular brachial plexus block: A prospective observational study. Indian J Pain. 2024;38(1):51-55.
[15] Kim D, Jeong JS, Park MJ, Ko JS. The effect of epinephrine on the perfusion index during ultrasound-guided supraclavicular brachial plexus block: A randomized controlled trial. Sci Rep. 2020;10(1):11585.
[16] Lal J, Bhardwaj M, Malik A, Bansal T. A study to evaluate the change in perfusion index as an indicator of successful ultrasound-guided supraclavicular block. Indian J Anaesth. 2021;65(10):738-43.
[17] Del Buono R, Pascarella G, Costa F, Agrò FE. The perfusion index could early predict a nerve block success: A preliminary report. Saudi J Anaesth. 2020;14(4):442-45.
[18] Tokuda K, Ouchi T, Sugiyama K. Perfusion index predicts successful nerve block in patients undergoing upper limb surgery: A prospective observational study. JA Clin Rep. 2020;6(1):10.
[19] Narasimhan MK, Kumaran NP, Vaidyanathan B. To predict the success of supraclavicular brachial plexus block using pulse oximeter perfusion index: A prospective observational study. Int J Acad Med Pharm. 2023;5(4):1559-63.
[20] Mahajan A, Katoch ML, Gupta S. To predict the success of supraclavicular brachial plexus block by using perfusion index as an indicator: A randomised prospective study. JK Science. 2025;27(4):236-240.
[21] Aurangabadwala SAA, Mujpurwala FK, Kandikatla PS, Shah DV. Use of pulse oximeter perfusion index to predict the success of supraclavicular brachial plexus block in various upperlimb surgeries. Ann Med Med Sci. 2025;4(11):988-91.
[22] Avcı O, Gündoğdu O. Evaluation of ultrasound guided supraclavicular block with traditional methods and perfusion index on upper extremity surgeries. Van Med J. 2020;27(1):38-44.
[23] Manoj A, Mahadeviah T, Ramasamy P, Paul P, Ramalingam S, Dominic JL. Perfusion index and perfusion index ratio as predictive tools for block success: A prospective observational study on ultrasound-guided supraclavicular brachial plexus block. Saudi J Anaesth. 2025;20(1):137-43.
[24] Mehta JB, Tailor R, Thomas SM. Evaluation of perfusion index as a tool for early detection of ulnar nerve sparing after brachial plexus block through supraclavicular approach: A prospective observational study. J Clin Diagn Res. 2026;20(1):UC10-UC14. Doi: 10.7860/JCDR/2026/79409.22200.
[25] Chu T, Zhou S, Peng T, Tao H, Chen H, Yan X, et al. Perfusion index predicts the effectiveness of supraclavicular brachial plexus block in children under general anesthesia: A randomized controlled trial. Anesthesiol Res Pract. 2025;2025:5583145.
[26] Brull R, McCartney CJL, Chan VWS, El-Beheiry H. Neurological complications after regional anesthesia: Contemporary estimates of risk. Anesth Analg. 2007;104(4):965-74.
[27] Neal JM, Bernards CM, Hadzic A, Hebl JR, Hogan QH, Horlocker TT, et al. ASRA practice advisory on neurologic complications in regional anesthesia and pain medicine. Reg Anesth Pain Med. 2008;33(5):404-15.



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