

## Correlation between Two Monitoring Tools by Subjective and Objective Methods for Evaluation of Adequacy of Brachial Plexus Block: An Observational Study

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### Abstract

**Introduction:** Supraclavicular block provides adequate anaesthesia and analgesia but lacking objective methods of assessment, so in this study PI index using pulse oximetry was used to assess the adequacy of block.

**Methods:** The study was conducted on 100 patients undergoing elective or emergency orthopaedic procedures under brachial plexus nerve block. After local anaesthetic injection, sensory and motor block success was assessed every 5min by traditional pinprick and Modified Bromage Scale methods respectively. The PI was recorded at baseline and at every 5 minutes till 30 minutes after anaesthetic injection in both blocked and non-blocked limbs. The PI ratio was calculated as the PI after 5min divided by the PI at the baseline.

**Result:** The PI was higher in the blocked limb at all time points except baseline and this was paralleled by a higher PI ratio compared with the unblocked limb. At the time when complete sensory block achieved, the correlation Pearson coefficient of PI was 0.979 ( $p < 0.001$ ) and for motor block it was 0.932 ( $p = 0.002$ ), which shows positive correlation between both the assessment methods.

**Conclusion:** PI and PI ratio are positively correlated with the traditional subjective methods of assessment of block adequacy. So, it can be a good alternative in uncooperative, sedated patients.

**Keywords:** Brachial plexus block, traditional methods, Perfusion Index, Pulse oximetry

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### Introduction

Supraclavicular brachial plexus block is trending among anaesthesiologists as sophisticated instruments like neurostimulators and ultrasound machines

are in common clinical practice nowadays. Regional anaesthesia is safe, effective and provide post-operative analgesia with comparatively lower systemic side effects.

There is no definite guideline or gold-standard technique for assessment of successful block. Definition of successful block is different among different studies. A review by Abdallah and Brull for definition of “block success” had mix definition like, a surgical block within a predetermined period of time, a sensory block within a period of time, no conversion to general anaesthesia. [1] Traditional methods to assess the block are sensory (response to pinprick) and motor assessment for which various scales and scores are available. [2] Subjective methods have variation in result according to evaluator and also require patient cooperation. These methods of assessment give subjective result which may not be accurate in uncooperative, deaf and dumb or semiconscious patients and are time consuming. [2]

PI was first introduced by MASIMO in 1995, but nowadays it is available in variety of other monitors also. PI measured the ratio of arterial blood flow (pulsatile) to venous capillary and tissue blood flow (non-pulsatile) and it is showed on the monitor screen as a percentage or absolute value. Perfusion index is measured by pulse oximetry and provide sanindication of peripheral per fusionat the sensor site (finger). In Literature there are reported works of using PI to assess the success of regional anaesthesia block. Human studies shows PI increments after brachial plexus block [4], stellate ganglion block [5], caudal anaesthesia [6]. So we hypothesize that analysis of PI variation after performing supraclavicular plexus block could have a role in predicting a successful nerve block.

Literature is lacking in comparing standard subjective method to PI variation after regional anaesthesia. So our study aimed at comparing these two techniques of assessment after supraclavicular plexus block.

## Material and Methods

After approval from institutional review board and informed written consent from the patients this perspective, observational was carried out in 100 patients of ASA class I-II, aged 20 – 60 years and posted for elective as well as emergency upper limb orthopaedic surgery requiring supraclavicular plexus block in the department of anesthesiology, GMC Bhavnagar from 2019-2020. Patients who refused to participate in the study, having allergy to local anaesthetic drug, contraindication to supraclavicular block, psychiatric, cardiac, respiratory illness, history of peripheral vascular disease were excluded from the study.

All the patients undergo pre-anaesthetic evaluation and necessary baseline investigation required will be obtained prior to surgery. In the pre-operative room adequate fasting assured and baseline vital parameters including pulse rate (PR), non-invasive blood pressure (NIBP), peripheral oxygen saturation (SpO<sub>2</sub>) and electrocardiogram were recorded. Baseline perfusion index (PI) recorded in both the upper limb. All the patients were premedicated with inj. ondansetron 0.08 mg/kg after securing IV line with 20G IV catheter. In the operation theatre maintenance fluid was started with crystalloids.

Nerve locator guided supraclavicular brachial plexus block was given under all aseptic and antiseptic precaution with 2-inch nerve locator needle. Once appropriate motor response was localized to the nerve to be blockade, at current 0.2-0.5mA, inj. lignocaine with adrenaline (2%) 15 ml and inj. bupivacaine (0.5%) 15 ml was given after negative tapping for blood. All blocks were performed with single injection technique. Vital parameters (HR, NIBP, SpO<sub>2</sub>) were recorded every 5 minutes till 30 minutes and then every 15 minutes till the completion of surgery. Effectiveness of the blockade (sensory and motor blockade) was assessed before the procedure and at interval of 5 minutes till 30 minutes after the block. Sensory

block was assessed by pinprick test using Hollmen scale (1- full sensation, 2- weak sensation, 3- recognized as light touch, 4- loss of sensation). Pinprick sensation was assessed using a 22-gauge hypodermic needle and compared with the patient's response to stimulation on the same dermatome of the unblocked limb. Motor blockade was assessed with modified bromage scale (0- Normal motor function with full flexion and extension of elbow, wrist and fingers, 1- Decreased motor strength with ability to move the fingers only, 2- Complete motor block with inability to move fingers).

In objective method, the pulse index (PI) was measured by pulse oximeter applied on index finger of block and unblocked limb. The PI and PI ratio was recorded at baseline (10 minutes before the local anaesthetic injection) and every 5 minutes till 30 minutes after the block.

After a minimum of 30 minutes, the operating surgeon was asked to assess the operative site for pain sensation using a surgical forceps. If patients reported pain at this time, the block was described as "failed" and a supplemental block or general anaesthesia was administered according to the decision of the anaesthesiologist responsible for each individual patient's care. After successful blocks, surgery proceeded as usual.

After surgery all the patients were shifted to the post anaesthesia care unit with all basic monitoring. Patients were mobilized after hemodynamic stability. Post operatively recovery of sensory, motor function was assessed at regular time interval.

According to previous study, value of PI and PI ratio at 10 minutes predict block success. Reference. To detect moderate correlation sample size of 68 is required for the 80% power of study to discover that the correlation is significantly from there being no correlation at 0.05 level. To compensate any dropout - exclusion and easy availability of patients we enrolled 100 patients. Analysis was done using Graph pad software. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Chi-square/Fisher's Exact test was used for categorical data and mann-Whitney for continuous data. A P value of < 0.05 was considered statistically significant.

## Result

Demographic variables were as shown in table 1.

No significant changes from baseline vital parameters after performing the supraclavicular plexus block. (Table 2)

**Table 1: Demographic data**

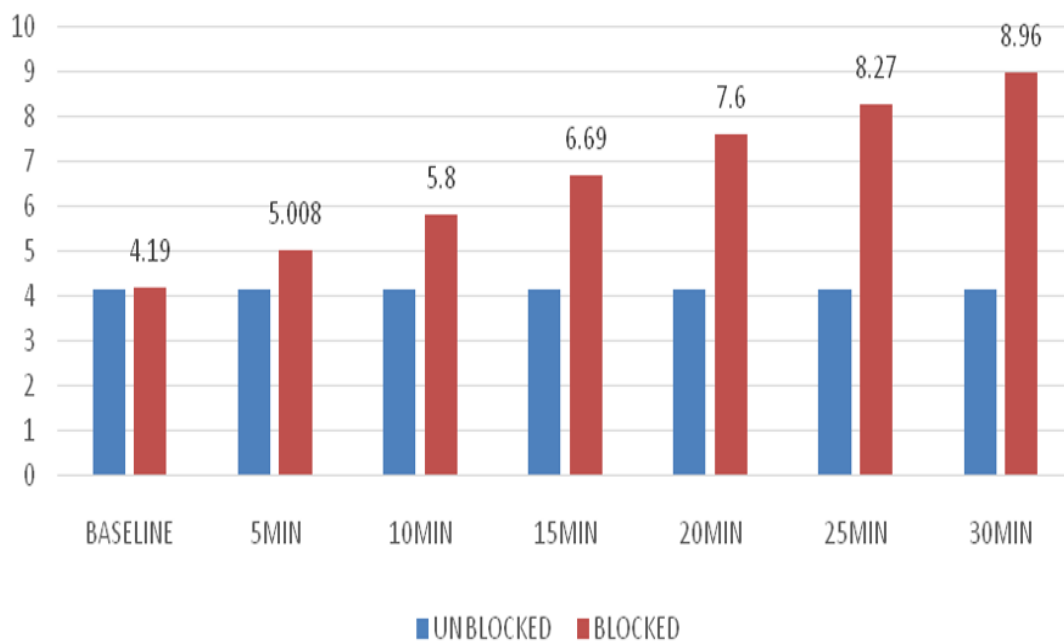
Characteristics	values
Patients (n)	100
Gender (M/F)	64/36
Age (20-40)	53
(41-60)	47
ASA (I/II)	45/55

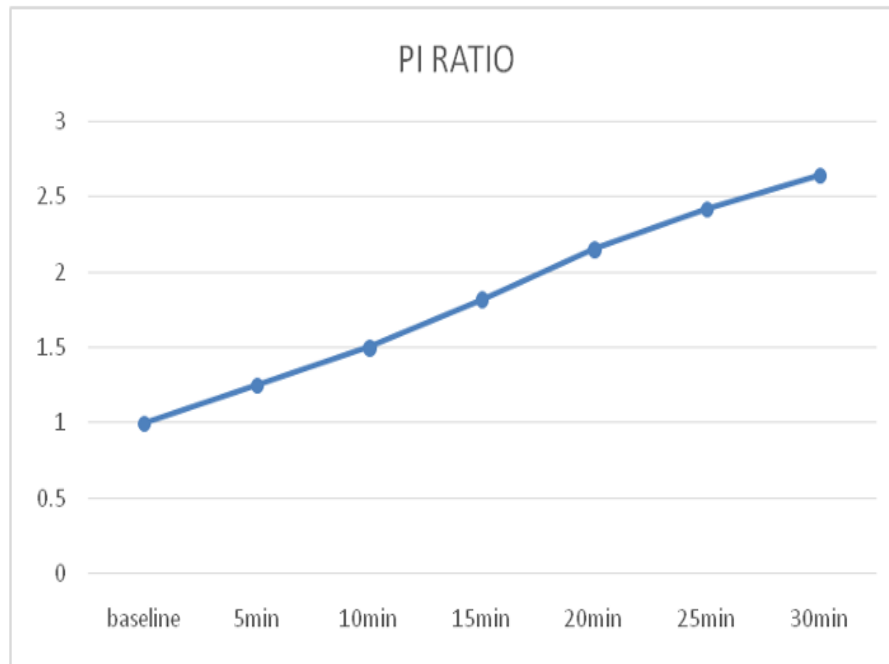
**Table 2: Vital parameters**

TIME	Pulse rate (Mean± SD)	SBP (Mean± SD)	DBP (Mean± SD)	SpO2 (Mean± SD)
Baseline	82.9 ±5.2	118.4±5.4	79.08±3.9	98.4±0.64
5 min	84.08±4.9	118.26±5.6	78.56±8.0	98.46±0.61
10 min	83.5±5.2	126±99.4	79.4±4.4	98.34±0.74
15 min	83.5±5.07	116.96±5.5	79.7±4.1	98.36±0.77
20 min	83.5±5.07	116.7±5.9	80.1±4.01	98.3±0.84
25 min	83.68±4.8	127.62±99.36	79.6±3.5	98.27±0.85
30 min	83.56±5.2	117.58±5.1	86±3.6	98.26±0.79

(SD = Standard deviation SBP = systolic blood pressure DBP = Diastolic blood pressure SpO2 = peripheral oxygen saturation)

Blocked arm shows statistically significant increase in PI at defined time points than unblocked arm (Figure 1). PI ratio increase was statistically significant in blocked limb (Figure 2).

**Figure 1: Perfusion Index at different time interval**



**Figure 2: PI Ratio in the blockade arm**

According to Pearson correlation coefficient PI and PI ratio had positive correlation with sensory and motor block assessment at defined time points, both increase with time after brachial plexus block. (Table 3, Table 4)

**Table 3: Correlation of sensory effect of brachial plexus nerve block with PI and PI ratio**

Objective method	Correlation coefficient (r)	p-value	Interpretation
PI	0.979	< 0.001	Significant positive correlation
PI ratio	0.976	< 0.001	Significant positive correlation

**Table 4: Correlation of motor effect of brachial plexus nerve block with PI and PI ratio**

Objective method	Correlation coefficient (r)	p-value	Interpretation
PI	0.932	0.002	Significant positive correlation
PI ratio	0.950	0.001	Significant positive correlation

## Discussion

Peripheral nerve blocks are cost effective anesthetic techniques used to provide good quality anesthesia and analgesia while avoiding airway instrumentation and hemodynamic consequences of general anesthesia. Brachial plexus block is an easy and relatively safe procedure for upper limb surgeries. Supraclavicular approach to brachial plexus block is associated with rapid onset and reliable anesthesia. [4,7]

Marked vasodilatation is seen with successful brachial plexus block. [9] Result of this study shows that the PI and the PI ratio are predictive for a successful brachial plexus nerve block. A relative increase in pulsatile flow in states of vasodilatation leads to an increase in the PI. The PI can therefore be considered as an objective measure for peripheral perfusion that can predict peripheral block success.

PI was previously investigated for evaluation of different conditions of vasodilatation, such as

induction of anaesthesia [8], epidural block, [9] stellate ganglion block, [10] successful thoracic sympathectomy [11], a marker of sympathetic stimulation. Abdelnasser's group previously reported that a low PI predicted the need for vasopressor therapy in severe sepsis. [3] The role of the PI in the prediction of peripheral block success was previously reported for infraclavicular, axillary, interscalene approach of brachial plexus block, [11] and sciatic nerve block. According to a claim by group of authors, they were first to report the use of the PI in the assessment of the successfulness of a supraclavicular nerve block. Our study result in terms of PI and PI ratio are in correlation with abdenaseer's study, but we also use subjective method assessment in same patient group and correlated subjective and objective method.

Galvin and colleagues reported the average time to be 12 min in sciatic block and 10 min in axillary block. Kus and colleagues reported a similar finding for infraclavicular block. Yamazaki and colleagues [4] reported a shorter interval (5 min) for the PI to reach a significant increase after stellate ganglion block. Some studies reported measurement of PI at wide time interval as their limitation. So, we took the shorter time interval of 5 minutes to measure the data.

In our study, PI and PI ratio increases in progressive correlation with sensory and motor parameters of assessment for block. However sensory and motor assessment is subjective, need patient co-operation. And it would not be predicted that every patient will co-operate in same manner. So PI and PI ratio for the block assessment can possibly eliminate that limitation of subjective block assessment. Other objective methods are there in use for block assessment that assess the degree of sympathetic block by vasodilatation, changes in blood flow and skin temperature. Most of them are either time consuming or need sophisticated instruments. PI and PI ratio can prove to be good alternative to this objective method of assessment.

To include in limitation of our study are 1) no failed block so could not estimate the cut off value with more failed blocks 2) unavailability of ultrasound machine and 3) we consider failed block as one (need for general anaesthesia) rather than grading (number of segments blocked). More studies with failed block with graded system required to generalize the result of this study.

We conclude that, PI and PI ratio is positively and progressively correlated with subjective methods of block assessment. PI can be useful tool for evaluation of successfulness of supraclavicular block.

### Conclusion

According to this study, objective method like PI & PI Ratio reliable tool for quick assessment of effect of brachial Plexus block compared to subjective method like pinprick method & modified bromage.

Doctors satisfaction was excellent after using perfusion index as assessment tool for brachial plexus block adequacy as it don't require patient cooperation and it was devoid of cumbersome of pin prick test, which had chance of needleprick injury and bleeding.

Hence we conclude that PI and PI ratio monitoring is very effective tool for adequacy of brachial plexus block.

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