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Original Research Article

To Predict the Success of Ultrasound Guided Brachial Plexus Block Using Pulse Oximeter Perfusion Index

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Abstract

Introduction: The effectiveness of supraclavicular brachial plexus block is usually evaluated by assessment of sensory and motor function. Perfusion index (PI) estimates the pulsatility of blood in the extremities and inversely related to the vascular tone. In this study we assessed changes in perfusion index following ultrasound guided brachial plexus block to predict success in this regional anaesthesia technique.

Material and Methods: A prospective observational study was conducted after obtaining institutional ethics committee clearance and written and informed consent from each patient. 60 adult patients undergoing upper limb surgery under ultrasound guided brachial plexus block were included and Perfusion index in the blocked and unblocked limb were measured using Masimo SET pulse oximeter.

Results: Perfusion index in the blocked limb was higher than the unblocked limb at all intervals. Delta Pi calculated as the difference between Pi at 10 mins and baseline was 1.3+/-0.6 in the blocked limb.

Conclusion: The PI is characterized by being simple, rapid, and user friendly compared with other objective methods for evaluation of block success.

Keywords: Ultrasound, Brachial Plexus, Pulse Oximeter.

Introduction

In this prospective observational study, 60 Patients undergoing upper limb surgery under ultrasound guided brachial plexus block in a tertiary care hospital were studied over a period of 1 year. Sample size was calculated with alpha error 0.05 and a power of 80 % with an effect size of 0.5 in reference to study by Abdelnasser and Abdelhamid [6] et al, total sample size is 54, calculated by G Power software 4.0.

A routine pre-operative assessment was ensured and the whole procedure was explained. On entering in the operating room, standard intraoperative monitors such as electrocardiogram, [2] pulse oximeter on both upper limbs, and non-invasive blood pressure were attached and baseline parameter were recorded. A baseline assessment of pin prick sensation was made in the distribution of each of ulnar, median, radial, and musculo cutaneous nerves before the performance of the block. The supraclavicular nerve block was performed under guidance of a linear transducer (8–14MHz; Acuson x300; Siemens Healthcare, Seoul, Korea) over the supraclavicular fossa in the coronal oblique plane immediately superior to the midclavicular point. The block was induced in the semi-sitting position, with the head of the patient turned away from the side to be blocked. A 22-gauge insulated block needle was inserted in-plane (lateralto medial) to the ultrasound probe. The brachial plexus was identified as a compact group of nerves, hypo-echoic, round or oval, located lateral and superficial to the pulsatile subclavian artery and superior to the first rib. Volume of 25ml of local anaesthetic (bupivacaine 0.5%, 12.5ml and lidocaine 2%, 12.5ml) was injected under vision strictly perineural to surround all the nerve cords. The limb was evaluated for block success every 3 min for the sensory block and every 5 min for the motor block.

Sensory function was assessed using pinprick in the dermatomal areas supplied by the four main nerves (median nerve, radial nerve, ulnar nerve, and musculocutaneous nerve). Motor block was assessed by the ability to flex the elbow and the hand against gravity. The supraclavicular nerve block was considered successful with regard to

neurological examination when brachial plexus dermatomes (C5–T1) were completely blocked. The gold standard for unsuccessful block was the need for general anaesthesia because of pain sensation at the site of the operation.

The PI was measured using Masimo SET pulse oximetry (Masimo Corporation, Irvine, CA, USA) applied on the index finger. The PI was recorded at baseline and at 10, 20, and 30 min after local anaesthetic injection in both the blocked limb and the contralateral unblocked limb using two separate oximeters.

The Delta PI was calculated as the ratio between the PI at 10 min after injection and the baseline PI. In every patient, a comparison between the blocked and unblocked limb was performed.

Results

Statistical calculations were performed using the Statistical Package for the Social Sciences (SPSS) software version 15 for Microsoft Windows (SPSS Inc., Chicago, IL, USA). Categorical data will be presented as frequency (percentage). Continuous data will be presented as mean (SD) or median (quartiles) as appropriate. Data will be tested for normality using the Shapiro–Wilk test. Comparison of PI between blocked and non-blocked limbs will be done using analysis of variance for repeated measures with post hoc pairwise comparisons using the Bonferroni test. Among 60 patients, 63% patient was male.

Mean and Standard Deviation of Perfusion Index of 60 patients at Baseline, 10, 20, and 30 mins of the blocked and unblocked limb were analysed and Pi of blocked limb was significantly higher($p<0.05$) than unblocked limb at all intervals.

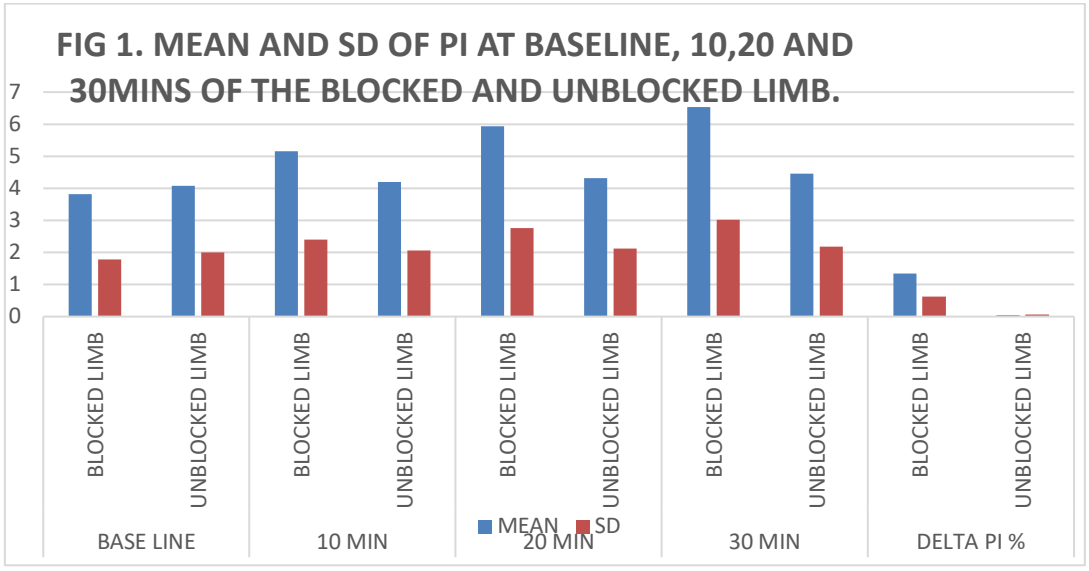

Figure 1:

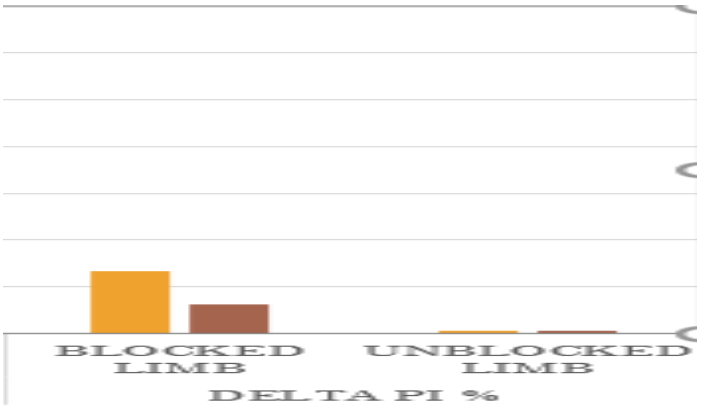

Figure 2: Mean and Standard Deviation of Delta Pi of Blocked and Unblocked Limb

Heart Rate and Mean Arterial Pressure of the patient was correlated with the change in perfusion index and there was no significant correlation (p=0.9)

Table 1:

Variables	N	Pearson Correlation	P Value
Heart Rate	60	0.43	0.9
Pi	60		

Table 2:

Variables	N	Pearson Correlation	P Value
Mean Arterial Pressure	60	0.21	0.9
Pi	60		

Discussion

The success of peripheral nerve blocks is usually evaluated by assessment of sensory and motor function; however, this method is subjective, time consuming, and depends on patient cooperation.

The perfusion index (PI) is a numerical value for the ratio between pulsatile and non-pulsatile blood flow measured by a special pulse oximeter. Although the special probe for PI measurement is relatively more expensive compared with ordinary pulse oximeter probes, its benefits as a marker of peripheral perfusion and as an index for sympathetic stimulation have increased its use progressively in many institutes. Few data are available for the PI as a tool for evaluation of peripheral block success.

PI is an indicator of peripheral blood flow, and peripheral blood flow in the upper limbs is a clinical sign of an effective block, increased PI on the side of the block may be a reliable means to determine the efficacy of infraclavicular block.

PI reflects changes in vasomotor tone which is influenced by sympathetic activity, pain, and temperature, factors which vary by patient. Hence, block effectiveness can be evaluated only by detecting the rate of increase of PI from the baseline value.

Among 60 patients who were given a supraclavicular brachial plexus block, the perfusion index of the blocked limb was higher than the unblocked limb at all intervals indicating that perfusion index can be used to assess the success of supraclavicular brachial plexus block.

The Mean Delta Pi calculated as the difference between Pi at 10 mins and baseline was higher in the blocked limb and the mean was 1.3+/- 0.6.

In a study conducted by Kus, Gurkan et al [21] in 2013, baseline values of Pi ranged from 0.6 to 4.7 in patients for whom infraclavicular block was effective and 1.8 to 2.4 in patients for who the block failed and hence concluded that block effectiveness can be evaluated by detecting the rate of increase of Pi from baseline value.

In a study by Abdelnasser et al [22] in 2017, successful block was paralleled by an increased Pi when compared with the unblocked limb at 10, 20 and 30 min after anaesthetic injection. Pi ratio of more than 1.4 was calculated to predict successful block whereas in this study Delta Pi of more than 1.3 was considered to be a predictor for successful block.

Conclusion

The PI is characterized by being simple, rapid, and user friendly compared with other objective methods for evaluation of block success. Early and accurate detection of peripheral block success would enable rapid corrective action either by block supplementation or by switching to general anaesthesia; this would save the operating room time and improve patient satisfaction. Objective methods of block success would also avoid excessive patient pinpricking and allow block evaluation in sedated and anaesthetized patients.

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