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Original Research Paper

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PREDICTION OF SUCCESSFUL SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING PULSE OXIMETER PERFUSION INDEX

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ABSTRACT

Background and goals: Supraclavicular approach to brachial plexus block is a popular approach for anaesthesia for upper limb surgeries. Conventional methods for evaluation of block success are time consuming. The aim of this study is to evaluate whether the change in perfusion index (PI) can be used to predict the ultrasound-guided supraclavicular nerve block success.

Methodology: The study was performed after written informed consent from 32 ASA PS I, II patients scheduled for elective hand, wrist and forearm surgery under ultrasound-guided supraclavicular nerve block. After local anaesthetic injection, sensory block success and motor block success was assessed every 5min.The PI was recorded at baseline and at 10, 20min after anaesthetic injection in both blocked and non-blocked limbs. The PI ratio was calculated as the PI after 20min divided by the PI at the baseline.

Results: Baseline values of PI ranged from 0.2 to 3.42 in 32 patients for whom supraclavicular block was performed. At 10 min, percentage increase of PI was (mean ± standard deviation) 484.38 ± 295.80 % from baseline. At 20 min, percentage increase of PI was 557.31 ± 239.25 % from baseline. All changes from baseline were significant ($p < 0.01$)

Conclusion: Perfusion index monitoring may provide a highly valuable tool to evaluate the success of regional anaesthesia of the upper extremity in clinical practice.

KEYWORDS : brachial plexus block, pulseoximetry, perfusion index.

INTRODUCTION

Brachialplexus block is the most commonly performed anaesthetic technique for upperlimb surgeries.it can be done either by landmark guided techniques or ultrasound guided technique. Ultrasound guided brachial plexus block has evolved dramatically over these years.This has led to a better understanding of sonoanatomy. It provides good anatomy of the area of interest in real-time and this imaging helps to visualize neural structures like nerve plexus and peripheral nerves and the surrounding structures like blood vessels and pleura and helps to pass the needle toward the target nerves or facial plane and visualize the extend of local anesthetic spread.

However, the success of peripheral nerve blocks is usually evaluated by assessment of sensory and motor function. The traditional method of assessing the degree of anaesthesia produced by brachial plexus block is based on the repeated use of a painful stimulus, usually pinprick. If sensation is intact, this may be unpleasant and may rapidly destroy the patient confidence. Also pin prick method is subjective, time consuming, and depends on patient cooperation and cognition(7).

Various objective methods for evaluation of block success are evaluation of the sympathetic block(4) and consequent physiological changes, such as vasodilation and changes in blood flow and skin temperature. However, most of the objective methods are either time consuming or dependent on sophisticated equipment.

A successful supraclavicular nerve block for limb surgery is associated with vascular dilatation. Perfusion index (PI), which is automatically calculated by pulse oximetry, provides an indication of peripheral perfusion at the sensor site. The Perfusion Index reflects the ratio between pulsatile and non-pulsatile blood flow and is a measure for the level of vascular dilatation(1). The increase in perfusion index is a good predictor for block success and can be used as an alternative for sensory or motor function tests.

AIM

The aim of the study is to investigate whether perfusion index (PI), a measure of peripheral perfusion from a pulse oximetry finger sensor, is a reliable and objective method for assessing the adequacy of supraclavicular blockade.

METHODOLOGY

This is a prospective observational study. Thirty-two adult patients of age between 18 and 60 years belonging to ASA Physical status I and II posted for hand, wrist and forearm surgeries were included in the study. Exclusion criteria were Patient refusal, ASA III and IV, Cardiovascular or cerebrovascular disease, BMI≥40, Diabetes mellitus, peripheral vascular disease, bleeding disorders, local infection at the site where needle for block was to be inserted, history of seizures, patient allergic to local anesthetics & study drugs.

Period of study was three months

After Institutional Review Board approval and written informed consent 32 patients scheduled for upper limb surgery were selected. Patients were shifted to Operating room and 18-gauge iv line was secured. Routine monitors - ECG, automated NIBP, pulse oximetry (SPO2) were connected for intraoperative monitoring. Baseline Pulse Rate, Systolic and Diastolic Blood Pressure, SPO2 were recorded. Premedication included ranitidine (50 mg) and midazolam (0.03mg/kg)

The baseline perfusion index is measured in the supine position using pulse oximeter probe of Philips medical system (Andover, MA 01810 USA) which was attached to the left index finger and right index finger of all patients to ensure uniformity in measured PI values.

After performing USG guided supraclavicular block with 30ml of local anaesthetic solution (bupivacaine 0.5% 15ml and lidocaine with adrenaline 2% 15ml),the PI was recorded at 10 and 20min in both the blocked limb and the contralateral unblocked limb using two separate oximeters of the same manufacturer.The PI Ratio was calculated as the ratio between the PI at 20 min after injection and the baseline PI.In every patient, a comparison between the blocked and unblocked limb was performed.

The limb was evaluated for block success every 10 min for the sensory block and motor block until 20 mins after injection. Sensory function was assessed by testing cold sensation in the dermatomal areas supplied by the four main nerves (median nerve, radial nerve, ulnar nerve, and musculocutaneous nerve).

The sensory blockade was graded as 0,1,2 with 0 as no loss, 1 as

partial loss and 2 as complete loss.

The motor block was evaluated using the forearm flexion, dorsiflexion of wrist, finger opposition and finger abduction (for the musculocutaneous, radial, median, and ulnar nerves, respectively). The motor block was graded as 0,1,2 with 0 as no loss of power, 1 as able to resist with less force and 2 as complete loss of power.

The quality of the block was evaluated in the intraoperative time: Satisfactory block is defined as either surgery without patient discomfort or without the need for supplementation or sensory and motor blockade of grade [2].

Unsatisfactory block is defined by a sensory region involved in the surgery is not completely anesthetized and the block was supplemented by Inj.Fentanyl 2mcg/kg body weight or sensory or/and motor blockade of grade 1 or/and 2

Complete failure if the patient still experience pain despite supplementation and general anesthesia was induced by the attending anesthesiologist.

PRIMARY OUTCOME

Correlation between successful supraclavicular block and change in perfusion index Parameters monitored were Demographic data including Age, weight, height of the individual, Preop baseline values (PI, SBP, DBP, MAP, HR, SPO2), Time of supraclavicular block performed, Intra operative change in perfusion index(PI), Time of onset of sensory blockade, Time of onset of motor blockade, Success of blockade, Duration of surgery

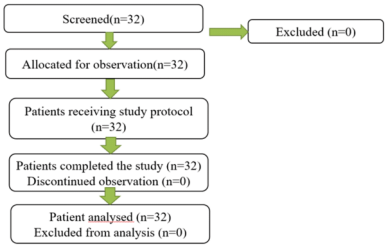

Figure 1: Consort diagram

STATISTICAL ANALYSIS

Sample size was calculated from a previous study(1), assuming 95% confidence interval, the power of study of 80% and α of 0.05,at least 28 patients were required. On anticipating 10% dropout, 32 patients were included. The data obtained were subjected to statistical analysis using paired student t test. The Statistical Software SPSS 23.0 were used for the analysis of the data and Microsoft word and Excel were used to generate graphs, tables etc. The value of $P < 0.05$ was considered significant.

RESULTS

Demographic variables were comparable between the two groups.

Table 1: Patient Characteristic data. Data presented as Mean(SD) or n(%)

Characteristic	Value
Age (yr)	32.8(12.9)
Male [n(%)]	21(65%)
BMI (kg/m2)	23.7(3.2)
Duration of surgery(min)	47.6(18.05)

Perfusion index was significantly increased in blocked arm at 10min and 20 min when compared to the unblocked arm. Perfusion Index ratio at 20min was also higher in the blocked arm when compared to the unblocked arm

Figure 2: Comparison of Perfusion index between blocked and unblocked arm

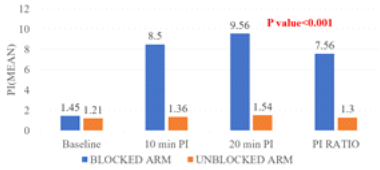

Table 2: Perfusion Index. Data are presented as Median (Range) and Mean (SD)

Perfusion index	Blocked arm(n=32)	Unblocked arm(n=32)	P value
Baseline			1
Median(range)	1.35(0.3-2.4)	1.15(0.2-3.42)	
Mean(SD)	1.45(0.65)	1.21(0.48)	
10 min			<0.001
Median(range)	8.85(0.3-4.06)	1.1(4.5-15.94)	
Mean(SD)	8.50(2.59)	1.36(0.77)	
20 min			<0.001
Median(range)	9.5(0.3-3.9)	1.2(4.4-13.2)	
Mean(SD)	9.56(2.22)	1.54(0.84)	
Pi ratio			<0.001
Median(range)	7.05(0.55-4.2)	1.1(3.3-13.5)	
Mean(SD)	7.56(3.32)	1.3(0.67)	

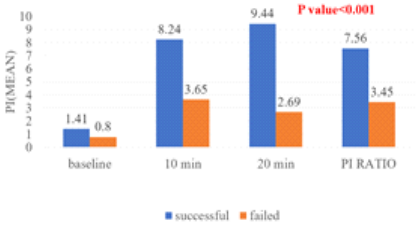

Figure 3: Perfusion index values at different time intervals in patients with successful and failed blocks

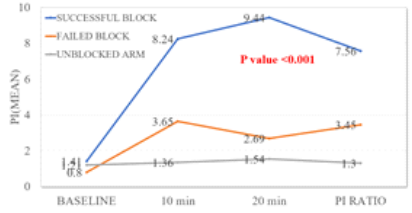

Figure 4: Perfusion index values at different time intervals in patients with successful and failed block and unblocked arm

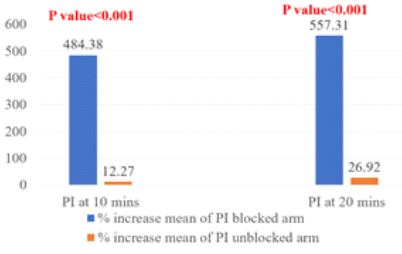

Figure 5: Percentage increase in Perfusion index

DISCUSSION

Objective methods for block assessment depend on the evaluation of the sympathetic block and consequent physiological changes, such as vasodilation and changes in blood flow and skin temperature.

However, most of the objective methods are either time consuming

or dependent on sophisticated equipment (thermographic temperature measurement(9),laser Doppler perfusion imaging(8) and skin electrical resistance(7)).

A relative increase in pulsatile flow in states of vasodilation leads to an increase in the PI.

This study shows that the PI and the PI ratio are predictive for a successful supraclavicular nerve block.

The PI can therefore be considered as an objective measure for peripheral perfusion that can predict peripheral block success The baseline PI was comparable between blocked and nonblocked limbs.

A successful block was paralleled by an increased PI when compared with the unblocked limb at 10 and 20min after anaesthetic injection. The PI ratio was higher in the blocked limb compared with the unblocked limb.

Both the PI at 10min and the PI ratio showed a good ability to predict block success which was earlier than the subjective method, where we wait for 20 min to assess the block success

LIMITATION

Delay in start of surgical procedure
Values are reported at wide intervals (10 min). We designed our measures according to the available data that reported the average time for PI to reach a significant value

Low number of failed blocks

We considered all failed blocks as one group without grading the degree of success (according to the number of anaesthetized segments)

CONCLUSION

Perfusion index monitoring may provide a highly valuable tool to quickly evaluate the success of regional anesthesia of the upper extremity

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