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EVALUATION OF PULSE-OXIMETRY PERFUSION INDEX AS A TOOL FOR ASSESSMENT OF EFFICACY OF RESCUE ANALGESIA IN POST OPERATIVE PATIENTS

Anaesthesiology

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ABSTRACT

Background: Pain in post operative patients is underestimated due to difficulty of its assessment. Various scales and hemodynamic changes are used for pain assessment which are difficult to assess and sometimes not reliable. Masimo pulse oximetry derived perfusion index is a simple non-invasive, rapid and objective tool for pain evaluation in post operative patients. **Objective:** To evaluate usefulness of perfusion index as objective indicator of pain after rescue analgesia administration in post operative patients. **Materials And Methods:** Data were collected from 120 non intubated post operative patients of age group 18 to 80 years. Masimo pulse oximetry probe was connected to the patients. At the first request of analgesia (T1) perfusion index, BPS-NI, patients haemodynamic were recorded following which rescue analgesia was given. Second measurements of the above parameters were taken again thirty minutes there after (T2). **Results:** There was significant increase of perfusion index with significant decrease of BPS-NI, MAP, heart rate following rescue analgesia administration. There was no significant change in mean axillary temperature, peripheral oxygen saturation following rescue analgesia. **Conclusion:** Pulse oximetry derived perfusion index is a non-invasive, easy method, less time consuming. It can be used for evaluation of pain assessment and assessment of efficacy of rescue analgesia in post operative patients.

KEYWORDS

Post Operative Pain, Perfusion Index, Pulse Oximetry, Rescue Analgesia.

INTRODUCTION:

Pain is underestimated due to the difficulty of evaluation in postoperative patients (Puntillo et al., 2004). Scales like Visual Analogue Scale and Numeric Rating Scale are used for pain assessment. However, these scales cannot be used for patients with communication problems (Tapar et al., 2018). Use of Vital signs has been shown to be neither valid nor reliable for pain assessment since hemodynamic changes are affected by numerous other aetiologies (Barr et al., 2013). The behavioural pain scale (BPS), whether used in intubated or non-intubated forms, be used to determine the presence of pain in adult patients unable to self-reporting (Gélinas et al., 2017). The Behavioural Pain Scale-Nonintubated (BPS-NI) requires numerous points of evaluation, time-consuming and impractical (Chanques et al., 2009).

Masimo set pulse oximetry device can be a quick, easy, non-invasive and objective instruments for pain assessment. It can calculate the relationship between pulsatile and static blood in peripheral tissues to determine the perfusion index (PI) at the monitored site. It relies on the volume of blood at the monitoring point rather than blood oxygenation, in contrast to a typical pulse oximeter. Perfusion index (PI) is viewed as an indirect, non-invasive and continuous indicator of peripheral perfusion. Perfusion index ranges between 0.02% (very weak pulse strength) and 20% (very strong pulse strength) (Chung et al., 2018). The sympathetic nervous system is activated by pain, which results in vasoconstriction and a decrease in the perfusion index (PI) (Hagar et al., 2004). The perfusion index (PI) may be used as an indirect, objective technique for measuring pain as a result of the direct relationship between pain and sympathetic activation.

AIM OF THE STUDY:

To evaluate usefulness of pulse oximetry derived perfusion index as indicator of pain after rescue analgesia administration in post operative patients.

MATERIAL AND METHODS:

With proper approval from the Institutional Ethics Committee of Assam Medical College and Hospital, the current hospital-based prospective observational study was conducted under the Department of Anaesthesiology and Critical Care in the Department of Surgery of Assam Medical College and Hospital, Dibrugarh for a year (June 2021 to May 2022). Taking 95% confidence interval with a power of 90% an expected correlation of 0.30, the sample size for the present study was calculated and rounded off 120 post-operative patients.

Inclusion criteria of the study were patients with 18 to 80 years aged with ASA physical status I-III, non-sedated (RASS SCORE ≥0), extubated postoperative patients of appendicectomy, splenectomy, hernia repair, cholecystectomy. Depending on baseline perfusion index, patients were divided into two groups- Patients with perfusion Index (PI) >3.5, with perfusion Index (PI) ≤3.5.

Exclusion Criteria included patient with high fever(>41.1^{0}C), hypothermia (<36^{0}C), history of neurological, psychiatric, dementia or chronic pain disorder, unconscious patient (RASS score ≤ -1), with combined general epidural anaesthesia or transversus abdominis block, intraoperative and postoperative severe bleeding(≥750ml). Written informed consent were taken from all patients. Any cost incurred during the study were borne by the researcher.

Study Manoeuvre:

Postoperative assessment was done on arrival to postoperative ward after extubation and full recovery. All baseline readings were recorded post operatively after standard monitors were being applied. All patients were supplemented with oxygen via nasal cannula at the rate of 4-6L/min. The pulse oximeter probe was attached to the middle finger tip of the hand after ensuring stable position of the patient and wrapped in a towel to decrease heat loss. The patients were kept warm to maintain axillary temperature 36.2-37.5^{0}C with wool blankets, warm i.v. fluids (37 -41^{0}C). All patients were observed until they asked for rescue analgesia. The sedation of patients was assessed by Richmond Agitation Sedation Scale Score (RASS) at specific timings: on arrival to ward after extubation and full recovery, after 1hour and 2 hours of arrival. Patients were given 1 gm iv paracetamol repeated every 6 hour and 5 mg nalbuphine increments upon patient's request or if behavioural pain scale non-intubated scoring system (BPS-NI) greater than equal 5 whatever first came. At the time of first request of rescue analgesia (T1), behavioural pain scale non-intubated scoring system (BPS-NI) were recorded with perfusion Index (PI), heart rate, mean arterial blood pressure (MAP), peripheral oxygen saturation,

axillary temperature following which 1gm paracetamol iv and 5mg nalbuphine iv were given. Second measurements for the same parameters were taken 30 minutes after recue analgesia administration (T2).

Statistical Analysis:

The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) and Microsoft Excel 2010. Results on continuous measurements were presented as mean ± standard deviation re compared using student t test. Discrete data were expressed as number (%) and were analysed using Chi square test and Fischer's exact test (where the cell counts were <5 or 0). For all analyses, the statistical significance was fixed at 5% level (p value <0.05).

RESULTS

120 post operative patients undergoing appendicectomy, splenectomy, hernia repair, cholecystectomy included in the analysis. Characteristics of study population and operative details shown in table below.

Table 1: characteristics of study population

Variables		PI > 3.5	PI ≤3.5
Sex	Male	33 (55.00%)	32 (53.33%)
	Female	27 (45.00%)	28 (46.67%)
Age (years)	18-30	17 (28.33%)	18 (30.00%)
	31-40	16 (26.67%)	9 (15.00%)
	41-50	8 (13.33%)	13 (21.67%)
	51-60	12 (20.00%)	12 (20.00%)
	61-70	4 (6.67%)	7 (11.67%)
	71-80	3 (5.00%)	1 (1.67%)
Weight (kg)		64.75 ± 13.00	65.75 ± 10.16
ASA	ASA I	18 (30.00%)	18 (30.00%)
	ASA II	26 (43.33%)	30 (50.00%)
	ASA III	16 (26.67%)	12 (20.00%)

Table 2: operative details

Variables		PI > 3.5	PI ≤3.5
Surgical Procedure	Appendicectomy	11 (18.33%)	12 (20.00%)
	Splenectomy	1 (1.67%)	0
	Hernia repair	13 (21.67%)	12 (20.00%)
	Cholecystectomy	35 (58.33%)	36 (60.00%)
Mean operative time (minutes)		65.92 ± 19.52	65.25 ± 20.39
Mean volume of transfuse blood (ml)		178 ± 41.80	185 ± 46.62
Mean intra-operative dosage (mg of morphine equivalent)		5.92 ± 5.47	6.33 ± 5.60
Mean time of first request of analgesia (minutes)		32.83 ± 12.05	34.34 ± 12.98
Request of rescue analgesia (%)	Paracetamol I.V.	60 (100%)	60 (100%)
	Nalbuphine I.V.	8 (13.33%)	29 (48.33%)

Table 3: Showing Mean BPS-NI Score

Mean BPS-NI Score	PI > 3.5			PI ≤ 3.5			p value*
	Mean	± S.D.	p value*	Mean	± S.D.	p value*	
Before Analgesia	5.42	0.50	–	5.62	0.61		0.052
30 minutes after Analgesia	3.55	0.62	<0.001*	3.25	0.44	<0.001*	0.003*

Table 3. states mean BPS-NI Score in the group with PI >3.5 decreased significantly 30 minutes after analgesia (P value <0.001). The group with PI≤ 3.5 also showed significant decrease (P value <0.001) after rescue analgesia. There was significant decrease of mean BPS-NI score in the group with PI≤ 3.5 with respect to the group PI>3.5 (P value 0.003) after administration of analgesia.

Table 4: Showing Mean Heart Rate (beats/min)

Mean Heart Rate (beats/min)	PI > 3.5			PI ≤ 3.5			value*
	Mean	± S.D.	p value*	Mean	± S.D.	p value*	
Before Analgesia	98.35	13.03		95.55	10.97		0.205
30 minutes after Analgesia	89.28	10.79	<0.001*	84.42	10.17	<0.001*	0.012*

Table 4. states mean HR in the group with PI >3.5 were decreased significantly after 30 minutes of analgesia (P value <0.001). The group with PI≤ 3.5 also showed significant decrease in mean HR after rescue analgesia (P value<0.001). There was significant decrease of mean HR in the group with PI≤3.5 with respect to the group with PI>3.5 (P value 0.012) after analgesic administration.

Table 5: Showing Mean Arterial Pressure (mmHg)

MAP (mmHg)	PI > 3.5			PI ≤ 3.5			p value*
	Mean	±S.D.	p value*	Mean	±S.D.	p value*	
Before Analgesia	90.12	8.66		88.75	7.68		0.362
30 minutes after Analgesia	82.83	8.45	<0.001*	79.62	7.38	<0.001*	0.028*

Table 5 states MAP (mmHg) in the group with PI >3.5 were decreased significantly after 30 minutes of analgesia (P value <0.001). MAP of the group with PI≤ 3.5 also decreased significantly (P value <0.001) after rescue analgesia. There was significant decrease of MAP in the group with PI≤3.5 compared to the group with PI>3.5(P value of 0.028).

Table 6: Showing Mean Axillary Temperature

Mean Axillary Temperature	PI > 3.5			PI ≤ 3.5			P value*
	Mean	±S.D.	P value*	Mean	±S.D.	P value*	
Before Analgesia	37.45	0.29		37.38	0.24		0.154
30 minutes after Analgesia	37.35	4.83	0.090	37.29	0.26	0.073	0.335

Table 6 states mean axillary temperatures in both the groups showed no significant change after 30 minutes of analgesia. There were no significant differences of mean axillary temperatures of both the groups after analgesic administration. (P value 0.335)

Table 7: Showing Mean SpO2

Mean SpO2 (%)	PI > 3.5			PI ≤ 3.5			P value*
	Mean	±S.D.	p value*	Mean	±S.D.	p value*	
Before Analgesia	98.02	1.02		97.82	0.87		0.250
30 minutes after Analgesia	98.30	1.06	0.138	98.13	1.13	0.088	0.406

Table 7 states mean SpO2 (%) of both the groups showed no significant change after 30 minutes of analgesia. There were no significant differences of mean SpO2 in both the groups after analgesia (P value 0.406).

Table 8: Showing Mean Perfusion Index and Percentage Change in PI >3.5

Mean Perfusion Index	PI > 3.5		Percentage (%) Change	p value*
	Mean	±S.D.		
Before Analgesia	3.89	0.26		
30 minutes after Analgesia	4.28	0.25	90.92	<0.001*

Table 8 states mean PI in the group with PI >3.5 were significantly increased after 30 minutes of analgesia (P value <0.001) with percentage change of 90.02%.

Table 9: Showing Mean Perfusion Index and Percentage in PI ≤3.5

Mean Perfusion Index	PI ≤ 3.5		Percentage (%) Change	p value*
	Mean	±S.D.		
Before Analgesia	1.87	0.81		
30 minutes after Analgesia	2.28	0.84	82.09	0.006*

Table 9 states mean PI in the group with PI ≤3.5 were significantly increased after 30 minutes of analgesia (P value 0.006) with percentage change of 82.09%.

DISCUSSION

Pain is an emotional condition that stimulates the sympathetic nervous system, releases stress hormones which result in vasoconstriction. Patient's pain should be assessed for effective management of postoperative pain. Self-report pain scales cannot be used always due to the difference in psychometric stability of patients. Assessment of these patients may be made possible by detecting the relationship between the perfusion index and pain. Our study showed significant increase of PI with significant decrease of BPS NI score, MAP, heart rate after analgesic administration in both the groups while there was no significant change of mean axillary temperatures and mean SpO2 after analgesia.

Similar to our study (Tapar et al., 2018**)** found a statistically significant difference between pre-analgesic and post-analgesic PI values and visual analogue scores in a prospective observational study for 89 patients undergoing minor to moderate surgical procedures, they concluded that increase in pain intensity caused decrease PI values. Another study conducted by (Mohamed et al., 2015) on 82 adult patients undergoing lumbar spine discectomy showed significant increase in PI with a decrease of VAS, HR and MAP with adequate relief of pain with use of paracetamol 1g iv and nalbuphine 5mg iv as rescue analgesia in postanaesthetic care unit (Nishimura et al., 2014**)** in his study observed significant decrease in PI in response to electrical stimulation, they concluded that PI may be a non-invasive method for objective evaluation of pain (Hasanin et al., 2017**)** also found a difference between MAP, PI, HR and pain intensity before and after the pain caused by positioning in ICU patients.

Limitations Of Our Study:

Perfusion index measurements are very sensitive to patient's movements. So, to overcome this, perfusion index measurements should be done after patients' stable position and the room temperature of the postoperative ward may interfere with the perfusion index.

CONCLUSION:

Pulse oximetry derived perfusion index is a non-invasive, easy method, less time consuming, can be used for evaluating pain and assessing the effectiveness of rescue analgesia in post operative patients. It also eliminates psychological factors so more useful to assess pain and to determine the effectiveness of analgesia in patients suffering from cognitive impairment and dementia.

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