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Pulse Oximetry Derived Perfusion Index As A Predictor Of The Efficacy Of Rescue Analgesia After Major Abdominal Surgeries

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Abstract:
Background*: Perfusion index is an assessment of the pulsatile strength at a specific monitoring site and as such PI is an indirect and non-invasive measure of peripheral perfusion. The changes in sympathetic tone affect smooth muscle tone and can alter the perfusion, but are not affected by saturation and HR variability.so this study was conducted to assess the perfusion index and its effectiveness on requirement of rescue analgesia.*
Materials and Methods: *A Prospective observational study was conducted among 30 who were undergoing major abdominal surgeries at R.L. Jalappa Hospital and Research Centre, Tamaka, Kolar. Sampling Method was Convenient sampling.*
Results *This study was conducted among 30 patients. The mean age of study participants 32.1 + 12.4 years. Females were more compared to males. The mean height was 156.4 cm and the mean weight was 71.2kg. Pre analgesic vitals findings, the mean HR was 62.5/min, mean RR was 13.1/min, the mean spo2 was 98% and the MAP was 70 mmhg. Post analgesic vitals findings, the mean HR was 92.5/min, mean RR was 15.5/min, the mean spo2 was 97% and the MAP was 80 mmhg. There was a statiscally significant difference between pre analgesia and post analgesia perfusion index.*
Key Word: *Pulse oximetry, Perfusion index, Rescue analgesia, Prognosis.*

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I. Introduction

Perfusion index is an assessment of the pulsatile strength at a specific monitoring site and as such PI is an indirect and non-invasive measure of peripheral perfusion.

1 Anaesthesia is a state of analgesia, unconsciousness, and muscle paralysis.
2 Quantification of nociception under anaesthesia is difficult, and therefore, reaction to nociception is used for monitoring it through increased sympathetic activity or the corresponding decreased parasympathetic stimulation (i.e., increased heart rate (HR)).
3 The changes in sympathetic tone affect smooth muscle tone and can alter the perfusion, but are not affected by saturation and HR variability. 4 Scarcity of literature regarding correlation between VAS score, Rescue analgesia and pulse oximetry derived perfusion index.

II. Aims & Objectives

- To assess the perfusion index and its effectiveness on requirement of rescue analgesia.
- To find out correlation between perfusion index and VAS score.

III. Materials And Methods

A Prospective observational study was conducted among 30 who were undergoing major abdominal surgeries at R.L. JALAPPA Hospital and Research Centre, Tamaka, Kolar. Sampling Method was Convenient sampling.

Sample size calculation:
Sample size was calculated by using open Epi.info software.
Confidence interval = 95%
Power of the test = 80%
Ratio of unexposed/exposed sample =20
Percent of exposed with outcome= 95
So, total sample size= 30.

Inclusion criteria

- Patients more than 18 years of age who will be undergoing major abdominal surgeries.

Exclusion criteria

- Patients who will not give consent for participation
- Patients with abnormal hemodynamics and unconscious.
- History of psychiatric illness.

The study was started after Institutional Ethical Clearance (IEC). Patients were included in the study after obtaining written, informed consent taken from patient. Patient baselines include age, sex, vital signs, ASA Grade, and VAS score as well as perfusion index were noted before and after anaesthesia. Vital signs include Heart rate (HR), temperature(C), mean arterial pressure (MAP), Respiratory rate (RR) was recorded.

Data were collected by using predesigned semi structured questionnaire. Age, gender, ASA Grade, comorbidities and RR, PR, Spo2, BP, MAP, VAS Score and PI were observed and noted.

Statistical analysis:

Collected data were coded and entered into a Microsoft excel sheet. All the quantitative measures were presented by (Mean +/- SD) and analysed using z test and Anova test. Qualitative data were described as frequency and percentages. P value less than 0.05 considered as a statically significant.

IV. Results

Figure 1 showing distribution according to age of study participants

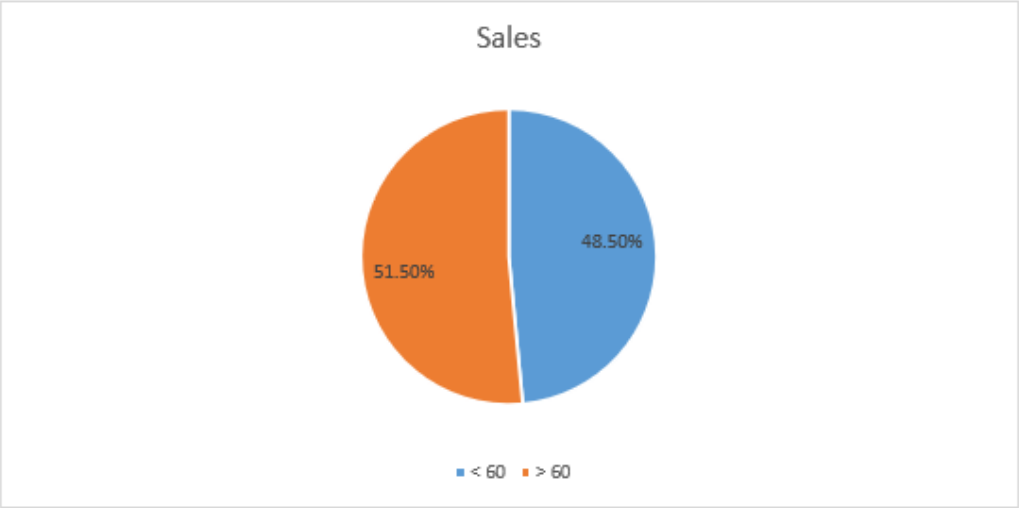

Figure :2 showing distribution according to groups

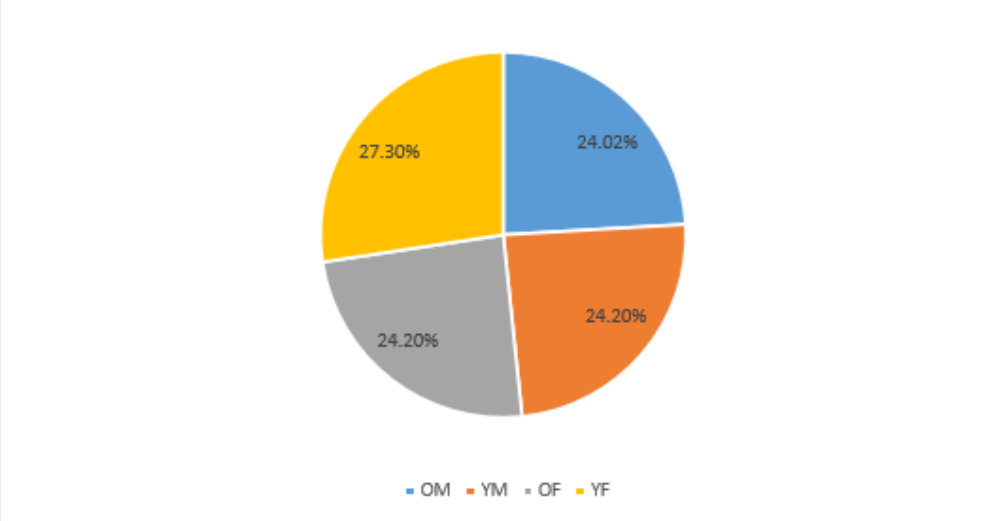

Table 2 Showing Mean and SD in study population

Variable	Mean	SD	Minimum	Maximum
Age	55.85	17.943	18	80
Volume of transfused blood (ml)	183.03	100.7	0	350
Intraoperative opioid dosage (mg of morphine equivalent)	17.12	2.5	15	20
Operative time (hr)	2.33	0.777	1	4
TFA request (min)	33.64	16.92	10	60

Table 3. Comparison of pain score, PI and other indicators of pain before and after analgesic administration.

Variable	Before analgesia	After analgesia	P-value*
BPS-NI score	5.4 ± 0.7	3.94 ±0.788	**< 0.0001***
PI	1.15 ± 0.442	2.12 ±0.960	**< 0.0001***
MAP	84.18 ± 9.319	80.82 ±10.719	0.1787
HR	99.61 ±9.500	63.88 ±40.82	**< 0.0001***
Axillary temperature	37.12 ±0.415	37.21 ±0.415	> 0.999
SpO2 (%)	97.97 ±1.0159	97.88 ±1.219	0.7455

Figure 3 showing comparison of mean before and after analgesia

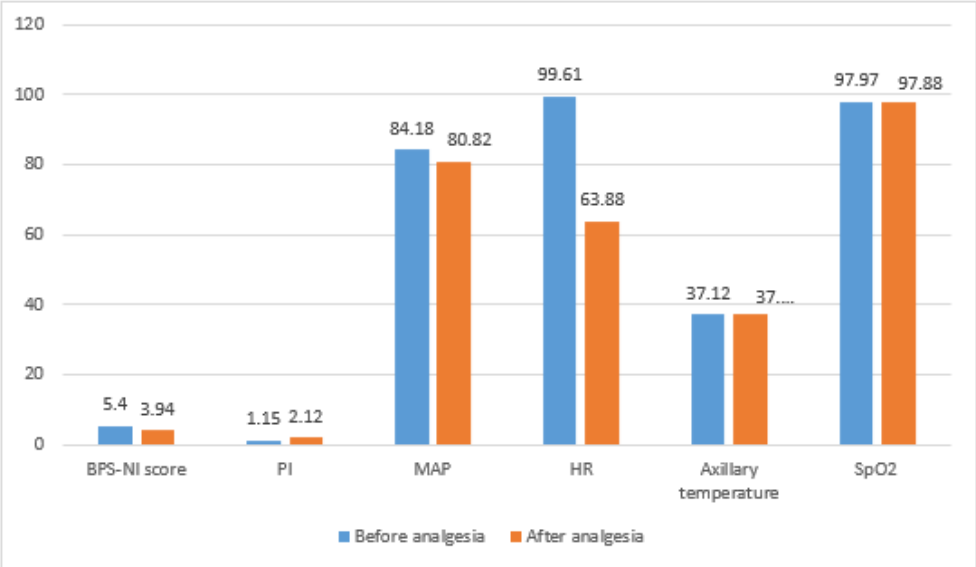

Table 4. Correlation of PI with pain score and other clinical indicators of pain before and after administration of analgesic.

Before analgesic		**PI**	
	Variable	**rho**	**P-value**
	BPS-NI	0.042	0.816
	MAP	0.219	0.220
	HR	0.111	0.537
	Axillary temperature	0.67	0.710
	SpO2	0.136	0.466
After analgesic		**PI**	
	Variable	**rho**	**P-value**
	BPS-NI	0.258	0.148
	MAP	0.515	**0.002***
	HR	0.348	**0.047***
	Axillary temperature	0.90	0.617
	SpO2	0.253	0.155

V. Discussion

Peripheral tissue, such as finger tips or ear lobes, has a pulse-to-non-pulsatile blood flow ratio, or PI. The two-component absorption of red and infrared light is the basis for the finger photoplethysmographic waveform. The initial element consists of the steady stream of light that is absorbed by pigment, bone, tissue, skin, and non-pulsatile blood. [5,6] It is said that a variable amount of light makes up the second component. The pulsatile arterial blood flow is used to measure it. The infrared pulsatile signal is indexed against the non-pulsatile infrared signal and expressed as a percentage for the purpose of PI computation.[7] The range is very weak pulse strength (0.02%) to very robust pulse strength (20%).[8]

Because ain stimulates the sympathetic nervous system, it causes vasoconstriction, which lowers PI.[9] Given the clear correlation between pain and sympathetic nerve stimulation, it is possible to assess pain using PI.[10] According to Lee et al. [11], measurements obtained from finger photoplethysmography seem appropriate for tracking activation of the autonomic nervous system. The utility of PI values for evaluating postoperative pain and analgesic response in the recovery room was assessed by Tapar et al. [12]. Based on the findings of Lee et al. [11] and Tapar et al. [12], this investigation was created to evaluate how patients undergoing general anaesthesia responded differently to painful stimuli.

The painful stimulation used to accomplish this was the piercing of the abdominal wall to introduce a port during laparoscopic cholecystectomy procedures. Comparing P2 and P3 to P1, the PI values were lower. The subsequent port insertion's painful sensations were lessened by the analgesic impact of fentanyl, as evidenced by the statistically significant drop in the PI value. Our results may be supported by those of another study, which found that applying electrical current to the anterior thigh of two healthy individuals who were given propofol for anaesthesia and were kept sevoflurane-free at varying concentrations (1%, 1.5%, 2%, and 2.5%) may be a useful clinical tool for measuring pain during the anaesthetised state. [5]

The unpleasant stimulus resulted in a drop in PI and an increase in HR and MAP.[6] In a trial involving fifty children who were going to have inguinal herniorrhaphy, four Masimo SET radical pulse oximeters were attached, one on each limb, and anaesthesia was produced using nitrous oxide-oxygen-sevoflurane via mask. A single-shot lumbar epidural block using 0.2% ropivacaine (0.7 ml/kg) was administered to the patients. The PI values of the patients' lower limbs were substantially higher than their upper limbs four minutes after they received the lumbar epidural injection dose.

Patients with symptoms indicative of a failed epidural block demonstrated a lower average PI of the lower limbs, leading researchers to conclude that PI value was a valuable tool for assessing the impact of epidural block and also demonstrated how analgesia affected PI in patients under anaesthesia.[13] In the current study, analgesia was administered, and there was a substantial increase in PI and drop in HR, but not a significant decrease in MAP. After analgesia was administered, there was a correlation between an increase in PI and a decrease in HR and MAP. Increased PI was significantly correlated with decreased HR, MAP, VAS, SBP, and DBP after analgesia was administered, and vice versa in studies cited above on painful stimuli. Similarly, in our study, there was a significant ($P < 0.001$) correlation between increased PI and decreased HR after analgesia was administered. [14,15]

VI. Conclusion

Perfusion index can be added to other indicators of pain assessment in ICU. It is easy, non-invasive, free of subjective interpretation, less time-consuming and finally, not affected by age or sex related factors.

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