"ASSESSMENT OF PERFUSION INDEX AS AN OBJECTIVE TOOL TO ASSESS ANALGESIA DURING LAPAROSCOPIC SURGERIES UNDER GENERAL ANAESTHESIA- A ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY"

By

REG NO. BA0121008

Dissertation

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In

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ABSTRACT

TITLE:

"Assessment of perfusion index as an objective tool to assess analgesia during laparoscopic surgeries under general anaesthesia-A one year hospital based cross sectional study"

BACKGROUND:

Anaesthesia is characterized by the absence of pain, loss of consciousness, and muscle paralysis. Proper intra-operative assessment under general anaesthesia plays a very crucial role. Changes in the sympathetic nervous system by pain can impact smooth muscle tone and can alter perfusion which can be monitored by perfusion index (PI), a non-invasive, indirect, and continuous measure of peripheral perfusion.

AIMS:

To assess perfusion index as an objective tool to assess analgesia during laparoscopic surgeries under general anaesthesia and to correlate perfusion index with haemodynamic parameters such as heart rate, mean arterial pressure (MAP) and non-invasive blood pressure.

MATERIALS AND METHODS:

Forty patients between the ages of 20 and 50 years, with informed consent, undergoing elective laparoscopic procedure, and belonging to the American

Society of Anaesthesiologists (ASA) physical status class I were connected with standard monitors along with PHILLIPS INTELLIVUE MP20 pulse oximetry to monitor PI. General anaesthesia was administered. PI, Heart rate (HR), and non-invasive blood pressure were recorded pre-induction, during induction, before and after intubation, at the time of pneumoperitoneum (P0), and first laparoscopic port insertion (P1). Later, intravenous injection of fentanyl 0.5 μg/kg was administered and values were recorded at the second (P2) and third (P3) port insertion. The aforementioned parameters were recorded for up to 30 minutes.

RESULT:

After the administration of fentanyl, from P1 to P2, the Perfusion Index (PI) increased from 2.53 ± 0.22 to 3.02 ± 0.4, and from P1 to P3, it further increased to 3.58 ± 0.44. Conversely, heart rate (HR) decreased from 91.45 ± 5.62 at P1 to 89.72 ± 6.27 at P2, and then to 87.15 ± 5.32 at P3.

CONCLUSION:

Perfusion index serves as an effective monitoring tool in the assessment of nociception in anaesthetized patients while administering analgesia.

KEYWORDS: Perfusion index, nociception, general anaesthesia

LIST OF ABBREVIATIONS

ASA	–	American society of Anaesthesiologists
PI	–	Perfusion Index
HR	–	Heart rate (bpm)
SBP	–	Systolic Blood Pressure (mm Hg)
DBP	–	Diastolic Blood Pressure (mm Hg)
SpO_2	–	Saturation of peripheral oxygen (%)
MAP	–	Mean arterial pressure
PPG	–	Photoelectric Plethysmography
AC	–	Alternating Current
DC	–	Direct Current
GA	–	General Anaesthesia
SPI	–	Surgical Pleth Index
ANI	–	Analgesic Nociceptive Index
VAS	–	Visual Analog Score
ICU	–	Intensive Care Unit
PACU	–	Post Anaesthesia Care Unit
ECG	–	Electrocardiogram
I.V	–	Intravenous
P0	–	Pneumoperitoneum
P1	–	First Laparoscopic port insertion

P2	–	Second Laparoscopic port insertion
P3	–	Third Laparoscopic port insertion
^{o}C	–	Degree Celsius
mcg	–	Micrograms
min.	–	Minutes
kgs	–	Kilograms
cm	–	Centimetres
ml	–	Millilitres
mm Hg	–	Millimetres of mercury
etCO2	-	end tidal CO2
MAC	-	Minimum alveolar concentration

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INTRODUCTION

Anaesthesia is characterized by the absence of pain, loss of consciousness, and muscle paralysis[1]. Proper intra operative assessment and effective management of pain under general anaesthesia plays a very crucial role as it helps maintain hemodynamic stability during the surgery, better surgical environment, improved post operative outcomes with faster recovery.

Measuring the extent of pain response (nociception) during anaesthesia is challenging, therefore it is monitored through the body's physiological indicators, which typically involves elevated sympathetic activation or reduction in the stimulation of parasympathetic stimulation causing increase in the blood pressure and heart rate.

Perfusion index (PI) provides a continuous real time assessment of peripheral blood flow other than being a non-invasive modality[2]. The smooth muscle tone is affected by changes in the sympathetic tone in response to various factors, pain being one of them which can alter the peripheral perfusion.

The Perfusion Index (PI) calculates the perfusion in the peripheral tissues by taking pulsatile component to that of non-pulsatile component ratio of arterial blood flow, obtained from fingertips, earlobes. The waveform derived from the photoelectric plethysmography (PPG) in the finger uses absorption of red & infrared wavelength light and consists of dual components, AC and DC.[3,4,5]

AC (alternating current) represents the difference in the absorption of red & infrared lights attributed to the difference in the diameters of pulsatile vasculature. DC (direct current) denotes absorption of light from the non-pulsatile arterial vasculature, venous vasculature, soft tissues and bones. Perfusion index value is computed as the ratio of AC to DC, with its normal range varying from 0.02% which means poor pulse strength until 20% which signifies strong peripheral perfusion, usually given in the percentage

form.

Due to the stimulation of sympathetic nervous system from a pain stimulus, there is peripheral vasoconstriction due to increase in tone of smooth muscle which leads to decrease in PI[6]. Conversely, with adequate analgesia, there is increase in PI. Hence, PI could be used as a modality for the assessment of intra operative nociception and analgesia based on the direct relationship between pain and stimulation of the sympathetic nervous system.

Laparoscopic surgeries conducted under general anaesthesia provides a good study group for investigation, as revealed in the study by Surekha et al.,[7] for the assessment of nociceptive stimulus and the adequacy of analgesia at different time points by using perfusion index. The insertion of laparoscopic ports which serve as a painful stimulus and the administration of an opioid for analgesia gives a good study frame for using perfusion index as a tool for the assessment of adequate pain control intraoperatively.

There is paucity of clinical studies investigating the impact of a nociceptive trigger on perfusion index general anaesthesia. But there have been proven reports in studies carried out in the post-operative care unit where PI values saw an increase post analgesia administration. Many such similar studies performed with regional anaesthesia in adults and paediatric patients, studies investigating the efficacy of ultrasound guided nerve blocks and assessment of pain scores using perfusion index in post operative care units have shown a significant correlation between pain, any surgical nociceptive stimulus (intra operatively and post operatively), adequacy of analgesia with perfusion index and other hemodynamic parameters. Hence, it makes it plausible to test the theory whether perfusion index could be utilised as a monitoring parameter in the assessment of intraoperative nociception. Hence, we did the study to evaluate the objective usefulness of PI by looking for changes in PI in response to a nociceptive stimulus and the onset of analgesia under general anaesthesia.

AIMS AND OBJECTIVES

Primary objective:

- To assess perfusion index as an 'objective tool to assess analgesia during laparoscopic surgeries under 'general anaesthesia.'

Secondary objective:

- To correlate perfusion index with haemodynamic parameters such as heart rate, mean arterial pressure (MAP) and non-invasive blood pressure.

REVIEW OF LITERATURE

The Perfusion Index (PI) calculates the perfusion in the peripheral tissues by taking the pulsatile component to that of non-pulsatile component ratio of arterial blood flow, obtained from fingertips, earlobes (AC/DC ratio).

Lee et al.[8,9]in 2016 performed a study where surgical pleth index (SPI) and analgesic nociceptive index (ANI) were investigated for their usefulness in the assessment of analgesia in conscious patients during their post operative period who received continuous remifentanil infusion. It was reported that the observations derived from the finger photoelectric plethysmography could be used as a tool for monitoring the response from the autonomic nervous system.

Comparable outcomes[10] were revealed in a 2018 study wherein a positive relationship was established between pain and PI by assessing and analysing the PI scores prior and following the administration of analgesic drug such as morphine in the post operative period. It was found that there was increase in the PI values with decreased VAS scores after the administration of morphine confirming the hypothesis.

Several other studies demonstrated the clinical relevance of assessing pain in an anesthetized state by subjecting the anterior thigh of two healthy individuals to electric current. These individuals received propofol induction and sevoflurane maintenance with different concentrations. The painful stimulus resulted in increase in HR and MAP, accompanied by reduction in Perfusion Index (PI).

Hagar et al[11], conducted research on 50 paediatric subjects posted for inguinal herniorrhaphy. After induction of general anaesthesia with sevoflurane using mask followed by attachment of pulse oximeters on every limb, subjects were administered with single dose of ‘lumbar epidural block’ using ropivacaine. Authors reported a significant increase in the PI value of lower limbs compared

to that of upper limb after the onset of lumbar epidural analgesia. Patients with signs of an unsuccessful epidural block showed reduced PI average values in bilateral lower limbs[12]. This finding led to the conclusion that PI is a valuable tool for evaluating the effectiveness of lumbar epidural block and the relation between analgesia and PI in patients under anaesthesia.

In prospective observational research by Hasanin A et al[13], in a surgical ICU in patients who were not intubated, it was noted that the PI values reduced after giving a nociceptive stimulus. Moreover, this research noted heart rate (HR), invasive blood pressure from the arteries and various other pain scales used in patients who aren't intubated prior to and following the application of a nociceptive stimulus (obtained by change in the position of the patient). The authors noted that repositioning the patient led to a notable rise in SBP, DBP, HR and pain scale values. A significant association was found between the perfusion index and the abovementioned values.

Unfortunately, not many studies have been conducted with 'general anaesthesia' investigating the perfusion index and its response to pain during the surgery but quite a few studies have reported an increment in PI in subjects admitted in post operative care unit setting following analgesic administration. One such study was conducted by Mohammad SA et al[14], on subjects posted for lumbar discectomy in the post operative period. Various hemodynamic parameters along with visual analog scores (VAS), oxygen saturation and axillary temperature were recorded at two different time points T1 and T2. T1 being the time when the patient first asked rescue pain medication (T1) and T2 was the point of observation half an hour after the administration of analgesia. The authors concluded that there was a rise in the PI values from T1 to T2 and the values were significantly more at T2 in comparison to T2. The increment in PI was also associated with the reduction in HR & MAP signifying the fact that PI could be utilised in the assessment of nociception and management in a PACU setting.

A finding similar to that of Lee et al was reported by Chu CL et al[15] in a post anaesthesia care unit setting on 80 patients in 2018 using 3mg of morphine as an analgesic for post operative analgesia. Various hemodynamic parameters along with VAS scores were noted at 10-minute intervals for a period of 30 minutes after giving morphine intravenously. After giving morphine(analgesia), there was a substantial rise in the values of PI and reduced VAS scores. A good extended conclusion of the study revealed: '12% increase in PI'. This could be used as a criteria for discharge from 'PACU.'

Among many studies done with evaluation of perfusion index in regional anaesthesia where an increase in PI could be attributed to the onset of epidural analgesia, an interesting study done by Kupeli I et al.,[16] gave similar findings. The research studied the correlation between increase in PI with the level of labour pain, onset of labour analgesia in patients undergoing normal vaginal delivery with epidural analgesia. The study revealed an increase in the perfusion index after the onset of neuraxial blockade post the administration of 10 ml of 0.25% bupivacaine. Additionally, a gradual decrease in PI was noted as the epidural analgesia wore off.

In a study done in 2022 by Abdelnasser et al[17], on 77 patients posted for elective orthopaedic procedures to evaluate the effectiveness of brachial plexus block (supraclavicular approach performed under ultrasound guidance) using the Perfusion Index (PI). The study followed the PI values for a period of 20 mins after performing the block and found that PI values increased from the baseline and subsequent time points after a successful block. Notably, the concept of the PI ratio—defined as the ratio of PI at a given time point post-block to the baseline PI—proved more insightful for assessing analgesia adequacy than merely noting

an increase in PI values. Similar studies have indicated that a PI ratio exceeding 1.4 is a reliable threshold for determining sufficient analgesia.

Taking the conclusions from Surekha et al.,[7] and similar research studies., we designed the study in order to understand and assess the usefulness of perfusion index as a modality in the assessment of intraoperative pain and adequacy of analgesia by looking for variation in PI values to a nociceptive stimulus and after administration of analgesia in patients posted for laparoscopic surgeries under 'general anaesthesia.'

BASIC SCIENCES

Photoplethysmography (PPG) has been extensively used for pulse oximetry monitoring in anaesthesia, perioperative and intensive care. However, some components of PPG signal have been employed for other purposes, such as non-invasive haemodynamic monitoring.

Perfusion index (PI) is derived from PPG signal and represents the ratio of pulsatile on non-pulsatile light absorbance or reflectance of the PPG signal.[18] PI determinants are complex and interlinked, involving and reflecting the interaction between peripheral and central haemodynamic characteristics, such as vascular tone and stroke volume. Recently, several studies have shed light on the interesting performances of this variable, especially assessing regional or neuraxial block success, and haemodynamic monitoring in anaesthesia, perioperative and intensive care[19]. Nevertheless, no review has yet been published concerning the interest of PI in these fields.

PRINCIPLES OF PLETHYSMOGRAPHY:

The principle of conventional PPG is based on indirect measurement of tissue volume variations by absorbance variations of light beams through this tissue. The oximeter probe generates incident red and ultra-red light beams, whose transmitted intensities are transformed into an electrical current by a photodetector, after penetrating a tissue. [22-24] Another PPG modality (PPG by reflection) uses reflection properties of the light in the tissue, according to the same principle. The photodetector is then placed next to the light source to measure the reflectance of the incident beams. Usually, two wavelengths are used

for PPG: red light (660 nm) and infrared light (940 nm), mainly absorbed by deoxyhaemoglobin and oxyhaemoglobin, respectively. The PPG curve is obtained with infrared light absorption variations. However some PPG devices use one, or more often more than two wavelengths.

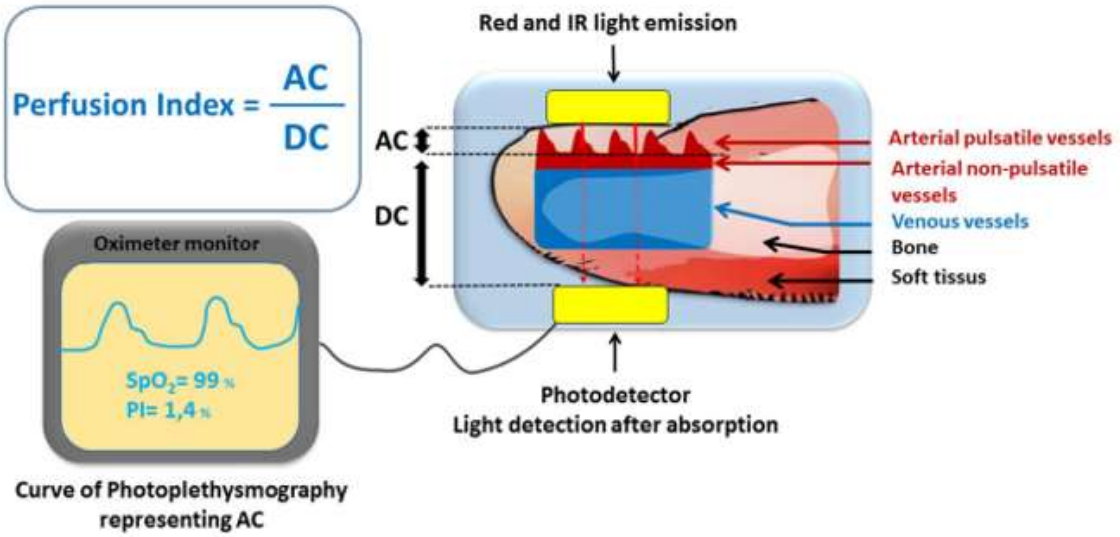


Figure 1: represents the principles of PPG and PI calculation. AC corresponds to the variation of red and IR lights absorption related to the variation of diameters of pulsatile vessels (i.e. arrowed arterial pulsatile vessels on the figure). DC corresponds to the light absorption of: arterial non-pulsatile vessels, venous vessels, bone and soft tissues. PI value is calculated as the AC/DC ratio. AC: alternating current; DC: direct current; IR: infrared light PI: perfusion index; PPG: photoplethysmography.

PI COMPONENTS: ALTERNATING AND DIRECT CURRENTS:

Light absorption varies across the cardiac cycle. The absorption is maximal during the systole, reflecting the dilatation of vessels under the systolic pressure, i.e., the increase of arterial blood volume under the light source. The signal received by the photodetector is then decomposed into pulsatile and non-pulsatile

signals. Pulsatile variations in light absorption, during systole, are commonly referred to as "alternating current" (AC)[22,23]. AC represents variations of absorbance or reflectance of the incident light beams due to pulsatile vessels under arterial pressure variations, i.e. the sum of the variations of the diameters of pulsatile vessels through which the light beams pass. AC then represents a volume variation measurement. It is important to underline that AC is therefore not a flow measurement in those vessels but an indirect measurement of the arterial volume variation during the cardiac cycle. The PPG curve displayed on actual monitors represents AC, derived from the infrared light signal, after signal processing. Restitution of AC requires computer processing of the raw signal received by the photodetector by computer filters to reduce signal artifacts. These manufacturer-dependent algorithms can significantly deform the PPG curve from one manufacturer to another. On the other hand, continuous absorption is referred to as "direct current" (DC), from which AC varies. DC corresponds to light absorption from other tissues, such as non-pulsatile capillaries and venous vessels, skin, soft tissues, and bones. DC is not displayed in current practice on usual oximeter's monitors.

PI CALCULATION: ALTERNATING AND DIRECT CURRENTS RATIO

PI represents the ratio of pulsatile light absorption on continuous light absorption, i.e., the ratio AC/DC. PI, often referred to as "peripheral PI" was initially used as a quality signal indicator for pulse oximetry. However, PI represents the local blood volume variation during systole, and varies according to the systemic and local haemodynamic status. Hence, PI can be used for non-invasive haemodynamic monitoring.

PHYSIOLOGIC VALUE OF PI:

In healthy awake volunteers, when measured at the finger, the mean PI values (± standard deviation) described in two studies were 2.2% ± 2.0 and 3.5% ± 2.4. This means that AC represents only around 2% to 3% of DC, and by analogy in vascular physiology, it means that the blood volume under the sensor increases by around 2% at each heartbeat. However, due to the wide variations in normal values in healthy volunteer (from < 1% to > 10%), it is difficult to propose a reliable normal value of this parameter. Determinants of PI are numerous and complex. When measured in a peripheral site, both AC and DC and their ratio, i.e., PI, are the resultants of systemic and local factors[23,29].

PI IN ASSESSMENT OF NOCICEPTION:

As sympathetic tone is highly affected by nociceptive stimuli, PI signal has been used for nociception assessment during anaesthesia and in critical care. Thus, the increase of vascular tone and MAP following nociceptive stimuli is associated with a decrease in PI[24] .Variation in PI could nevertheless be viewed only as a measurement of haemodynamic variation, i.e., increase of sympathetic tone, following nociceptive stimulation. Hence, it may not be accurate in patients with external control of adrenergic receptors, such as those under high dose of vasopressors or contrarily, in case of pharmacological blockade of their sympathetic tone (e.g., epidural anaesthesia or peripheral nerve blockade).

Physiological and pathophysiological determinants of Perfusion Index:

Factors influencing AC

SYSTEMIC FACTORS-

- Volæmia and venous return
- Diastolic function and inotropism

- Valvulopathy/Vascular tone (sympathetic, parasympathetic and non-adrenergic/non-cholinergic tones)
- Arterial stiffness / Vasoactive and cardiac medications

LOCAL FACTORS:

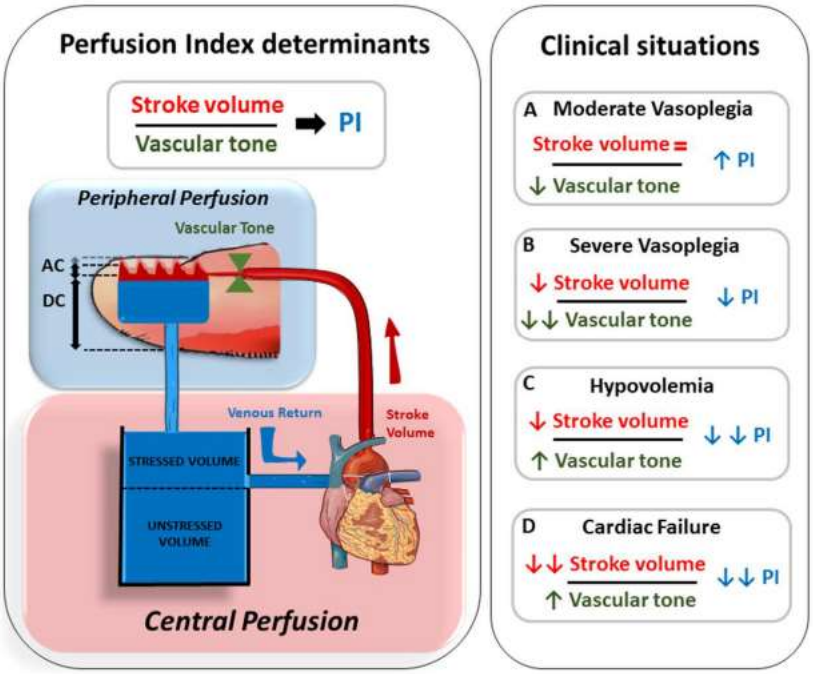
- Obliterant arteriopathy
- Position of the limb in relation to the heart
- Vascular compression
- Local temperature exposure
- Local arterial compliance
- Local vascular tone

FACTORS AFFECTING DC:

-Vascular tone (notably venous tone),Volaemia, position of the limb,body position,Vascular compression, soft tissues compression, local vascular tone.

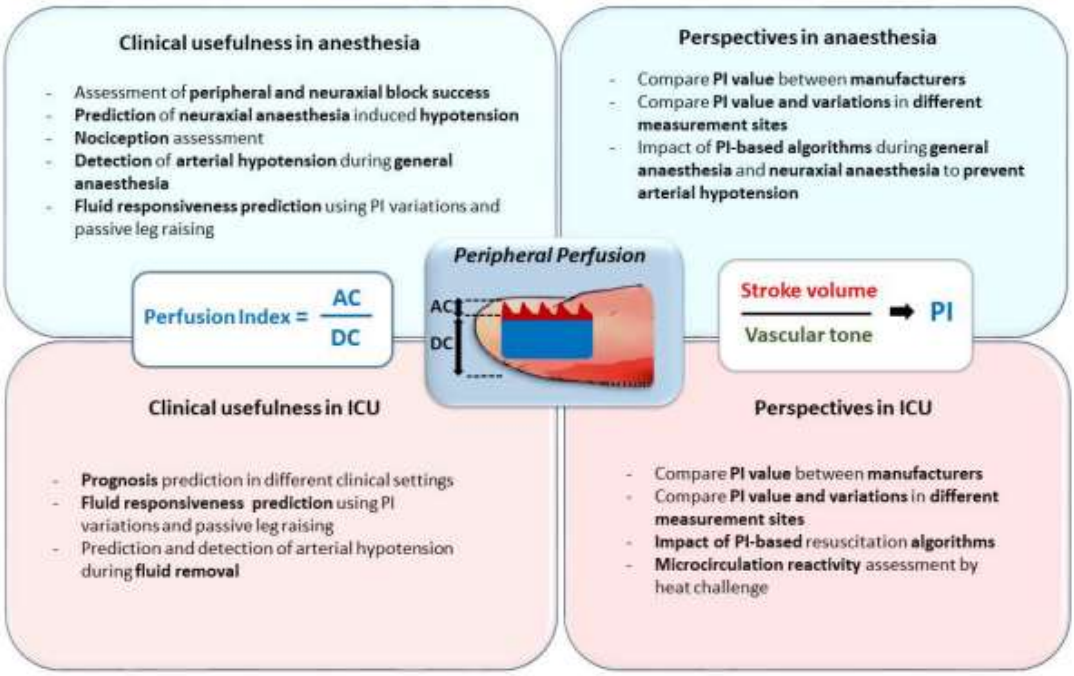
External light,Nail polish, Tissues and vascular extrinsic compressions, Probe and/or patient movements could affect both the components AC & DC. Numerous intrinsic or extrinsic factors influence AC and/or DC, and therefore their ratio, i.e. Perfusion Index. The main determinants are stroke volume and vascular tone, themselves influenced by many factors. Determinants of stroke volume all may influence AC and PI. Volaemia[26], external temperature, stress, nociception, and medications (e.g. norepinephrine, vasodilator effect of anaesthetic drugs, etc.) are determinants of vascular tone and therefore of Perfusion Index.

FIGURE 2: DETERMINANTS OF PI AND TYPICAL CLINICAL SITUATIONS



PI results from the local perfusion balance between peripheral determinants, mainly vascular tone and central determinants, i.e. SV. Situation A represents the components of moderate vasoplegia: decreased vascular tone with single arterial vasodilatation, without significant variations in SV, resulting in an increase in PI. If vasoplegia[27] becomes severe (situation B), with arterial and venous vasodilatation, the drop of stressed volume, venous return and thus SV leads to a secondary decrease in PI, despite the decrease of vascular tone. In situation C and D, i.e. hypovolaemia and cardiogenic shock, the drop of SV and the increase in vascular tone both contributes to a decrease in PI. AC: alternating current; DC: direct current; PI: perfusion index; SV: stoke volume.

FIGURE 3: Summary of clinical usefulness and perspectives of PI use in anaesthesia and critical care:



AC: alternating current; DC: direct current; IR: infrared light; PI: perfusion index; PPG: photoplethysmography; AC: alternating current; DC: direct current

PI is a PPG-derived variable, already given by most devices, measuring perfusion at crossroads between central and peripheral perfusion. It appears to be a useful, non-invasive additional tool for haemodynamic monitoring in anaesthesiology, perioperative and critical care for clinicians. Knowing its determinants is crucial to be able to interpret its variations. Whether the use of PI in resuscitation algorithms would improve patient outcomes remains to be explored[29].

MATERIALS AND METHODS

Source of Data:

Patients aged twenty to fifty years of either gender classified under ASA grade I posted for elective laparoscopic surgery under general anaesthesia at KLE's Prabhakar Kore Hospital and Medical Research Centre, Nehru Nagar, Belagavi-10 during the period from August 2022 to September 2023.

Study Design: Observational study: cross sectional study

Study Period: One year (August 2022-September 2023)

Sample Size:

The formula for determining the minimum sample size is based on the prevalence rate,

$$n = \frac{z_\alpha{}^2 P(1-P)}{d^2}$$

where P represents the prevalence rate and d denotes the percentage likely difference in prevalence.

The value zα is associated with the significance level. For a significance level of 5%, z α equals 1.9610.

Reference: Jin Young Lee et al., study on the correlation of perfusion index change and analgesic efficacy in transformational block for lumbosacral radical pain[28].

The calculation considers the parameter where 61.9% of patients reported a reduction in pain greater than 50%. Given P=61.9% and d=25% of P=15.48%, the initial sample size is determined to be 38. To ensure adequacy, the sample size is rounded up to 40.

Sampling technique:

A one-year observational cross-sectional study. Universal sampling technique was used for this study.

Inclusion Criteria:

Patients classified under grade I ASA class.

Patients aged twenty to fifty years of either gender posted for elective laparoscopic surgery under 'general anaesthesia'

Exclusion Criteria:

- Patient refusing to participate.
- Psychiatric disorders, neurological disorders.
- Patients with long standing symptoms of pain disorder.
- PVD, 'Hypertension, Diabetes mellitus, Ischaemic heart disease'
- Patients with autonomic dysregulation.
- Patients with allergic reaction to any of the drugs used in our study.
- Compromised hemodynamic status

MATERIALS AND METHODS:

Approval for conducting the study was received from the Departmental research committee along with clearance from the institutional ethical board. This study was registered with Clinical Trials Registry –India (Registration No. CTRI/2024/01/061050). Informed consent was obtained from the subjects. Forty healthy volunteers who were between twenty and fifty years of age under ASA I scheduled to undergo laparoscopic surgery under 'general anaesthesia' were enrolled in the study.

After shifting the patient to the operating room on the scheduled day of surgery, standard ASA monitors which comprised of NIBP, pulse oximeter, ECG were attached. Blood pressure monitoring cuff was applied on one arm and pulse oximeter on the index finger of the other arm. Study parameters included Perfusion Index (PI), SBP, DBP, HR & MAP which were documented before the start of induction of anaesthesia.

Premedication was administered with i.v midazolam dose of 0.05 mg/kg, glycopyrrolate 0.005 mg/kg, and fentanyl 2 μg/kg. Induction was achieved with intravenous propofol induction dose of 2 mg/kg, followed by neuromuscular blockade using i.v vecuronium loading dose of 0.1 mg/kg. The above-mentioned hemodynamic parameters i.e, HR, MAP, SBP/DBP were recorded shortly following induction.

After the confirmation of endotracheal intubation using capnography, a nasopharyngeal temperature probe was secured. Ventilatory parameters involved maintaining a tidal volume of around 6–8 ml/kg, adjusting ventilatory rate to keep the EtCO2 between a range of 30 to 40 mmHg. Anaesthesia was maintained with isoflurane at 0.6-1 MAC and maintenance doses of vecuronium given intermittently (0.05 mg/kg). MAP was targeted to maintain above 60 mmHg during the intraoperative phase.

Thermal neutrality was maintained with a room temperature of 25°C, a warming bedding underneath, and warm intravenous fluids. Prior to intubation, immediately following intubation, and during the creation of pneumoperitoneum (P0) using a Veress needle, the hemodynamic parameters mentioned in our study are recorded. Additional recordings were taken at the first laparoscopic port insertion(P1), after which analgesia was provided with i.v fentanyl (0.5mcg/kg). After the second laparoscopic port(P2) and third laparoscopic port (P3) insertion, subsequent readings were noted.

After the insertion of third port, perfusion index and other study hemodynamic parameters such as heart rate, MAP, SBP, DBP were recorded every minute for the first 10 minutes of the procedure and every 5 minutes until the next 30 minutes after the start of surgical procedure. Adequate neuromuscular reversal was obtained with glycopyrrolate (0.01mg/kg) & neostigmine (0.05mg/kg). The observations were tabulated, analysed, and compared between PI and various other hemodynamic parameters at all different time points.

DATA PROCESSING AND STATISTICAL ANALYSIS:

Microsoft Excel and the statistical program R 4.4.0 are used for data analysis. Frequency tables are used to present categorical variables. The form of continuous variables is Mean ± SD / Median (Min, Max). The QQ plot and the Shapiro-Wilk test are used to determine whether a variable is normal. Parametric tests will be applied if the data has a normal distribution. If not, tests that are not parametric will be employed. To compare the distribution of variables over time points, use the Wilcoxon test. To determine the association between PI alterations and changes in ‘HR, MAP, SBP/DBP’ one can utilize Spearman's rank correlation test. A P-value of 0.05 or less denotes statistical significance.

RESULTS:

Our study is an observational cross-sectional study conducted at the Department of Anaesthesiology, KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre between august 2022 till September 2023. The study was done on 40 adult volunteers between the ages of twenty and fifty years posted to undergo laparoscopic surgeries performed under 'general anaesthesia', out of which 26 were males and 14 were females with an average age of 25.4 ± 8.6 years. All the patients who enrolled finished the study. Demographic parameters are displayed in table 1.

TABLE 1:

AGE AND GENDER DISTRIBUTION

AGE	MALE	FEMALE
20-30 YEARS	14	8
30-40 YEARS	7	4
40-50 YEARS	3	4

In our study, 65 % of patients comprised of males whereas 35% of the subjects were comprised of females. Out of all the patients enrolled in the study, 55 % of patients were between the ages of twenty and thirty, 27.5% between thirty and forty years age group, 17.5% were aged between forty and fifty years.

The following table 2 reveals alterations in PI values following the administration of fentanyl and gives the comparison of hemodynamic parameters between P1 vs P2 & P1 vs P3.

Table 2:

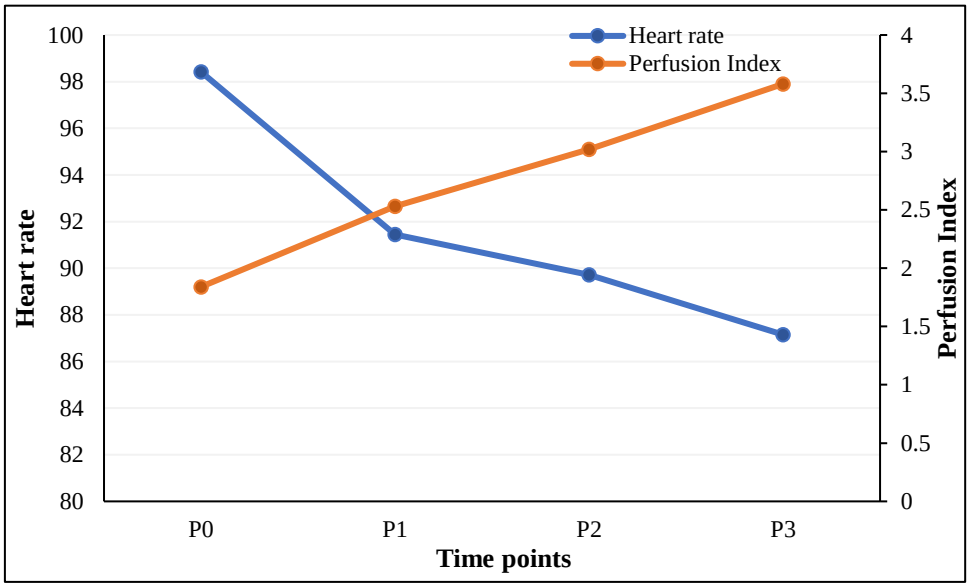
Comparison of alteration in PI and various haemodynamic parameters between P1 vs P2 and P1 vs P3.

Haemodynamic parameters	P1 vs P2	P1 vs P3
PI	**< 0.001^{W*}**	**< 0.001^{W*}**
HR	**< 0.001^{W*}**	**< 0.001^{W*}**
SBP	**< 0.001^{W*}**	**< 0.001^{W*}**
DBP	**< 0.001^{W*}**	**< 0.001^{W*}**
MAP	**< 0.001^{W*}**	**< 0.001^{W*}**

*Abbreviation: PI - Perfusion Index, HR - Heart rate, SBP – Systolic blood pressure, DBP – Diastolic blood pressure, MAP – Mean arterial pressure, P1: Time of first laparoscopic port insertion, P2 - Time of second laparoscopic port insertion, P3 –time of third laparoscopic port insertion, W – Wilcoxon test, * indicates statistical significance.*

From P1 to P2, the Perfusion Index (PI) increased from 2.53 ± 0.22 to 3.02 ± 0.4, and from P1 to P3, it further increased to 3.58 ± 0.44. From Wilcoxon test, it was noted that, Perfusion Index (PI) increased significantly from P1 to P2 (p-value < 0.001) and from P1 to P3 (p-value < 0.001). Meanwhile, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) all decreased significantly from P1 to P2 (p-values < 0.001) and from P1 to P3 (p-values < 0.001). **This finding confirms the primary objective of our study - there is a significant increase in PI following the 'administration of analgesia' along with reduction in 'heart rate and mean arterial pressure' which are also the physiological indicators of adequate analgesia.**

Graph 1: Comparison of PI vs HR at various time points.



The changes in the PI value were noted (Table 3) at different time points, tabulated and analysed in response to port insertion and administration of fentanyl and also correlated with various other hemodynamic parameters.

Table 3:

Haemodynamic changes in subjects over timepoints.

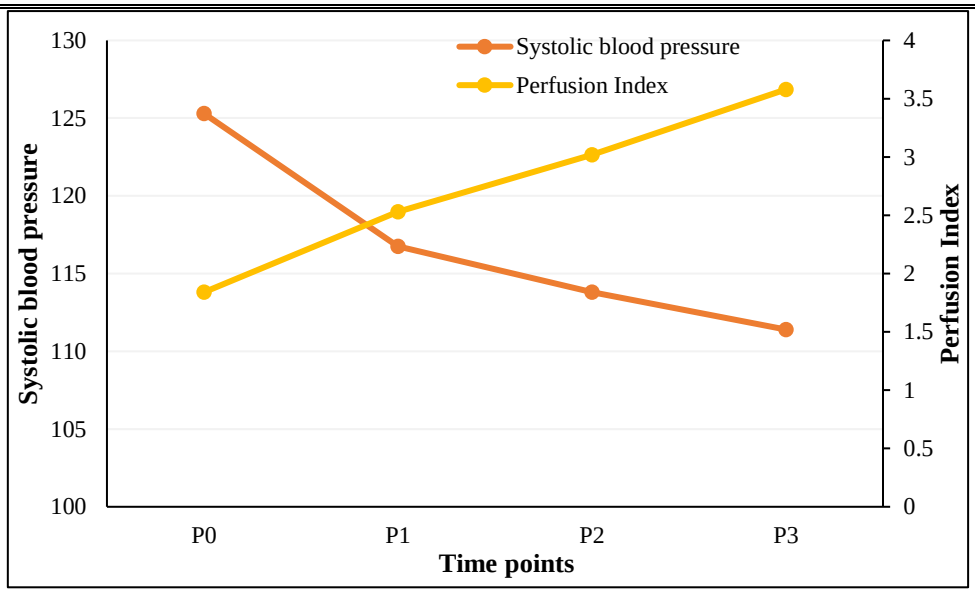
Time points	PI	HR	SBP	DBP	MAP
Pre-induction	2.09 ± 0.42 2.1 (1.2, 2.8)	88.75 ± 8.52 91 (71, 100)	116.53 ± 5.52 117 (108, 126)	78.7 ± 2.24 78 (76, 82)	91.33 ± 1.23 91 (89, 93)
Induction	2.34 ± 0.18 2.3 (2, 2.8)	89.5 ± 7.74 90 (74, 101)	116.5 ± 3.89 116 (112, 124)	80.15 ± 2.56 80 (78, 86)	92.17 ± 2.23 93 (89, 95)
Before Intubation	2.31 ± 0.24 2.4 (1.6, 2.8)	90.4 ± 7.11 94 (76, 98)	119 ± 6.21 119.5 (108, 127)	81.35 ± 5.16 82 (72, 88)	93.95 ± 3.68 93 (88, 99)

After intubation	2.18 ± 0.25 2.2 (1.6, 2.6)	95.72 ± 7.01 98 (84, 109)	123.65 ± 3.72 124 (118, 132)	84.55 ± 6.44 88 (72, 92)	97.6 ± 4.66 98.5 (89, 103)
P0	1.84 ± 0.26 1.8 (1.4, 2.4)	98.42 ± 5.94 100 (88, 111)	125.3 ± 5.66 126 (116, 134)	85.5 ± 3.92 84 (80, 92)	98.8 ± 3.38 98.5 (94, 103)
P1	2.53 ± 0.22 2.4 (2.2, 3.2)	91.45 ± 5.62 93 (82, 99)	116.75 ± 3.29 116 (112, 124)	78.9 ± 2.02 78 (76, 82)	91.55 ± 1.47 91 (89, 95)
P2	3.02 ± 0.4 2.9 (2.4, 3.8)	89.72 ± 6.27 92 (78, 98)	113.8 ± 2.88 114 (110, 122)	77.53 ± 0.85 78 (76, 78)	89.62 ± 1.17 90 (87, 91)
P3	3.58 ± 0.44 3.6 (2.8, 4.6)	87.15 ± 5.32 88 (76, 94)	111.4 ± 2.49 112 (108, 116)	76.3 ± 0.85 76 (76, 80)	88.03 ± 1.05 88 (87, 92)
1 min	3.96 ± 0.52 3.8 (3, 4.8)	85.62 ± 5.7 87 (76, 94)	112 ± 3.2 114 (106, 116)	75.5 ± 1.85 75 (74, 82)	87.55 ± 1.11 87 (87, 93)
2 mins	4.23 ± 0.51 4.15 (3.2, 5)	84.9 ± 5.3 88 (76, 92)	109.6 ± 3.04 110 (104, 114)	74.75 ± 2.67 74 (72, 80)	86.35 ± 1.29 86 (85, 91)
3 mins	4.51 ± 0.48 4.45 (3.8, 5.2)	83.8 ± 5.2 86 (76, 92)	108.65 ± 3.12 110 (102, 112)	70.9 ± 2.22 70 (70, 78)	83.22 ± 1.07 83 (82, 87)
4 mins	4.54 ± 0.37 4.5 (3.8, 5.4)	83.92 ± 6.38 86 (74, 93)	106.75 ± 3.29 108 (100, 114)	69.78 ± 3.13 68 (68, 78)	81.9 ± 2.07 81 (79, 89)
5 mins	4.51 ± 0.41 4.6 (3.7, 5.6)	84.75 ± 5.87 86 (74, 94)	110.6 ± 3.08 112 (104, 112)	72.45 ± 0.96 72 (72, 76)	84.9 ± 0.63 85 (84, 88)
6 mins	4.32 ± 0.54 4.4 (3, 5.4)	84.7 ± 5.31 86 (76, 91)	107.7 ± 0.85 108 (106, 110)	69.58 ± 2.86 68 (68, 77)	82.05 ± 1.95 81 (81, 87)
7 mins	4.08 ± 0.56 4 (2.8, 5)	84.47 ± 6.63 88 (73, 92)	106.2 ± 1.26 106 (106, 114)	72.1 ± 1.01 72 (70, 74)	83.4 ± 0.81 83 (83, 85)
8 mins	3.85 ± 0.57 3.8 (2.8, 4.8)	85.65 ± 5.93 89 (76, 92)	109.35 ± 2.52 108 (108, 116)	72 ± 2.94 71 (71, 82)	84.28 ± 2.77 83 (83, 93)

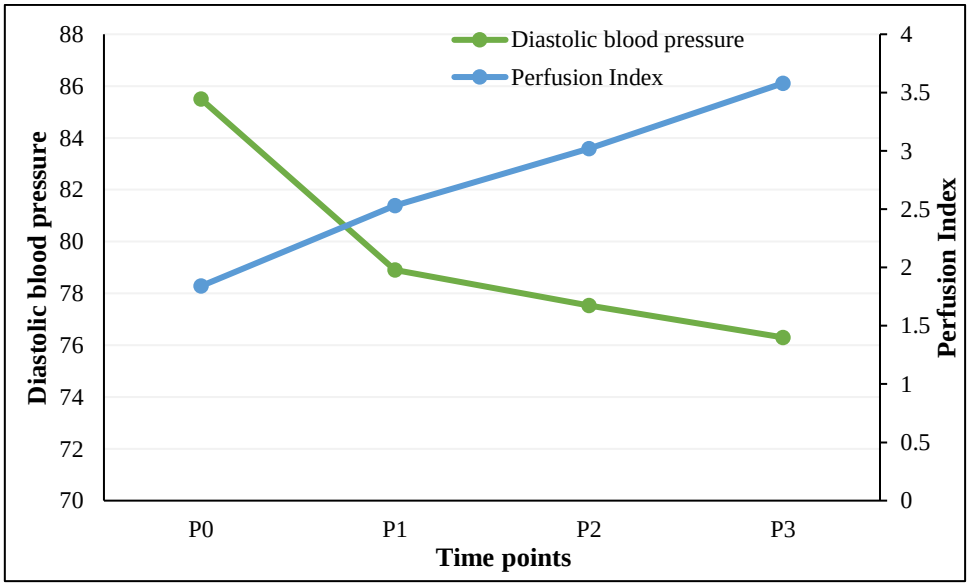
9 mins	3.81 ± 0.57 3.6 (2.9, 4.8)	86.1 ± 6.6 88 (74, 94)	111.97 ± 2.68 110 (110, 116)	70.55 ± 4.08 68 (68, 78)	84.45 ± 3.55 82 (82, 91)
10 mins	3.72 ± 0.64 3.9 (2.8, 4.8)	85.97 ± 7.26 88 (72, 98)	111.7 ± 0.85 112 (110, 114)	72.83 ± 2.84 72 (70, 82)	85.53 ± 1.71 85 (84, 91)
15 mins	3.44 ± 0.51 3.6 (2.6, 4.1)	86.5 ± 7.35 88 (72, 96)	115.6 ± 0.81 116 (114, 116)	71.5 ± 3.77 70 (70, 84)	85.97 ± 2.42 85 (85, 94)
20 mins	3.34 ± 0.49 3.4 (2.6, 4.2)	86.45 ± 8.11 90 (70, 96)	113.4 ± 1.71 114 (110, 118)	71.6 ± 3.3 70 (70, 82)	85.75 ± 1.68 85 (85, 91)
25 mins	3.22 ± 0.43 3.3 (2.4, 3.8)	86.88 ± 7.17 88 (74, 96)	112.8 ± 2.34 114 (108, 116)	73.22 ± 2.83 72 (72, 82)	86.45 ± 1.47 86 (85, 91)
30 mins	3.15 ± 0.39 3.4 (2.4, 3.8)	86.58 ± 7.28 88 (74, 99)	114.25 ± 2.11 114 (112, 118)	73.45 ± 4.34 73 (68, 84)	87.17 ± 3.37 86 (83, 95)

Abbreviation: PI - Perfusion Index, HR - Heart rate, SBP – Systolic blood pressure, DBP – Diastolic blood pressure, MAP – Mean arterial pressure.

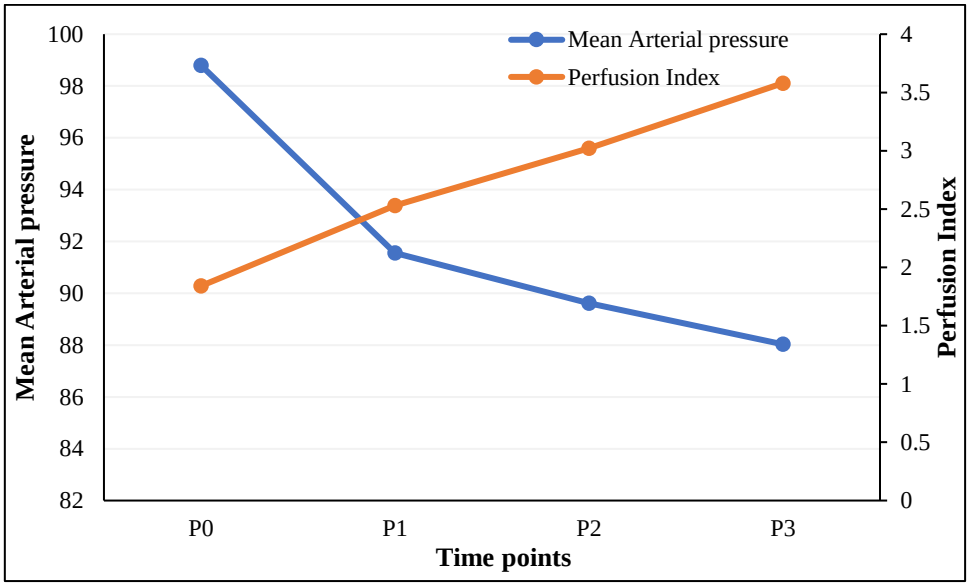
Heart rate (HR) decreased from 91.45 ± 5.62 at P1 to 89.72 ± 6.27 at P2, and then to 87.15 ± 5.32 at P3. Systolic blood pressure (SBP) also showed a reduction, dropping from 116.75 ± 3.29 at P1 to 113.8 ± 2.88 at P2, and to 111.4 ± 2.49 at P3. Similarly, diastolic blood pressure (DBP) declined from 78.9 ± 2.02 at P1 to 77.53 ± 0.85 at P2, and further to 76.3 ± 0.85 at P3. Mean arterial pressure (MAP) followed the same trend, decreasing from 91.55 ± 1.47 at P1 to 89.62 ± 1.17 at P2, and to 88.03 ± 1.05 at P3.



Graph 2: PI versus SBP at various time points



Graph 3: PI versus DBP at various time points.



Graph 4: PI versus MAP at various time points.

The following table gives the correlation of alterations in PI with variation in heart rate, SBP, DBP and MAP prior to and following administration of intravenous injection Fentanyl 0.5 µg/kg.

Table 4:

'Correlation of variation in PI versus changes in heart rate, SBP, DBP and MAP prior and following administration of Fentanyl, i.v dose of 0.5 µg/kg'

Variables	P2-P1		P3-P1	
	Correlation coefficient	p-value SP	Correlation coefficient	p-value SP
ΔPI vs ΔHR	-0.1723	0.2878	0.1913	0.2371
ΔPI vs ΔSBP	0.0193	0.9060	0.1860	0.2505
ΔPI vs ΔDBP	0.3233	**0.0419***	-0.0857	0.5992
ΔPI vs ΔMAP	0.0920	0.5723	0.0147	0.928

*Abbreviation: Δ – Difference, PI - Perfusion Index, HR - Heart rate, SBP – Systolic blood pressure, DBP – Diastolic blood pressure, MAP – Mean arterial pressure, P1: Time of first laparoscopic port insertion, P2 – Time of second laparoscopic port insertion, P3 – Time of third laparoscopic port insertion, SP – Spearman's rank correlation coefficient, * indicates statistical significance.*

Although there was a reduction in heart rate, SBP, DBP, MAP as evident from table 3, from Spearman's rank correlation test, it is observed that, there is no significant correlation between changes in the PI and changes in HR, SBP, MAP from P1 to P2 & from P1 to P3. Additionally, there is no significant correlation between changes in PI and DBP from P1 to P3. However, there is a significant positive correlation between changes in PI and DBP from P1 to P2 (p-value = 0.0419). **Hence, in our study of the secondary objective, we found no significant correlation between perfusion index and heart rate, systolic/ diastolic blood pressure and mean arterial pressure except for a positive correlation between changes in PI and DBP from P1 to P2.**

DISCUSSION:

Intraoperative pain management is a critical component of modern anaesthetic practice, essential for ensuring patient safety, comfort, and optimal surgical outcomes. Meticulous intraoperative pain management is very crucial to maintain physiological stability as pain can trigger a range of autonomic responses, including increase in heart rate and blood pressure[7].

Anaesthesiologists rely on a combination of physiological indicators, autonomic responses, and advanced monitoring techniques to infer the presence and severity of pain, each with its own pros and cons. Perfusion index is a newer, less studied modality as a parameter to assess analgesia which we aimed to study in our research as it is easy, non-invasive, reliable and cost effective.

Due to the stimulation of sympathetic nervous system from a pain stimulus, there is peripheral vasoconstriction leading to decrease in PI[6]. Conversely, with adequate analgesia, there is increase in PI. Based on studies conducted by lee et al., Surekha et al.,[7] this research design was devised in order to study the alterations in PI in response to pain stimulus and analgesia.

40 patients aged twenty to fifty years under ASA grade 1 who met the inclusion criteria were studied. Perfusion index and other hemodynamic parameters (MAP, HR, SBP/DBP) were studied and compared from the baseline, after induction, during a nociceptive stimulus from the laparoscopic port insertion and after administration of analgesic dose of fentanyl. The observations were tabulated, compared and assessed.

After the administration of fentanyl, from P1 to P2, the Perfusion Index (PI) increased from 2.53 ± 0.22 to 3.02 ± 0.4, and from P1 to P3, it further increased to 3.58 ± 0.44. Conversely, heart rate (HR) decreased from 91.45 ± 5.62 at P1 to 89.72 ± 6.27 at P2, and then to 87.15 ± 5.32 at P3. Systolic blood pressure (SBP) also showed a reduction, dropping from 116.75 ± 3.29 at P1 to 113.8 ± 2.88 at

P2, and to 111.4 ± 2.49 at P3. Similarly, diastolic blood pressure (DBP) declined from 78.9 ± 2.02 at P1 to 77.53 ± 0.85 at P2, and further to 76.3 ± 0.85 at P3. Mean arterial pressure (MAP) followed the same trend, decreasing from 91.55 ± 1.47 at P1 to 89.62 ± 1.17 at P2, and to 88.03 ± 1.05 at P3.

Perfusion Index (PI) increased significantly from P1 to P2 (p-value < 0.001) and from P1 to P3 (p-value < 0.001). Hence**, there is a positive association between perfusion index and the adequacy of analgesia and this finding was very much in accordance with the previous studies conducted by lee et al, Surekha et al.**

Meanwhile, parameters under our secondary objective - heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) all reduced significantly from P1 to P2 (p-values < 0.001) and from P1 to P3 (p-values < 0.001) which was found to be in line with previously conducted studies.

From Spearman's rank correlation test, it was derived that, there is absence of any significant correlation between variations in the PI and changes in HR, SBP, MAP from P1 to P2 & from P1 to P3. Additionally, there is no significant association between changes in PI and DBP from P1 to P3. However, there is a significant positive correlation between changes in PI and DBP from P1 to P2 (p-value = 0.0419). This result was contrary to the findings present in the previous conducted studies wherein the increment in PI values between the insertion of first and the second port correlated with reduction in HR and MAP and was found to be of statistical significance.

The PI findings in our investigation can be additionally validated with similar results published by another study.,[10] in which the perfusion index parameter was found to be of relevance in the assessment of pain in patients maintained under anaesthesia with propofol and sevoflurane by subjecting two healthy individuals to electric current to their anterior aspect of thigh. The nociceptive stimulus led to a rise in heart rate & MAP with a reduction in PI, which was also found during first laparoscopic port insertion which served as the painful stimulus trigger in our study.

Hagar et al.,[11] conducted a research on 50 paediatric subjects posted for inguinal herniorrhaphy. After induction of general anaesthesia with sevoflurane using mask followed by attachment of pulse oximeters on every limb, subjects were administered with single dose of 'lumbar epidural block' using ropivacaine. Authors reported a significant increase in the PI value of lower limbs compared to that of upper limb after the onset of lumbar epidural analgesia. Patients with signs of an unsuccessful epidural block showed reduced PI average values in bilateral lower limbs[12]. This finding led to the conclusion that PI is a valuable tool for evaluating the effectiveness of lumbar epidural block and the relation between analgesia and PI in patients under anaesthesia. Our finding was also in line with this study as there was a significant rise in the 'perfusion index' and reduction in the heart rate after the 'administration of analgesia.'

In a prospective observational research by Hasanin A et al.,[13] in a surgical ICU in patients who were not intubated, it was noted that the PI values reduced after giving a nociceptive stimulus. Moreover, this research noted heart rate (HR), invasive blood pressure from the arteries and various other pain scales used in patients who aren't intubated prior to and following the application of a

nociceptive stimulus (obtained by change in the position of the patient). The authors noted that repositioning the patient led to a notable rise in SBP, DBP, HR and pain scale values. A significant association was found between the perfusion index and the abovementioned values. Our study also provided comparable results as there was reduction in PI value during port insertion which acted as a painful stimulus in our research and notable rise in 'heart rate and mean arterial pressure'.

Similar results were observed during a study conducted by Mohamed at al.,[14] in a post anaesthesia care unit setting where thirty minutes after the first request for analgesia was provided, there was a statistically significant increase in PI with decrease in 'heart rate and mean arterial pressure' at the 30-minute interval more than the 0^{th} minute revealing that PI can be used for pain monitoring in post anaesthesia care unit.

Many studies performed using perfusion index in patients receiving regional anaesthesia demonstrated a rise in PI after the beginning of neuraxial blockade. Kupeli et al[16], studied the association between PI and labour analgesia in patients going for normal vaginal delivery. It was observed that there was increase in perfusion index with onset of epidural analgesia and reduction in the same with the wearing off of analgesia. Similar finding were revealed in our study where the perfusion index significantly increased after the administration of fentanyl with particularly peak increase at 2^{nd} – 7^{th} minute time points followed by a gradual decrease in the PI as the effect of fentanyl started to wear off.

Abdelnasser at al.,[17] did a study to evaluate the success of brachial plexus block (under ultrasound guidance supraclavicular approach) with the help of perfusion index. It was found that in the 20-minute study period, perfusion index increased

from the baseline after a successful block. Interestingly enough, the concept of PI ratio, which can be defined as the ratio of PI at a particular time point after the block to the baseline PI seems to provide more valuable insight in understanding the adequacy of analgesia than a simple increase in PI value. Similar studies pointed towards a PI ratio of more than 1.4 to be a reliable cut off for assessing adequate analgesia. Our study revealed similar findings where, P2/P1 ratio, P3/P1 ratio and subsequent time points there onwards showed a significant increase in the PI ratio by more than 1.4.

The strength of this study is the usefulness of PI as an investigating tool as its non-invasive, cost effective, provides real time observation and a reliable indicator of pain during the surgery and adequacy of given analgesia.

Our study does have its own share of limitations. One notable limitation is the use of multiple exclusion criteria, which restricts the applicability of utilising ASA grade I cases for procedures without fluid shifts, as this introduces a confounder. A smaller sample size of our study is another limitation. A larger sample size could offer stronger proof to back up initial conclusions presented here. A Phillips pulse oximeter was used to conduct this study, perhaps the use of a more sensitive monitor for perfusion index, for example, the Masimo's sedline pulse oximeter (the company claims to have the most reliable perfusion index monitor) would have yielded superior results compared to the current findings. Although no gold standard is present currently for intraoperative assessment of nociception and pain control, use of other advanced objective tools in our study such bispectral index (BIS), Analgesia nociceptive index (ANI) monitors or entropy index as a comparison parameter with perfusion index alongside the physiological indicators such as 'heart rate and mean arterial pressure' used in

this study may have provided better insight into the subject and more reliable results. The concept of PI ratio as mentioned in the earlier references, which was found to be a much better indicator of pain monitoring was not applied in our research methodology. Perhaps, the use of PI ratio may have provided better insight into the relevance of perfusion index in being a reliable indicator in assessment of intraoperative nociception.

CONCLUSION:

In our study titled: **"Assessment of perfusion index as an objective tool to assess analgesia during laparoscopic surgeries under general anaesthesia-A one year hospital based cross sectional study"** we conclude that there was a significant positive correlation between the changes in 'Perfusion index' values and nociception during surgery. We also found, although there was a positive correlation between 'perfusion index' and diastolic blood pressure from P1 and P2, no significant correlation was observed between perfusion index and heart rate, systolic/diastolic blood pressure, mean arterial pressure overall.

SUMMARY:

In this study titled " **Assessment of perfusion index as an objective tool to assess analgesia during laparoscopic surgeries under general anaesthesia-A one year hospital based cross sectional study"**, we have evaluated the efficacy of 'perfusion index' as a surrogate monitoring tool in the assessment of analgesia by studying the changes in PI in response to a nociceptive stimulus of port insertion and after administration of fentanyl in patients posted for laparoscopic surgeries under 'general anaesthesia'.

40 patients aged between twenty and fifty years classified under ASA grade 1 who fulfilled the inclusion criteria were studied. Perfusion index and other hemodynamic parameters ('heart rate and mean arterial pressure' with 'systolic/diastolic blood pressure' were studied and compared from the baseline, after induction, during a nociceptive stimulus from the laparoscopic port insertion and after administration of analgesic dose of fentanyl. The observations were tabulated, compared and assessed.

In our study, it was observed that the PI decreased during the port insertion and PI values increased after the administration of fentanyl. Hence, our study found a positive correlation between changes in the values of perfusion index to the level of nociception and analgesia intra operatively. We also found no significant correlation between changes in the 'perfusion index' and the haemodynamic parameters such as 'heart rate and mean arterial pressure,' 'systolic/diastolic blood pressure.'

Perfusion Index (PI) is a real time, cost effective, non-invasive and easy to use adjunctive tool for monitoring intraoperative nociception and adequacy of analgesia to help guide intervention during surgery. Perfusion index serves as a good surrogate monitoring in the assessment of analgesia during laparoscopic surgeries under general anaesthesia[30].

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Annexure 1: Informed Consent

KAHERs JNMC
BELAGAVI
INFORMED CONSENT FORM

"ASSESSMENT OF PERFUSION INDEX AS AN OBJECTIVE TOOL TO ASSESS ANALGESIA DURING LAPAROSCOPIC SURGERIES UNDER GENERAL ANAESTHESIA: A ONE YEAR CROSS SECTIONAL STUDY"

Name of Student/Principal Investigator: REG NO: BA0121008

OBJECTIVES:

PRIMARY OBJECTIVE: Assessment of perfusion index as an objective tool to assess analgesia during laparoscopic surgeries under general anaesthesia, a one-year observational study.

SECONDARY OBJECTIVE: The secondary objective is to compare PI with haemodynamic parameters such as heart rate, non-invasive blood pressure, mean arterial pressure(MAP).

Procedure: On the day of surgery, after being shifted to the operating room, standard monitors consisting of pulse oximeter, non-invasive blood pressure and electrocardiogram will be attached. Surgery will be performed under general anaesthesia and perfusion index values will be observed at different time intervals intra operatively along with other hemodynamic parameters such as heart rate, blood pressure and mean arterial pressure.

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact principal investigator.

If you have any question or complaints with regard to your right as study participant you may contact Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "Assessment of perfusion index as an objective tool to assess analgesia during laparoscopic surgeries under general anaesthesia- a one-year hospital based cross sectional study."

My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

Annexure II: Proforma

PROFORMA

"Assessment of perfusion index as an objective tool to assess analgesia during laparoscopic surgeries under general anaesthesia- A one year cross sectional study AT DR. PRABHAKAR KORE CHARITABLE HOSPITAL, BELAGAVI"

Patient's Name:

Gender: IP no:

Age: Date of examination:

Address: Anaesthesiologist:

Pre examination evaluation:

Past History:

- HTN/DM/IHD/Arrhythmia/Valvular heart diseases/Bronchial asthma:
- H/o previous surgery/drug allergies:

General physical examination:

Weight(Kg)/Height(cms) : Temperature (deg F) :

Pallor : PR:

Cyanosis : BP:

Pedal edema : RR:

Clubbing :

Musculoskeletal disorders:

Teeth: Jaw movements:

Airway assessment: Spine:

Investigations:

Hb%: Platelet Count:

TLC: INR:

FBS:

Systemic examination:

CNS: RS:

CVS: GIT:

Preoperative physical status:

American society of anaesthesiologist: ASA class

Diagnosis:

Proposed surgery:

Pulse oximetry:

NIBP:

ECG:

Room Temp:

INTRA OPERATIVE STUDY PARAMETERS:

PI-PERFUSION INDEX

HR-HEART RATE

SBP/DBP-SYSTOLIC BLOOD PRESSURE/DIASTOLIC BLOOD PRESSURE

MAP – MEAN ARTERIAL PRESSURE

INTRA-OPERATIVE STUDY FINDINGS:

Time of reading	PI	HR	SBP	DBP	MAP
Pre induction					
After induction					
After intubation					
P0					
P1(FENTANYL GIVEN)					
P2					
P3					
1 min					
2 min					
3 min					
4 min					
5 min					
6 min					
7 min					
8 min					
9 min					
10 min					
20 min					
30 min					

INVESTIGATOR'S SIGNATURE: WITNESS'S SIGNATURE

SIGNATURE OF THE GUIDE: ANESTHESIOLOGIST'S SIGNATURE

Annexure III. Photographs

Photo 1

Photo 2

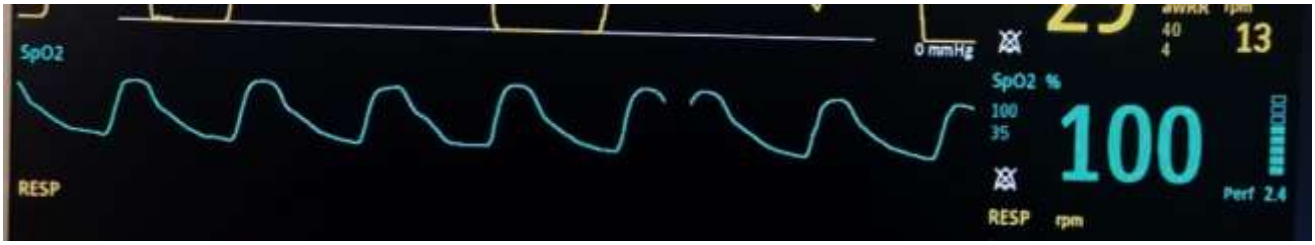

Photo 3

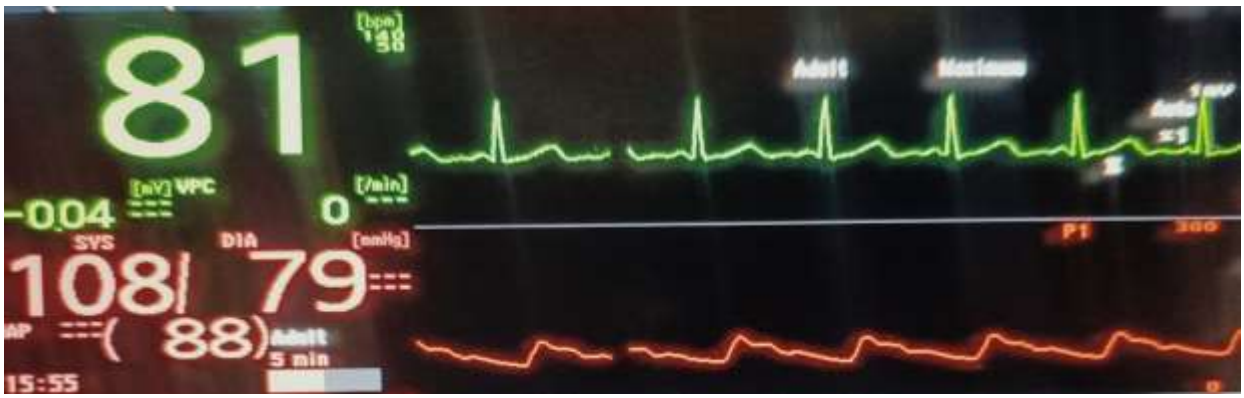

Photo 4

Annexure IV: Master charts

PERFUSION INDEX

SL NO	AGE/SEX	PRE-IND	IND	BEF-INT	A-INT	P0	P1	P2	P3	1 MIN	2 MIN	3 MIN	4 MIN	5 MIN	6 MIN	7 MIN	8 MIN	9 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN
1	M/22		2.2	2.8	2.6	2	2.4	2.9	3.6	3.4	3.6	3.9	3.8	3.8	3	2.8	2.8	2.9	3	2.6	2.6	2.8	2.8
2	M/24	1.2	2.3	2.4	2.2	1.8	2.6	2.9	3.8	4.2	4.8	5	4.6	4.6	4	3.8	3.6	3.6	3.4	2.8	2.6	2.4	2.4
3	F/28	2.6	2.4	2.4	2.2	2.2	2.6	3.4	3.9	4.5	4.5	4.7	4.9	5.2	4.9	5	4.8	4.2	4	3.6	3.4	3.3	3.4
4	F/22	2.4	2.6	2.2	2.2	2.4	3.2	3.8	4.6	4.8	5	5.2	4.8	4.6	4.4	4.4	4.2	4.4	4.8	4	3.6	3.6	3.6
5	F/20	2.1	2.4	2.4	2	2.2	2.8	3.8	3.6	3.8	4.4	4.6	4.4	4.4	4.2	4	3.6	3.2	2.8	3	3.2	2.8	2.8
6	M/31	1.9	2.2	2.2	1.6	1.4	2.4	2.8	2.8	3.6	3.9	4	4.5	4.2	4.4	4.4	4.6	4.8	4.6	4.1	3.8	3.6	3.4
7	M/24	2.6	2.4	2.4	2.6	2.2	2.4	2.6	2.8	3	3.8	4.4	4.4	4.2	4.6	4	3.8	3.6	3.9	3.8	3.6	3.6	3.4
8	F/29	2.6	2.2	2	2	1.8	2.4	2.8	3.8	4.6	4.8	5.2	5.4	5	5.2	4.6	4.4	4.2	4	3.8	4.2	3.8	3.8
9	M/27	1.6	2.2	2.4	2.2	1.8	2.4	2.4	3	3.4	3.8	4.2	4.2	4.6	4.6	4	3.4	3.4	3.2	3.2	3.4	3	3
10	M/36	2.5	2.2	2.2	2	2	2	2.6	2.9	3.4	3.8	3.9	4.6	4.8	4.9	4.6	3.8	3.9	4.1	3.9	3.6	3.6	3.4
11	F/22	1.9	2.2	2.6	2.4	2.2	2.2	2.4	2.8	3.9	3.9	3.6	3.8	3.7	3.5	3.1	2.9	2.9	3	2.6	2.6	2.8	2.8
12	F/25	2	2.3	2.4	2.4	1.8	2.6	2.9	3.6	4.6	4.8	4.8	4.6	4.6	4.2	3.8	3.6	3.6	3.4	3	2.6	2.8	2.8
13	M/25	2.6	2.4	2.4	2.2	2.2	2.6	3.4	3.9	4.5	4.5	4.7	4.9	5.2	4.9	5	4.8	4.2	4	3.6	3.4	3.3	3.4
14	M/23	2.2	2.6	2.4	2	1.6	2.8	3.6	4.4	4.8	5	4.8	4.8	4.6	4.4	4.4	4.2	4.4	4.8	4	3.6	3.6	3.6
15	F/29	1.5	2	1.9	2	1.8	2.8	3.6	3.8	3.8	4.2	4.8	4.4	4.4	4.2	4	3.6	3.4	2.8	3.2	3.2	2.8	2.8
16	M/34	1.4	2.2	2	1.8	1.4	2.4	3	3.2	3.6	3.9	4	4.5	4.2	4.4	4.4	4.6	4.8	4.6	4.1	3.8	3.6	3.4
17	M/30	1.6	2.4	2.2	2.2	1.8	2.4	3.2	3.8	4	4.1	4.4	4.4	4.2	4.6	4	3.8	4	3.9	3.8	3.6	3.6	3.4
18	F/28	2.4	2.2	2	2	1.6	2.4	2.8	3.8	4.6	4.8	5.2	5.4	5.6	5.4	4.8	4.4	4.2	4	3.8	4.2	3.8	3.8
19	F/24	1.9	2.2	2.4	2.2	1.8	2.4	2.4	3.2	3.4	3.8	4.2	4.4	4.6	4.2	4.1	3.4	3.4	3.2	3.2	3.4	3.2	3
20	M/22	2.6	2.2	1.6	2	1.5	2.6	2.9	4	4.2	4.4	4.5	4.9	4.6	4.9	4.6	3.8	3.9	4.1	3.9	3.6	3.6	3.4
21	M/26	2.2	2.8	2.8	2.6	2	2.4	2.9	3.6	3.4	3.2	3.9	3.8	3.8	3	2.8	2.8	2.9	3	2.6	2.6	2.8	2.8
22	F/21	1.6	2.3	2.4	2.2	1.8	2.6	2.9	3.8	4.2	4.8	5	4.6	4.6	4	3.8	3.6	3.6	3.4	2.8	2.6	2.4	2.4
23	F/35	2.6	2.4	2.4	2.2	2.2	2.6	3.4	4.1	4.5	4.5	4.7	4.9	5.2	4.9	5	4.8	4.2	4	3.6	3.4	3.3	3.4
24	F/28	2.4	2.6	2.2	2.2	1.8	3.2	3.8	4.6	4.8	5	5.2	4.8	4.6	4.4	4.4	4.2	4.4	4.8	4	3.6	3.6	3.6
25	F/23	2.1	2.4	2.4	2.4	1.6	2.8	3.6	3.6	3.8	4.4	4.6	4.4	4.4	4.2	4	3.6	3.2	2.8	3	3.2	2.8	2.8
26	M/21	1.7	2.2	2.2	1.8	1.4	2.4	2.8	3	3.6	3.9	4	4.5	4.2	4.4	4.4	4.6	4.8	4.6	4.1	3.8	3.6	3.4
27	M/21	1.9	2.2	2.4	2.2	1.8	2.4	2.4	3.2	3.4	3.8	4.2	4.4	4.6	4.2	4.1	3.4	3.4	3.2	3.2	3.4	3.2	3
28	F/29	2.6	2.2	2	2	1.6	2.4	2.8	3.8	4.6	4.8	5.2	5	5	5	5	4.6	4.4	4.2	4	3.8	4.2	3.8
29	M/33	1.8	2.2	2.4	2.2	1.8	2.4	2.4	3	3.4	3.8	4.2	4.2	4.6	4	4.4	3.6	3.4	3.4	3.2	3.4	3	3
30	M/27	2.5	2.2	2.2	2	2	2.2	2.9	3.6	3.8	4	3.9	4.6	4.8	4.9	4.9	4.6	3.8	3.9	4.1	3.9	3.6	3.4
31	M/24	2.2	2.8	2.8	2.6	2	2.4	2.8	3.6	3.4	3.2	3.9	3.8	3.8	3.8	3	2.8	2.8	2.9	3	2.6	2.8	2.8
32	M/21	1.6	2.3	2.4	2.2	2	2.2	2.9	3.8	4.2	4.8	5	4.6	4.6	4.6	4	3.8	3.6	3.6	3.4	2.6	2.4	2.4
33	F/24	1.4	2.2	2	1.8	1.6	2.4	3	3.2	3.6	3.9	4	4.5	4.2	4.4	4.4	4.6	4.8	4.6	4.1	3.8	3.6	3.4
34	M/28	2	2.3	2.4	2.4	1.8	2.6	2.9	3.6	4.6	4.8	5.2	4.8	4.6	4.2	3.8	3.6	3.6	3.4	3	2.6	2.8	2.8
35	M/32	2.1	2.4	2.4	2.6	1.6	2.8	3.8	3.6	3.8	4.4	4.6	4.4	4.4	4.2	4	3.6	3.2	2.8	3	3.2	2.8	2.8
36	M/25	1.9	2.2	2.2	1.8	1.4	2.4	2.8	3.4	3.6	3.9	4	4.5	4.2	4.4	4.4	4.6	4.8	4.6	4.1	3.8	3.6	3.4
37	M/39	2.6	2.4	2.4	2.6	2	2.4	2.6	2.8	3	3.6	4.4	4.4	4.2	4.6	4	3.8	3.6	3.9	3.8	3.6	3.6	3.4
38	F/32	2.8	2.4	2.2	2.2	2	2.4	3.2	3.3	4	4.1	4.4	4.4	4.2	4.6	4	3.8	4	3.9	3.8	3.6	3.6	3.4
39	M/26	1.9	2.2	2.4	2.2	1.8	2.4	2.9	3.6	3.6	3.8	4.2	4.2	4.6	4	3.6	3.4	3.4	3.2	3.2	3.4	3	3
40	M/40	1.8	2.3	2.4	2.4	1.8	2.6	2.9	3.6	4.6	4.8	5.2	4.8	4.6	4.2	3.8	3.6	3.6	3.4	3	2.6	2.8	2.8

HEART RATE

SL NO	AGE/SEX	PRE-IND	IND	BEF-INT	A-INT	P0	P1	P2	P3	1 MIN	2 MIN	3 MIN	4 MIN	5 MIN	6 MIN	7 MIN	8 MIN	9 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN
1	M/22	98	99	94	102	104	96	94	90	90	88	86	88	88	89	92	91	94	98	96	96	96	95
2	M/24	88	86	88	96	98	92	90	86	84	84	86	82	84	83	82	84	88	86	88	90	88	85
3	F/28	86	88	89	94	96	88	84	84	82	82	78	78	81	84	82	82	80	81	84	86	88	86
4	F/22	79	82	80	84	89	82	81	80	79	78	76	75	74	76	73	76	77	78	79	78	76	74
5	F/20	99	101	98	109	100	99	98	92	94	92	92	93	94	90	88	92	92	92	94	96	96	99
6	M/31	91	90	96	99	102	95	92	88	87	89	85	86	86	86	88	89	91	88	88	84	86	88
7	M/24	71	74	76	84	92	84	80	78	78	76	76	74	78	76	74	76	74	72	72	70	78	78
8	F/29	100	98	96	101	103	97	97	92	92	90	88	92	91	91	90	89	91	92	92	91	90	90
9	M/27	91	92	97	98	100	92	94	92	90	88	87	89	89	90	92	92	88	89	90	91	91	89
10	M/36	79	82	84	88	90	82	82	78	76	77	78	78	79	79	79	80	78	77	74	74	74	78
11	F/22	98	99	94	102	104	95	94	92	90	88	86	88	88	89	92	91	94	98	96	96	96	95
12	F/25	88	86	88	96	98	92	90	88	84	84	86	82	84	83	82	84	88	86	88	90	88	85
13	M/25	86	88	89	94	96	88	84	86	82	82	78	78	81	84	82	82	80	81	84	86	88	86
14	M/23	79	82	80	84	89	82	81	82	79	78	76	75	74	76	73	76	77	78	79	78	76	74
15	F/29	99	101	98	109	100	98	98	92	94	92	92	93	94	90	88	92	92	92	94	96	96	99
16	M/34	91	90	96	100	104	95	92	88	87	89	85	86	86	86	88	89	91	88	88	84	86	88
17	M/30	71	74	76	84	88	84	78	76	78	76	76	74	78	76	74	76	74	72	72	70	78	78
18	F/28	100	98	96	101	105	97	97	92	92	90	88	92	91	91	90	89	91	92	92	91	90	90
19	F/24	91	92	97	98	102	94	94	92	90	88	87	89	89	90	92	92	88	89	90	91	91	89
20	M/22	79	82	84	88	90	84	82	78	76	77	78	78	79	79	79	80	78	77	74	74	74	78
21	M/26	98	99	94	102	104	96	94	92	90	88	86	88	88	89	92	91	94	98	96	96	96	95
22	F/21	88	86	88	96	98	92	90	86	84	84	86	82	84	83	82	84	88	86	88	90	88	85
23	F/35	86	88	89	94	96	88	84	86	82	82	78	78	81	84	82	82	80	81	84	86	88	86
24	F/28	79	82	80	84	89	82	81	82	79	78	76	75	74	76	73	76	77	78	79	78	76	74
25	F/23	99	101	98	100	106	99	98	94	94	92	92	93	94	90	88	92	92	92	94	96	96	99
26	M/21	91	90	96	99	102	95	92	88	87	89	85	86	86	86	88	89	91	88	88	84	86	88
27	M/21	91	92	97	98	100	94	94	92	90	88	87	89	89	90	92	92	88	89	90	91	91	89
28	F/29	100	98	96	101	103	97	97	92	92	90	88	92	91	91	90	89	91	92	92	91	90	90
29	M/33	91	92	97	98	100	94	94	92	90	88	87	89	89	90	92	92	88	89	90	91	91	89
30	M/27	79	82	84	88	94	84	82	78	76	77	78	78	79	79	79	80	78	77	74	74	74	78
31	M/24	98	99	94	102	107	96	94	92	90	88	86	88	88	89	92	91	94	98	96	96	96	95
32	M/21	88	86	88	96	100	92	90	88	84	84	86	82	84	83	82	84	88	86	88	90	88	85
33	F/24	91	90	96	99	102	95	92	88	87	89	85	86	86	86	88	89	91	88	88	84	86	88
34	M/28	88	86	88	96	98	92	90	88	84	84	86	82	84	83	82	84	88	86	88	90	88	85
35	M/32	99	101	98	104	111	99	98	94	94	92	92	93	94	90	88	92	92	92	94	96	96	99
36	M/25	91	90	96	99	102	95	92	88	87	89	85	86	86	86	88	89	91	88	88	84	86	88
37	M/39	71	74	76	84	88	84	80	78	78	76	76	74	78	76	74	76	74	72	72	70	78	78
38	F/32	79	82	80	84	89	82	81	82	79	78	76	75	74	76	73	76	77	78	79	78	76	74
39	M/26	91	92	97	98	100	94	94	92	90	88	87	89	89	90	92	92	88	89	90	91	91	89
40	M/40	88	86	88	96	98	92	90	88	84	84	86	82	84	83	82	84	88	86	88	90	88	85

SYSTOLIC BLOOD PRESSURE

SL NO	AGE/SEX	PRE-IND	IND	BEF-INT	A-INT	P0	P1	P2	P3	1 MIN	2 MIN	3 MIN	4 MIN	5 MIN	6 MIN	7 MIN	8 MIN	9 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN
1	M/22	110	112	108	118	126	112	110	108	106	104	102	100	104	106	106	114	116	110	114	110	108	112
2	M/24	121	116	116	132	134	124	122	116	114	112	112	114	112	110	114	116	115	114	114	118	116	114
3	F/28	123	118	126	128	118	116	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	114
4	F/22	120	119	127	128	119	116	115	110	112	112	110	108	112	108	106	108	116	112	116	114	114	112
5	F/20	116	114	121	124	116	114	110	110	110	108	110	108	112	108	106	109	112	112	116	114	114	112
6	M/31	118	121	124	121	128	120	114	110	112	110	110	108	112	108	106	108	110	112	116	114	114	116
7	M/24	126	124	118	126	134	122	118	116	116	114	110	108	112	108	106	108	110	112	116	114	114	115
8	F/29	114	116	118	122	126	116	114	112	114	112	110	108	112	108	106	108	110	112	116	114	112	118
9	M/27	117	116	122	126	130	118	116	114	114	110	110	108	112	108	106	108	110	112	116	114	114	112
10	M/36	108	112	116	122	128	118	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	116
11	F/22	110	112	108	118	126	112	110	108	106	104	102	100	104	106	106	114	116	110	114	110	108	116
12	F/25	110	112	108	118	126	112	110	108	106	104	102	100	104	106	106	114	116	110	114	110	108	112
13	M/25	123	118	126	128	118	116	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	114
14	M/23	120	119	127	128	119	116	115	110	112	112	110	108	112	108	106	108	116	112	116	114	114	112
15	F/29	116	114	121	124	116	114	110	110	110	108	110	108	112	108	106	109	112	112	116	114	114	112
16	M/34	118	121	124	121	128	120	114	110	112	110	110	108	112	108	106	108	110	112	116	114	114	116
17	M/30	126	124	118	126	134	122	118	116	116	114	110	108	112	108	106	108	110	112	116	114	114	115
18	F/28	114	116	118	122	126	116	114	112	114	112	110	108	112	108	106	108	110	112	116	114	112	118
19	F/24	117	116	122	126	130	118	116	114	114	110	110	108	112	108	106	108	110	112	116	114	114	112
20	M/22	108	112	116	122	128	118	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	116
21	M/26	110	112	108	118	126	112	110	108	106	104	102	100	104	106	106	114	116	110	114	110	108	116
22	F/21	110	112	108	118	126	112	110	108	106	104	102	100	104	106	106	114	116	110	114	110	108	112
23	F/35	123	118	126	128	118	116	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	114
24	F/28	120	119	127	128	119	116	115	110	112	112	110	108	112	108	106	108	116	112	116	114	114	112
25	F/23	116	114	121	124	116	114	110	110	110	108	110	108	112	108	106	109	112	112	116	114	114	112
26	M/21	118	121	124	121	128	120	114	110	112	110	110	108	112	108	106	108	110	112	116	114	114	116
27	M/21	126	124	118	126	134	122	118	116	116	114	110	108	112	108	106	108	110	112	116	114	114	115
28	F/29	114	116	118	122	126	116	114	112	114	112	110	108	112	108	106	108	110	112	116	114	112	118
29	M/33	117	116	122	126	130	118	116	114	114	110	110	108	112	108	106	108	110	112	116	114	114	112
30	M/27	108	112	116	122	128	118	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	116
31	M/24	110	112	108	118	126	112	110	108	106	104	102	100	104	106	106	114	116	110	114	110	108	116
32	M/21	110	112	108	118	126	112	110	108	106	104	102	100	104	106	106	114	116	110	114	110	108	112
33	F/24	123	118	126	128	118	116	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	114
34	M/28	120	119	127	128	119	116	115	110	112	112	110	108	112	108	106	108	116	112	116	114	114	112
35	M/32	116	114	121	124	116	114	110	110	110	108	110	108	112	108	106	109	112	112	116	114	114	112
36	M/25	118	121	124	121	128	120	114	110	112	110	110	108	112	108	106	108	110	112	116	114	114	116
37	M/39	126	124	118	126	134	122	118	116	116	114	110	108	112	108	106	108	110	112	116	114	114	115
38	F/32	114	116	118	122	126	116	114	112	114	112	110	108	112	108	106	108	110	112	116	114	112	118
39	M/26	117	116	122	126	130	118	116	114	114	110	110	108	112	108	106	108	110	112	116	114	114	112
40	M/40	110	112	116	122	128	120	114	112	114	110	110	108	112	108	106	108	110	112	116	114	114	116

DIASTOLIC BLOOD PRESSURE

SL NO	AGE/SEX	PRE-IND	IND	BEF-INT	A-INT	P0	P1	P2	P3	1 MIN	2 MIN	3 MIN	4 MIN	5 MIN	6 MIN	7 MIN	8 MIN	9 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN
1	M/22	80	78	85	88	92	82	78	76	78	80	72	68	74	70	71	72	78	74	72	74	76	72
2	M/24	78	80	82	88	88	78	76	80	82	80	74	77	76	72	70	74	76	75	76	74	75	78
3	F/28	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
4	F/22	76	81	82	88	84	78	78	76	76	74	70	68	72	68	71	71	68	70	71	70	72	74
5	F/20	82	86	88	92	84	76	76	78	76	74	70	72	72	74	74	71	74	72	70	70	72	70
6	M/31	76	80	72	74	84	78	78	76	74	74	70	68	72	68	72	71	68	72	70	72	72	78
7	M/24	76	78	80	84	88	82	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
8	F/29	80	78	78	82	88	78	78	76	76	72	70	72	72	68	72	71	68	72	70	70	72	74
9	M/27	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	68
10	M/36	82	78	74	72	80	78	76	76	74	72	70	68	72	68	72	71	68	72	70	70	72	76
11	F/22	78	78	88	90	92	82	77	76	78	78	78	78	74	77	74	82	78	82	84	82	82	84
12	F/25	80	78	85	88	92	82	78	76	78	80	72	68	74	70	71	72	78	74	72	74	76	72
13	M/25	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
14	M/23	76	81	82	88	84	78	78	76	76	74	70	68	72	68	71	71	68	70	71	70	72	74
15	F/29	82	86	88	92	84	76	76	78	76	74	70	72	72	74	74	71	74	72	70	70	72	70
16	M/34	76	80	72	74	84	78	78	76	74	74	70	68	72	68	72	71	68	72	70	72	72	78
17	M/30	76	78	80	84	88	82	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
18	F/28	80	78	78	82	88	78	78	76	76	72	70	72	72	68	72	71	68	72	70	70	72	74
19	F/24	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	68
20	M/22	82	78	74	72	80	78	76	76	74	72	70	68	72	68	72	71	68	72	70	70	72	76
21	M/26	80	78	88	90	92	82	78	76	78	80	78	78	74	77	74	82	78	82	84	82	82	84
22	F/21	80	78	85	88	92	82	78	76	78	80	72	68	74	70	71	72	78	74	72	74	76	72
23	F/35	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
24	F/28	76	81	82	88	84	78	78	76	76	74	70	68	72	68	71	71	68	70	71	70	72	74
25	F/23	82	86	88	92	84	76	76	78	76	74	70	72	72	74	74	71	74	72	70	70	72	70
26	M/21	76	80	72	74	84	78	78	76	74	74	70	68	72	68	72	71	68	72	70	72	72	78
27	M/21	76	78	80	84	88	82	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
28	F/29	80	78	78	82	88	78	78	76	76	72	70	72	72	68	72	71	68	72	70	70	72	74
29	M/33	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	68
30	M/27	82	78	74	72	80	78	76	76	74	72	70	68	72	68	72	71	68	72	70	70	72	76
31	M/24	80	78	88	90	92	82	78	76	78	80	78	78	74	77	74	82	78	82	84	82	82	84
32	M/21	80	78	85	88	92	82	78	76	78	80	72	68	74	70	71	72	78	74	72	74	76	72
33	F/24	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
34	M/28	76	81	82	88	84	78	78	76	76	74	70	68	72	68	71	71	68	70	71	70	72	74
35	M/32	82	86	88	92	84	76	76	78	76	74	70	72	72	74	74	71	74	72	70	70	72	70
36	M/25	76	80	72	74	84	78	78	76	74	74	70	68	72	68	72	71	68	72	70	72	72	78
37	M/39	76	78	80	84	88	82	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	70
38	F/32	80	78	78	82	88	78	78	76	76	72	70	72	72	68	72	71	68	72	70	70	72	74
39	M/26	78	82	84	88	82	78	78	76	74	74	70	68	72	68	72	71	68	72	70	70	72	68
40	M/40	82	78	74	72	80	78	76	76	74	72	70	68	72	68	72	71	68	72	70	70	72	76

MEAN ARTERIAL PRESSURE

SL NO	AGE/SEX	PRE-IND	IND	BEF-INT	A-INT	P0	P1	P2	P3	1 MIN	2 MIN	3 MIN	4 MIN	5 MIN	6 MIN	7 MIN	8 MIN	9 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN
1	M/22	90	89	93	98	103	92	89	87	87	88	82	79	84	82	83	86	91	86	86	86	87	85
2	M/24	92	92	93	103	103	93	91	92	93	91	87	89	88	85	85	88	89	88	89	89	89	90
3	F/28	93	94	98	101	94	91	90	88	87	86	83	81	85	81	83	83	82	85	85	85	86	85
4	F/22	91	94	97	101	96	91	90	87	88	87	83	81	85	81	83	83	84	84	86	85	86	87
5	F/20	93	95	99	103	95	89	87	89	87	85	83	84	85	85	85	84	87	85	85	85	86	84
6	M/31	90	94	89	90	99	92	90	87	87	86	83	81	85	81	83	83	82	85	85	86	86	91
7	M/24	93	93	93	98	103	95	91	89	88	87	83	81	85	81	83	83	82	85	85	85	86	85
8	F/29	91	91	91	95	101	91	90	88	89	85	83	84	85	81	83	83	82	85	85	85	85	89
9	M/27	91	93	97	101	98	91	91	89	87	86	83	81	85	81	83	83	82	85	85	85	86	83
10	M/36	91	89	88	89	96	91	89	88	87	85	83	81	85	81	83	83	82	85	85	85	86	89
11	F/22	89	89	95	99	103	92	88	87	87	87	86	85	84	87	85	93	91	91	94	91	91	95
12	F/25	90	89	93	98	103	92	89	87	87	88	82	79	84	82	83	86	91	86	86	86	87	85
13	M/25	93	94	98	101	94	91	90	88	87	86	83	81	85	81	83	83	82	85	85	85	86	85
14	M/23	91	94	97	101	96	91	90	87	88	87	83	81	85	81	83	83	84	84	86	85	86	87
15	F/29	93	95	99	103	95	89	87	89	87	85	83	84	85	85	85	84	87	85	85	85	86	84
16	M/34	90	94	89	90	99	92	90	87	87	86	83	81	85	81	83	83	82	85	85	86	86	91
17	M/30	93	93	93	98	103	95	91	89	88	87	83	81	85	81	83	83	82	85	85	85	86	85
18	F/28	91	91	91	95	101	91	90	88	89	85	83	84	85	81	83	83	82	85	85	85	85	89
19	F/24	91	93	97	101	98	91	91	89	87	86	83	81	85	81	83	83	82	85	85	85	86	83
20	M/22	91	89	88	89	96	91	89	88	87	85	83	81	85	81	83	83	82	85	85	85	86	89
21	M/26	90	89	95	99	103	92	89	87	87	88	86	85	84	87	85	93	91	91	94	91	91	95
22	F/21	90	89	93	98	103	92	89	87	87	88	82	79	84	82	83	86	91	86	86	86	87	85
23	F/35	93	94	98	101	94	91	90	88	87	86	83	81	85	81	83	83	82	85	85	85	86	85
24	F/28	91	94	97	101	96	91	90	87	88	87	83	81	85	81	83	83	84	84	86	85	86	87
25	F/23	93	95	99	103	95	89	87	89	87	85	83	84	85	85	85	84	87	85	85	85	86	84
26	M/21	90	94	89	90	99	92	90	87	87	86	83	81	85	81	83	83	82	85	85	86	86	91
27	M/21	93	93	93	98	103	95	91	89	88	87	83	81	85	81	83	83	82	85	85	85	86	85
28	F/29	91	91	91	95	101	91	90	88	89	85	83	84	85	81	83	83	82	85	85	85	85	89
29	M/33	91	93	97	101	98	91	91	89	87	86	83	81	85	81	83	83	82	85	85	85	86	83
30	M/27	91	89	88	89	96	91	89	88	87	85	83	81	85	81	83	83	82	85	85	85	86	89
31	M/24	90	89	95	99	103	92	89	87	87	88	86	85	84	87	85	93	91	91	94	91	91	95
32	M/21	90	89	93	98	103	92	89	87	87	88	82	79	84	82	83	86	91	86	86	86	87	85
33	F/24	93	94	98	101	94	91	90	88	87	86	83	81	85	81	83	83	82	85	85	85	86	85
34	M/28	91	94	97	101	96	91	90	87	88	87	83	81	85	81	83	83	84	84	86	85	86	87
35	M/32	93	95	99	103	95	89	87	89	87	85	83	84	85	85	85	84	87	85	85	85	86	84
36	M/25	90	94	89	90	99	92	90	87	87	86	83	81	85	81	83	83	82	85	85	86	86	91
37	M/39	93	93	93	98	103	95	91	89	88	87	83	81	85	81	83	83	82	85	85	85	86	85
38	F/32	91	91	91	95	101	91	90	88	89	85	83	84	85	81	83	83	82	85	85	85	85	89
39	M/26	91	93	97	101	98	91	91	89	87	86	83	81	85	81	83	83	82	85	85	85	86	83
40	M/40	91	89	88	89	96	92	89	88	87	85	83	81	85	81	83	83	82	85	85	85	86	89