ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 06 | June - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

# ASSESSING THE OXYGEN SATURATION LEVELS AND PERFUSION INDEX VALUES DURING PRESSOR RESPONSE AMONG PATIENTS FOLLOWING PRE-TREATMENT WITH SEVOFLURANE – A COMPARATIVE ANALYSIS

Anaesthesiology

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## ABSTRACT

**Background:** Perfusion index (PI) is a reliable and accurate indicator to conventional hemodynamic criteria for recognition of stress response to insertion of endotracheal intubation during Propofol, Fentanyl and Isoflurane anaesthesia among adult patients. However, there is scarce literature indicating its relation with Sevoflurane. The current study was executed to examine the changes in PI as an indicator of pressor response after ETT and laryngoscopy supplemented with Sevoflurane. **Methodology:** A single prospective randomized comparative controlled trial was carried out at one of the public medical schools in Maharashtra. A total 60 patients were distributed into two groups namely Group S (study group) - patients mask ventilated with 100% Oxygen and 1% Sevoflurane and Group C (control group) - patients mask ventilated with 100% Oxygen only. **Results:** The perfusion index following pre-medication did not change significantly. No significant change was detected after pre-oxygenation. After induction, there was a rise in PI after Propofol administration whereas after mask ventilation, it remained stable in group C but in group S it was improved after giving Sevoflurane. **Conclusion:** During mask ventilation, 1% Sevoflurane is effective in controlling the perfusion index after laryngoscopy and endotracheal intubation.

## KEYWORDS

Intubation, Laryngoscopy, Perfusion Index, Pre-oxygenation, Sevoflurane

## INTRODUCTION

Laryngoscopy and endotracheal intubation (ETT) is an integral part of balanced general anaesthesia. [1] During ETT, the blade of direct laryngoscope presses against the base of tongue to lift up the epiglottis and exposes the vocal cords. [1] It is a noxious stimulus, which incites untoward response in respiratory, cardiovascular as well as other physiological systems.[2] Pressor response is sympathetic as well parasympathetic in origin. However, parasympathetic response is evident in paediatric population, while in adults, sympathetic response is predominant. [2,3]

The pressor response during direct laryngoscopy and ETT persuades clinical relevant changes in hemodynamic variables.[4] Perfusion Index (PI) is the ratio of the pulsatile blood flow to the non-pulsatile static blood flow in a patient's peripheral tissue and is an indication of the pulse strength at the sensor site.[5] It is a non-invasive method of assessing peripheral perfusion based on the pulsatile strength at a specific site such as fingers or toes. [5] It is calculated by expressing the pulsatile signal (arterial) as a percentage of the non-pulsatile signal, both derived from the amount of the infrared (940 nm) light absorbed. Perfusion index can be monitored using a Masimo radical signal extraction technology (SET). The PI's values range from 0.02% for very weak pulse to 20% for extremely strong pulse. [5,6]

The perfusion index varies depending on patient's physiological conditions and monitoring sites. [6] The conclusive evidence indicates that perfusion index (PI) is a reliable, accurate and easier alternative to conventional hemodynamic criteria for detection of stress response to insertion of ETT during propofol, fentanyl and isoflurane anaesthesia among adult patients.[7]

However, there is scarce literature indicating its relation with Sevoflurane. In addition, sparse studies have been conducted documenting the changes in the perfusion index levels during pressor response during mask ventilation and endotracheal intubation. The present study was implemented to investigate the changes in perfusion index as an indicator of pressor response after ETT and laryngoscopy supplemented with Sevoflurane.

## MATERIAL AND METHODS

### *Ethical Consideration*

Prior to commencement of the study, an ethical approval was acquired from the research committee of the respective institution. An informed consent was received from the study participants.

### *Study Design*

The study was performed as a single prospective randomized comparative controlled trial.

### *Study Settings*

The study was implemented at one of the government tertiary level medical institutions in Maharashtra State between 1st April 2019 to 31st January 2020.

### *Study Participants and Sample Size Estimation*

A total 88 patients who were scheduled for elective body surface surgery under general anaesthesia (GA) at the concerned institute during study period were considered as a sampling frame. Of which, 28 patients were not willing to participate in the study and hence were excluded. Therefore, in the current study, 60 patients of both genders between 18 to 60 years of age were enrolled as study participants.

### *Inclusion Criteria*

1. ASA (American Society of Anaesthesiologists)[7] grade I patient.
2. Body mass index (BMI) $\leq$ 30 kg/m2
3. Patients undergoing elective surgeries under general anaesthesia.
4. Patients with MPC (Modified Mallampati Classification) class I and II.[8]

### *Exclusion Criteria*

1. Pregnancy
2. Patients who were posted for emergency surgeries.
3. Patients with pre-existing comorbidities like cardiovascular, respiratory, metabolic or neurovascular disorders and allergies.
4. Patients who were anticipated for difficult intubation.

### *Procedures*

The study population was allocated into two groups namely Group S (study group) - patients mask ventilated with 100% Oxygen and 1% Sevoflurane and Group C (control group) - patients mask ventilated with 100% Oxygen only. The participant's age, gender, ASA grade, duration and type of surgery were documented in pre-determined proforma. All participants were kept NBM (Nil by mouth) overnight. On the day of surgery, on arrival in the operating room, NBM status and consent was re-confirmed from the participants.

The readings of electrocardiographic heart rate and non-invasive oscillometric arterial blood pressure (NIBP) were noted by GE Datex Ohmeda S/5 Anaesthesia Monitor. The perfusion index (PI) was checked through Masimo Radical SET (Masimo Corporation, California) with its reported (by manufacturer) lower and upper limits of 0.02 to 20% respectively.

Among both the groups, intravenous line was secured using 18G/20G cannula and Ringer Lactate infusion was started at the rate of 40-60 ml/kg/hour. All participants were pre-medicated with intravenous injection of Glycopyrrolate 0.004 mg/kg and intravenous Fentanyl 1µg/kg IV. After pre-medication, the participants were pre-oxygenated for 5 minutes and subsequently the induction was done with IV Propofol 2mg/kg followed by intravenous injection of Rocuronium 1 mg/kg for muscle relaxation. After induction, In Group

S, participants were mask ventilated with 1% Sevoflurane and oxygen and among Group C, participants were mask ventilated with 100% oxygen only. Direct Laryngoscopy was performed using Macintosh laryngoscope followed by tracheal intubation which was done by cuffed endotracheal tube of appropriate size. Heart rate, perfusion index, SpO2 and NIBP was documented prior to induction of anaesthesia and before and after insertion of intubation device every 1st, 3rd and 5th minute before commencing the surgery. Perfusion index responses to device insertion were well defined from preceding literature as PI decrease ≥10% after the insertion of airway devices.[9] The sensitivity, specificity and predictive values were determined for perfusion index depending on heart rate as the gold standard.

### Statistical Analysis

The data was statistically described in terms of mean (±SD), frequencies (number of cases) and percentages whenever appropriate. Comparison of quantitative variables between the study groups was carried out using 'unpaired t-test' for normally distributed data or by 'Mann Whitney test' for non-normally distributed data. For comparing categorical data, 'Chi square test' was performed. 'Fisher Exact test' was considered during calculation when expected frequency was less than 5. A probability value (p value) <0.05 was considered statistically significant. The data analysis was performed using SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 21 for windows.

## RESULTS

### *A. General Attributes of Study Participants*

Table 1 delineates the mean age and gender distribution of participants. The study could not reveal any statistically significant differences between both the groups pertaining to age, gender, height and weight measurements.

**Table 1: Age and Gender Distribution of Study Participants (n=60)**

| Variable | Group C | Group S | p value |
|---|---|---|---|
| Mean age ( years) | 29.47± 11.78 | 35.63 ± 12.42 | 0.053 |
| Gender | | | |
| Male | 11 (36.7%) | 14 (46.7%) | 0.601 |
| Female | 19 (63.3%) | 16 (53.3%) | |

P<0.05 = statistically significant

### *B. Comparison of $SpO_2$ between Group C and S*

On comparing mean $SpO_2$ in both groups, it was observed that, the mean baseline $SpO_2$ before administering drug was 97.47 ± 1.43 % and 98.40 ± 1.25% respectively at room air which was comparable (Figure1). $SpO_2$ after pre-medication had no significant change in both the groups (group C 97.93±1.39% and group S 98.40±1.30%). It gradually augmented after mask ventilation (Group C 99.73 ± 0.74 % and Group S 99.97 ± 0.18 %). After induction, $SpO_2$ further enhanced and reached maximum (100%) in both the groups and remained so after intubation in both groups (Figure1).

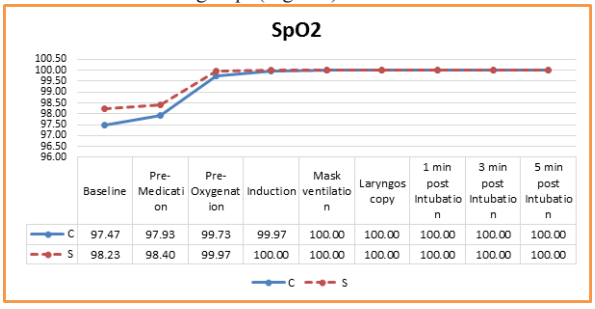


**Figure 1:** Comparison of $SpO_2$ between Group C and S

### *C. Comparison of Perfusion Index between Group C and S*

Table 2 summarizes that, the perfusion index (PI) following pre-medication did not change significantly. Similarly, no significant change was observed after pre-oxygenation. However, after induction, there was a rise in PI after Propofol administration whereas after mask ventilation, it remained stable in group C but in group S it was enhanced after giving Sevoflurane. In the present study, it was also noted that, in post intubation phase, PI gradually decreased in group C and remained constant in group S after 1st minute of intubation and the difference was significant (Table 2). After 3rd minute of intubation, PI did not change considerably but that change was statistically significant (Table 2). However, after 5th minute of intubation, there was a mild upsurge of PI in group C and mild reduction of PI in group S which was statistically significant (Table 2).

**Table 2: Changes in Perfusion Index During Various Events (n=60)**

| Perfusion index | Group | N | Mean (%) | SD | p- value | Percentage increase |
|---|---|---|---|---|---|---|
| Baseline | C | 30 | 5.11 | 2.15 | <0.01 | NA |
| | S | 30 | 2.59 | 1.71 | | NA |
| Pre- Medication | C | 30 | 5.03 | 2.14 | <0.01 | -1.4% |
| | S | 30 | 2.70 | 1.66 | | 4.1% |
| Pre-Oxygenation | C | 30 | 5.01 | 2.13 | <0.01 | -1.9% |
| | S | 30 | 2.76 | 1.66 | | 6.3% |
| Induction | C | 30 | 5.23 | 2.07 | <0.01 | 2.4% |
| | S | 30 | 3.41 | 1.53 | | 31.4% |
| Mask ventilation | C | 30 | 5.21 | 2.05 | 0.105 | 2.0% |
| | S | 30 | 4.46 | 1.39 | | 71.9% |
| Laryngoscopy | C | 30 | 3.65 | 1.90 | 0.023 | -28.5% |
| | S | 30 | 4.62 | 1.25 | | 78.0% |
| 1 min post Intubation | C | 30 | 3.47 | 1.89 | 0.012 | -32.1% |
| | S | 30 | 4.61 | 1.50 | | 77.8% |
| 3 min post Intubation | C | 30 | 3.48 | 1.89 | 0.014 | -31.8% |
| | S | 30 | 4.59 | 1.46 | | 76.8% |
| 5 min post Intubation | C | 30 | 3.56 | 1.89 | 0.034 | -30.3% |
| | S | 30 | 4.49 | 1.38 | | 72.9% |

P<0.05 = statistically significant, SD= Standard deviation, N= Number, NA= Not applicable

## DISCUSSION

The majority of general anaesthesia (GA) procedures in the contemporary anaesthetic practice have been implemented with endotracheal intubation (ETT).[10] Laryngoscopy and ETT are observed to be the most critical events during administration of GA as they incite transient but noticeable sympatho-adrenal response in the form of hypertension and tachycardia.[11] Such responses are short-lived, variable and may be insignificant among normal persons. However, among the patients with cardiac morbidities and intracranial aneurysms, it may predispose to potentially detrimental effects.[9-11]

The multiple inhalational anaesthetic drugs including lignocaine, opioids and calcium channel blockers have been utilized by several authors for diminishing haemodynamic response to ETT and laryngoscopy.[12-13] However, its use is restricted due to its unfavourable pharmacodynamic and pharmacokinetic properties.[12-13]

The current study used perfusion index (PI) for detecting stress response after laryngoscopy and intubation and used Sevoflurane to attenuate the hemodynamic response associated with the intubation and laryngoscopy. In the study, perfusion index (PI) increased significantly in both groups after induction phase with Propofol induced peripheral vasodilation. There was a trivial rise in PI in study group due to Sevoflurane with no change in control group. These findings corroborated with findings of study conducted by Mizuno et al.[14] Another similar study in Mumbai, Maharashtra [13] reported that perfusion index showed maximum percentage of positive stress response at one minute of intubation comparing to 3rd and 5th minute of intubation. These findings were comparable with present study where PI indicated marked stress response at 1st and 3rd minute after intubation in control (c) group. In this study, no significant changes were seen in saturation levels (SpO2) of participants in both the groups. However, it improved after induction and remained stable after intubation among both the groups. The similar results were also reported in the study done by Waghalkar P and Akude N.[13]

Inhalation of volatile anaesthetics has been formerly used as a method for suppressing the hemodynamic response prior to endotracheal intubation. Few studies reported the attenuation of rise in blood pressure by using 3% Enflurane and 2% Halothane.[15] However, the availability of literature on the effect of Sevoflurane on perfusion index to laryngoscopy and ETT is limited. In our study, it was evident that, 1% Sevoflurane given during mask ventilation was observed to be effective in controlling perfusion index after laryngoscopy and ETT in study group participants. Isoflurane with oxygen and nitrous oxide also attenuates the stress response but is related with sympathetic stimulation, and escalates plasma norepinephrine.[16] The attenuation

mechanism is primarily due to vasodilatory effect of Isoflurane. However, the effect of Sevoflurane on the cardiovascular system is different to that of Isoflurane.[14] The results obtained in other studies that Sevoflurane caused significant lesser rise in systolic blood pressure and heart rate compared to Isoflurane and other agents.[13,14] It is also found to be depress sympathetic activity without altering the parasympathetic response.[14] There were certain limitations in the current study. All study participants belonged to ASA grade I and the study could not involve any participants with difficult airway or systemic disease, so outcomes may not be applicable to patients with ASA grade more than I representing patients with mild or life threatening systemic illness. The restricted sample size in the study may not generalize the inferences reiterating the need for multicentric studies with large sample size for better exploration of results.

## CONCLUSIONS

The study showed that 1% Sevoflurane given during mask ventilation is effective in controlling the perfusion index after laryngoscopy and intubation as compared to control group. Perfusion index is a reliable and simplified substitute to conventional haemodynamic criteria for assessment of stress response as well as changes in peripheral vasodilation during laryngoscopy and endotracheal intubation.

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