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Comparative Evaluation of Oxygen Saturation Level and Heart Rate Using Pulse Oximeter during Non - Surgical and Surgical Periodontal Therapy – An Observational Study

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Abstract: ***Stress and anxiety can alter the respiratory rate which in time, may alter oxygen saturation levels in the blood. Pulse oximetry is used to record oxygen saturation (SpO_2) and heart rate (HR). AIM: To establish a relationship between SpO_2 level and HR duringperiodontal therapy using pulse oximeter. Methodology: 20 subjects with chronic periodontitis, requiring periodontal non - surgical or surgical (periodontal flap surgery) intervention were divided into two groups: Group A (N = 10)-Non-surgical therapy andGroup B (N = 10)-Surgical therapy. Plaque index, probing pocket depth were evaluated and SpO_2 and HR were recorded using pulse oximeter. Results: The highest values of SpO_2 and HR level were observed preoperatively and least values were observed intraoperatively in periodontal non-surgical and surgical therapy. A decrease was noted in $SpO_2$and HR values preoperatively, intraoperatively and postoperatively in nonsurgical periodontal therapy as compared to surgical periodontal therapy. Conclusion: In contrast to common clinical perception of periodontal surgical procedure being more stressful and traumatic there was greater decrease in oxygen saturation levels and heart rate during nonsurgical periodontal therapy than surgical periodontal therapy indicating that stress induced by periodontal procedures can be managed by the dentist-mediated behavioral control.***

Keywords: Chronic periodontitis, Oxygen saturation, Pulse Oximeter, Stress, Periodontal therapy

1. Introduction

Medical emergencies can occur in the dental practice.[1] Hyperventilation, seizures,hypoglycaemia, vasovagal syncope, angina pectoris, anaphylaxis, and respiratory distress are the common medical emergencies occurring in patients.[2] Hyperventilation and syncope represents the most commonly encountered emergency situation in dentistry which can be precipitated by psychological stress.[3] Stress and anxiety can alter the respiratory rate which in time, may alter oxygen saturation levels in the blood.[4]

Pain and anxiety triggered by dental treatment can induce the secretion of endogenous catecholamines which may increase its undesirable effects on the cardiovascular system and the respiratory system.[5] Monitoring is important for observation and data recording for evaluating patient's physical condition. It provides essential information for assessing vital signs.such as heart rate, blood pressure and rhythm, oxygen saturation levels. [6]

Oxygen saturation is defined as the percentage of haemoglobin that carries oxygen. Acceptable normal range of oxygen saturation level is from 95-99%. Pulse oximetry is a noninvasive method which is used to record oxygen saturation (SpO_2) and heart rate (HR). The pulse oximeter was developed by *Takuo Aoyagi* and *MichioKishi* in the year 1972 using the ratio of red to infrared light absorption of pulsating components. It utilizes a pair of small light-emitting diodes facing a photodiode through a translucent part of the patient's body, usually a fingertip which allows the monitoring of the oxygenation of a patient's hemoglobin.[7]

Hence, the aim of this study was to assess SpO_2 level and HR using Pulse Oximeter during periodontal non-surgical and surgical therapy and to compare these two treatment modalities using the pulse oximeter.

2. Materials and Methods

The study was conducted by selecting the subjects from the Out Patient Department, Department of Periodontology of Y.M.T. dental college, Kharghar, Navi Mumbai. This study was conducted on subjects who gave signed written informed consent in the language that was best understood by them and after prior ethical clearance from the institute. 30-50 years old subjects having chronic periodontitis (according to American Association of Periodontology 1999 classification)requiring periodontal non-surgical or surgical intervention were included in the study. They were selected on the basis of the following criteria:

Inclusion criteria

- Systemically healthy and cooperative subjects.
- Subjects within the age group of 30-50 years of either sex.
- Subjects with chronic periodontitis with probing pocket depth (PPD) of
- < 5mm (Group A-periodontal non-surgical therapy) and
- ≥ 5mm (Group B-periodontal surgical therapy) in four or more sites

- Subjects with mean plaque score > 1 according to Plaque Index (PI) (Silness and Loe in 1964)
- Subjects those were indicated for non-surgical therapy and those who needed further referral to periodontal flap surgery were included in group Aandsubjects requiring surgical therapy after completion of their phase I therapy were included in group B.

Exclusion criteria

- Subjects with history of any periodontal non-surgical and surgical treatment in the past 6 months.
- Pregnant or lactating women.
- Subjects under antidepressant drugs and patients with severe uncontrolled pain.

A detailed case history of the subjects participating in the study was recorded. The following clinical parameters were recorded:

- Plaque Index (PI) (Silness and Loe in 1964)
- Probing pocket depth (PPD)
- Oxygen saturation level (SpO_2)and heart rate (HR) were registered preoperatively, intraoperative and postoperatively using pulse oximeter.

The selected subjects were divided into two groups: **Group A**- 10 subjects undergoing non-surgical periodontal therapy and **Group B**- 10 subjects undergoing surgical periodontal therapy. **Nonsurgical periodontal therapy** included scaling and root planing (SRP) using ultrasonic instrument of sites with PPD < 5 mm. **Surgicaltreatment** was done in patients with persisting pocket depth of ≥ 5 mm; 3 weeks post SRP. All periodontal flap surgeries were done using Kirkland flap procedure.

The monitoring of oxygen saturation level and heart rate was done using pulse oximeter (ChoiceMMed) (Fig 2). HR and oxygen saturation levels were monitored continuously and was registered preoperatively, intraoperatively and post operatively. Preoperatively value was registered 10 minutes before the start of the procedure. Oxygen saturation level and HR was continuously monitored intraoperatively and the lowest drop in the oxygen saturation level was registered. Postoperatively oxygen saturation level and HR value was registered 10 minutes after the procedure was completed. The study design of this study has been summarized in Fig 1.

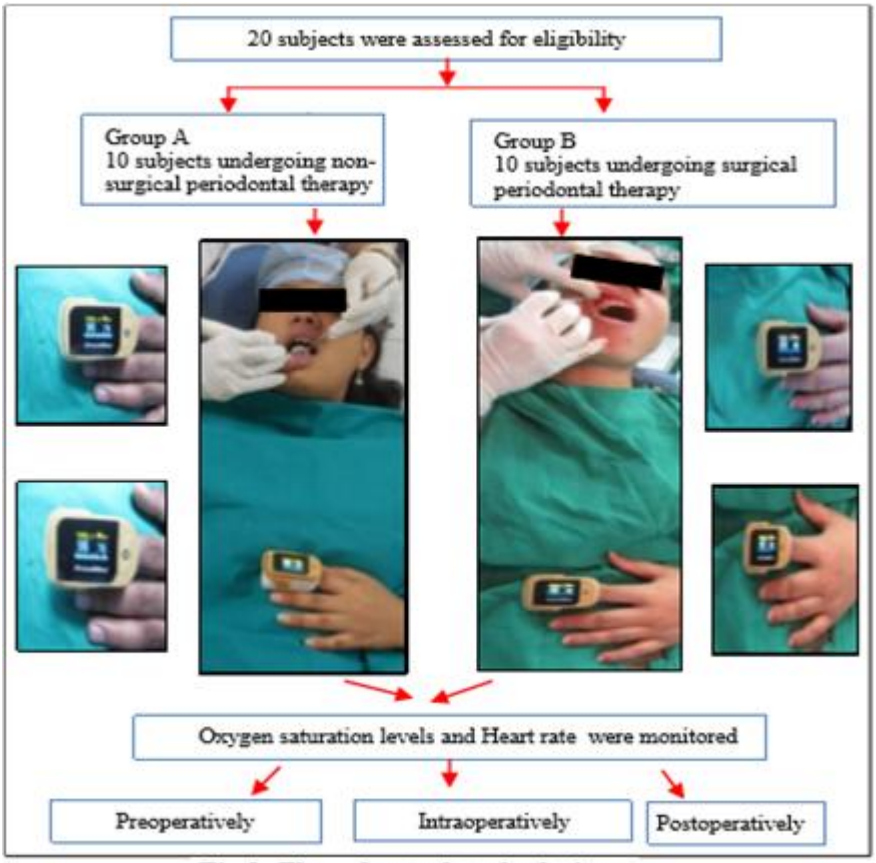


Fig 1. Flow chart of study design

Fig 2. Pulse oximeter device

3. Statistical Analysis

Data obtained was compiled on a MS Office Excel Sheet (v 2010). Data was subjected to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM). Inter group comparison of scoring has been done using t test. Intra group comparison in both the groups has been done using ANOVA test (Analysis of variance). pvalues of <0.05 was considered to be statistically significant.

4. Result

The study was conducted in 20 patients who were divided into two groups based on their treatment modalities. All patients were in the age ranging from 30 to 50 years. The intragroup comparison of oxygen saturation levels and heart rate was assessed for group A and group B (Table 1). There was a statistically non-significant difference seen for the intra group comparison of the outcome variables group A ($p>0.05$). There was a statistically highly significant difference seen for the intra group comparison of the outcome variables like oxygen saturation level and heart rate in group B, ($p<0.001$) with higher values preoperatively followed by postoperatively and least values intraoperatively.

The intergroup comparison of oxygen saturation levels and heart rate was assessed for group A and group B (Table 2 and Graph 1 and Graph 2). There was a statistically significant / highly significant difference seen for the inter group comparison of the outcome variables ($p<0.05$ or $p<0.001$) at all time intervals with higher values in group B as compared to group A.

Table 1: Intra group comparison of variable in both the groups

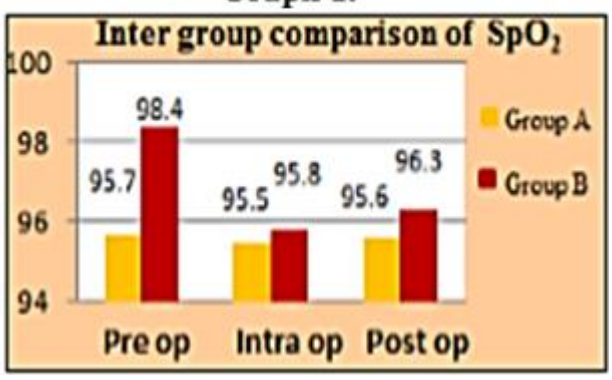
		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum	p value
O group A	Preop	10	95.7	0.483	0.153	95	96	0.684#
	Intra op	10	95.5	0.527	0.167	95	96	
	Post op	10	95.6	0.516	0.163	95	96	
	Total	30	95.6	0.498	0.091	95	96	
HR group A	Preop	10	62.6	6.15	1.945	51	69	
	Intra op	10	59	5.981	1.892	51	68	0.344#
	Post op	10	62.2	5.633	1.781	54	68	
	Total	30	61.27	5.948	1.086	51	69	
O group B	Preop	10	98.4	0.699	0.221	97	99	
	Intra op	10	95.8	0.422	0.133	95	96	0.000**
	Post op	10	96.3	0.675	0.213	95	97	
	Total	30	96.83	1.289	0.235	95	99	
HR group B	Preop	10	82.1	4.095	1.295	76	90	
	Intra op	10	68	1.7	0.537	65	71	0.000**
	Post op	10	70.5	3.308	1.046	65	75	
	Total	30	73.53	6.967	1.272	65	90	

* = statistically significant difference ($p<0.05$)
** = statistically highly significant difference ($p<0.001$)
# = non significant difference ($p>0.05$)

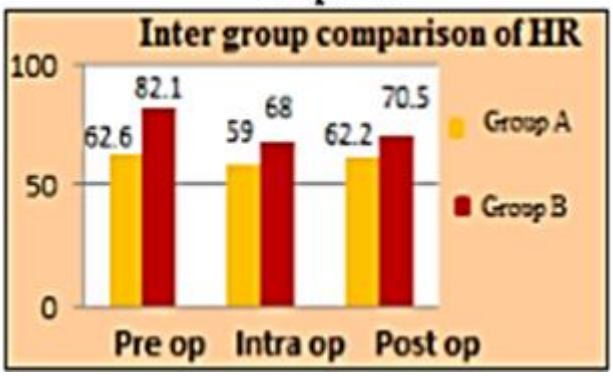
Table 2: Inter group comparison of variable in both the groups

	Groups	N	Mean	Std. Deviation	Std. Error Mean	p value
Preop O	A	10	95.7	0.483	0.153	0.000**
	B	10	98.4	0.699	0.221	
intra op O	A	10	95.5	0.527	0.167	0.177#
	B	10	95.8	0.422	0.133	
postop O	A	10	95.6	0.516	0.163	0.018*
	B	10	96.3	0.675	0.213	
pre HR	A	10	62.6	6.15	1.945	0.000**
	B	10	82.1	4.095	1.295	
intra HR	A	10	59	5.981	1.892	0.000**
	B	10	68	1.7	0.537	
post HR	A	10	62.2	5.633	1.781	0.001**
	B	10	70.5	3.308	1.046	

Graph 1.



Graph 2.



5. Discussion

In group A and group B highest values were observed preoperatively and least values were observed intraoperatively. There were statistically highly significant intragroup changes in $SpO_2$and HR levels when observed in group B as compared to group A. This suggests an increased fluctuation in SpO_2 levelfrom preoperative to intraoperative and intraoperative to postoperative values in surgical cases. Greater decrease in SpO_2 and HR were observed in group A (nonsurgical periodontal therapy) as compared to group B (surgical periodontal therapy).Changes in HR and SpO_2, i.e. oxygen saturation levels are affected by pain and by certain individual factors such as age, gender, hypertension, previous experience with dental treatment and psychological response.[6] In 2003, a study by Aeschliman et al recommended the use of diazepam given orally to healthy patients who may require slight to mild sedation during periodontal surgery.[4]

In this study, there was greater decrease in oxygen saturation levels during nonsurgical periodontal therapy than surgical periodontal therapy but was within normal range indicating that dental stress in patients can be managed by the dentist-mediated behavioral control. If psychological stress is minimized, medical emergencies in the dental office can be decreased.
In contrast to common clinical perception of periodontal surgical procedure being more stressful and traumatic there was greater decrease in oxygen saturation levels and heart rate during nonsurgical periodontal therapy than surgical periodontal therapy but was within normal range indicating that stress induced by periodontal procedures can be managed by the dentist-mediated behavioral control. Thus, if psychological stress is controlled, the occurrence of medical emergencies in dental offices may be minimized.

This may be probably because traumatized surface area is smaller in surgical periodontal treatment than whole mouth non-surgical periodontal treatment and local anesthesia is administered before the start of the surgical treatment procedure. It is also reasonable to believe that there is alleviation in patient anxiety with subsequent follow-ups, as seen in patients undergoing surgical phase of treatment when compared to patients undergoing non-surgical phase (initial phase) of treatment.

Also subgingival instrumentation would be associated with greater bacteremia as opposed to periodontal surgery. Patients undergoing periodontal treatment experience perturbations of systemic inflammation of a greater magnitude after nonsurgical than surgical periodontal therapy.

6. Conclusion

Greater decrease in oxygen saturation level and heart rate was observed during non-surgical periodontal therapy than in periodontal surgical procedure. The attenuation of stress with sedation can be used to reduce the cardiovascular response associated with patient anxiety, although in these cases dentist mediated patient behavioral control appears to play a fundamental role.

Thus, possible detrimental vascular effects following dental procedures can be controlled by continuous patient monitoring, proper anaethesia and by dentist mediated behavioral control.

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