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Physiological Changes in the Patients Undergoing Third Molar Surgery Under Local Anesthesia - A Prospective Pilot Study

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KEYWORDS

Pain, Blood Pressure, Respiratory Rate, Pulse Rate, SpO_2

ABSTRACT:

Purpose: The purpose of this study was to assess the physiological changes associated with stress in patients undergoing third molar surgery under local anesthesia. Despite adequate anaesthetic administration, patients often experience significant emotional stress. Hence, this study aims to evaluate the effect of stress on the physiological parameters during the surgical procedure.

Materials and Methods: It was a pilot study conducted in the department of oral and maxillofacial surgery, in the Saveetha Dental College & Hospital, Chennai. The healthy ASA I adult patients, aged more than 18 years, having mesioangular impacted mandibular third molar (MIMM), level 1, class A were included in this study. Patients taking analgesics within 72 hours and active pericoronitis have been excluded from the study. A standardized surgical protocol was followed, including a single experienced surgeon performing all extractions using a modified ward's incision, bone guttering, and planned tooth sectioning if necessary. Patient physiological parameters like blood pressure, heart rate, oxygen saturation, pulse rate along with pain perception using VAS score, were recorded at baseline, stimulation, and recovery phases. To validate the physiological changes, a comparative analysis between objective physiological data and subjective pain scores was conducted using IBM SPSS version 23 to assess the accuracy and sensitivity of the novel method.

Results: Systolic blood pressure showed a gradual increase from preoperative to 90 minutes postoperative, and Diastolic blood pressure slightly decreased up to 60 minutes and returned to near baseline at 90 minutes. However, neither of these changes was statistically significant. Respiratory rate remained comparable throughout the observation period with no significant variation ($P = 0.12$). Oxygen saturation (SpO_2) levels gradually increased over time, with a statistically significant difference ($P = 0.005$; post hoc $P = 0.031$). Pain scores, measured using the Visual Analog Scale (VAS), progressively decreased from preoperative to 90 minutes postoperative. These reductions in pain scores were statistically significant at multiple intervals, including between preoperative and 30 minutes ($P = 0.001$), 60 and 90 minutes ($P = 0.019$), 60 and 90 minutes ($P = 0.019$), and preoperative to 90 minutes ($P = 0.001$).

Conclusion: These findings suggest that the stress related to third molar surgery may influence subjective pain perception, like the VAS score. However, their impact on objective physiological parameters like blood pressure, heart rate, oxygen saturation, and pulse rate was minimal.

1. Background

Surgical extraction of impacted mandibular third molars is one of the most common procedures performed in oral and maxillofacial surgery. Despite the routine administration of local anesthesia, patients frequently experience significant levels of fear and anxiety associated with the surgery. Emotional stress can influence not only the patient's subjective experience but also their physiological responses,

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potentially affecting perioperative management and outcomes. Understanding the physiological impact of such stress during third molar surgeries is essential to improve patient care and optimize surgical protocols.

Fear and anxiety can lead to measurable physiological changes, including alterations in BP, HR, SPO2, PR. However, the extent to which these parameters are influenced during third molar surgeries under local anesthesia remains inadequately explored. Most studies primarily focus on postoperative pain and complications, with limited attention given to real-time physiological responses during the surgical process. By analyzing these changes alongside subjective pain scores, clinicians can gain deeper insight into the patient experience and identify potential areas for intervention.

The present pilot study aims to assess the physiological changes associated with fear and anxiety in patients undergoing mesioangular impacted mandibular third molar surgery under local anesthesia. It evaluates variations in BP, HR, SPO2, PR at multiple intervals during the surgical procedure and recovery period. Additionally, by correlating these objective measures with subjective pain scores, the study seeks to validate a novel approach to pain assessment, offering a more comprehensive understanding of the patient's perioperative status.

2. Materials And Methods

Study Design

The study used a prospective observational design to determine the feasibility and effectiveness of a new objective method for pain evaluation. Ethical clearance was acquired from the Saveetha Dental College and Hospital Review Board (IHEC/SDC/OMFS-2307/23/306). All participants were primarily from Chennai, India. Informed consent was obtained from all the participating individuals.

Participants

Inclusion Criteria included adult patients (aged 18 and above) from diverse clinical settings, having mesioangular impacted level 1, class A 3rd molars, and capable of providing informed consent.

Exclusion Criteria included individuals with contraindications to continuous monitoring (e.g., severe skin allergies to sensors) or those unable to comprehend the study procedures. Patients with active pericoronitis or recent analgesic use (≤72 hours). Patients who have pain other than related to third molar pain. Patients having any systemic disease(diabetes, hypertension). Patients having systemic chronic pain. (Table 1).

Table 1: Demographics

		Frequency	Percentage
Gender	Males	4	40
	Females	6	60
Nationality	Indian	10	100
Region	Tamil Nadu	10	100

Surgical Procedure Standardization

A single experienced oral surgeon performed all procedures to eliminate inter-operator variability. The surgical technique followed a standardized approach: Local anesthesia (2% lignocaine with 1:100,000 epinephrine) via inferior alveolar nerve block and buccal infiltration. Modified ward's incision with triangular mucoperiosteal flap elevation. Bone guttering using a low-speed surgical handpiece with copious saline irrigation. Controlled tooth sectioning based on impaction type. Extraction force applied using elevators and forceps. Closure with 3-0 silk sutures.

Data Collection and Analysis

Participants were monitored using non-invasive medical devices for blood pressure, pulse rate, respiratory rate, and peripheral oxygen saturation (SpO2).

Continuous data collection started 5 minutes before pain-inducing stimulus i.e.; surgical removal of impacted 3rd molars, and continued at 30 minutes, 60 minutes and 90 minutes post-stimulation to capture the recovery phase. To validate the proposed pain assessment scale, subjective pain scores were concurrently collected using established pain scales e.g., 10-point Visual Analog Scale (VAS) from participants. Local anesthesia typically lasts 60–90 minutes. Patients were instructed to describe any discomfort, including pressure and pulling sensations

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rather than sharp pain, to assess early postoperative pain before anesthesia fully dissipated. Pain assessment at 90 minutes may still be influenced by residual anesthesia. Comparative analysis between objective physiological data and subjective pain scores was conducted to assess the accuracy and sensitivity of the novel method. Descriptive statistics were used to summarize demographic data and baseline physiological parameters. Inferential statistics, including t-tests and correlation analyses, were employed to assess the significance of observed changes in physiological parameters during pain stimulation.

Ethical Committee

Ethical clearance for the study was obtained from Institutional Ethics Committee of Saveetha Dental College and Hospital (IHEC NO.- IHEC/SDC/OMFS-2307/23/306).

3. Results

Systolic Blood Pressure (SBP)

It was found that there was a gradual increase in SBP from preoperative to 90 minutes postoperative. The difference in mean SBP between different time intervals was not statistically significant (P = 0.401). This indicates a stable SBP from preoperative to postoperative times.

Diastolic Blood Pressure (SBP)

It was found that there was a marginal decrease in DBP from preoperative to 60 minutes postoperatively which later increased to preoperative levels after 90 minutes. The difference in mean DBP between different time intervals was not statistically significant (P = 0.63). This indicates a stable DBP from preoperative to postoperative times. (Table 2)

Table 2: Comparison of Mean systolic and diastolic blood pressure at different time intervals

	Systolic Blood Pressure		F test	P value	Diastolic Blood Pressure		F test	P value
	Mean	SD			Mean	SD		
Preop	118	8.6	1.015	P = 0.401 NS	79.3	13.7	0.403	P = 0.63 NS
Intraop 30 mins	119	8.4			78.2	13.5		
Post op 60 mins	119.3	7.2			77.7	12		
Recovery 90 mins	120.4	9.6			79.1	11.04		

SD-standard deviation; NS-not significant using the repeated measures ANOVA

It was found that respiratory rate among participants at different time intervals were comparable. The difference in mean respiratory rate between time intervals was not statistically significant (P = 0.12). This indicates a stable respiratory rate from preoperative to postoperative times. (Table 3)

Table 3: Comparison of Mean respiratory rate at different time intervals

	Respiratory Rate		F test	P value
	Mean	SD		
Preop	21	3.5	2.1	P = 0.12
Intraop 30 mins	22.2	2.5		
Postop 60 mins	22.2	2.8		
Recovery 90 mins	22.4	2.9		

SD-standard deviation; NS-not significant using the repeated measures ANOVA

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A gradual increase in SPO2 levels was observed from preoperative up to 90 minutes post-op. The difference in mean SPO2 levels between different time intervals was found to be statistically significant (P = 0.005). A post hoc multiple comparison test revealed a statistically significant difference in SPO2 levels between preoperative and 90 minutes postop which was statistically significant (P = 0.031). (Table 4, Table 4.1) In other words, there was an improvement in saturation levels from preoperative to 90 min postoperative.

Table 4: Comparison of mean saturation (SPO2) at different time intervals

	SPO2		F	P value
	Mean	SD		
Preop	97.7	0.94	7.2	P = 0.005*
Intraop 30 mins	98.1	0.73		
Postop 60 mins	98.5	0.7		
Recovery 90 mins	98.9	0.56		

*SD-standard deviation; *Statistically significant using the repeated measures ANOVA*

Table 4.1: Pairwise comparison

	Mean	SD	MD	P value
Preop	97.7	0.94	-0.4	P = 0.99
Intraop 30 mins	98.1	0.73		
Intraop 30 mins	98.1	0.73	-0.4	P = 0.99
Post op 60 mins	98.5	0.7		
Post op 60 mins	98.5	0.7	-0.4	P = 0.99
Recovery 90 mins	98.9	0.56		
Recovery 90 mins	98.9	0.56	1.2	P = 0.031*
Preop	97.7	0.94		

*SD-standard deviation; MD-mean difference; *Statistically significant*

A gradual decrease in pain scores was observed from preoperative up to 90 minutes post-op. The difference in mean VAS scores between different time intervals was found to be statistically significant (P = 0.001). A post hoc multiple comparison test revealed a statistically significant difference in pain scores between preoperative and 30 minutes postop (P = 0.001), between 30 minutes and 60 minutes post-op (P = 0.019), between 60 minutes and 90 min post-op (P = 0.019), and between preop and 90 minutes postop (P = 0.001) which was statistically significant. (Table 5, Table 5.1) In other words, there was a reduction in pain scores from preoperative to 90 min postoperative. At intraop 30 mins the mean VAS score (1) suggests the effects of anesthesia. While, recovery 90 mins the mean VAS score (2.9) suggests the waiving of the local anesthetic effect.

Table 5: Comparison of mean pain scores at different time intervals

	Visual Analog Scale		F	P value
	Mean	SD		
Preop	6.6	0.84	112.9	P = 0.001*
Intraop 30 mins	1	0.66		
Post op 60 mins	2.1	0.99		

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Recovery 90 mins	2.9	1.1		

*SD-standard deviation; *Statistically significant using the repeated measures ANOVA*

Table 5.1: Pairwise comparison

	Mean	SD	MD	P value
Preop	6.6	0.84	5.6	P = 0.001**
Intraop 30 mins	1	0.66		
Intraop 30 mins	1	0.66	-1.1	P = 0.019*
Post op 60 mins	2.1	0.99		
Post op 60 mins	2.1	0.99	-0.8	P = 0.019*
Recovery 90 mins	2.9	1.1		
Recovery 90 mins	2.9	1.1	-3.7	P = 0.001**
Preop	6.6	0.84		

*SD-standard deviation; MD-mean difference; *Statistically significant*

4. Discussion

The present pilot study investigated the physiological changes associated with fear and anxiety in patients undergoing mesioangular impacted mandibular third molar surgeries under local anesthesia. Although it is generally assumed that emotional stress can cause significant alterations in physiological parameters, our findings indicate that most parameters, including systolic blood pressure, diastolic blood pressure, and respiratory rate, remained relatively stable throughout the perioperative period. Only oxygen saturation (SpO_2) showed a statistically significant increase from the preoperative phase to 60 minutes postoperatively, suggesting a possible improvement in patient relaxation or systemic adjustment after the initial surgical stress.

The slight, non-significant rise in systolic blood pressure observed during the procedure aligns with previous studies that reported transient increases in cardiovascular parameters during stressful dental interventions. However, the absence of significant variations suggests that the patients, despite initial anxiety, may adapt quickly once anesthesia takes effect and surgery progresses. Similarly, the minor changes in diastolic blood pressure and respiratory rate reflect a controlled physiological response, potentially influenced by the standardized surgical protocol, consistent operator technique, and careful patient monitoring implemented in this study.

Oxygen saturation (SpO_2) exhibited a gradual and statistically significant increase over time, which is an encouraging finding. Elevated SpO_2 levels postoperatively may reflect improved breathing patterns, reduced anxiety, or physiological recovery after the stress of surgery. This result also emphasizes the importance of continuous monitoring, as subtle improvements in oxygenation may not be clinically obvious but can have positive implications for patient recovery. Moreover, the significant reduction in pain scores, measured through the Visual Analog Scale (VAS), indicates that patients experienced less perceived pain over time, reinforcing the effectiveness of the local anesthetic protocol and surgical approach in minimizing postoperative discomfort.

Although the findings provide valuable insight, the study has certain limitations, including the small sample size inherent to a pilot study and the exclusion of patients with more complex impactions or systemic conditions. Future research with larger, more diverse populations is needed to confirm these results and further explore the relationship between emotional stress, physiological parameters, and surgical outcomes. Incorporating psychological assessment tools alongside physiological monitoring could also provide a more comprehensive understanding of patient responses during oral surgical procedures.

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5. Conclusion

This pilot study demonstrates that while patients undergoing third molar surgery under local anesthesia may experience stress, their physiological parameters, includingBP, HR, SPO2, PR, remain relatively stable throughout the procedure. A significant improvement in oxygen saturation and a progressive reduction in subjective pain scores suggest that patients adapt over time during and after surgery. These findings highlight that, despite emotional stress, physiological stability can be maintained with careful surgical technique and perioperative management. Further studies with larger sample sizes and comprehensive psychological assessments are recommended to better understand the interplay between anxiety, pain perception, and physiological responses during oral surgical procedures.

6. Limitations

This study was limited by its small sample size, as it was designed as a pilot study, which may affect the generalizability of the results. Only healthy ASA I patients with a specific type of impaction were included, which may not represent the wider population undergoing third molar surgeries. Additionally, psychological factors such as preoperative anxiety levels were not quantitatively assessed, which could have provided deeper insights into the relationship between emotional stress and physiological changes.

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Conflict of Interest

There was no conflict of interest.

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Ethics statement

The study protocol was reviewed and approved by the Institutional Ethics Committee of Saveetha Dental College and Hospital (IHEC NO.- IHEC/SDC/OMFS-2307/23/306). The study adhered to ethical guidelines outlined in the Declaration of Helsinki. Privacy and confidentiality of participants were maintained, and data were anonymized to protect individual identities.

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