

Original research article

## A clinical study to assess the hemodynamic changes occurs during dental extractions

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### Abstract

**Aims:** The aim of the study was evaluation of Hemodynamic Changes Caused during Dental Extractions.

**Methods:** The study included 100 patients who underwent dental extraction at Department of Dentistry, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India, for 1 year. The patients indicated for tooth extraction under local anesthesia and age between 18-55 years was included in this study. The SpO<sub>2</sub> was recorded using a non-invasive GIBSON infrared digital pulse oximeter placed on the patient's index finger. Change in Heart Rate (HR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) during Dental Extraction from the baseline was measured recorded.

**Results:** The study included 100 patients with mean age of 42.3± 3.5 years. Among them, there were 44 men and 56 women. Baseline pulse rate (mean ± S.D) of patients before the procedure was 83.7±12 beats/min which has risen to 90.2±12 beats/min after administration of local anesthesia and reduced to 86.7 ± 17 beats/min, 5 minutes after the dental extraction. Mean Percentage Oxygen saturation in patients before procedure was 98.4± 2.6%, which slightly increased to 98.9 ± 1.3% after injecting local anesthesia and then reduced back to 96.6 ±2.3% after completion of the procedure. The average baseline systolic blood pressure for all of the patients were 125 ± 24 mm Hg. Administration of local anesthetics and tooth extraction caused increases in both systolic blood pressure and pulse rate, and the peak systolic blood pressure occurred after tooth extraction (132 ± 32 mm Hg). After injecting local anesthesia, the mean systolic blood pressure was 130± 12 mm Hg. However, diastolic blood pressure did not change significantly during the entire treatment period (baseline= 79 ± 7 mm Hg, post anesthetic= 80.8 ± 11 mm Hg and post extraction= 83.1 ± 9.7 mm Hg). Whereas significant increase in blood pressure was seen in 65% patients after administration of local anesthesia and in 72% patients after dental extraction. (p < 0.001).

**Conclusion:** Systolic blood pressure is increased due to increased sympathetic activity which is due to local anesthesia injection and dental extractions. Pulse rate and oxygen saturation vary in anxiety. Any major fluctuation in these variables which is noted early, may alert us to prevent any medical emergency during routine dental procedures.

**Keywords:** Blood pressure; Pulse rate; Oxygen saturation; Local anesthesia; Dental extractions

## Introduction

Local anesthetics reversibly block nerve conduction, inhibiting excitation of the myelinated and unmyelinated nerve fibers, slowing the velocity of the process in the depolarization phase, and reducing sodium ion influx. The local anesthetics most often used in dental practice include lidocaine, articaine and mepivacaine. These drugs are normally used in combination with a vasoconstrictor, with the purpose of slowing systemic absorption of the anesthetic – thus prolonging its action and the intensity of block. The use of a vasoconstrictor also increases safety, because lower anesthetic doses are needed, thereby contributing to lessen toxicity. In addition, a certain degree of ischemia is maintained, which facilitates hemostatic action and lessens bleeding.<sup>1</sup> The most commonly used vasoconstrictors are epinephrine (adrenalin) and the norepinephrine (noradrenalin). These drugs act upon the alpha-adrenergic receptors of the vascular smooth muscle, causing vasoconstriction of the arterioles and venules of the local microcirculation. While epinephrine exerts its maximum action three minutes after injection, and the effect persists for about 30 minutes, it can cause adverse effects upon the central nervous and cardiovascular systems. Sung et al.<sup>2</sup> found that the administration of progressive doses of epinephrine at concentrations lower than those used in dental practice gives rise to increases in myocardial yield and oxygen consumption. This is commonly achieved with the use of local anesthetics, which are pharmacological agents that cause reversible interruption in the conduction of a nerve impulse to an anatomic part of the body.<sup>3-4</sup> The successful provision of many dental treatments including tooth extraction, therefore, depends on achieving excellent perioperative local anesthesia.<sup>5,6</sup> The vasoconstrictors and local anesthetics commonly used in oral surgery can induce hemodynamic changes during tooth extraction in the same way as other factors such as patient anxiety or stress.<sup>6,7</sup> The adrenaline added to the anesthetic solution is used in oral surgery to increase the potency and duration of anesthesia, reduce the plasma concentrations of the anesthetic, and improve the local control of bleeding.<sup>1,2,8</sup> Adrenaline containing local anesthetic has been criticized due to the risk of possible massive systemic absorption of the drug, resulting in undesirable cardiovascular effects.<sup>9,10</sup> This risk is more likely in patients with cardiovascular disease and hypertension; an increase in blood pressure (BP) has also been reported after the injection of anesthetics even in normotensive patients.<sup>5,11</sup> It is also widely claimed that the use of local anesthetics with adrenaline predisposes to undesirable cardiovascular changes that may result in life-threatening medical complications, representing a risk to patients with heart disease, especially those previously undiagnosed.<sup>11</sup> The possibility of dental extraction as a risk factor for altered blood pressure, SpO<sub>2</sub> and pulse rate remains unknown. It is a question whether dental extraction could cause a significant change in blood pressure which in combination with psychologic and physical stress, painful stimuli, and the action of catecholamine's present in local anesthetic solutions, that could cause harm or even death to the patient if not managed properly.<sup>12,13</sup> The purpose of the present study was to compare the incidence and extent of changes in blood pressure, pulse rate and oxygen saturation alteration after administration of local anesthesia and after extraction using local anesthesia with adrenaline.

## Material and Methods

A prospective observational study was conducted in the Department of Dentistry, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India, for 1 year, after taking the approval of the protocol review committee and institutional ethics committee.

## Methodology

The study included 100 patients who underwent dental extraction. The patients indicated for tooth extraction under local anesthesia and age 18-55 years were include in this study. The Patients with disease like hypertension, diabetes, and bleeding disorders, history of cardiac surgery, Smokers, alcoholics, and drug abusers, Pregnant patients, were exclude from study. Measurements

The parameters of the study involved measurement of Change in Peripheral Oxygen Saturation (SpO<sub>2</sub>), during Dental Extraction from the baseline SpO<sub>2</sub> (Time Frame: Baseline, 5-min post anesthesia injection and 5-min post extraction). The SpO<sub>2</sub> was recorded using a non-invasive GIBSON infrared digital pulse oximeter placed on the patient's index finger. Change in Heart Rate (HR) during Dental Extraction was recorded using a non-invasive GIBSON infrared digital pulse oximeter placed on the patient's left index finger. Change in Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) during Dental Extraction from the baseline was measured utilizing the analog sphygmomanometer and stethoscope and recorded in mmHg. The patients were kept in a supine position for 10 min after which blood pressure, oxygen saturation and pulse rate were measured and were defined as the Baseline values. Local anesthesia was administered after a control period of at least 10 min. Lidocaine, 2% with epinephrine (1:80,000), was used as an anesthetic for all of the patients. 5 minutes following local anesthesia injection blood pressure, oxygen saturation and pulse rate were again recorded in the similar manner. Surgery was begun 10 min after injection of the local anesthetic. After surgery, the patients were kept in a supine position during the recovery period. 5 minutes following completion of dental extraction blood pressure, oxygen saturation and pulse rate were recorded in the similar manner. All procedures (local anesthesia administration and tooth extraction) were performed by the same operator and the parameters were also recorded by the same personnel for all patients.

## Results

The study included 100 patients with mean age of  $42.3 \pm 3.5$  years. Among them, there were 44 men and 56 women. Baseline pulse rate (mean  $\pm$  S.D) of patients before the procedure was  $83.7 \pm 12$  beats/min which has risen to  $90.2 \pm 12$  beats/min after administration of local anesthesia and reduced to  $86.7 \pm 17$  beats/min, 5 minutes after the dental extraction. (Table 2) Mean Percentage Oxygen saturation in patients before procedure was  $98.4 \pm 2.6\%$ , which slightly increased to  $98.9 \pm 1.3\%$  after injecting local anesthesia and then reduced back to  $96.6 \pm 2.3\%$  after completion of the procedure. (Table 3) The average baseline systolic blood pressure for all of the patients were  $125 \pm 24$  mm Hg. Administration of local anesthetics and tooth extraction caused increases in both systolic blood pressure and pulse rate, and the peak systolic blood pressure occurred after tooth extraction ( $132 \pm 32$  mm Hg). After injecting local anesthesia, the mean systolic blood pressure was  $130 \pm 12$  mm Hg. (table 3) However, diastolic blood pressure did not change significantly during the entire treatment period (baseline=  $79 \pm 7$  mm Hg, post-anesthetic=  $80.8 \pm 11$  mm Hg and post extraction=  $83.1 \pm 9.7$  mm Hg). Middle-aged and older patients had higher blood pressures and lower pulse rates compared with young patients. There was slight reduction of mean SPO<sub>2</sub> by 0.3% after the injection of local anesthesia and there was overall decrease of 0.22% after extraction which is certainly not significant. Administration of local anesthesia caused mean rise in Pulse rate of 5/min but decreased by 2/min after completion of extraction. ( $p < 0.001$ ). Evaluation of pre anesthesia, post anesthesia and post extraction pulse rate shows no significant change in pulse rate in 5.8 per cent of the patients studied and 89.7 per cent of the patient had an increase in pulse rate post-extraction. Whereas significant increase in blood pressure was seen in 65% patients after administration of local anesthesia and in 72% patients after dental extraction. ( $p < 0.001$ ).

**Table 1: Demographic distribution of patients**

Gender	N=100	%
Male	44	44
Female	56	56
Age	42.3± 3.5 (mean)	

**Table 2: Pulse rate of patients**

	Baseline	After administration of local anesthesia	5 min after the extraction
Pulse rate	83.7±12 beats/min	90.2±12 beats/min	86.7 ± 17 beats/min

**Table 3: Percentage Oxygen saturation of patients**

	Baseline	After administration of local anesthesia	5 min after the extraction
Oxygen saturation	98.4± 2.6%	98.9 ± 1.3%	96.6 ±2.3%

**Table 4: Systolic blood pressure of patients**

	Baseline	After administration of local anesthesia	5 min after the extraction
SBP	125 ± 24 mm Hg	132 ± 32 mm Hg	130± 12 mm Hg
DBP	79 ± 7 mm Hg	80.8 ± 11mm Hg	83.1 ± 9.7 mm Hg

## Discussion

Many patients who visit dental clinics have systemic diseases such as hypertension, ischemic heart disease, and other atherosclerotic diseases. In one study, 65% of the elderly patients who visited the dental clinic were found to have one or more systemic diseases, and among them hypertension was the most frequent systemic disease, occurring in 32% of the patients.<sup>14</sup> Furthermore, cardiovascular accidents caused by hypertension during dental surgery have also been reported.<sup>15</sup> It is therefore important to determine the responses of blood pressure and sympathetic outflow during dental surgery. Koehler-Knoll et al.<sup>16</sup> have demonstrated that catecholamine's present in local anesthetics causes increase in blood pressure. However, studies conducted by Davenport et al.<sup>17</sup> and Salonen et al.<sup>18</sup> did not show such an increase. The sympathetic nervous system activity tends to increase during dental surgery, as a result of painful stimuli, psychological stress or the epinephrine contained in the local anesthetic. This increased sympathetic activity would therefore increase the blood pressure and pulse rate and can also affect oxygen saturation.<sup>19</sup> In the present study, The average baseline systolic blood pressure for all of the patients were 125 ± 24 mm Hg. Administration of local anesthetics and tooth extraction caused increases in both systolic blood pressure and pulse rate, and the peak systolic blood pressure occurred after tooth extraction (132 ± 32 mm Hg). After injecting local anesthesia, the mean systolic blood pressure was 130± 12 mm Hg. (table 3) However, diastolic blood pressure did not change significantly during the entire treatment period (baseline= 79 ± 7 mm Hg, post-anesthetic 80.8 ± 11 mm Hg and post extraction= 83.1 ± 9.7 mm Hg). The middle-aged and older patients had a greater increase in blood pressure after dental extraction, which can be due to enhanced sympathetic activity or may be due to the atherosclerotic changes and augmented vascular reactivity in older patients. Plasma epinephrine concentrations remain high 30 min after its administration with local anesthesia. Therefore, the combined effects of

factors including painful stimuli and psychological stress and the direct effect of epinephrine contained in the local anesthetics might elicit a greater sympathetic response. Bible et al.<sup>20</sup> conducted a meta analysis which concluded that local anesthetics like lidocaine with epinephrine tend to increase the systolic blood pressure and also heart rate. These findings are consistent with our results. Salonen and colleagues showed that the use of Lidocaine in combination with epinephrine caused a significant increase in heart rate of the patients which are comparable and consistent with our findings.<sup>18</sup> The present study showed that injection of lidocaine caused reduction of pulse rate. This may be attributed to vasodilative effect of Lidocaine. There was no major change in oxygen saturation alteration during LA administration. Many previous studies showed SpO<sub>2</sub> values remained constant throughout dental surgery, regardless of the anesthetic combination involved.<sup>19</sup> Pulse rate and oxygen saturation vary in anxious patients. Any major fluctuation in these variables which is noted early may alert us to prevent any medical emergency during routine dental procedures.

### Conclusion

Systolic blood pressure is increased due to increased sympathetic activity which is due to local anesthesia injection and dental extractions. Pulse rate and oxygen saturation vary in anxiety. Any major fluctuation in these variables which is noted early may alert us to prevent any medical emergency during routine dental procedures.

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