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Blood Pressure and Pulse Rate Changes in Patients Undergoing Tooth Extraction

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Abstract: ***Introduction***: Tooth extraction is a common dental procedure that can lead to physiological changes, including alterations in blood pressure (BP) and pulse rate (PR). The administration of local anesthesia, particularly lidocaine with epinephrine, can temporarily impact cardiovascular parameters. This study aimed to evaluate changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate before and after tooth extraction. ***Aim of study:*** To evaluate changes in blood pressure and pulse rate during tooth extraction procedures and assess the impact of anxiety and stress on cardiovascular responses in dental patients. ***Material and method:*** This study was carried out during the period from October 2024 till February 2025, which included a sample size of 40 patient (31 were male and 9 were female), and was selected from the Faculty of Dentistry at Tikrit University / Iraq. Three readings were taken for both systolic and diastolic blood pressure were measured (in mmHg), and heart rate, the measurements were carried out with the aid of a digital oximeter. ***Result:*** The results showed a significant increase in SBP and DBP following lidocaine administration (SBP: 124±9 mmHg to 133±8 mmHg, DBP: 81±8 mmHg to 89±6 mmHg). However, after extraction, these values returned closer to baseline (SBP: 125±8 mmHg, DBP: 83±5 mmHg). Pulse rate followed a similar pattern, rising from 86±8 bpm to 90±6 bpm after lidocaine and stabilizing at 88±7 bpm post-extraction. No statistically significant differences were found between males and females or between different age groups. ***Conclusion:*** The study confirms that local anesthesia with epinephrine causes temporary elevations in blood pressure and pulse rate, likely due to both physiological responses and patient anxiety. While these changes are self-limiting in healthy individuals, they highlight the importance of preoperative monitoring, particularly in hypertensive or anxiety-prone patients. Future research should focus on the long-term cardiovascular effects of local anesthetics in different patient populations.

Keywords: Blood pressure, Heart rate, Tooth extraction, Dental surgery.

Research Paper

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INTRODUCTION

Extraction of a tooth is one of the basic oral surgical procedures, many times performed when the teeth cannot be saved. Various reasons for extraction of teeth include, periodontitis, dental caries, supernumerary and malposed teeth, teeth extraction for orthodontic treatment, non-restorable teeth and the most frequent operation in oral surgery is tooth extraction. Ideally, it involves removing the entire tooth or its roots from its socket without causing any discomfort and with as little damage to the soft tissues around it as possible. [1]. Extraction of teeth is generally perceived as a painful procedure by most of the patients, leading to patient's anxiety, fear, and apprehension. Additionally, excessive bleeding and cardiovascular fluctuations are frequent complications that can pose significant risks, particularly for patients with underlying health conditions, such as cardiovascular diseases [2].

Depending on the level of anxiety, some individuals may experience a rise in blood pressure (BP), especially in those who have systemic changes associated with psychological factors. Nerve stimulation is one of the factors causing BP elevation [3].

Anesthesia also causes a state of stress in the patient, thus affecting blood pressure. During stress, there is an increase in the release of cortisol by stimulation of the adrenal cortex and the stimulation of the adrenal medulla by the autonomic nervous system, and this in turn releases endogenous catecholamines, epinephrine, and norepinephrine in an amount 40 times higher than the level at rest, causing faster heart rate, elevation in the systolic volume of the heart and the constriction of the vascular bed, thereby increasing both systolic and diastolic pressures [4]. Cardiovascular changes during dental procedures are typically harmless in healthy individuals, they may present significant risks in patients with a history of heart disease [5]. Monitoring vital signs, such as blood pressure and cardiac frequency, can provide essential information about the patient's stress response, especially in surgical contexts. However, Hypertension represents one of the most common medical histories obtained from the patients who visit dental clinics, hypertensive patients constitute an important risk group in dental treatment [6]. Therefore, it is important for the dentists to routinely measure blood pressure in patients prior to procedures, especially surgical in order to avoid possible complications [5].

The clinical impact of cardiovascular and hemodynamic changes caused by the anxiety and introduction of exogenous adrenaline during anesthesia its use among hypertensive individuals a controversial subject in dentistry. General contraindication to vasoconstrictors are well documented, but one criticism regarding the current guidelines is their vagueness and ambiguity for patients with cardiovascular disorders [7].

MATERIAL AND METHOD

1. **Basic data:** This study was carried out during the period from October 2024 to February 2025. During this period, diagnosis, sample collection, data analysis, and research writing. Before starting the study, approval from the patient was taken.
2. **The sample:** In this study, a sample size of 40 patient (31 were male and 9 were female), was selected and participated in the study. The subjects were between the ages of 16-35 years.
3. **Instruments and supplies:** The following instruments and accessories were used for diagnosis:
    1. Sphygmomanometer (speidel and keller)
    2. Oximeter
    3. Disposable dental mirrors
    4. Disposable dental probes
    5. Disposable tweezers
    6. Gloves
    7. masks
    8. Carpules of anesthesia (20 mg of 2% lidocaine with epinephrine 12.5 mcg)
    9. Dental syringe
    10. Dental needle

Figure 1: Sphygmomanometer and Oximeter used in the study

4. **Survey Method:** This study was conducted at the Faculty of Dentistry at Tikrit University in the department of surgery. The number of the patients participating in the study those came to extract their teeth was fourty (31 male & 9 female) and the age ranged from (16-35) years old.

All patients participating in the study should be healthy without hypertension, heart disease, diabetes mellitus or any disease and nonsmokers. Consent form was taken from all patients who agree to participate in the study.

Three readings were taken for both systolic and diastolic blood pressure were measured (in mmHg), and heart rate, the measurements were carried out with the aid of a digital oximeter (clinically validated measurement accuracy 2004, German Hypertension Society). At three different times: waiting room before giving the anesthesia, (5min.) after the patient was taken anesthesia (20 mg of 2% lidocaine with epinephrine 12.5 mcg), after the extraction of tooth (about 5 min.) from the second measurement.

5. **Data Analysis:** Data analysis and processing were carried out using a statistical package for social science (SPSS version 23).

RESULTS

This study sample is predominantly young, with 85% of participants aged 18–29 and only 15% in the 30–50 range. Additionally, 70% of the participants are male while 30% are female. Such an imbalance in age and gender distribution should be considered when generalizing the findings, as the predominance of young and male subjects might influence the overall response patterns, as shown in table 4.1.

Table 4.1: Demographic characteristics of study participants

Variable		Count	Percentage
Age	**Young (18-29)**	34	85%
	Middle-aged (30-50)	6	15%
Sex	**Male**	28	70%
	Female	12	30%

Table 4.2: Medical History of Study Participants

Variable		Count	Percentage
Smoker	**No**	28	70%
	Yes	12	30%

The medical history data indicates that 70% of participants are non-smokers, with 30% identified as smokers.

Table 4.3: Pulse Rate and Blood Pressure Changes among Study Participants

Variable	Before (Mean ± SD)	After Lidocaine (Mean ± SD)	After Extraction (Mean ± SD)
PR	86±8	90±6	88±7
SBP	124±9	133±8	125±8
DBP	81±8	89±6	83±5

This table presents the mean and standard deviation (SD) of pulse rate (PR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) measured at three stages: before the procedure, after lidocaine administration, and after extraction. The key observations are:

- **Pulse Rate (PR):** Increased from 86±8 before lidocaine to 90±6 after lidocaine, then slightly decreased to 88±7 after extraction.
- **SBP:** Rose from 124±9 before lidocaine to 133±8 after lidocaine, then dropped to 125±8 after extraction.
- **DBP:** Elevated from 81±8 before lidocaine to 89±6 after lidocaine, then decreased to 83±5 after extraction.

These patterns indicate a transient increase in cardiovascular parameters following lidocaine administration, which tends to partially revert after the extraction phase. This transient response might reflect a physiological reaction to the lidocaine or procedural stress.

Table 4.4: Comparison of SBP, DBP, and PR between Different Stages

Comparison	Mean Difference	SD	Std. Error Mean	95% CI (Lower)	95% CI (Upper)	p-value
SBP Before – SBP After Lidocaine	-9.63	4.30	0.68	-11.00	-8.25	< 0.001*
SBP After Lidocaine – SBP After Extraction	8.75	3.71	0.59	7.56	9.94	< 0.001*
SBP Before – SBP After Extraction	-0.88	3.90	0.62	-2.12	0.37	0.164
DBP Before – DBP After Lidocaine	-8.25	7.47	1.18	-10.64	-5.86	< 0.001*
DBP After Lidocaine – DBP After Extraction	6.75	5.26	0.83	5.07	8.43	< 0.001*
DBP Before – DBP After Extraction	-1.50	5.80	0.92	-3.35	0.35	0.110
PR Before – PR After Lidocaine	-3.55	3.87	0.61	-4.79	-2.31	< 0.001*

Comparison	Mean Difference	SD	Std. Error Mean	95% CI (Lower)	95% CI (Upper)	p-value
PR After Lidocaine – PR After Extraction	2.25	4.03	0.64	0.96	3.54	0.001*
PR Before – PR After Extraction	-1.30	2.57	0.41	-2.12	-0.48	0.003*

In this comparison table, mean differences, standard deviations, standard errors, 95% confidence intervals, and p-values are provided for pairwise stage comparisons:

- SBP:
    - Before vs. After Lidocaine: Mean difference of –9.63 ($p < 0.001$)
    - After Lidocaine vs. After Extraction: Mean difference of 8.75 ($p < 0.001$)
    - Before vs. After Extraction: Mean difference of –0.88 ($p = 0.164$)
- DBP:
    - Before vs. After Lidocaine: Mean difference of –8.25 ($p < 0.001$)
    - After Lidocaine vs. After Extraction: Mean difference of 6.75 ($p < 0.001$)
    - Before vs. After Extraction: Mean difference of –1.50 ($p = 0.110$)
- PR:
    - Before vs. After Lidocaine: Mean difference of –3.55 ($p < 0.001$)
    - After Lidocaine vs. After Extraction: Mean difference of 2.25 ($p = 0.001$)
    - Before vs. After Extraction: Mean difference of –1.30 ($p = 0.003$)

The significant p-values ($p < 0.001$ or $p = 0.001$) for the comparisons between “Before” and “After Lidocaine” as well as “After Lidocaine” and “After Extraction” indicate that lidocaine administration significantly alters SBP, DBP, and PR. However, the overall difference between the initial and final stages is not significant for SBP and DBP ($p = 0.164$ and 0.110, respectively), while the change in PR remains statistically significant ($p = 0.003$). This suggests that the cardiovascular parameters largely return toward baseline after extraction, with pulse rate being an exception.

Table 4.5: Changes of SBP, DBP, and PR across gender

Variable	Female		Male		P-value
	Mean	SD	Mean	SD	
PR Before	89	7	85	8	>0.05 NS
PR After Lidocaine	92	6	89	6	>0.05 NS
PR After Extraction	90	5	86	8	>0.05 NS
SBP Before	121	5	125	9	>0.05 NS
SBP After Lidocaine	131	7	134	8	>0.05 NS
SBP After Extraction	123	7	125	8	>0.05 NS
DBP Before	81	3	81	9	>0.05 NS
DBP After Lidocaine	89	7	89	6	>0.05 NS
DBP After Extraction	83	5	83	5	>0.05 NS

This table compares cardiovascular measurements between female and male participant’s at all three stages:

- For PR, SBP, and DBP across all stages, the p-values are >0.05 (not significant).

This indicates that there is no statistically significant difference between males and females regarding the response of these parameters to the intervention. In other words, the physiological responses measured in this study are consistent across genders.

Table 4.6: Changes of SBP, DBP, and PR across Age Groups

Variable	Middle-aged (30-50)		Young (18-29)		P-value
	Mean	SD	Mean	SD	
PR Before	88	6	86	8	>0.05 NS
PR After Lidocaine	91	5	90	6	>0.05 NS
PR After Extraction	87	5	88	7	>0.05 NS
SBP Before	123	10	124	8	>0.05 NS
SBP After Lidocaine	133	10	133	8	>0.05 NS
SBP After Extraction	125	8	124	8	>0.05 NS
DBP Before	78	4	81	8	>0.05 NS
DBP After Lidocaine	87	5	90	6	>0.05 NS
DBP After Extraction	80	0	83	5	>0.05 NS

The table contrasts the responses between the middle-aged group (30–50 years) and the young group (18–29 years) for PR, SBP, and DBP:

- Again, all comparisons yield p-values >0.05 (not significant).

This lack of statistically significant differences between age groups suggests that the intervention's effects on the cardiovascular parameters are similar regardless of whether the subjects are young or middle-aged.

DISCUSSION

In this study, which examined the hemodynamic changes in participants before and after the administration of lidocaine and post-extraction, it was found that the most significant differences occurred in SBP, DBP, and PR immediately after lidocaine injection. The results indicated that SBP increased from 124±9 mmHg to 133±8 mmHg, while DBP rose from 81±8 mmHg to 89±6 mmHg following lidocaine administration. These changes align with previous findings, which suggest that the administration of local anesthetics, particularly those containing epinephrine, leads to transient cardiovascular responses. Henk *et al.*, and Meyer *et al.*, [8, 9] reported that both BP and HR tend to rise in response to dental procedures, particularly during extractions and before local anesthesia is administered. This increase is attributed to a combination of pain anticipation, anxiety, and the pharmacological effects of epinephrine [10].

Following tooth extraction, SBP and DBP values returned closer to baseline levels, with SBP measuring 125±8 mmHg and DBP at 83±5 mmHg. This suggests that the BP elevation was a short-term effect primarily due to the anesthetic rather than the extraction itself [11]. The stress associated with dental procedures can trigger the release of endogenous catecholamines, further affecting BP and HR [12].

Alemany *et al.*, and Karanam AK *et al.*, [13, 14] stated that preoperative anxiety plays a significant role in BP fluctuations. This supports the notion that patient anxiety, in addition to the vasoconstrictive properties of epinephrine, may contribute to the observed changes [13, 14].

Similarly, pulse rate (PR) increased from 86±8 bpm to 90±6 bpm after lidocaine administration, before slightly decreasing to 88±7 bpm post-extraction. The transient elevation in PR is consistent with previous studies indicating that both anticipated and actual dental procedures elicit physiological responses. Henk *et al.*, highlighted that HR changes are particularly evident before anesthesia administration and during extractions. This emphasizes the role of both stress and pharmacological agents in modulating cardiovascular responses [8].

When comparing hemodynamic responses between males and females, no statistically significant differences were observed. Both genders exhibited similar patterns of PR and BP changes before and after lidocaine injection, as well as post-extraction. Additionally, there were no significant differences between young adults (18–29 years old) and middle-aged participants (30–50 years old) in terms of BP or PR fluctuations. This finding suggests that the autonomic response to lidocaine is relatively uniform across different demographic groups, provided there are no underlying medical conditions such as hypertension [15]. Henk *et al.*, also reported that BP and HR changes are not necessarily dependent on age but are rather linked to anxiety and physiological reactivity to pain and anesthetic agents [8].

It is important to note that while the majority of patients in this study were normotensive, even in the absence of hypertension, transient increases in BP were observed following lidocaine administration. Highlights that normotensive individuals may experience temporary BP elevations due to stress and epinephrine. The potential for significant cardiovascular responses in hypertensive patients underscores the importance of monitoring BP before and after anesthesia administration, especially in individuals with pre-existing conditions.

Given the observed BP and PR changes, stress reduction strategies should be considered as part of preoperative dental care [16]. Alemany *et al.*, emphasized that sedation and anxiolytics have beneficial effects in lowering cardiovascular responses related to preoperative anxiety [13]. Although behavioral management techniques, such as reassuring the patient and explaining the procedure in detail, are the first line of intervention, additional measures like controlled breathing exercises or mild sedation may help minimize BP fluctuations [17].

CONCLUSION AND RECOMMENDATION

1. **Conclusion:** This study reinforces the temporary yet significant cardiovascular effects of lidocaine with epinephrine. While the changes observed were self-limiting in healthy individuals, caution should be examined when administering local anesthesia to hypertensive or highly anxious patients. Future research with a larger and more diverse sample, including hypertensive individuals, could provide further insights into the long-term implications of these hemodynamic changes.
2. **Recommendation**

   1- Blood pressure and pulse rate should be measured before administering local anesthesia, especially in patients with a history of hypertension or cardiovascular disease.

2- For patients with hypertension or cardiovascular concerns, the use of local anesthetics with lower epinephrine concentrations or epinephrine-free alternatives should be evaluated.
3- Stress reduction techniques, including preoperative counseling, controlled breathing exercises, and, if necessary, sedation, should be considered to minimize anxiety-related BP fluctuations
4- Studies with larger sample sizes, including hypertensive patients, should be conducted to better understand the long-term implications of local anesthesia on cardiovascular health.

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