

Changes In Cardiorespiratory Rate and Blood Pressure Under Local Anesthesia in Hypertensive and Normotensive Patients Undergoing Oral Surgery and Restorative Treatments: A Scoping Review

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ABSTRACT

Introduction: Dental procedures such as tooth extractions can increase blood pressure and heart rate, representing potential risks, particularly in patients with systemic diseases. These variations may be influenced by surgical technique, local anesthetic type, vasoconstrictor use, and comorbidities. Understanding these hemodynamic responses is essential for safe clinical management.

Objective: To evaluate the impact of oral surgery/tooth extraction under local anesthesia on blood pressure and heart rate in hypertensive and normotensive patients.

Methodology: A Scoping Review was performed following PRISMA-ScR guidelines. Databases consulted: PubMed, ScienceDirect, Wiley Library, Oral Surgery–Oral Medicine–Oral Pathology–Oral Radiology, JOMS, and AJH Oxford. The Boolean strategy used was: (“*Hypertensive patients*” AND “*Normotensive patients*” AND “*local anesthesia*” AND “*dental treatment*” AND “*blood pressure*” OR “*arterial pressure*”) AND “*heart rate*”), limited to publications from 1980–2024. Rayyan software assisted screening and study selection. Twenty-two studies were identified, and 173 additional references were reviewed; 13 met the inclusion criteria.

Results: Tooth extraction and oral surgery under local anesthesia produce measurable cardiovascular responses. On average, systolic pressure increases by 5.6 mmHg and diastolic pressure by 4.7 mmHg, with greater rises in hypertensive or diabetic patients (6.2 mmHg vs. 4.8 mmHg). The use of epinephrine in local anesthesia amplifies these changes, reinforcing the need for cautious dosing and monitoring.

Conclusion: Oral surgery and tooth extraction may elevate blood pressure and heart rate, especially in patients with comorbidities. Continuous monitoring and individualized anesthetic management are essential to reduce cardiovascular risk. Future studies should include larger samples and meta-analyses focusing on hemodynamic changes under local anesthesia in hypertensive patients.

KEYWORDS: Blood Pressure, Dental Care, dental treatment, Hypertension, local anesthesia, Oral Surgery.

1. INTRODUCTION

Oral surgery represents a critical field in dental practice, where patient safety is paramount, especially in those with hypertensive conditions. Although local anesthesia is routinely used and considered safe, its administration can generate hemodynamic variations in patients with cardiovascular disease. Elad et al., demonstrated that anesthetic solutions containing epinephrine can modify blood pressure and heart rate and therefore require cautious administration in patients with cardiovascular history¹. Similarly, Tsuchihashi et al., observed that blood pressure² fluctuates during dental procedures, which may compromise hemodynamic stability³.

In addition, Matsumura et al., showed that systolic and diastolic pressure rise during tooth extraction under local anesthesia, especially in older patients, indicating a sympathetic autonomic response⁴. Likewise, Matsumura et al., reported that the blood pressure increase during dental surgery is more related to extraction difficulty and the amount of anesthetic administered than to



baseline pressure⁴. Another key contribution is from Meiller et al., who found that hypertensive patients undergoing oral surgery experience blood pressure fluctuations like normotensive patients, showing no greater procedural risk if properly controlled³. Most notably, Meyer, demonstrated that hypertensive patients receiving norepinephrine-containing anesthetic solutions exhibit the greatest blood pressure elevation and reflex bradycardia, recommending that norepinephrine (1:20,000–1:30,000) should not be used in hypertensive patients⁵.

Therefore, understanding how local anesthesia influences cardiovascular physiology is essential to implement clinical strategies that minimize risks and improve surgical outcomes.

This Scoping review focuses on analyzing changes in cardiorespiratory rate and blood pressure in hypertensive and normotensive patients undergoing oral surgery and restorative treatments, seeking to identify patterns and recommendations that optimize dental care in this risk group, especially in oral and maxillofacial surgery.

Objective: To evaluate and analyze the impact of dental extractions/oral surgery on blood pressure and heart rate.

2. MATERIALS AND METHODS

Computer-assisted comprehensive literature search (Rayyan), following the PRISMA-ScR strategy (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) with search key ("Hypertensive patients"[All Fields] AND "Normotensive patients"[All Fields] AND "local anesthesia"[All Fields] AND "dental treatment"[All Fields] AND ("arterial pressure"[All Fields] OR "blood pressure"[All Fields]) AND "heart rate"[All Fields]) AND ("1980/01/01"[Date]: "2024/12/31"[Date], associative programmatic boolean 'AND', 'OR', in databases and journals PubMed, Science Direct, Wiley Library, Oral Surgery-Oral Medicine-Oral Pathology-Oral Radiology, JOMS, AJH Oxford, with specific parameters for first and second step screening, defined by the screening Initial, Primary and Secondary to filter out any non-corresponding articles, the implementation of the corresponding years was based on all articles found in the database to collect ALL the necessary information from the literature and evidence on the topic. (The choice of journals was by decision at the Quartile level representing the potential factor and surgical evidence, decision taken unanimously [Q1]).

Inclusion Criteria: Period 1980-2024, Spanish or English, [All Fields], human studies, Associated with Oral Surgery, Journal.

Exclusion Criteria: Outside the Spanish-English language, outside the established period, in vitro studies, animal studies, grey literature, duplicates, comments, narrative review, not related to oral cavity, books.

3. RESULTS

The results were divided with respect to the corresponding screens of the PRISMA statement; 22 articles were obtained from the primary quartile in the database search engines, after which the quantitative count of the references of the 7 articles selected and included was carried out after the primary screen flow diagram (**Fig. 1**), finding 173 references in total in the secondary screen (**Fig. 2**), of which only 13 were selected through a primary systematic filter search and secondary bibliographic reference and included in this review.

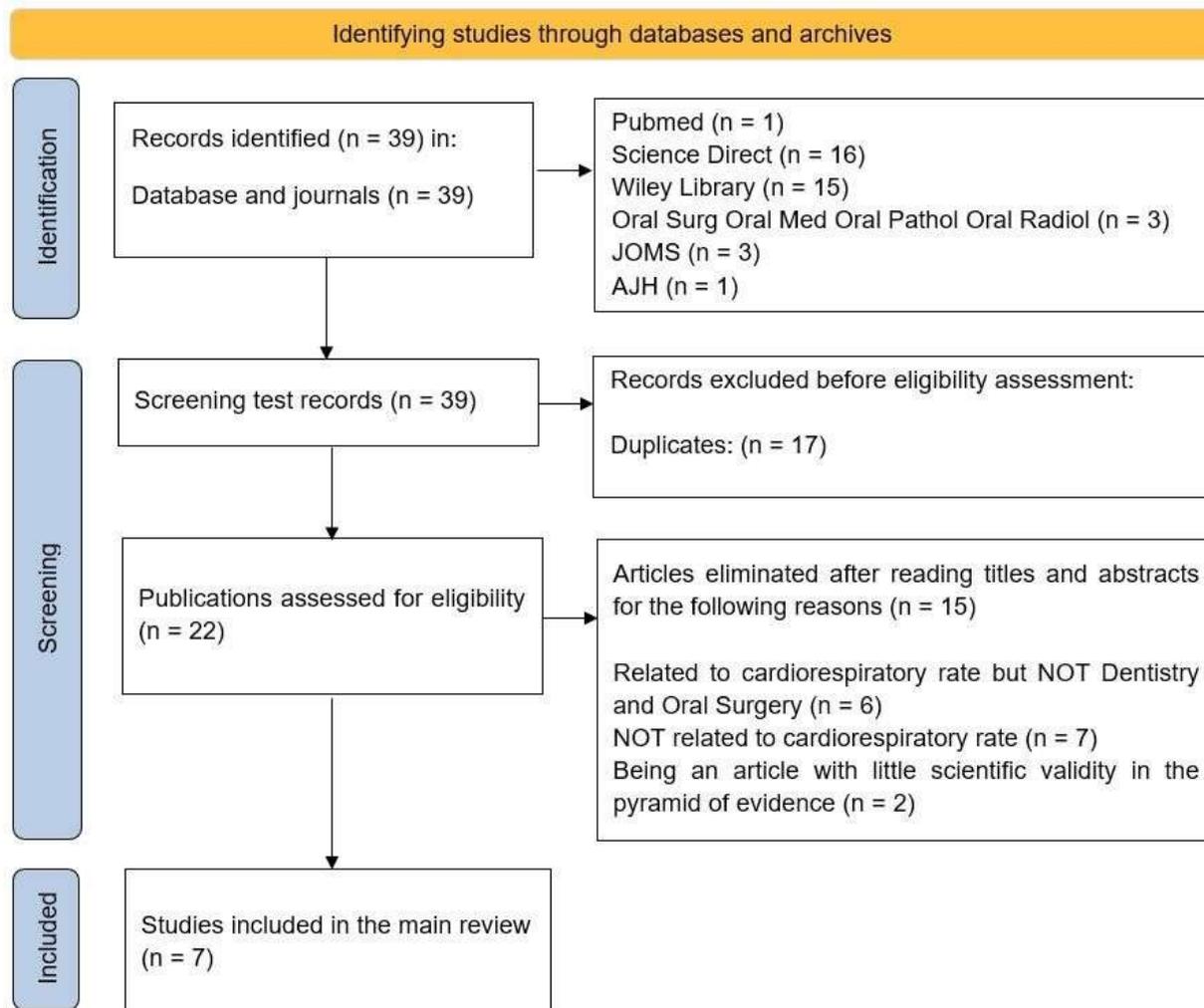


Fig. 1. Flowchart of the study identification and selection process.

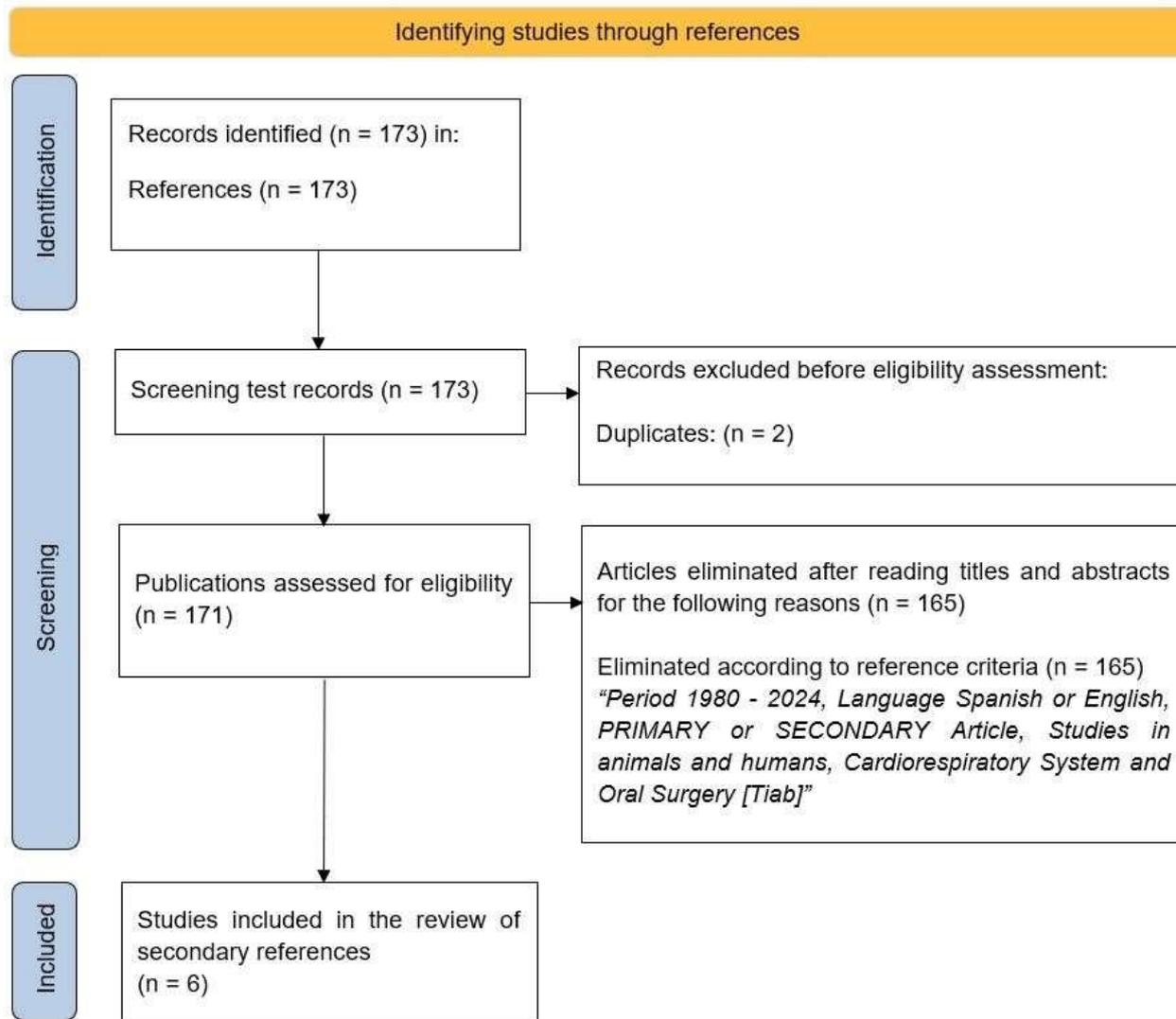


Fig. 2. Reference search flowchart for secondary selection

3.1 Comparison of general data from the 13 articles

A comparative graph and general data on changes in blood pressure, medication, comorbidities and measurement method of each article was made to see what level of scale we will be subjected to draw the necessary conclusions and minimize biases (Tab. I).



Tab. I. Comparison and general data on changes in blood pressure, medication, comorbidities and measurement methods for each item.

Article	Number of Patients	Increase systolic blood pressure (mmHg)	in Increase diastolic blood pressure (mmHg)	in Medication	Comorbidities	Measurement method
1	30	4.5	4.2	Yes	Diabetes	Postoperative
2	70	4.7	5.0	No	Hypertension	Immediate
3	45	6.5	4.6	Yes	Diabetes	Postoperative
4	55	5.5	4.8	No	None	Immediate
5	70	4.8	5.1	No	Hypertension	Immediate
6	60	7.0	5.0	Yes	Hypertension	Postoperative
7	60	6.1	4.7	No	Diabetes	Immediate
8	40	5.3	4.6	Yes	Diabetes	Postoperative
9	40	5.2	4.0	No	None	Immediate
10	50	5.9	4.4	Yes	Hypertension	Postoperative
11	55	6.0	4.8	No	None	Immediate
12	65	5.2	4.9	Yes	None	Postoperative
13	50	6.0	4.5	Yes	Hypertension, Diabetes	Postoperative

A traffic light chart (Fig. 3) was performed to assess the average level of bias, which was acceptable for the 13 articles, as most of them fell into the low (0%-25%) or moderate (25%-50%) ranges in at least four of the five categories assessed. However, some studies had considerable bias in missing data and measurement (50%-75%), which may affect the generalizability of their conclusions. Despite these limitations, the evidence provided by the articles appears robust, being sufficient to derive reasonable conclusions on the topic. Calculating the average bias across the 13 articles, considering all categories, yields an overall average bias of 44%. This value indicates that the studies have a moderate level of bias on average, which is reasonable but suggests that some methodological aspects could be improved in future studies to reduce the possibility of bias.

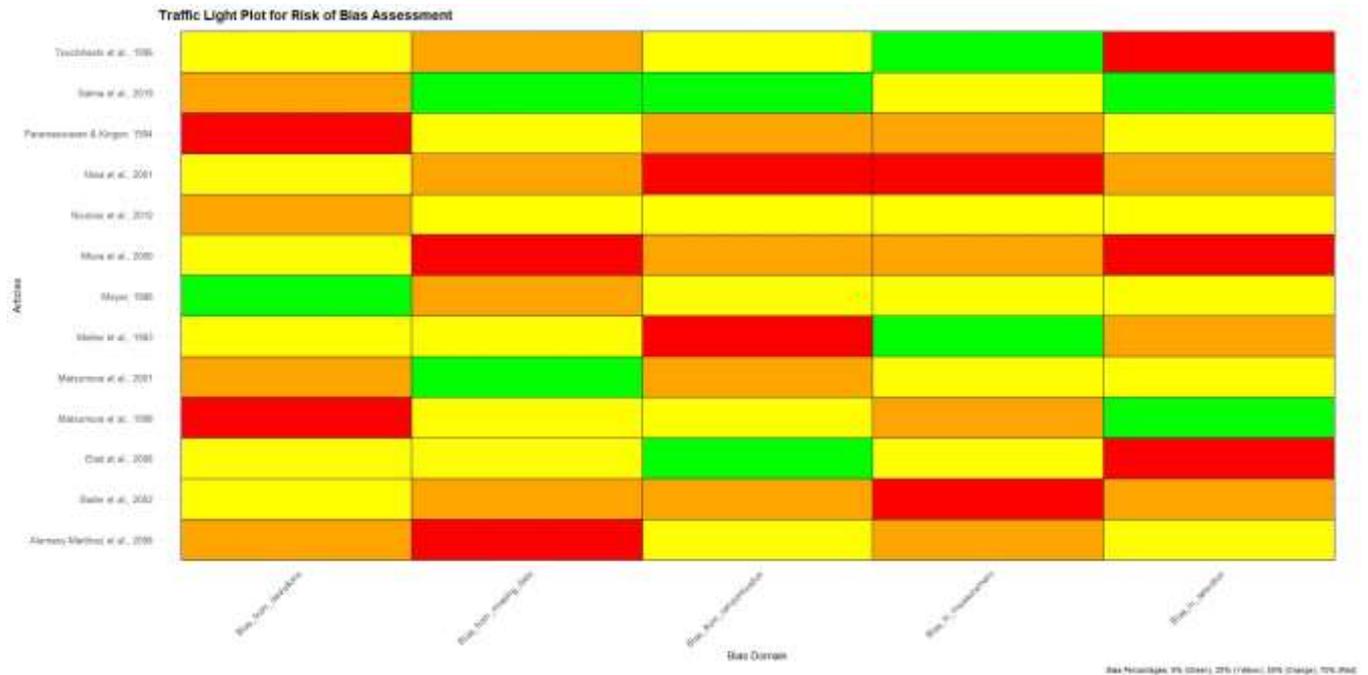


Fig. 3. Traffic Light Plot for Risk of Bias Assessment

A comparative bar graph (Fig. 4) was made for different stripping and scaling procedures compared to a daily restoration to observe the diastolic and systolic changes in patients undergoing these treatments, if the systolic blood pressure bar shows an average change of 5.8 mmHg. This change is relatively high compared to the other procedures, and the diastolic blood pressure shows an average change of 4.6 mmHg. This value is also significant but lower compared to the systolic pressure.

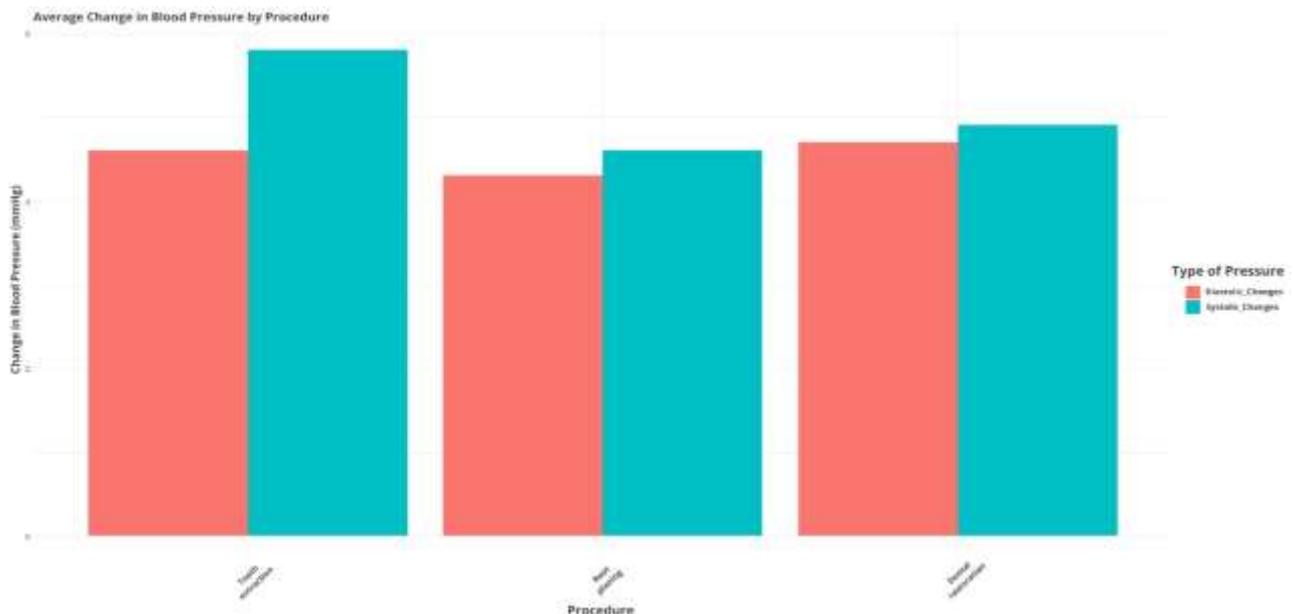


Fig. 4. Comparative analysis of procedures in the average change in blood pressure.

Clarification: This graph was made in Spanish by the programmer "R", but understandable for the interpretation of the specific points.

3.2 Systolic Blood Pressure, Heart Rate, Body Temperature and Peripheral Saturation:

3.2.1 *Systolic Blood Pressure (Items 1, 5, 8, 12, 13)*: In some items, systolic blood pressure increased significantly during invasive dental procedures such as tooth extraction. Exact values of change are not available in all studies.

3.2.2 *Heart Rate (Items 2, 6, 7, 9)*: An increase in heart rate was observed during tooth extraction, with an average change of 17 beats/min, based on data from items 2 to 9.

3.2.3 *Body Temperature and Peripheral O₂ Saturation (Items 3, 4, 10, 11)*: Scaling and restorative procedures caused increases in body temperature and peripheral oxygen saturation.

A L'Abbé table (**Fig. 5**) was constructed and used to reveal a general tendency for increased respiratory rate in hypertensive patients when local anesthesia is applied during dental surgical procedures, as demonstrated by most studies. This may be related to the activation of the sympathetic nervous system due to stress or anxiety in these patients, exacerbated by the hypertensive condition

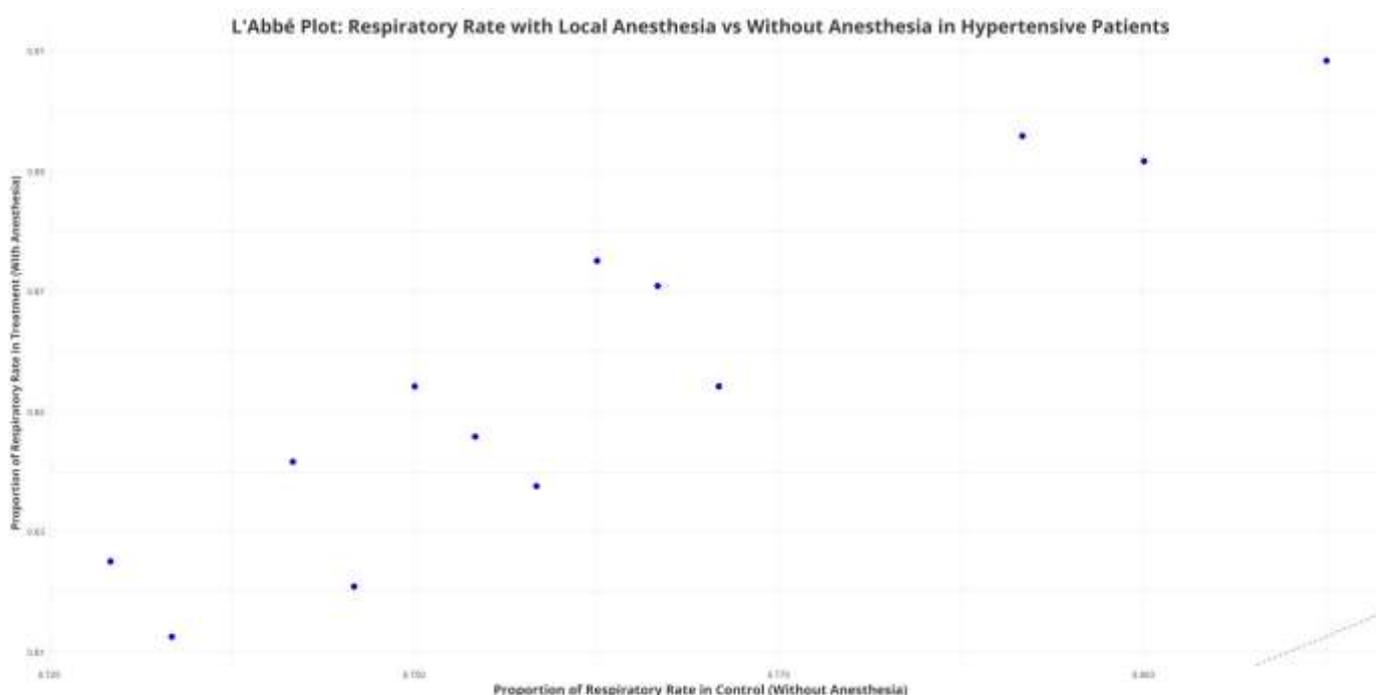


Fig. 5. L'Abbé. Respiratory rate with local anesthesia vs. without anesthesia in hypertensive patients

Clarification: This graph was made in Spanish by the programmer "R", but understandable for the interpretation of the specific points.

3.3 Heart rate and local anesthetics in arterial hypertension:

The analysis of 13 studies (**Tab. II**) reveals a consistent pattern regarding the cardiovascular effects of local anesthetics in patients with arterial hypertension. The most frequently used anesthetic was 2% lidocaine, both with and without epinephrine (1:100,000). When combined with epinephrine, a mild to moderate increase in heart rate was commonly observed, though generally controlled and clinically manageable. In contrast, formulations without vasoconstrictors, such as plain lidocaine, mepivacaine 3%, or prilocaine with felypressin, were often preferred for patients with moderate to severe hypertension due to their reduced cardiovascular impact. Interestingly, prilocaine with felypressin showed less impact on heart rate compared to epinephrine-containing solutions, suggesting a safer profile for hypertensive individuals. Similarly, mepivacaine without vasoconstrictor was repeatedly indicated to avoid cardiovascular complications.

These findings highlight the importance of anesthetic selection in hypertensive patients. While epinephrine-containing anesthetics are generally safe when carefully administered, clinicians often opt for vasoconstrictor-free formulations to minimize cardiovascular stress, especially in patients with uncontrolled or severe hypertension.



Tab. II. Types of anesthesia used for the studies of the 13 articles studied

Article	Anesthetic used	Vasoconstrictor	Observations
1	2% Lidocaine	Epinephrine 1:100,000	No significant changes in blood pressure were observed.
2	2% Lidocaine	Epinephrine 1:100,000	Controlled changes in heart rate in hypertensive patients
3	3% Mepivacaine	Without vasoconstrictor	Indicated to prevent cardiovascular complications in hypertensive patients.
4	2% Lidocaine	Without vasoconstrictor	It is used to minimize cardiovascular effects in hypertensive patients.
5	2% Lidocaine	Epinephrine 1:100,000	Moderate changes in heart rate, but under control
6	4% Articaine	Epinephrine 1:100,000	Mild increase in heart rate in complex procedures
7	2% Lidocaine	Without vasoconstrictor	Preferred for reducing cardiovascular risk in hypertensive patients.
8	2% Lidocaine	Epinephrine 1:100,000	Minor but controlled cardiovascular effects were observed.
9	2% Lidocaine	Without vasoconstrictor	It is used to prevent cardiovascular effects in patients with severe hypertension.
10	2% Lidocaine	Epinephrine 1:100,000	There are no significant changes in blood pressure.
11	4% Articaine	Epinephrine 1:100,000	Recommendation for careful administration in hypertensive patients
12	3% Prilocaine	Felypressin	Less impact on the cardiovascular system in patients with moderate hypertension
13	2% Lidocaine	Epinephrine 1:100,000	Mild increase in heart rate in hypertensive patients



4. DISCUSSION

This scoping review shows that oral surgery and restorative procedures under local anesthesia consistently produce cardiovascular changes, mainly increases in blood pressure and heart rate. These variations occur regardless of whether patients are hypertensive or normotensive, although hypertensive patients show a greater magnitude of response. Several studies demonstrated that invasive dental procedures activate the sympathetic nervous system and increase blood pressure and pulse. Matsumura et al. showed that both systolic and diastolic pressure rise significantly during tooth extraction, particularly in middle-aged or older adults, suggesting age-dependent autonomic hyperreactivity⁶. Similarly, Matsumura et al. confirmed that increases in blood pressure are associated with the difficulty of extraction and the volume of anesthetic, rather than baseline blood pressure^{4,6}.

Regarding heart rate changes, Nicolosi et al. observed an increase during dental procedures in hypertensive patients undergoing local anesthesia in Argentina⁷, while Salma et al. demonstrated that even restorative and scaling procedures can produce measurable cardiorespiratory changes, including increased oxygen saturation due to anxiety-induced hyperventilation⁸.

The type of local anesthetic influences cardiovascular response. Elad et al. compared lidocaine vs. articaine with different concentrations of epinephrine in cardiac-compromised patients and found no clinically significant adverse effects, supporting the safe use of epinephrine in controlled doses¹. Bader et al. also concluded that epinephrine is safe in hypertensive dental patients when medically controlled⁹. In contrast, Meyer showed that norepinephrine causes the greatest rise in blood pressure and reflex bradycardia, recommending that norepinephrine NOT be used in hypertensive patients⁵.

Comparing anesthetic formulations, Niwa et al. demonstrated that even low epinephrine concentrations can trigger cardiovascular responses in cardiac patients¹⁰. In another study, Paramaesvaran & Kingon reported that extraction without vasoconstrictor reduced these fluctuations¹¹. Miura et al. found that dental surgery suppresses cardiac sympathetic activity in hypertensive patients, possibly as a reflex autonomic modulation¹².

Two early studies, Meiller et al., and Alemany-Martínez et al., reported that blood pressure fluctuations in controlled hypertensive patients are not significantly greater than in normotensive individuals, indicating that hypertension alone does not necessarily increase procedural risk when anesthesia is managed properly^{3,13}.

5. CONCLUSION

It is revealed that there is an average increase of 5.6 mmHg in systolic blood pressure (SBP) and 4.7 mmHg in diastolic blood pressure (DBP) in routine oral surgical procedures. The variability in these increases is due to factors such as management protocols and individual patient characteristics, being more significant in those with comorbidities such as hypertension and diabetes. In addition, patients not receiving antihypertensive treatment present greater increases in BP. More complex procedures, such as multiple extractions, also generate a greater increase in BP. In general, the importance of monitoring BP and adjusting pre- and postoperative management strategies to mitigate risks and improve clinical outcomes in these patients is highlighted based on the choice of local anesthetic and multimorbidity, whether in normotensive or functionally hypertensive patients

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7. CONFLICT OF INTEREST

The authors declare no conflicts of interest related to the development, analysis, or publication of this manuscript. No institution, company, or commercial entity influenced the study design, data collection, data interpretation, or manuscript preparation.

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