



Research Article

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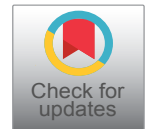
Haemodynamic Changes during Mandibular Third Molar Disimpaction

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Abstract

Objective: This study assesses the changes in the haemodynamic parameters of normotensive patients that underwent surgical extraction of impacted mandibular third molars following the administration of Lidocaine Hydrochloride (HCl) 2% with Adrenaline 1:80,000.

Materials and methods: This prospective cohort study was conducted on 168 patients who presented at the outpatient clinic with the indication(s) for surgical extraction. Patients aged 18 years and above, whose SBP was between 90 mmHg - 120 mmHg and whose DBP was between 60 mmHg - 80 mmHg, were included in the study. The patients' HP was taken at four different time points, namely T1, T2, T3, and T4, using a pre-calibrated non-invasive electronic BP machine (ANDON BPM) and Pulse oximeter (CA-MI).

Statistical analysis was done using the Statistical Package for Social Sciences (IBM) 25.0 version. The significant level was set at a p-value of < 0.05 at a 95% confidence interval.

Results: All the SBP and DBP readings showed a gradual increase in values from SBP1 and DBP1 to SBP4 and DBP4, respectively, with a statistically significant difference ($p < 0.001$). The highest elevation was recorded between SBP1 and SBP4 at 12.2 mmHg change as well as between DBP1 and DBP4 at 11 mmHg change. There was an increase in the values of HR throughout the surgery, showing a statistically significant difference ($P < 0.001$). There was a decrease in the SPO₂ values throughout the surgical extraction, with a statistically significant difference of ($p < 0.001$).

Conclusion: This study revealed an increase in systolic blood pressure, diastolic blood pressure and heart rate but a decrease in the oxygen saturation level of the patients. There was a statistically significant change in the haemodynamic parameters across all four points studied.

Keywords

Haemodynamic parameter, Local anaesthetic agent, Surgical extraction

Introduction

Hemodynamic parameters (HP) are the important factors that determine cardiac function and those values that have to do with the efficacy of circulatory and respiratory systems in terms of organ perfusion and tissue oxygenation [1]. These parameters are the fundamental blood pressure (BP), heart rate (HR) and oxygen saturation level (SPO₂) [2]. All these parameters can be derived when the concerned individuals are closely monitored to provide feedback on their overall safety when undergoing certain invasive surgical procedures, such as surgical extraction of the impacted mandibular third molars [2]. Surgical extraction of the impacted mandibular third molar is one of the most common operations performed in the oral and maxillofacial surgery clinic [3]. Unusual reaction

is sometimes observed because of the physical stress, dental fear, psychological factors, painful stimuli and the action of the local anaesthetic agent that those individuals are exposed

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to during the procedure [3]. Assessment of HP is a reliable way to measure stress experienced by subjects during dental procedures [4].

The pain perceived during dental treatment can trigger endogenous catecholamine release, which can lead to changes in HP, such as an increase in BP and HR, which may even produce cardiac arrhythmia.

Local anaesthesia administered during dental procedures controls pain, but it does not affect the psychological stress of the clinical environment, or the annoyance associated with oral manipulations [5]. All these may also contribute to the changes seen in the HP of such individuals [5].

Local anaesthetic agents (LAA) are combined with a vasoconstrictor, most commonly Adrenaline, a natural hormone released by the adrenal medulla [6]. The overall effect of Adrenaline is the vasoconstriction in the blood vessels and consequent rise in cardiac function, which is seen as an increase in heart rate and cardiac output [7,8]. Adrenaline exerts its maximum action three minutes after injection, and the effect persists for about 30 minutes [6]. Some authors reported a significant increase of about (5-12 mmHg) in SBP in patients subjected to root scaling and planning using LAA with a vasoconstrictor [7,9,10]. Over the years, there have been controversies over using vasoconstrictors combined with LAA [9], causing an undesirable change in the HP of subjects undergoing dental procedures.

Even a short conversation between the dental surgeon and the patient before the procedure in the clinical setting raised the SBP by 5 to 6 mmHg, whereas waiting in the dental chair may raise the heart rate by an estimation of 12 bpm increase [9].

It is sometimes important to record and monitor patients' HP during surgical extraction of impacted mandibular third molars to immediately discover the increased risk that such patient is predisposed to before, during and after the procedure to predict or diagnose it early enough for possible prevention of consequent complications [2,11].

This study assessed the changes in the haemodynamic parameters of normotensive subjects that underwent surgical extraction of impacted mandibular third molars following the administration of Lidocaine Hydrochloride (HCl) 2% with Adrenaline 1:80,000.

Objective

This study assesses the changes in the haemodynamic parameters of normotensive patients that underwent surgical extraction of impacted mandibular third molars following the administration of Lidocaine Hydrochloride (HCl) 2% with Adrenaline 1:80,000.

Methods

This prospective cohort study was conducted on 168 subjects aged 18 years and above who presented at the outpatient clinic with the indication(s) for surgical extraction of at least one mandibular third molar and met the inclusion criteria. This study was conducted from July 2020 to February

2021 at the Oral and Maxillofacial Surgery Department, Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos, Nigeria.

Patients aged 18 years and above, whose SBP was between 90 mmHg - 120 mmHg and whose DBP was between 60 mmHg - 80 mmHg, were included in the study. However, patients with routine contraceptive usage, steroid usage, debilitating medical conditions, alcohol abuse, tobacco and pregnant women were excluded from this study.

HP of the patients, which were taken at the four different time-points, namely T1, T2, T3, and T4, using a pre-calibrated non-invasive electronic BP machine (ANDON BPM) and Pulse oximeter (CA-MI).

T1; was the first time point in the waiting room when the first haemodynamic parameters (HP) were taken and recorded. It was 15 minutes before the start of surgery. The HP taken were first SBP (SBP1), first DBP (DBP1), first HR (HR1) and first SPO₂ (SPO₂1).

T2; was the second time-point on the dental chair, 4 minutes after LAA administration, when the second HP was taken and recorded. They were the second SBP (SBP2), second DBP (DBP2), second HR (HR2) and second SPO₂ (SPO₂2).

T3; was the third time-point, immediately after ostectomy, when the third HP were taken and recorded. They were the third SBP (SBP3), third DBP (DBP3), third HR (HR3) and third SPO₂ (SPO₂3).

T4; was the fourth time-point, 15 minutes after tooth removal, when the fourth HP were taken and recorded. They were the fourth SBP (SBP4), fourth DBP (DBP4), fourth HR (HR4) and fourth SPO₂ (SPO₂4).

All the patients had surgical extraction of the mandibular third molar under local anaesthesia by one of the researchers employing the buccal guttering technique. Patients were reviewed a day postoperatively, then one week (for suture removal).

Statistical analysis was done using the Statistical Package for Social Sciences (IBM) 25.0 version. The significant level was set at a p-value of < 0.05 at a 95% confidence interval.

Result

168 subjects with impacted mandibular third molars who satisfied the inclusion criteria were recruited, and their haemodynamic parameters were recorded and analyzed for this study. The overall mean age was 33.8 ± 10.5 years, with a female to a male ratio of 1.6:1 (Table 1).

All the SBP and DBP readings showed a gradual increase in values from SBP1 and DBP1 to SBP4 and DBP4, respectively, with a statistically significant difference ($p < 0.001$) (Table 2). The highest elevation was recorded between SBP1 and SBP4 at 12.2 mmHg change as well as between DBP1 and DBP4 at 11 mmHg change (Table 3).

Table 4 revealed an increase in the values of HR throughout the surgery, showing a statistically significant difference ($P < 0.001$). There was a decrease in the SPO₂

Table 1: Socio-demographic characteristics in 168 Nigerian subjects for third molar surgical disimpaction.

Variable	Frequency (n = 168)	Percentage (%)
Age group (years)		
21-30	85	50.6
31-40	36	21.4
41-50	31	18.5
> 50	16	9.5
Mean ± SD	33.8 ± 10.5	
Gender		
Male	65	38.7
Female	103	61.3

Table 3: Changes in the systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurements.

BP (mmHg)	Change (mmHg)	Change (%)
SBP2 - SBP1	5.3	4.8
SBP3 - SBP1	7.7	7.0
SBP4 - SBP1	12.2	11.1
DBP2 - DBP1	3.6	4.8
DBP3 - DBP1	6.6	8.9
DBP4 - DBP1	11.0	14.8

Table 2: Mean systolic blood pressure (SBP) and mean diastolic blood pressure (DBP) measurements.

Time-points	Mean ± SD SBP (mmHg)	F-value	P-value	Time-points	Mean ± SD DBP (mmHg)	F-value	P-value
T1	110.3 ± 6.3			T1	74.4 ± 4.4		
T2	115.6 ± 7.6	119.5	< 0.001*	T2	78.0 ± 5.6	222.1	< 0.001*
T3	118.0 ± 9.9			T3	81.0 ± 6.5		
T4	122.5 ± 10.9			T4	85.4 ± 7.5		

Table 4: The subjects' mean heart rate (HR) and the mean oxygen saturation level (SPO₂) measurement.

Time-points	Mean ± SD HR (bpm)	F-value	P-value	Time-points	Mean ± SD SPO ₂ (%)	F-value	P-value
T1	79.4 ± 6.9			T1	98.8 ± 0.4		
T2	83.1 ± 7.1	165.7.1	< 0.001*	T2	98.2 ± 0.4	144.1	< 0.001*
T3	85.6 ± 7.3			T3	98.0 ± 0.4		
T4	88.9. ± 7.8			T4	97.8 ± 0.7		

Table 5: Changes in the subjects' heart rate (HR) and the oxygen saturation level (SPO₂) measurements.

Heart rate (bpm)	Change (bpm)	Change (%)
HR2 - HR1	3.7	4.7
HR3 - HR1	6.2	7.8
HR4 - HR1	9.5	12.0
Oxygen Saturation Level SPO ₂ (%)	Change (SPO ₂ %)	Change (percentage, %)
SPO ₂ 2 - SPO ₂ 1	-0.6	-60
SPO ₂ 3- SPO ₂ 1	-0.8	-80
SPO ₂ 4- SPO ₂ 1	-1.0	-100

values throughout the surgical extraction, with a statistically significant difference of (p < 0.001) (Table 5).

Discussion

Several works on haemodynamic parameters of subjects undergoing surgical extraction of impacted mandibular third molar have been published [2,3,7,12-14], but none has been done in Nigeria. Most of those published works gave contradictory results [2,3,12,14]. Ping, et al. [15] reported

an increase in SBP, DBP and HR of patients that had surgical extraction of their impacted mandibular third molar; and a drop in HR values during ostectomy while SBP and DBP values dropped after tooth removal. Meanwhile, Stella, et al. reported decreased DBP but increased HR values after LAA injection [3].

This study recorded low SBP (SBP1) in the waiting room. It contrasted with some studies where the highest SBP values were taken in the waiting room [15-17]. The low SBP1

found in our study may be because patients had presurgical counselling and reassurance in the waiting room.

SBP2 (SBP after LAA administration) was high, which was in consonance with the findings of some investigators [18,19]. Increased SBP2 was due to increased plasma epinephrine level after LAA injection [16,17]. Epinephrine in LAA leaks into the systemic circulation to cause increased SBP2 [16,17].

We observed an increase in SBP after ostectomy (SBP3), which was similar to the findings of Gadve, et al. [20], Alemany Martinez, et al. [2] and Ping, et al. [14]. However, Pablo Tarazona Alvarez, et al. published a contrary low value [21]. The high SBP3 value discovered in this research may be attributed to the effect of the vibration of the instrument used for bone removal.

Our study revealed a higher value for SBP4, which was at variance with the findings of Sindel, et al. [22], and Alemany Martinez, et al. [2], who published a lesser value of SBP after tooth removal. Higher SBP4 values gotten in our work may be related to subjects becoming fatigued later in the surgery.

DBP1 (DBP taken in the waiting room) was low. It was in contrast with the results of some authors who found high DBP1 [20,21]. The reason for low DBP in our study could be attributed to the fact that DBP1 was recorded in the waiting room, where patients had presurgical counselling.

High DBP2 (DBP gotten after LAA administration) was found in our work. This is similar to some previous studies [20,23]. However, Reyes Fernandez, et al. found no change in DBP in the waiting room or after LAA administration [24]. The higher DBP2 values recorded in this work had been documented due to the action of exogenous catecholamines present in LAA [25]. It may also be due to the effect of the anticipation of injection and pain during the injection.

High DBP3 (DBP values discovered after bone removal) corresponds to previous works [2,25]. The high value may be due to the psychosomatic response exhibited by subjects undergoing surgical procedures [20]. The highest value of DBP was assessed 15 minutes after tooth removal (DBP4). This agreed with the results of some authors [14,20], but at variance with researchers who published low DBP4 values [2,3]. This increase was associated with a strong anticipatory response of the subject to a stressful event [20].

Our low HR1 values are contrary to previous studies [14,20,21], but agree with the results of Alemany Martinez, et al. [2]. The low HR1 probably could be a result of the preoperative counselling in the waiting room. High HR reading was taken in our study after LAA administration (HR2). The outcome of some studies supported this [3,13,14,20]. This high HR2 may be due to endogenous epinephrine release from emotional stress [23].

Some researchers similarly recorded high HR (HR3) values during ostectomy [3,14] while some published low results [2,21]. High HR3 obtained in this study during ostectomy may be a result of an alarming reaction manifested by the hypothalamus-oriented vasoconstriction and vasodilation in patients undergoing tooth extraction [20].

High HR4 in our study was at variance with the results in some published studies that recorded lower values [3,14]. High HR4 may be due to patients' still in sight of all the used surgical instruments.

Our research yielded high results of SPO₂ in the waiting room (SPO₂1), but some studies gave low results [26]. The high SPO₂1 may be because patients could breathe adequately because there is no obstruction either from the surgeon's hand or instrument at this period.

After LAA administration in our study, SPO₂ (SPO₂2) values were reduced, which was in support of the work of Abu Mostafa, et al. who found reduced SPO₂ after LAA injection even in routine extraction [13] but was not in agreement with the findings of some authors who got higher SPO₂ values [2,13,17,27]. Desaturation had been documented to be due to stress-related oxygen consumption of tissues in response to increased circulating catecholamines [28].

During ostectomy, the values of SPO₂ (SPO₂3) in our study were further reduced, which was similar to the results of Gadve, et al. [20]. Reduced SPO₂3 found in this study could be due to patients who were mouth breathers whose breathing was partially impaired when the surgeon worked in the mouth [29]. It may also be due to the inability of subjects to take a very deep breath during the period of bone removal. Some published works found an increase in SPO₂ after tooth removal [2,20], which contrasts with the results in this study. However, some researchers reported similar findings [13,29]. The reason for the decrease in SPO₂4 had been reported to be a result of an increase in myocardial oxygen consumption that usually occurs in tooth extraction [29].

Conclusion

After comparison and analysis, this study that assessed the change in the haemodynamic parameters of normotensive subjects undergoing surgical extraction of impacted mandibular third molars revealed changes in all the haemodynamic parameters evaluated. The changes were an increase in the systolic blood pressure, diastolic blood pressure and heart rate but a decrease in the oxygen saturation level of the subjects. There was a statistically significant change in the haemodynamic parameters across all the four points studied.

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