IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 8 Ser. 5 (August. 2019), PP 42-47
www.iosrjournals.org

Differences in Blood Pressure Before and After Administration of Local Anesthetic among Obese Adult Female Patients

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Abstract: *This study showed that there was a strong correlation between dental extraction and blood pressure and provedthat using epinephrine in anesthetic solutionshad an effect on blood pressure on female patients with normal BMI and obese. To determine the differences in blood pressure of female patients aged 26-45 years with normal Body Mass Index (BMI) and obesity after administration of local anesthetic containing adrenaline beforedental extraction in the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Universitas Sumatera Utara.This was an experimental study with a single group pretest-posttest design. Simple random samplingwas used to select the subjects. 16 female patients with normal BMI and 16 female patients with obesity visited the clinic for dental extraction in the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of North Sumatera. Blood pressure of each subject was measured before and after administration of anesthesia.Data obtained was statistically analyzed usingDependent T-test.Systolic blood pressure between normal and obese subjects after administration of local anesthetic with adrenaline 1:80000 showed significant differences (p<0.05). Diastolic blood pressure between normal and obese subjects after administration of local anesthetic with adrenaline 1:80000 showed less significant differences (p>0.05).Administration of local anesthetic with adrenaline 1: 80000 can increase the blood pressure in obese patients and patients with normal BMI.Obese subjects had higher systolic blood pressure changes compared to subjects with normal BMI.*

Date of Submission: 26-07-2019 Date of Acceptance: 12-08-2019

I. Introduction

The 4 cardinal vital signs are blood pressure, heart rate, respiratory rate and body temperature. Blood pressure is capable in providing an overview of an individuals' cardiovascular status. Furthermore, measurement of the blood pressure is not only performed on patients with suspected hypertension but is also recommended for all patients in need of dental extraction. This examination could be used as a beneficial toolto prevent adverse events during or after invasive dental treatment.[1]

In the field of oral and maxillofacial surgery, use of local anesthesia often containvasoconstrictors.[2] Epinephrine (adrenaline) is added to the solution to improve its anesthetic efficiency, principally duration and it also provides a near bleedless operative field and decreases the absorption rate of local anesthetics by reducing the plasma concentration. The injection of an anesthetic solution with or without vasoconstrictor must always be carried out slowly (1 ml/min). The most commonly used local anesthetic for dental surgery is 2 % lidocaine with (1: 80,000) adrenaline. Epinephrine is a sympathomimetic catecholamine which is believed to increase (both systolic and diastolic) blood pressure.[3]In the study of Managutti A et al., significant cardiovascular effects were observed in the study as seen in the statistical analysis, there was significant rise in the mean pulse rate when 1:80000 adrenaline used whereas no significant change observed in 1:200000 used. There was significant rise in the systolic and diastolic blood pressure when local anesthesia with 1:80000 adrenaline used while 1:200000 adrenaline concentrations showed significant rise in pulse rate as well as blood pressure as compared wdid not bring any significant change.Coming to the cardiovascular effects, 1:80000 adrenaline ith the other drug.[4]

Besides adrenaline in local anesthetics, an individuals' body weight could also be a causal factor in increasing blood pressure. Obesity is a symptom with abnormal or excessive fat accumulation in adipose tissues which result in severe systemic diseases. In general, obesity is a prime characteristic of hypertensive patients. The prevalence of obesity tends to increase with age, and reaches its peak in adulthood.[5] According to the World Health Organization (WHO), the calculation of Body Mass Index (BMI) could be used as an important tool in measuring an individuals' weight based on his/her height.[6]

According to the report by National Health Survey of Indonesia (Riskesdas) in 2007 and 2010, the combined prevalence of overweight/obesity (BMI >25 kg/m^2) in adults between ages 19-55 years increased from 19.8% in 2007 to 23.0% in 2010, with a higher predisposition in women (24.6% and 28.7%, respectively)

compared to men (14.8% and 17.0%, respectively) in both years.[7] The prevalence of obesity among men and women varies greatly within and between different countries. Framingham Study demonstrated that both men and women had an increase in blood pressure with increased overweight. Persons in the highest body mass index quartile had a 16 mmHg higher systolic blood pressure and a 9 mmHg higher diastolic blood pressure than persons in the lowest body mass index quartile.Attributable risk estimates from the Framingham Offspring Study of 2,027 men and 2,267 women aged 20 to 49 years followed for 8 years showed that obesity may be responsible for 78% of hypertension in men and for 65% of hypertension in women. Changes in body fat over 8 years were associated with changes in both systolic and diastolic blood pressure.[8] Women, in particular, have a higher predisposition of obesity that increases with age. These gender disparities are exacerbated among women in developing countries, particularly in the Middle East, North Africa and Indonesia. In middle-aged women, the biological factor and hormonal changes affects fat distribution that may increase risk or exacerbate detrimental effects of obesity on health. These biological and related socio-cultural differences warrant specific studies on women.[9]

Hence, the authors were interested to determine the differences in systolic and diastolic blood pressure of adult female patients with normal and obese Body Mass Index (BMI) after administration of local anesthetic containing adrenaline beforedental extraction in the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of North Sumatera.

II. Materials And Methods

Study Design: Experimental study with a single grouppretest-posttest design

Study Location:This experiment was conducted with female patients between the ages 26-45 visited Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of North Sumatera for dental extraction

Study Duration: April 2018 to June 2018

Sample size: 32 female adult patients

Sample size calculation: 32 female adult patients between the ages 26-45, visited the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of North Sumatera for dental extraction from April 2018 to June 2018.The subjects were divided into 2 groups; the control group which consisted of 16 female patients with normal Body Mass Index (BMI) and the case group composed of 16 female patients with obesity.The sample size was calculated using the paired numerical analytic formula.

Subjects & selection method: The study subjects was from patients who visited the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of North Sumatera for dental extraction from April 2018 to June 2018.The subjectseligible for this study were adult female patients, between the ages 26-45 years. The subjects were divided into 2 groups; the control group which consisted of 16 female patients with normal Body Mass Index (BMI) and the case group composed of 16 female patients with obesity.

Measurement of Height and Body Weight: Height and weight of each subject wastaken to determine the Body Mass Index (BMI) which is a calculation of an individuals' weight in relation to his/her height. In this study, a BMI value of 18.5-22.9 kg/m^2 was considered normal while a BMI value of >25.0 kg/m^2 was categorized as obese.[5]The height of subjects was measured using a measuring tape. The tape was secured to the wall and each subject was asked to stand erect against the tape without shoes, looking straight ahead. The height was then recorded in meters. The weight of the subjects was measured using a weighing scale. The subjects were asked one after the other to stand erect on the scale without shoes as well. The weight was then recorded in kilograms and BMI was calculated.[10]

Inclusion criteria:

1. Female patient with aged 26-45 years;
2. Required either single mandibular premolar or molar extraction;
3. Without any historic of systemic diseases and medical allergies.

Exclusion criteria:

1. Patients that were underweight;
2. Patients with historic of systemic diseases and medical allergies;
3. Patients that were not interested to participate in this study.

Procedure methodology

Verbal questioning regarding medical history was conducted to ensure the subjects were in good health and that they were not taking any medication which could possibly affect pain sensation and blood pressure.This study was conducted from 8 to 11 am in order to avoid circadian influences.[9] Patients were asked to sit and relaxon the dental unit in a supine position for 5 minutes before beginning the procedure. Systolic and diastolic

blood pressure was then measured using a Littman stethoscope and mercury sphygmomanometer on the patient's right arm parallel to the heart, 5 minutes before the administration of local anesthetic solution.[11,12] Anesthetic solution used was Pehacain® (PT. Phapros Tbk, Semarang, Indonesia) which contained 2% lidocaine solution with adrenaline (1:80000). The anesthetic solution was administered through a mandibular block [conventional inferior alveolar nerve block (IANB)] and an estimated 1.0 ml was deposited in the inferior alveolar nerve while 0.5 ml was deposited in the lingual nerve.The procedure for administering local anestheticwas conducted by the faculty's clinical students with a minimum of 1 year experience.5 minutes after administration of anesthesia, systolic and diastolic blood pressureswere measured again and the data was recorded.Each measurement was carried out at least three times toobtain the average reading. Measurement of blood pressure was done by an intra-rater (measured by T.M. under supervision of A.R.). After administration of local anesthetic, the subjects in this study received dental extraction by the clinical students. [13]

Ethical considerations: Before conducting this research, ethical clearance was approved by the Health Ethical Research Committee of University of North Sumatera (274/160518/KEPK FK USU-RSUP HAM/2018). In compliance with the Declaration of Helsinki, the consenting participants were informed that if they provided written informed consent, they would be included in this study.

Statistical analysis

Data processing was done using the Statistical Package for the Social Sciences version 17 (SPSS, Inc., Chicago, IL, USA) software and analyzed using Dependent T-Test. P values < .05 were considered statistically significant.

III. Results

The results for average systolic and diastolic blood pressure among normal and obese subjects showed increase in blood pressures before and after administration of anesthesia. However, obese patients were found to have a higher difference in systolic and diastolic blood pressure after administration of local anesthesia (Table 1).

Table 1. Average systolic and diastolic blood pressures between normal and obese subjectsbefore and after administration of local anesthesia.

Groups	N	Blood Pressure (Pre and Post Anasthesia)	Mean (mm Hg)	Standard deviation (±)
Normal BMI	16	Systolic	9.27	3.33
		Diastolic	5.00	4.67
Obese	16	Systolic	16.35	5.24
		Diastolic	7.29	5.16

The resultsofthe difference in systolic blood pressure after administration of local anestheticswith adrenaline 1: 80000 onnormal and obese patients showed that obese patients had higher systolic blood pressure compared to normal weighted patients (Table 2).

Table2. Differences in systolic blood pressure post administration of local anesthetic with adrenaline using depenent T-test.

Group	N	Meanand Standard Deviation (mmHg)	p-value (T-test)
Normal	16	7.71±2.35	0.003
Obese	16		

The dependent T-test between both groups showed significant differences in systolic blood pressure between normal and obese patients (p=0.003)(Table 2).

The resultsofthe difference in diastolicblood pressure after administration of local anestheticswith adrenaline 1: 80000 onnormal and obese patients showed that obese patients had higher diastolic blood pressure compared to normal weighted patients (Table 3).

Table3. Differences in diastolic blood pressure post administration of local anesthetic with adrenaline

Group	N	Meanand Standard Deviation (mmHg)	p-value (T-test)
Normal	16	0.94±1.63	0.0570
Obese	16		

The dependent T-test between both groups showed less significant differences in diastolic blood pressure between normal and obese patients (p=0.0570, p>0.05)(Table 3).

IV. Discussion

Consistently across the studies, more women are obese than men. However, among young adults, more men are obese than women. By the late 20s, women had overtaken men in obesity; the cause of this is usually attributed to weight gain after pregnancy. This greater prevalence of more women are overweight compared to men.[14] It appears that a similar finding was reported among Indonesian women where women are more prone to obesity than men.[7] Furthermore, the gap between the prevalence of obesity between women and men had widened throughout the years.

The Joint National Committee on Prevention, Detection, Evaluation and Treatment of high blood pressure had classified blood pressure into four categories, namely; normal, pre-hypertension, stage-one hypertension, and stage-two hypertension. The normal category refers to blood pressure range of less than 120/80 mmHg, prehypertension is in the 120-139/80-89 mmHg range, stage one is 140-159/90-99 mmHg range and stage two is blood pressure equal to or greater than 160/100 mmHg. Obese individuals have a 3.5- fold increased likelihood of having hypertension; 60% of hypertensive adults are >20% overweight. It had been estimated that 60–70% of hypertension in adults may be directly attributable to adiposity.[10],[15] Despite reports from previous studies,[5] we found that the initial blood pressure among female obese patients was within the normal range in this study (Table 1). It is possible that despite having a high BMI, majority of the female subjects in this study had a higher socioeconomic status, hence they were more exposed to health information and be more likely than men to modify their unhealthy lifestyles. This could also explain their awareness on dental health and the importance of routine dental treatment.[16]

According to Managutti A et al., the use of 2% lidocaine with adrenaline 1: 80000 showed a significant increase in pulse rate and blood pressure, especially in systolic values.[4] In the study by Ketai M, Shaami MS and Alaie M, using local anesthetics containing adrenaline showed a rise in systolic and diastolic pressure but only asmall increment in blood pressure was reported, thus rendering this as clinically and medically irrelevant.[17]The effect of adrenaline on beta 1 adregenic receptors in the heart stimulates the action of the heart by increasing contractile strength and conduction rateof the heart which can subsequently increase blood pressure greatly.[18,19,20] On the other hand, it is known that pain during dental treatment may trigger release of endogenous catecholamine, which can cause hemodynamic changes, such as increase in blood pressure and heart rate, and subsequently lead to arrhythmias. Few studies had reported significant increase (5-12 mmHg) in systolic blood pressure in patients subjected to scaling and root planning using anesthesia with a vasoconstrictor.[21]

Patients that visit the dentist for the first time tend to fear dental extractions thus experiencing high levels of stress and anxiety.[22]Anxiety associated with the thought of visiting the dentist for preventive care and over dental procedures is referred to as dental anxiety. The reason may be that dental treatment is mostly considered by patients as a stressful or fearful experience regardless of the age. Possible reasons may be one's or a friend's past unpleasant experience. Patients are generally afraid of the dental instruments especially the needle for local anesthesia. The fear of witnessing the whole procedure and the blood in case of minor oral surgical procedures increases the level of anxiety of the patient. Patient's stress and fear when they see a medical practitioner or visit a dentist's clinic may result in elevation of arterial blood pressure termed as White Coat Syndrome.[23]It activates the endocrine system by stimulating the hypothalamus to secrete the Adrenocorticotropin Hormone (ACTH). ACTH will then activate the adrenal cortex to secrete cortisol. Cortisol plays a pivotal role in increasing blood pressure. In the report by Iksan et al., a person that experiences anxiety would experience exponential increase in blood flow to the heart hence increasing cardiac pressure load.[22] Blood pressure is defined as the force exerted by the blood against any unit area of the vessel wall.It has been demonstrated that both stress induced release of endogenous catecholamine and administration of local anaesthetic agents containing sympathomimetics can alter blood pressure. The cardiovascular reaction to a stressful situation is thought to be influenced by cardiac-vagal withdrawal and adrenergic activation, resulting in increased cardiac chonotropic and ionotropic influences as well as an increased total peripheral resistance. It is possible that cardiac and vascular reactivity reflects individual differences in sympathetic adrenal activation during a stressful situation. The administration of a vasoconstrictor in combination with local anesthetics has been shown to be a source of exogenous catecholamine, which when combined with unmarked endogenous catecholamine induced from increased anxiety due to anticipation of the dental procedure, may cause effects on cardiovascular reactions.[24]

Generally, women are less susceptibleto cardiovascular diseases including hypertension compared to men of the same age due to cardioprotective effects of estrogen. Estrogen provides a protective effect against cardiovascular diseases, which causes a decrease in Low Density Lipoprotein (LDL) and an increase in levels of High Density Lipoprotein (HDL) in blood plasma.[25,26]In obese adult female patients, blood pressure showed a higher increase compared to adult female patients with normal BMI. Based on the Journal of Clinical

Hypertension, Oparil stated that hormonal changes that often occurredin obese women causes them to be more likely to have high blood pressure. Obese women are also known to have higher blood pressure than men of the same age, and this is often associated with female sex hormones such as estrogen.Estrogen is responsible for reducing arterial stiffness, endothelial dysfunction and accumulation of blood fats.In obese female patients, there is a continuous increase in adipose tissue formation. Estrogen levels in adipose tissuemodulatesAngiostenin II to activate Renin-Angiotensin-Aldosterone system (SRAA). Increase in activation of SRAA can lead to an increase in blood pressure by inducing systemic vasoconstriction, sodium and water retention and an increase in aldosterone.[25,26,27] However, after reaching stage of menopause, the drop estrogen level associated with menopause causes heart disease risk in adult female patients. When the estrogen levels decline, level of LDL increases and levels of HDL decreases, leading to build up of fat and cholesterol in the arteries that cause to increase in blood pressure which contribute to cardiovascular disease.Therefore, caution should be exercised in using local anesthetics containing vasoconstrictors as a source of exogenous catecholamine in patients with obesity and due to the endogenous factor of increasing blood pressure.[26,27]

V. Conclusion

Despite the limitations in this study, it can be concluded that administration of local anesthetic lidocaine 2% with a combination of adrenaline 1: 80000 can increase the blood pressure of adult female patients with normal Body Mass Index (BMI) and obesity. There was a significant increase of systolic blood pressure in post administration of local anesthetic with adrenaline but as for diastolic blood pressure, there wereless significant differences in post administration of local anesthetic with adrenaline.The results of this study are expected to be a source of information that the use of local anesthetics containing vasoconstrictors has an influence on the cardiovascular risk. For futher research, assessment of other variables that also increase blood pressure of patients, both internal and external variables that affect the rise in blood pressure to be further developed.

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Ahyar Riza. "Differences in Blood Pressure Before and After Administration of Local Anesthetic among Obese Adult Female Patients." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 8, 2019, pp 42-47.