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Effect of Valsalva (Valsalva-Weber) Maneuver on Heart Rate and Blood Pressure in Young Healthy Male Volunteers

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ABSTRACT

The Valsalva Weber maneuver is one of the most informative study methods employed to evaluate the integrity of cardiac autonomic function based on heart rate responses accompanying with the arterial pressure stabilizing baroreflex mechanism. The aim of this study is to evaluate the effect of the maneuver on heart rate and blood pressure especially during straining (Phase II) and immediately after the straining stage (Phase IV). Non-smoker, sedentary male subjects (n=25) of age 20-22 year participated in the study. The study was carried out in Dhulikhel hospital (Kathmandu University Hospital). All the aforesaid variables were recorded keeping the volunteer in supine position, using mercury sphygnomanometer for blood pressure and Holter for continuous recording of heart rate. During this procedure, after a full inspiration, the subject was asked to blow against the resistance represented by one mouthpiece tubing connected to a sphygmomanometer to maintain a constant expiratory effort equivalent to an intra-oral pressure of 40 mmHg for 15 seconds, without permitting the escape of air from the nose and mouth. After this period, the expiratory straining is suddenly released, and respiration was maintained as regularly as possible without gasping. Pre-strain (casual), strain (Phase II) and post-strain (Phase IV, immediately after 15 seconds strain) heart rates recorded were 74.2±8.56, 82.88±11.24 and 65.68±7.32 per minute respectively. Pre-strain and post-strain systolic blood pressures were118.72±4.92 and 131.36±6.8 mmHg respectively and diastolic blood pressure were 75.68±5.61 and 87.2±7.39 mmHg respectively. Statistical analysis (t-test) revealed significant increase in heart rate during Valsalva maneuver whereas significant decrease in heart rate with significant increase in both systolic and diastolic blood pressures immediately after this maneuver($P<0.05$).

Keywords: Blood pressure, Heart rate, Valsalva maneuver

INTRODUCTION

The procedure of Valsalva maneuver extensively used as a physiological maneuver was employed with the therapeutic aim of expelling foreign bodies or exudates from the middle ear is used till today. Antonio Maria Valsalva described the procedure in detail, his most remarkable work, *De Aure Humana Tractatus* in 1704.[1-3] The name of the procedure was coined as Valsalva maneuver honoring a great physician and investigator, who was able to give practical importance to a procedure. After about a century, in 1851, the German physiologist Edward Weber detailed the cardiovascular alterations associated with the maneuver.[2, 4] The valsalva weber maneuver is a forceful expiration against the closed glottis.[2] This procedure executed in many functional situations in our everyday life such as during coughing, defecation and heavy lifting.[5] Thus, the aim of this study is to evaluate the effect of this maneuver on heart rate and blood pressure especially during straining and immediately after the straining.

MATERIALS AND METHODS

Non-smoker, sedentary male subjects (n=25) of age 20-22 year participated in the study as volunteers. The study was carried out in Dhulikhel hospital -Kathmandu University Hospital in the month of October to December, 2013. The volunteers were requested to abstain from beverages like tea, coffee for preferably 12 hours and strenuous physical activity and alcohol at least a day prior to maneuver. Furthermore, they were requested to take simply light breakfast. The experiment was performed in the morning (9:30-10:30 AM) with ambient temperature 20-22 C. Training session was conducted before valid testing session in order to avoid the difficulty of volunteers in adequately performing the maneuver. Once the volunteer was trained, all the variables were recorded in supine position. Blood pressure was recorded by using mercury sphygmomanometer and stethoscope. Pre-strain (casual), strain, post-strain(immediately after 15 seconds strain) heart rate were recorded continuously by using Holter (24 hour ambulatory ECG recording Machine) with precise recording of these timings. The

casual blood pressure and heart rate of the normotensive participants were recorded after allowing them to take rest for five minutes.[6] Then the volunteers were requested to perform the Valsalva maneuver. During this procedure the subject was asked to blow after a full inspiration against the resistance represented by one mouthpiece tubing connected to as phygmomanometer to maintain a constant expiratory effort equivalent to an intra-oral pressure of 40 mmHg for 15 seconds, without permitting the escape of air from the nose and mouth (Fig. 1). After this period, the expiratory straining is suddenly released, and respiration was maintained as regularly as possible without gasping.[7] This is followed by immediate recording of blood pressure. Systolic blood pressure was noted at the point where Korotkoff sound become audible and diastolic blood pressure was noted at the point where the sound muffed.[8,9] The procedure was sequentially repeated three times after an interval of five minutes so that the variables returned to baseline levels following each maneuver and the average data of the parameters were taken.

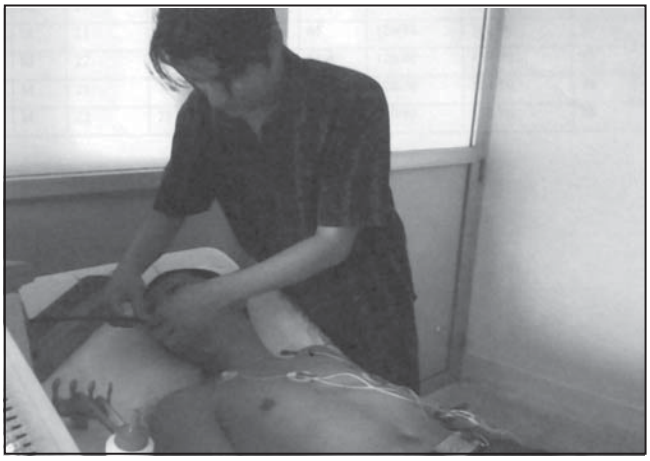

Fig.1. Volunteer performing Valsalva Maneuver.The electrodes of the Holter were connected to the specific area for continuous recording of heart rate.

RESULTS

From the Table, it is evident that during Valsalva maneuver (Phase II) there is significant rise in heart rate whereas inPhase IV there is significant fall in heart rate (P< 0.05). Furthermore, in Phase IV, there is significant rise in systolic and diastolic blood pressure (P< 0.05). (Table : 1)

DISCUSSION

The Valsalva maneuver was first described in 1704 whereas its cardiovascular effect was described in 1851.[10] In standard practice, this maneuver is done in four stages: Starting of forced expiration-Phase I, continuous straining for 15 seconds-Phase II, release of respiratory strain-Phase III and immediately after release of respiratory strain-Phase IV. Present study revealed that during staining, Phase II, there is increase in heart rate (P<0.05). Straining for 15 second increases the intra-thoracic and intra-abdominal pressure that results in decrease in venous return to the heart with an increase in venous pressure, progressive arterial pressure reduction, and consequently, progressive compensatory barorefl ex-mediated heart rate increase.[11] Study also showed a significant fall in heart rate but rise in blood pressure in Phase IV (P<0.05). Following cessation of the straining phase, the functional changes that occurred during straining were abruptly reversed, resulting in an overshoot of arterial pressure accompanied by a rapid and progressive baroreflex mediated decrease in heart rate.[12]During this period the sympathetic nerve activity is low

[13] and the increase in blood pressure in Phase IV is explained by continuing action of adrenal medulla hormones.[14]The responses based on rise and fall of heart rate to sudden transient sequential induction and liberation of forced expiration against standardized resistance (i.e. Valsalva maneuver) results in an abrupt change in arterial pressure. Thus, we must execute this maneuver cautiously, especially by those patients who are sensitive to transient changes of arterial pressure and heart rate, that is being performed in day to day life (e.g., during defecation or heavy weight lifting) otherwise have chance to meet cerebrovascular accidents viz. stroke.

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Table1: Blood Pressure and Heart Rate variation in different stages (Casual, Phase II and Phase IV) of the maneuver[1]

Volunteers	Conditions	HR (Mean±SD)	SBP (Mean±SD)	DBP (Mean±SD)
n = 25	Pre strain(Casual)	74.2±8.56	118.72±4.92	75.68±5.61
	Phase II (Strain for 15seconds)	82.88±11.24*		
	Phase IV(Post-strain, immediately after 15 seconds Strain)	65.68±7.32*	131.36±6.8*	87.2±7.39*

*P < 0.05, HR= Heart Rate, SBP=Systolic Blood Pressure, DBP=Diastolic Blood Pressure

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