

Short Research Article**Evaluation of arterial pulse amplitude ratio and Valsalva ratio in different age groups**

Abstract: Valsalva maneuver is usually used to assess autonomic function, this study interplay between arterial pressure responses and heart rate responses during the maneuver depending on Valsalva ratio for heart rate and arterial pulse amplitude ratio in different age groups. 40 subjects were included in this study, group1 with age range(15-39)years old, group2 with age range(40-55)years old. strips of leadII were recorded during performing Valsalva maneuver and measurement of blood pressure during phaseI and phaseII by mercury sphygmomanometer. results were :Valsalva ratio for group1(1.5 ± 0.3) and for group2(1.39 ± 0.21), pulse amplitude ratio for group1(0.80 ± 0.19) and for group2 (0.77 ± 0.19) and there were no significant differences between two groups which could be explained that autonomic nervous system still intact in those old group. The recommendation for this study is to continue this study in patient with increased pulmonary capillary wedge pressure to find the pulse amplitude ratio which suggest this disease so VM could be a substitute for invasive technique in diagnosis and follow up, also to perform other tests for autonomic nervous system in old subjects who do not have any risk factors or cardiovascular disease so may found that aging by itself not affect autonomic system.

Introduction: The Valsalva maneuver(VM) is performed by attempting to forcibly exhale while keeping the mouth and nose closed. eliciting a complex series of changes in pulse rate and BP involving both vagal and

sympathetic responses. It is used as a diagnostic tool to evaluate the condition of the heart and is sometimes done as a treatment to correct abnormal heart rhythms or relieve chest pain¹

There are four phases during the Valsalva maneuver^{2,3}: Phase one is the onset of straining with increased intrathoracic pressure. The heart rate does not change but blood pressure rises. phase II may be divided into early and late phases. In early phase II, reduced preload and stroke volume lead to a fall in cardiac output despite the tachycardia caused by decreased vagal activity. Total peripheral resistance increases due to increased sympathetic discharge (nucleus tractus solitarius) and an increase in plasma epinephrine concentration. The fall in blood pressure is thus arrested, and is termed “late phase II”; in normal patients there is actually a rise in blood pressure just before release⁴. Phase three is the release of straining with decreased intrathoracic pressure and normalization of pulmonary blood flow. Phase four marks the blood pressure overshoot (in the normal heart) with reflex bradycardia.

Valsalva ratio: this is the ratio of heart rate during phase IV/heart rate during phase II, and is essentially a measure of vagal function. The normal response is an increase in heart rate during phase II in response to the fall in blood pressure, and the baroreflex response to the blood pressure overshoot in phase IV is transient bradycardia. In dysautonomic patients, there is typically a loss of both the blood pressure overshoot and the reflex bradycardia⁴. arterial pulse amplitude ratio is the ratio of the lowest aortic pulse pressure during active straining (phase II) to the greatest aortic pulse pressure at onset of the strain. Precaution of Valsalva maneuver should not be performed by patients who have severe coronary artery disease, have experienced recent heart attack, or have a moderate to severe reduction in blood volume. Risks of VM that the patient may

feel dizzy or faint during the procedure, but serious consequences are rare. There is a risk that the Valsalva maneuver can cause blood clots to detach, bleeding, and abnormal rhythms originating in the ventricle. It can also cause cardiac arrest. Consequently, the procedure is usually performed in a setting where emergency equipment is accessible.

Materials and methods :

- Subjects 40 subjects were included in this study ,they were divided in to two age groups: G1: 25 subjects with age range (15-39)years old.group2:15 subjects with age range(40-55)years old. all of them were normal .full history and examination were taken to exclude any disease like hypertension, diabetes mellitus,...etc. and exclude any risk factors (e.g) smoking, hyperlipidemia.

-Mercury sphygmomanometer: Two devises were needed.

-Electrocardiography(ECG):to record strip of leadII during VM.

Methods: subject put in supine position ,limb leads electrodes were connected to the subject. Mercury Sphygmomanometer was used for measuring blood pressure . after reaching the steady state ,the subject should exhale forcefully after a normal inspiration into tube that was connected to another sphygmomanometer .A tiny air leak was placed in the tube to ensure that airway pressure was produced from the thoracic cavity and not pharynx⁵. Valsalva maneuver was performed at a pressure of 40 mmHg for 15 seconds⁶.measurment of blood pressure at the beginning of straining-phaseI, then repeat the VM after reaching the steady state to measure the blood pressure during phaseII which is occur after 5 seconds of beginning of straining⁷. ECG recording performed during the strain phase and after the maneuver. After that measurement of

pulse pressure of phaseI and phaseII according to equation: pulse pressure =systolic blood pressure-diastolic blood pressure. Then pulse amplitude ratio=minimumBP/maximum BP. Valsalva ratio calculated from longest R-R interval(during phaseIV)/shortest R-R interval(during phaseII).

Statistical analysis: All values expressed as mean±SD, comparison between group1 and group2 were done by unpaired student t-test , p-value <0.05 considered statistically significant⁸

Results:

In group1:During the Valsalva maneuver, maximum (phase I) pulse pressure (mean ± SD = 51 ± 11 mmHg)which is a result of systolic blood pressure(150mmHg)-diastolic blood pressure(99mmHg) during phaseI of VM , and minimum (phase II) pulse pressure (41 ± 5 mmHg)from(136mmHg-95mmHg). This resulted in pulse amplitude ratio (minimum/maximum pulse pressure) (0.80 ± 0.19).

R-R interval during phaseII is 16 ± 6 small square (93.4 ± 5.03 beat/min) and during phaseIV is 24.1 ± 1.9 (HR= 62.01 ± 7) so The Valsalva ratio was 1.5 ± 0.3 .

In group2: , maximum (phase I) pulse pressure (mean ± SD = 53 ± 13 mmHg) from (160mmHg-107mmHg), and minimum (phase II) pulse pressure (41 ± 3.99 mmHg) from(146mmHg-105mmHg). This resulted in pulse amplitude ratio (minimum/maximum aortic pulse pressure) (0.77 ± 0.19).

R-R interval during phaseII is 17 ± 9.2 small square (88.1 ± 10.1 beat/min) and during phaseIV is 23.79 ± 2.01 (HR= 63.03 ± 8.03 beat/min) so The Valsalva ratio was 1.39 ± 0.21 .

The systolic and diastolic blood pressure of group2 were higher than values of systolic and diastolic blood pressure of group1 but There were no significant differences between pulse amplitude ratio of group1 and group2, and there were no significant differences between Valsalva ratio of both groups.Figure-1.

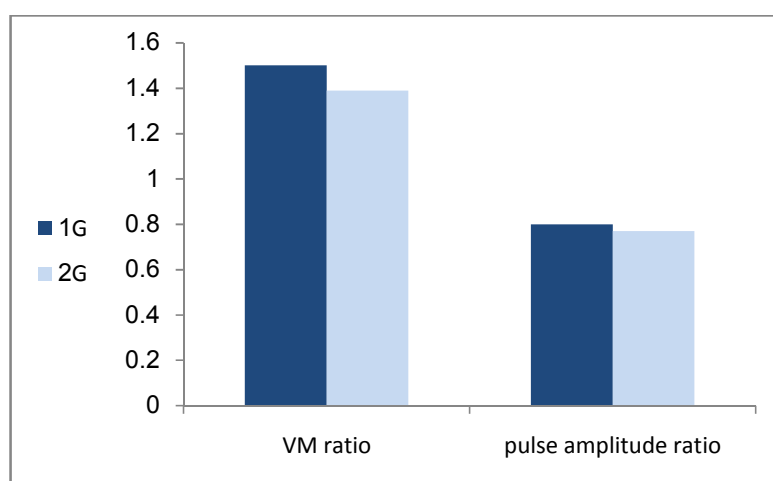


Figure-1: Comparison between VM ratio and pulse amplitude ratio of G1 and G2.(VM:Valsalva ratio, G1:group1(15-39)years old,G2:group2(40-55)years old.P<0.05.

Discussion: Beside that Valsalva maneuver is usually used to assess autonomic function^{9,10},as from changes of heart rate responses during different phases of VM and the changes of systolic and diastolic blood pressure which reflect the integrity of autonomic function, arterial pressure response during the strain phase of the Valsalva maneuver might reflect either LV function^{11,12}, or right-sided pressures¹³, or both^{14,15,16}. Some authors have suggested that the pulse amplitude ratio may improve the assessment of cardiac status^{16,17} and may furnish a noninvasive scale of myocardial dysfunction. Some studies show that arterial pressure decreases during the strain phase of the maneuver in healthy subjects but not in patients with increased pulmonary capillary wedge pressure^{14,15,12}, in these patients the increase in blood pressure in phase1 followed by

plateau during phase II. So it seems of physiological interest to clarify this issue and measure values of different age group which are normal and then to continue this study in the future with different disease states. This study shows that systolic and diastolic blood pressure of older group were higher than the younger age and this is due to increasing age is associated with increased intimal thickness, vascular smooth muscle hypertrophy, fragmentation of the internal elastic membrane and an increase in the amount of collagen and collagen cross-linking in arterial walls¹⁸, intimal thickening occurs even in population of low incidence of atherosclerosis¹⁹. But there were no significant differences between pulse pressure response to strain pattern of VM of the two groups which could be explained that the autonomic nervous system is still intact and not affected yet by the vascular wall changes and this is also documented by the finding of Valsalva ratio of heart rate responses to VM there were also no significant difference between the two groups this is in line with the fact that baroreceptor- heart rate responses are proportional with changing pressures during VM²⁰. So aging process by itself may not influence the autonomic function unless the presence of other risk factors or cardiovascular disease.

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