Cardiovascular Responses With Valsalva Maneuver During Activities Of Daily Livings In Healthy Adults

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Abstract:

Purpose of Study: To measure CV responses in SLF, and SQ with & without VM, Study design: Cross sectional Observational study, Materials: assessment form, 36 SF Health Questionnaire, Modified Sphygmomanometer, BP apparatus, Nike-HRM-TRIAX, Methodology: 335 (M=146) subjects participated to perform SLF and SQ position with & without VM and SBP, DBP and HR were recorded. Data Analysis: SPSS -10.1, LOS was set at 0.05 or CI 95 %. Result: Study has shown significant increases in SBP in SQ and increase HR in SLF position with and without VM. Discussion: the impact of Heart Rate Variability and baroreflex sensitivity in CV system plays vital role in maintaining hemodynamic status while performing valsalva like activities. Conclusion: SQ has significant impact on SBP and DBP as compared to SLF position with and without VM as well as SLF position has a significant impact on HR as compared to SQ with VM, however these need to be taken into consideration while planning life style modification for high risk population

Key words: Valsalva Maneuver (VM), Sitting Lean Forward (SLF) position, Squatting (SQ) Position, Cardiovascular (CV) responses

INTRODUCTION:

Activities of daily livings (ADL) involve several stressful physical events such as lifting weight, pushing objective ground level activities, defecation, urination, etc... These stressful events are not recognized among healthy people, but it may be life threatening for peoples with compromised CV system.8, 10

It has been observed that more than 1/3 population, who dies following the cerebrovascular accident, dies in and around the toilet, in the morning. 7, 12, 15 Urination and defecation has integrated sequences of breath holding strategies which involves isometric muscular contraction to increases interathoracic and abdominal pressure.

It may be more stressful in case of constipation, obesity, pregnancy etc... Generating high intraabdominal pressure and frequent releasing of "breath hold" has great impact on hemodynamic status. Moreover, the positions of performing defecation such as SLF and SQ have significant impact on CV system. Clinically, breath holding with forced expiratory effort against closed glottis is known as a Valsalva Maneuver (VM). It is also used as a test of functional integrity of the autonomic nervous system.[1, 2] Hemodynamic changes describe into 4 phases when VM performed at 40-mmHg pressures for 20 seconds with open glottis.

CV responses in stress-provoked defecation positions with VM among healthy adults will provide the associate evidence to understand the impact on compromised CV disorders.

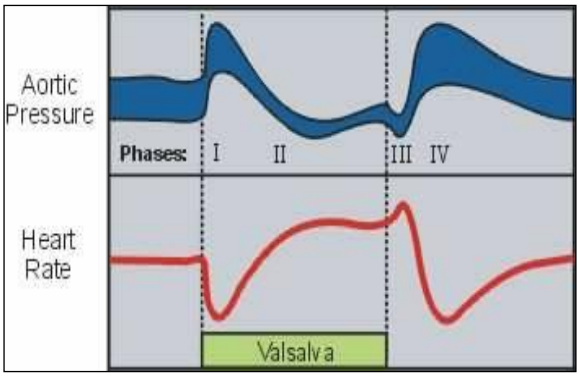
CV responses on ADLs have been of common interest for many researchers. ADLs with maneuver like

valsalva may throw further light on integrity of autonomic and CV system, which may be useful or detrimental to normal and patient population. 2, 5, 10

The various researchers have shown interest in positional impact of defecation on CV status. It was observed that when normal subjects squat, the arterial mean pressure and pulse pressure increases. This increase is greater after few seconds due to which mean pressure falls. This fall in pressure eventually stabilizes at higher level than that observed in sitting position.5,1 The studies has concluded that CV stability during straining with VM is higher in the lean forward as compared to lean backward position. 9

The VM is a useful technique to assess the CV changes.[6.] Some studies concluded that CV changes could be obtained as a result of a 15-sec VM, performed at 40-mmHg airway pressures.[7,8.] Some of the researchers have suggested 20 seconds of VM at 40-mmHg pressure.[12]

Figure I, Four phase valsalva response



The hemodynamic changes associated with the VM were described by invasive techniques.[7, 6,10.] These changes are classically divided into four phases. (Fig-I) **Phase-I** is beginning of the strain to a transient rise in mean arterial BP (MABP), as the increase in intrathoracic pressure to constrain the arterial tree. **Phase-II** has further divided into Phase IIa and IIb. During phase IIa, the atrial filling pressure falls so MABP decreases. In phase IIb there is increased sympathetic activation, causing a rise in peripheral vascular resistance and HR, which leads to a small increase in MABP. **Phase-III** is associated with release of the strain and a sudden fall in MABP due to the influence of release of the intrathoracic pressure on the arterial tree. Finally, **phase-IV** sees an immediate ‘‘overshoot’’ in MABP because of the persistence of increased sympathetic tone and systemic vascular resistance. A reflex bradycardia then results due to stimulation of arterial baroreceptors, and both MABP and HR return to baseline values. [11, 13] It has been concluded with VM at severe degree, results in decrease of HR by 9.2 beats/min.[9]

This study was designed to evaluate CV responses in two stress provoking defecation positions of ADLs, SLF and SQ positions. However, comparing the CV responses with and without VM in these stress-provoked positions can provide prospective guidelines for high-risk population with CV disorders.

METHODOLOGY

The Cross sectional study has sample of 235 healthy adults, (M=143) with the mean age = 26.6 year with prior informed consent and ethical clearance. Subjects were screened with 36-SF health questionnaire to consider health status. [17] Subjects were excluded with poor physical efforts to perform VM, failed to complete the procedure, and to recover to basal parameters in given time.

Method:

All subjects satisfying the criteria for the study were made to achieve

relaxed sitting (RS) position on the chair with feet supported on floor (hips and knees 90 degree flexion) for 3 min., prior to the test procedures. parameters (SBP, DBP, and HR) were measured in the RS position.

The subject blows air at 40-mmHg pressures for 25 seconds into a mouthpiece, which was attached to a modified sphygmomanometer to measure airway pressure. In this study, the glottis remains open to communicate for measurement of pressures from the thorax into the sphygmomanometer. A small needle was routinely placed into the rubber tube to provide a small air leak. This prevents the subject from closing their glottis and from developing the necessary pressures with the cheek muscles. (Fig-II)

SBP and DBP were recorded by sphygmomanometer from brachial artery at elbow. HR was recorded by Nike - strap at Xiphoid-sternal level. This strap made to sense the left ventricular apex beats and watch to receive the impulses. Considering the basal parameters in RS position in chair, subjects were allowed SLF with forearms supported on thigh for a minute and parameters were recorded.

Figure III, SLF position with VM

Resting for a minute in SLF position, VM was performed and only change in HR (max) was recorded during 25 seconds. Immediate post VM release changes in parameters were recorded in SLF position. After the recording of post valsalva release response, subjects were allowed to resume RS position and parameters were recorded at the end of 3rd minute. (Fig – III) On the second day, subjects were asked to perform the similar procedure with SQ and parameters recorded.

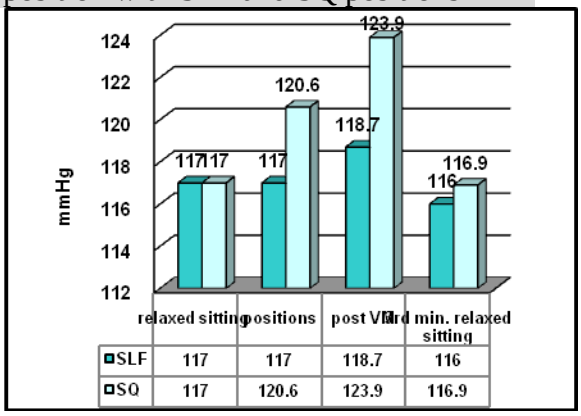
Figure III, SQ position with VM

Data analysis

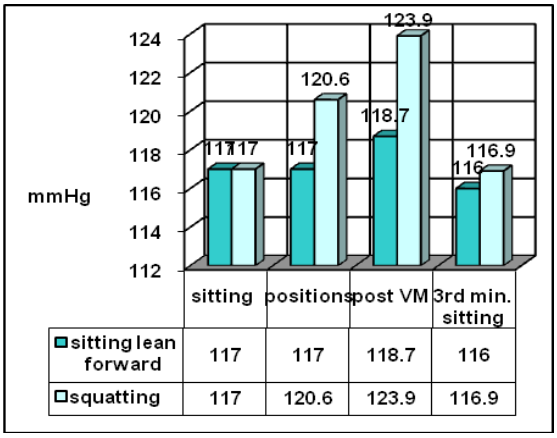
Statistical analysis was performed with SPSS for repeated Measures ANOVA for comparison of the measured variables (SBP, DBP, and HR) within and between the two positions defecation. The LOS was set at < 0.05 or 95 % confident interval (CI).

RESULT

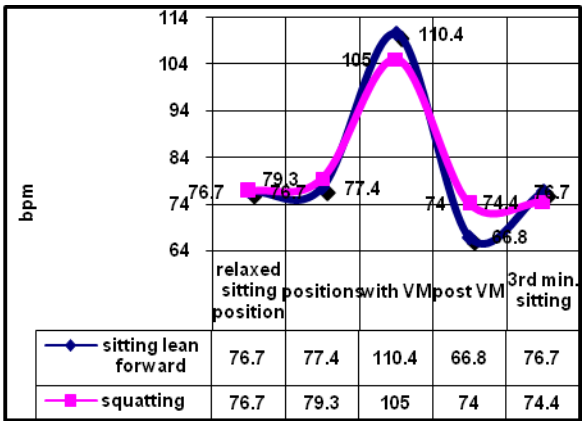
Graph I. Graphical representation suggesting of SBP responses in RS position with SLF and SQ positions



Graph II. Graphical representation suggesting of DBP responses in RS position with SLF and SQ positions



Graph III. Graphical representation suggesting of HR responses in RS position with SLF and SQ positions



DISCUSSION

SLF vs. SQ positions without VM :

This study has shown significant difference in variables of SQ and SLF positions as compared to RS position. SBP and DBP significantly increases in SQ compared to SLF position. In SQ position, intraabdominal and so interathoracic pressures are responsible for increasing the SBP. HR shows significant response in SQ compared to SLF.

SLF vs. SQ positions with VM :

A high significant raise has shown in HR by both the positions with VM. But, increase in HR was more significant in SLF than SQ position. Significant increase in HR was higher in SLF position, because in VM at the onset of strain, contraction of thoracic cage compresses the lung and causes the large raise in interathoracic pressure; this compresses the vessels within the chest. Moreover, compression of thoracic vena cava compromise venous return to the heart, resulting in a large falls in cardiac output. This leads to secondary fall in aortic pressure and as aortic pressure falls, the baroreceptor reflex increase the HR. 5, 9

SLF vs. SQ post VM release :

When the subject relieves VM, and begins with normal breathing again – deep inspiration follows. When compression of vena cava removed, venous return suddenly increases causing a rapid raise in cardiac output several seconds latter, which leads to overshoot of arterial pressure as the systemic vascular resistance increases due to sympathetic activation that occurred with VM. However, peripheral circulation to lower limbs is compromised in SQ compared to SLF position may be responsible to increase the BP in the upper half of the body, which was recorded from upper limbs by the sphygmomanometer.

HR reflexively decreases in response to the transient elevation in arterial pressure. Fall in HR post VM was seen in SLF position and in squatting position, this anatomical spacing of blood volume in abdominal cavity and lower limbs decreases the venous returns to the heart, a direct effect of kinking the femoral veins. So,

venous return is decreased in SQ when compared to SLF position. This might have caused a comparative decrease in cardiac output in squatting position, which was responsible for controlling the large variation in HR in SQ as compared to SLF position. [13, 14]

CONCLUSION

This study has considered the impact of CV system in SLF and SQ positions with and without VM. It is shown that SQ has significant impact on SBP and DBP as compared to SLF position with and without VM. SLF position has a significant impact on HR as compared to SQ with VM. It can be concluded that SLF and SQ with and without VM influence changes in cardio-vascular status. These need to be taken into consideration while planning life-style modifications for high risk population with compromised CV status.

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