

Blood pressure response to standing and sustained handgrip test during pregnancy

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Abstract

Background: Several important changes in maternal hemodynamics take place during pregnancy. An increase in blood volume due to an increase in plasma result in increased cardiac output. The present study was designed with the objectives to study the blood pressure response to standing and sustained handgrip test during normal pregnancy.

Material and methods: This case – control study conducted in Department of Physiology at Rural Medical College Loni in Maharashtra. The cases were 120 pregnant women each in 2nd and 3rd trimester of pregnancy (Total 240) control group comprised of 120 age-matched, non-pregnant women. The blood pressure response to standing and sustained handgrip test were done using “CANWIN”.

Results: Blood pressure response to standing was non-significant in 2nd trimester but significant in 3rd

trimester of pregnancy as compared to non-pregnant women.

Conclusion: According to the findings of the present study the fall in BP in response to orthostatic hypotension test in 2nd trimester imply that the cardiovascular system was incompletely adapted during the first half of pregnancy.

Keywords: pregnancy, hypotension, Blood pressure.

Introduction

The normal activity of autonomic nervous system is necessary for adaptation in the cardiovascular system as per the hemodynamic needs of body. It is important not only under pathophysiological conditions like haemorrhage and shock, but also in physiological condition like pregnancy.¹

Pregnancy is associated with an increase in blood volume due to an increase in plasma volume. The increased blood volume result in increased cardiac output. The augmentation of cardiac output during

pregnancy is due to asynchronous increase in heart rate and stroke volume.^{2,3} The change from recumbent to standing position resulted in significant fall in Systolic Blood Pressure (SBP). Advancing gestation was associated with a smaller fall in SBP.⁴

In pregnant women, systolic and diastolic blood pressure (DBP) both decreases promptly on standing. The reduction in oscillation of right atrial distension due to diminished pulsatility of venous return has been described in pregnant subjects. This may responsible for the lowering of DBP in pregnancy.⁵

An increase in resting heart rate during pregnancy was mediated by the lower level of parasympathetic/vagal mediation.⁶ Early pregnancy is associated with sympathetic reactivity to orthostatic stress, but during latter half of pregnancy increased hemodynamic stability to orthostatic stress observed.⁷

It was found that lower viscosity potentiates fall in vascular resistance. Both these factors independently contribute to fall in after load. These changes are responsible for decrease in blood pressure during pregnancy. There are evidence that increased Nitric Oxide (NO) activity plays a major role in pregnancy-associated decrease in systemic resistance and this decrease in systemic resistance continued up to 25th weeks of pregnancy.^{8,9,10}

Circulating estrogens increases progressively during pregnancy. It may stimulate vascular function by various means including increased NO availability. Estrogen exerts an acute vasodilator effect by relaxing vascular smooth muscle most probably by blocking cell membrane voltage-dependent Ca²⁺ channels.^{11,12}

All these hormonal and autonomic changes result in altered response to various autonomic function tests during pregnancy. These changes are more remarkable during the latter half of pregnancy. So we decided to

study the blood pressure changes in response to standing (Postural Hypotension Test) and sustained handgrip (SGHT) during 2nd and 3rd trimester of pregnancy and compare it with non-pregnant women.

Materials & methods

The study was approved by the Institutional Ethics Committee of Pravara Institute of Medical Sciences (DU), Loni. The study was performed as per the Ethical Guidelines for Biomedical Research on Human participants (ICMR October 2006) This was a case control observational study carried out in department of Physiology, Rural Medical College Loni in Maharashtra. Non-probability purposive sampling was used for present study. The study Participants were taken from rural areas of Loni.

A total of 360 participant women aged from 18 to 30 years without any recent history of cardiac diseases were selected. 240 pregnant(Cases) and 120 were in the non-pregnant(Control).240 pregnant women were equally divided in 2nd, and 3rd trimester of pregnancy. Blood pressure response to standing orthostatic hypotension test (PHT) and blood pressure response to sustained handgrip test (SHGT) measured in normal pregnant and normal non-pregnant women.

Healthy Non-pregnant women & Pregnant Women 2nd & 3rd Trimester:

Inclusion Criteria

- Age group between 18 to 30 years.
- Pregnant women visiting the hospital for routine ANC checkup.
- Free from any systemic illness.

Exclusion Criteria

- H/O cardiovascular disorders
- Healthy females with history of addiction to tobacco, mishri, alcohol etc.

Data collection method

Blood pressure response to standing postural/orthostatic hypotension test (PHT) and Blood pressure response to sustained handgrip test (SHGT) both these test done on CANWIN® Cardiac Autonomic Neuropathy Analyzer as per the instructions on manual as follows.

1 Blood pressure response to standing postural/orthostatic hypotension test (PHT):

Procedure: The participant was relaxed, lying down comfortably. B.P. was recorded in supine position. The participant was asked to stand up quickly and the B.P. recorded immediately after standing. Then the BP recorded again at the end of one minute after standing. The test ends automatically and the result was displayed immediately.¹³

Blood pressure response to sustained handgrip test (SHGT):

Procedure: The B.P. was recorded in sitting position. Then the participant was asked to hold the spring of dynamometer in the dominant hand, and instructed to compress the spring of dynamometer with the full efforts for the period of 5 minutes. The BP was recorded thrice during these 5 minutes automatically and the alteration in the B.P. just before the release of hand grip test.¹³

Data Analysis

Data was pooled and tabulated for analysis using MS-excel Sheet . Data analysis done using Statistical Package for Social Sciences (SPSS)-23 version. Data was presented as Mean \pm SD. For statistical analysis one-way ANOVA test (Kruskal-Wallis Test) was used and multiple comparisons were done to compare the three study groups. The mean difference at $P < 0.05$ taken as significant.

Results and Discussion

Blood pressure response to standing (PHT)

Systolic Blood pressure response to standing shows significant difference in 3rd trimester of pregnancy as compared to non-pregnant, but in 2nd trimester of pregnancy difference was non-significant.

The hemodynamic response may be due to a decrease in the baroreceptor sensitivity, which may develop in early pregnancy. The fall in SBP to orthostatic stress occurring in the 1st trimester imply that the cardiovascular system is incompletely adapted to pregnancy. The increased blood volume seems to improve hemodynamic stability, especially during the second half of pregnancy.¹⁴

The findings of present study are similar to many other studies. Study of Thomas R E and on 15 non-pregnant women and 16 pregnant women significant fall in SBP in response to postural change observed. However, result in 2nd and 3rd trimester were not significant.¹⁵

Clark's study on 10 normotensive pregnant cases and 10 normotensive non-pregnant women found that SBP decreases significantly in case of 1st and 2nd trimester but this fall becomes no-significant in 3rd trimester.¹⁶ Del Bene R, Barletta G studied effects of posture on cardiovascular function in pregnancy. The decrease in cardiac output associated with early standing attenuated significantly at the early 2nd trimester and was absent at mid 3rd trimester.¹⁷

But few other studies results were not in agreement with present study. Avery et al. found no difference in systolic blood pressure response to standing between the pregnant and non-pregnant groups. Another study by Jayawardana (2001), observed that decreased stimulation of the high pressure baroreceptors as the arterial pressure falls and decreased stimulation of cardiopulmonary receptors because of diminished right

ventricular filling pressure leads to reflex vasoconstriction and recovery of the diastolic blood pressure^{18,19}.

Blood pressure response to sustained handgrip test (SGHT)

Blood pressure response to sustained handgrip test (SGHT) shows a significant increase in DBP in 2nd and 3rd trimester of pregnancy as compared to non-pregnant. Heart rate responses were similar in both case and control but BP response was slightly weaker in the second trimester group. The sustained handgrip test cause increase in cardiac output and a change in the total systemic resistance. The increase in vascular resistance caused by sustained handgrip test is smaller in 2nd trimester women as compare to non-pregnant women. This could depend on a lesser concentration of norepinephrine (NE), a diminished contractile response of the vascular smooth muscle or an antagonistic effect of progesterone

The present study has similar findings from earlier studies like Heiskanen H, he concluded that decreased sympathetic tone prevails during the second half of pregnancy which may be the reason for failure of increase in DBP in SGHT.³ Whittaker et al and Robinovici found blunted plasma NE responses after sustained handgrip test during second half of gestation.^{20,21} Van Hook JW has shown that the pressor response to maximal sustained handgrip test of short duration is affected by pregnancy. They concluded that pressor changes to sustained handgrip test were different in both pregnant and control group.^{22,23}

Similar findings were observed by some other researchers like Ekholm EMK et al Antila KJ. They concluded that these cardiovascular response to isometric handgrip exercise are primarily mediated by sympathetic stimulation. This sympathetic stimulation

become weaker during 2nd and 3rd trimester of pregnancy and can be observed by a significantly reduced alteration in DBP in these two groups.

Figure 1: Mean ± SD values of Blood pressure changes to standing and sustained handgrip.

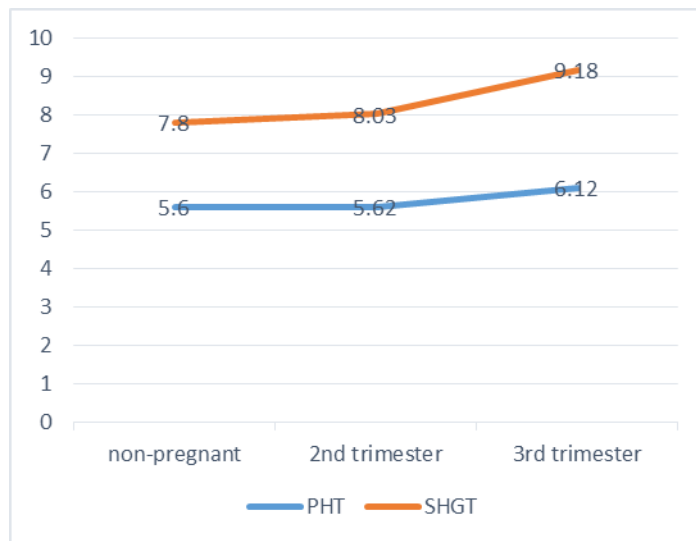


Figure 2: Comparison between non-pregnant and 2nd trimester of pregnancy.

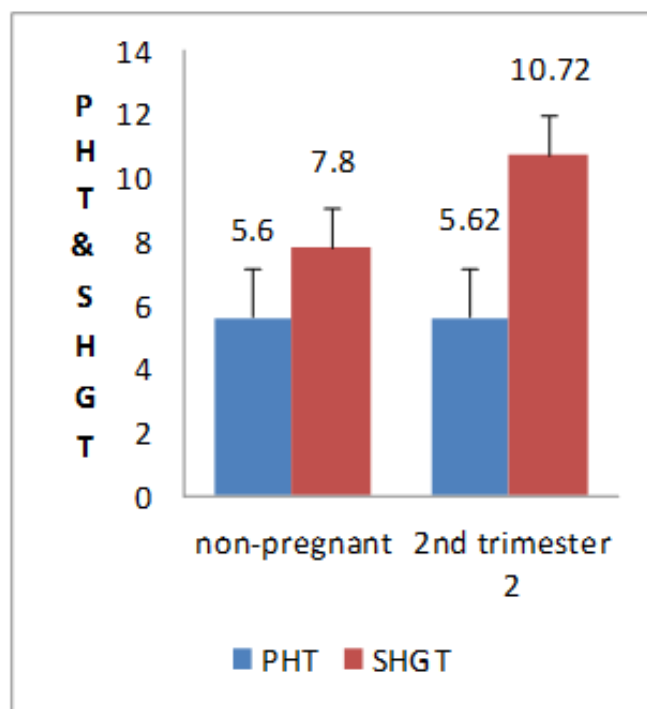
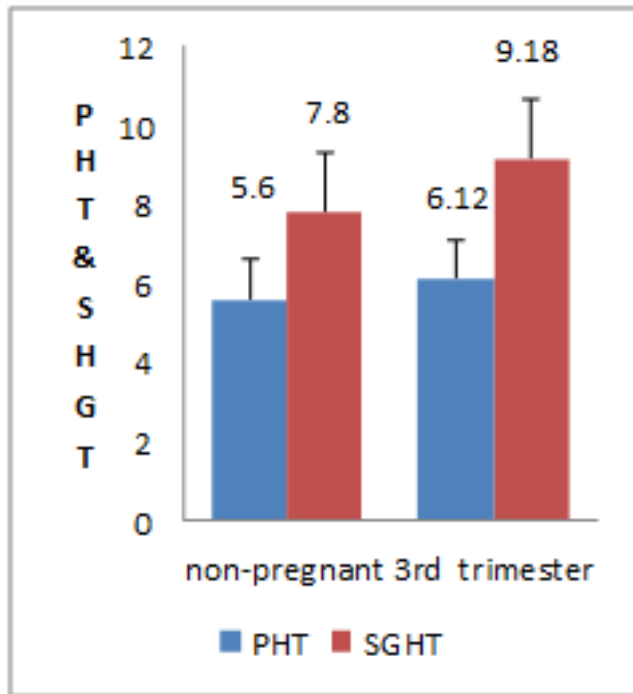


Figure 3: Comparison between non-pregnant (controls) and 3rd trimester of study participants



Conclusion

According to the findings of the present study the fall in Blood Pressure in response to Postural/orthostatic hypotension test (PHT) in 2nd trimester shows that the cardiovascular system was incompletely adapted during the first half of pregnancy.

The present study showed a diminished Blood Pressure response to sustained handgrip test (SGHT) response in 2nd trimester. As the studies have shown contradictory result, the sustained handgrip test may not be recommended for research on cardiovascular reactivity in pregnancy.

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